

Trypillia Megasites West of the River Southern Buh: Preliminary Results of Bilyi Kamin Site Investigation in 2018

Vitalii Rud, Robert Hofmann, Viktor Kosakivskiy, Olha Zaitseva, Johannes Müller

Abstract

In Bilyi Kamin, Ukraine, a Trypillia megasite of the Chechelnyk group was systematically investigated by high-resolution magnetometry, targeted excavations and radiometric dating. These new data make it possible to discuss afresh the significance of the large settlements west of the River Southern Buh and their relation to the already much longer intensively investigated megasites of the Southern Buh-Dnipro interfluvium. The research confirmed that the settlement Bilyi Kamin had an extraordinary size of almost 100 ha and undoubtedly was of a carefully planned character. In order to realise a settlement of this size in the hilly landscape, enormous height differences within the settlement were accepted. Apparently, the intention to place three monumental integrative buildings on a promontory, widely visible from afar, played a decisive role. The study includes a detailed examination of the architecture and find materials of a dwelling. Compared to settlements of the Southern Buh-Dnipro interfluvium, these investigations reveal, among other things, differences in waste disposal and similarities in architectural features. In the wider context, the newly obtained dating results from Bilyi Kamin seem to indicate that the peak of population concentration in Trypillia giant settlements in the region west of the River Southern Buh was already passed around 3800/3750 BCE. By contrast, this agglomeration process continued in the Southern Buh-Dnipro interfluvium until about 3650 BCE. As possible reasons for these different trajectories differences in social organisation are taken into account.

Introduction

We are observing the development of settlements of up to 320 ha during the last centuries of the 5th and the first half of the 4th millennium BCE on the Southern Buh–Dnipro interfluvium that have been under intensive investigation since Soviet times (Videiko/Rassmann 2016). Currently, these so-called Trypillia megasites or giant settlements are again in the focus of various international research projects (Menotti/Korvin-Piotrovskiy 2012; Chapman et al. 2014; Terna et al. 2016; Hofmann et al. 2018; Müller et al. 2016; Uhl et al. 2014; (2017). With improved methods such as high resolution magnetometry and a wide spectrum of scientific methods, those projects are attempting to contribute to answers to the newly discussed question on the nature of these megasites in European prehistory (Шмаглий/Видейко 2005; Kruts 2012; Diachenko 2012; Diachenko/Menotti 2017;

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Chapman/Gaydarska 2016; Diachenko/Menotti 2017; Chapman 2017; Nebbia et al. 2018; Müller et al. 2018; Ohlrau 2019; Chapman et al. 2019).

So far, research effort regarding Cucuteni-Trypillia megasites has to a large extent focused on the region to the east of the River Southern Buh. In contrast, the Southern Buh-Dnister interfluvium has stood for a long time in the shadow of its eastern neighbour. To improve this situation and to gain a better understanding of the macro-regional variability within the Cucuteni-Trypillia cultural complex (CTCC), in spring 2018 the exploration of the large CTCC site Bilyi Kamin, which belongs to the largest settlements in this region, was started by an international team of researchers from Kiel University (Germany) and the Institute of Archaeology (IA) of the National Academy of Sciences of Ukraine (NASU) (Kyiv, Ukraine). The exploration was conducted as part of the fieldwork of the East Podillia Archaeological Expedition of the IA NASU and with the participation of scientists from Vinnytsia State Pedagogical University (Ukraine) and Borys Grinchenko Kyiv University (Ukraine). From the Kiel side, the activities took place in the framework of the CRC 1266 “Scales of Transformations” and the subproject D1 “Population agglomerations at Tripolye-Cucuteni megasites”.

Research in megasites on the Southern Buh-Dnister Interfluvium

The field explorations of CTCC sites in the southern area between the Rivers Southern Buh and Dnister began in the last decade of the 19th century. Fieldwalking was conducted by the local Zborovskiy family and excavations (1894–1896) by V. Antonovych near the village of Krynychky (Зборовський 1927). Since then, for over 130 years, archaeological studies in the region have been episodic (Рудь 2018, 25–47). Systematic studies of the CTCC in the region were not conducted. It is not surprising, since, for the last 50 years, the study of megasites of the CTCC that are located between the Rivers Southern Buh and Dnipro (Видейко 2013) was the priority. Since the 1990s, it has been noted several times that sites with an area of more than 100 ha are located between the Rivers Southern Buh and Dnister. Those are Trypillia CI on the left side of the River Dnister basin, Yaltushkiv I of the Petreny group (Рижов 1993, 87) and the site Stina 1/4 with Chechelnyk, Petreny and Tomashivka traditions (Видейко 2013, 104). Over time, these data were revised. In the case of Yaltushkiv I, recalculating with the use of GIS applications shows that the area of the site is not 70 ha (Шумова/Рижов 2005), but no more than 55 ha. The size of the site Stina 1/4 became reduced to only 6.2 ha (Рудь 2018, 321).

According to the anomalies seen on the satellite image of Google Earth Pro, the size of Rohizna 3 (Гаскевич/Кононенко 2012, 27–28; 95–97 figs. 5; 42) amounts to 95–100 ha. The site is located directly on the right side of the Southern Buh. The artefacts, found in small numbers (Гаскевич/Кононенко 2012, 27–28; 95–97 fig. 42), allow the site to be dated within the Trypillia periods BI–BII or the beginning of BII. The Trypillia BII and CI sites west of the Southern Buh with areas of more than 45 ha are listed in Table 1 and their distribution is displayed in Figure 1.

The CTCC site between the villages of Bilyi Kamin and Rohizka was initially documented by S. Hamchenko's expedition in 1903–1913 (Гамченко 1926, 31) and examined in 1927 by I. Ch. Zborovskiy, who recorded the destruction of the cultural layer during the construction of buildings by the residents of Bilyi Kamin. In 1928, the excavations led by S. Hamchenko were conducted with the participation of

Table 1. Trypillia BII and CI sites with areas of more than 45 ha (see Fig. 1 for their distribution).

Site	Period	Regional group	Size (ha)	Source
Bilyi Kamin	C I	Chechelnyk	97	Geophysical and topographical data
Chechelnyk	C I	Chechelnyk	56.5	Рудь 2018, табл. 1
Chychykkozivka	C I	Tomashivka	254.3	
Dobrovody	C I	Tomashivka	210.9	
Fedorivka	B II	Volodymyrivka	122.7	Ohlrau et al. 2016, tab. 5
Hlybochok	B II	Nebelivka	100	
Khrystynivka 1	B II	Nebelivka	72.3	
Kryshypivka	B II	Serednobuzka	47.1	Видейко 2013, табл. 2 (recalculated by V. Rud after Дяченко 2010)
Maidanetske	C I	Tomashivka	200	Ohlrau et al. 2016, tab. 5
Nebelivka	B II	Nebelivka	235.5	
Olhopil	C I	Chechelnyk	58.5	Рудь 2018, табл. 1
Perehonivka	B II	Volodymyrivka	50	Ohlrau et al. 2016, tab. 5
Rohizna 3	B II (?)	-	97	Satellite image, measured by V. Rud
Romanivka	C I	Tomashivka	57.7	
Rozsohuvatka	B II	Nebelivka	55	
Sushkivka	C I	Tomashivka	76.9	
Talianky	C I	Tomashivka	320	Ohlrau et al. 2016, tab. 5
Tomashivka	C I	Tomashivka	117.4	
Valiava	B II	Nebelivka	80	
Vasylkiv	C I	Tomashivka	113	
Viitivka	C I	Chechelnyk or Tomashivka	49.4	Рудь 2018, табл. 1
Volodymyrivka	B II	Volodymyrivka	50.2	Ohlrau et al. 2016, tab. 5
Yaltushkiv I	C I	Petreny	55	Satellite image, measured by V. Rud
Yatranivka 1	C I	Tomashivka	60	Ohlrau et al. 2016, tab. 5

M. Makarevych (Макаревич 1940). From 1987, fieldwalking was conducted many times by V. Kosakivskiy. Since 2011, the site has been monitored by V. Rud together with V. Kosakivskiy. The area of Bilyi Kamin was measured by GPS at that time (Kosakivskiy/Rud 2011). With approximately 102 ha, this makes the site the biggest in the CTCC territory to the west of the Southern Buh, or at least one of the biggest in that area.

Based on partially preserved ceramic material from the excavations in 1928 and a few collections in recent decades, Bilyi Kamin is considered to be from the final phase of the Chechelnyk group development (Рижов 1999b, 145; Рудь 2018, 170). This correlates chronologically with the sites of the fourth (final) phase of the Tomashivka group (Рижов 1999a, 11) between the Southern Buh and the Dnipro. On a macro level, Bilyi Kamin is an example of the finale of Trypillia CI on the right bank of the middle basin of the Southern Buh. It is the time of the Chechelnyk and Tomashivka groups' disappearance in the Dnister-Dnipro region and transformations in the river basins of the Prut-Dnister and Middle Dnister (Рыжов 2000, 471).

The various contacts of the Chechelnyk group with its neighbours have been studied for a long time (Рижов 1999b, 148;



Рижов 2007, 466; Ткачук 2008; Рудь 2017). We see the reflection of the contacts in mutual ceramic imports and imitations as well as so-called syncretic sites, ceramics complexes which combine traits of two or more neighbouring ethnocultural complexes (Рижов 1999b, 148; Ткачук/Якубенко 2002–2003). Imported fine ware of the Tomashivka group was also found in Bilyi Kamin (Рудь 2018, 180 fig. 45,2). Thus there is clear evidence for the coexistence of the Tomashivka and Chechelnyk groups. The latter, according to S. Ryzhov, existed longer than the Tomashivka and was finally merged into the Kosenivka group (Рижов 2007, 469).

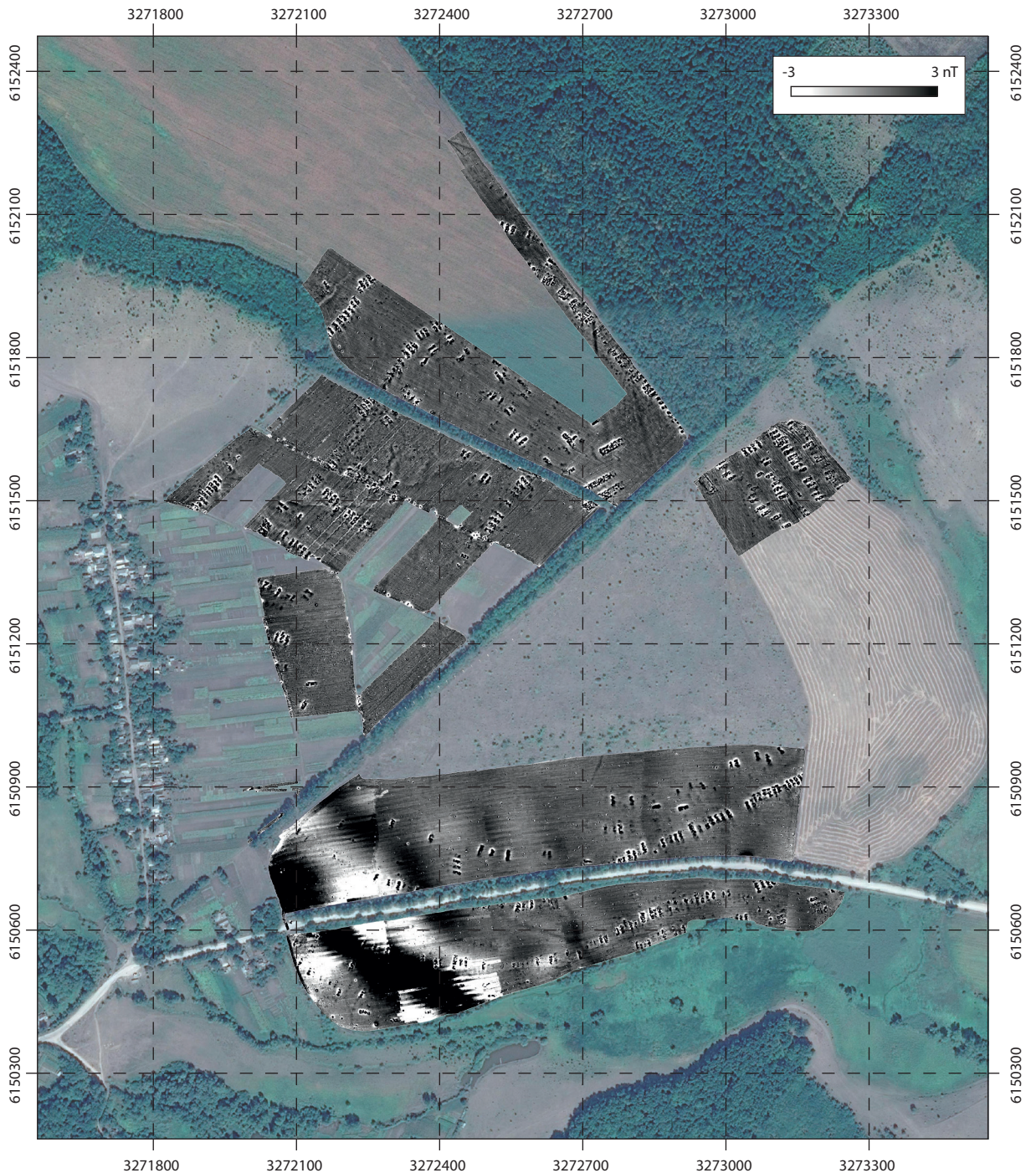
Fig. 1. The distribution of Trypillia BII and CI sites with areas of more than 45 ha (see Table 1).

Geography and topography of the Bilyi Kamin site

The Bilyi Kamin site (48°16' 01.9" N, 29° 24' 00.3" E) is situated in the south-east part of the Vinnytsia region in Ukraine (Fig. 1), 35 km to the north-east of the Ukrainian-Moldavian border. The settlement is located between the villages Bilyi Kamin and Rohizka in the Chechelnyk district. From an administrative perspective, it also occupies lands of the village of Piatkivka in the Bershada district.

From a topographical perspective (Figs. 2–3), the settlement is located on the wide left bank of the River Rohizka and runs from there upslope to the plateau above the river valley. The height difference between the lower south and the higher north parts of the site amounts to more than 70 m. In the south-west and north-east, the site is constrained by two unnamed streams whose valleys form a kind of promontory.

Today, the north-east part of the site is forested, while the west part is overbuilt by houses of the Bilyi Kamin village, and the central part covered by grassland. The territory of the site is crossed by the Chechelnyk-Bershada road and two forest lines. The rest of the territory is used for agriculture.



Hydrologically, the River Rohizka has its source 10 km north-west of the sites, from where it drains towards the south-east. Thirteen kilometres to the south-east, it joins the River Savranka from the right side. The latter belongs to the system of the Southern Buh, which flows into the Black Sea. The site is located in the south part of the current forest steppe zone, approximately 60 km to the north of the current border between steppe and forest steppe.

Fig.2. Magnetic plan of the Bilyi Kamin site against the background of the Google satellite image. UTM coordinate system (zone 35N) and WGS 84 ellipsoid.

Magnetometry

In early spring 2018, magnetometry was performed in an area of 40.6 ha (Fig. 2) in Bilyi Kamin using the MAGNETO® MX V3 Survey System of the company SENSYS Sensorik & Systemtechnologie GmbH Bad Saarow (Germany). The device was installed on a hand-pushed

wheeled cart with eight sensors at intervals of 0.5 m and a total width of 3.5 m. The geomagnetic device is coupled with a GPS system (Leica, GNSS/GPS systems Viva GS 10), enabling continuous grid measurements (zigzag) in a short amount of time.

During our survey, large areas in the south, north and near the centre of the site were measured. Based on these data, the total extent of the site can be estimated to be approximately 97 ha.

Different categories of magnetic anomalies can be identified in Bilyi Kamin (Fig. 3):

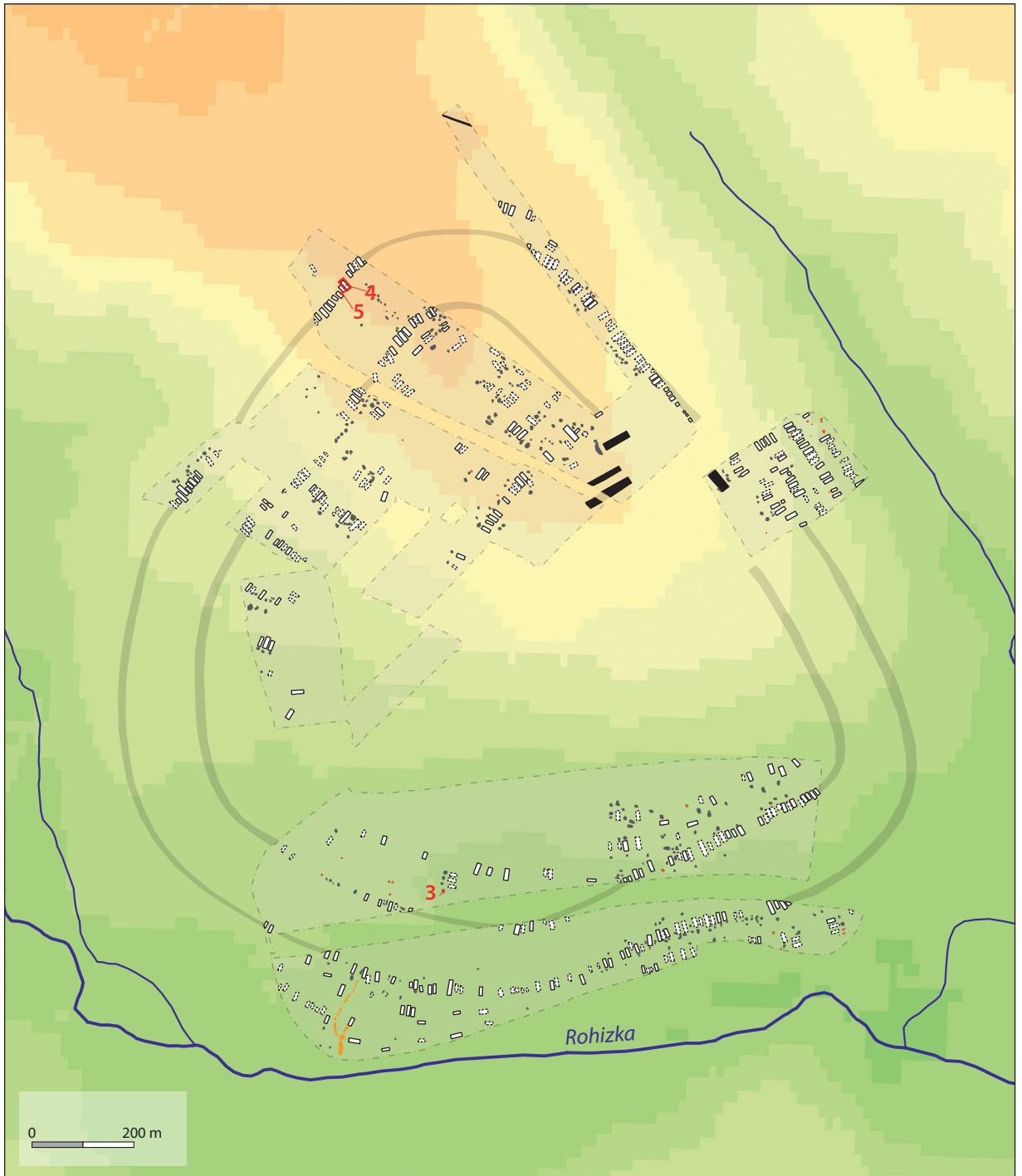
- 297 rectangular anomalies, which are the ruins of intensively burnt clay houses
- 141 rectangular anomalies of houses, burnt with less intensity or eroded
- four rectangular anomalies of unique buildings, so-called “megastructures”
- 351 anomalies of differently shaped objects, most of which can be interpreted as pits
- twelve stretched objects, presumably road to the south of the site
- one linear anomaly of a ditch or natural gully.

Two circles of houses are built on the site (Fig. 3). They are concentrated clearly in the north and south parts of the site. The ring corridor between the circles, 73–94 m wide, is free of buildings.

Some buildings are located outside the circles as well. Their disposition in the south part appears to have no system. There, we locate lines (2–9 houses each) positioned both radially and in parallel relative to the circles. Meanwhile, in the north-east part of the site, the buildings are grouped in three lines, which are parallel to the circles. Short radial streets (2–4 buildings) are also present.

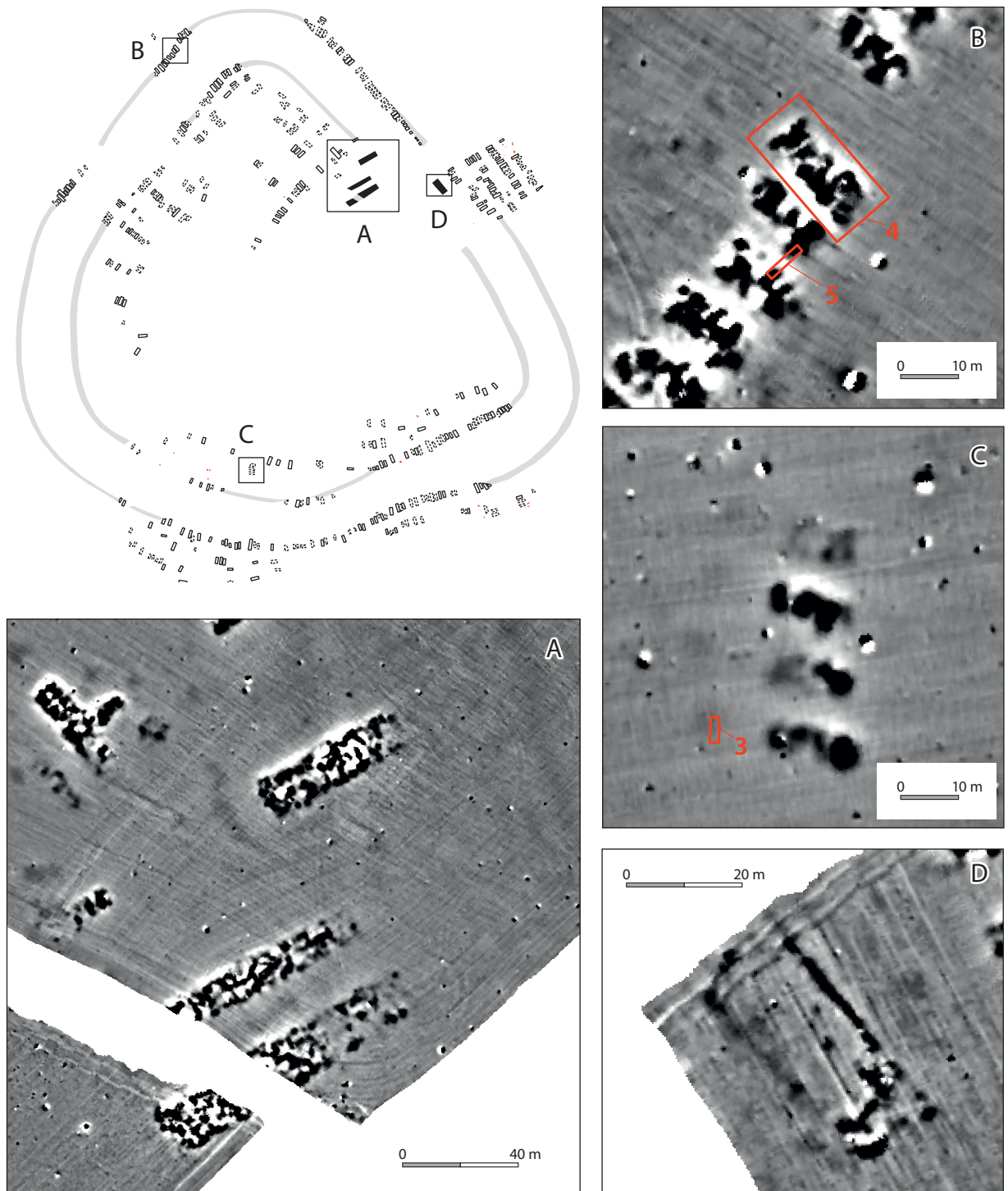
The space inside the circles is partially built-on. In the north and north-west parts of the site, the buildings are grouped mostly in long radial lines. The longest radial street, approximately 270 m long, inside the site is located to the north-west of “the square” or “plaza” with megastructures. It includes 15 buildings. There are also separate buildings located parallel and at right angles to the circles. In the south part of the site, the number of buildings inside the circles is smaller. Initially, we can conclude that most of them are located in short lines, parallel to the inner circle. Four buildings on this area create a radial line. Generally, the north part of the site contains more buildings than the south one.

The group of three parallel megastructures (Fig. 4A) is located in the north-east part of the site, presumably at the break point of the inner circle of buildings. The long axis of the buildings runs north-east to south-west. The biggest of the buildings (no. 1) had an area of 825 m² (66 × 12.5 m). The magnetic plan shows only its ends with a total area of 680 m². Its central part, as well as the south-west border of the neighbouring megastructure (no. 2), is blocked by the modern forest line. The anomaly of megastructure number 2 extends over an area of 375 m². Its width was approximately 8 m, and the minimal length 48 m. The original length of the megastructure cannot be more than 62 m, as no anomalies were found near the west edge of the forest line. The distance between megastructures 1 and 2 is 10.5 m. Their north-east edges are located on the same level. The azimuth of the long axis of the buildings is 60°. Megastructure number 3 with an area of 370 m² (37 × 10 m) is located 28 m to the north from the megastructure number 2 with an azimuth of 58°. According to the strong anomalies of the megastructures, we can conclude that their ruins are represented by large amounts of daub.



- | | |
|---|--|
| <ul style="list-style-type: none"> ■ mega-structures □ houses, burnt □ houses, burnt (low amount of daub) ● pits >10 nT ● pits <10 nT — linear structure — path — reconstruction of house rows — border magnetic survey — rivers □ trenches 2018 | <ul style="list-style-type: none"> elevation (m a.s.l.) ■ 150 ■ 160 ■ 170 ■ 180 ■ 190 ■ 200 ■ 210 ■ 220 ■ 230 ■ 240 |
|---|--|

Fig.3. Digital elevation model of the Bilyi Kamin site combined with interpreted magnetic features. Digital base map: SRTM 1 Arc-Second Global.



Their north-east sides have the lowest nT-values, which allows the assumption that the entrance was in that part of the building.

The anomalies of the pits near the megastructures also have very low nT-values. The elongated pits are located near the south-west edge of megastructure number 3, as well as between megastructures numbers 1 and 2. The anomaly of a further building with a nearby group of pits is located to the north-west of megastructure number 2. The area of the building is approximately 50 m² (10 × 4.8 m). Its long axis lies in the same direction as those of the megastructures.

The far east house of the radial street of the inner part of the site is a building which, due to its anomalous form, should go into a separate category. It has a rectangular form, 25 × 8 m. To one of its sides at right angles a smaller rectangular anomaly (8 × 3.7 m) is

Fig. 4. Details of the magnetic map and their locations within the settlement. A Three megastructures on the “square” (“plaza”) and the anomalous form building; B North part of the external concentric row of houses with trenches 4 and 5; C Internal radial row of houses and position of trench 3; D Megastructure 4 positioned parallel to the concentric row of houses.

connected (Fig. 4A). These two anomalies can be seen as a) ruins of one building with atypical form or b) ruins of two neighbouring buildings. In any case, with an area of 200–230 m², it is the biggest building on the site, not counting the aforementioned megastructures. It is possible that its size is connected somehow with the immediate proximity to the megastructures 35–55 m away.

The fourth megastructure (360 m², 30 × 11.5 m) is located 100 m to the east of megastructure number 1 and 18 m to the west of the buildings line (Fig. 4D). The areas to the north and west of megastructure number 4 were not geophysically scanned. Therefore its surroundings remain unclear. It is localized either a) within a so-called “plaza” or b) between the two main circles of buildings. Option “b)” is more likely because of the direction of the long axis of the building (azimuth 313°), which is parallel to the nearby line of buildings.

The pits from Bilyi Kamin are usually located near the buildings, at their sides or ends (Fig. 3). However, there is no regularity of their location in relation to building lines. Some groups of pits are not connected to buildings, for example the lined group of pits located in the north part of the site between the circles of buildings, as well as the group of pits to the north of the “square” with megastructures.

In respect to the nT-values, the anomalies were divided into the following classes: a) up to 5 nT, b) 5–10 nT, c) 10–20 nT, d) 20–30 nT, e) 30–37 nT (Fig. 3). Type “a)” represents the highest number – 291 pit anomalies, spread all over the site. The rest of the types are mostly located in the south and north-east parts of the site. The difference in nT values presumably reflects that pits are filled with materials of different types. For instance, “d” and “e” type objects are probably filled with large amounts of daub. However, it is also possible that some of those with the highest nT-values represent other kinds of objects – like, for example, pottery kilns (Korvin-Piotrovskiy et al. 2016).

In the south part of the site, a number of anomalies similar to pits was discovered. They are located in a row, creating a line up to 5 m wide, which runs from the south of the site and then divides into two. One line goes to the house outside the outer circle, the other one to the house in the outer circle. This line might reflect a path from the houses to the river (Fig. 3).

Another linear anomaly 2.6–3.3 m wide is located 130 m to the north-west of the north part of the outer circle (Fig. 3). The observed area is rather limited, so the anomaly is only 42 m length. The line is parallel to the outer circle. Therefore we assume that it was a ditch, however, it might also be an ancient gully.

Excavations in Bilyi Kamin

In 1928, the investigation of Bilyi Kamin (Макаревич 1940) started with two trenches (Table 2), the exact coordinates of which are impossible to determine. Trench 1 was located on the north-west edge of the site, in the courtyard between the houses of the eastern street of the village of Bilyi Kamin. The ruins of one wood-clay building were excavated completely (no. 2); two more (nos. 1, 3) were excavated partly. The ruins of three more houses (nos. 4–6) were excavated completely through trench 2, which is located in the south-east part of the site.

During 2018, three trenches with a total area of 136 m² were excavated (Figs. 3; 4B–C). The first trench now has the number 3, thus continuing the numbering started by S. Hamchenko in 1928. It was decided to continue the numbering of houses as well. Therefore the first completely excavated house of the 2018 campaign now has the number 7; two others, partly excavated, are numbered 8 and 9. All of

Table 2. General information about the Trypillia culture objects excavated during the 1928 (Макаревич 1940) and 2018 campaigns.

Campaign	Trench no.	Trench area (m ²)	Site part/structure	Objects	House width (m)	House length (m)
1928	Trench 1	348	West	House 1 (partly)		
				House 2	≈ 6	≈ 15
				House 3 (partly)		
	Trench 2*	284	South-east	House 4	4–5	7–9
				House 5	3.5–4	9–11
				House 6	6–7	10–11
2018	Trench 3	3	South/inner radial street	Pit 3 (partly)		
				House 7	4.3	12.5
				House 8 (partly)		
	Trench 4	128	North/outer circle	Pit 4013 (partly)		
				Pit 4016 (partly)		
	Trench 5	5	North/outer circle	Material assemblage 4006/4017		
			House 9 (partly)			

* Six burials of Bilohrudivka culture (final Bronze Age) were unearthened too.

them are located nearby within the outer circle. The general information about excavations and researched objects in 1928 and 2018 is given in Table 2.

Trench 3, pit 3 – stratigraphy and features

Pit 3 belongs to a building from a radial line in the inner space of the site (Fig. 4C). It is situated 4.7 m to the west from the end of the building. The anomaly has low nT-values and is circular with a 4.3 m diameter. The south-east sector of the pit was excavated with trench 3 (3 × 1 m).

The archaeological layers of the pit (Figs. 5–6) were found at a depth of about 188.0 m a.s.l.¹ They were covered by a massive layer of chernozem (3001a, 3001b, 3002) 1.3–1.7 m thick. The maximum depth of the pit that was dug in loam (3003) and loess (3005) is 1.3 m. The deepest part of the pit is 186.7 m a.s.l., its slopes drop smoothly to the bottom.

The pit has been filled in several processes with different types of material. These processes are reflected by seven horizontal layers, which are in a fixed stratigraphic order. Throughout the whole depth of the pit, the number of artefacts is very small and includes ceramics, bones and fragments of burnt clay. Object 3006 is filled with ash, while a large amount of charcoal can be found in object 3010 and in smaller amounts in objects 3004 and 3009. In the grey-yellow soil of object 3007, we have found slightly burnt fragments of an installation made of clay with an admixture of sand (?). Some clay fragments had flat surfaces.

We assume that the pit served for extracting clay for the building nearby. However, with time, it was transformed into a place for domestic waste from the adjacent household. It was not filled completely, or it has slipped, which can be deduced from the concave form of the lower border of object 3002. The thickness of the chernozem layer above the pit can be explained by colluvial processes, as the pit is located topographically below the rise in the central part of the site.

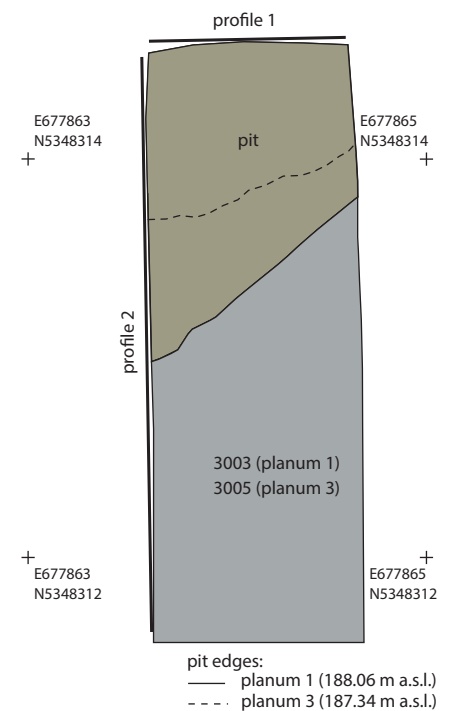


Fig. 5. Trench 3. The borders of the pit on the level of the plana 1 and 3. Location of the profiles 1 and 2.

1 The local topographical survey of the excavation area was conducted with a Leica DGPS (GNSS Viva). Due to the ellipsoid used (WGS84 UTM 35N), all elevation data require correction by approximately -30 m.

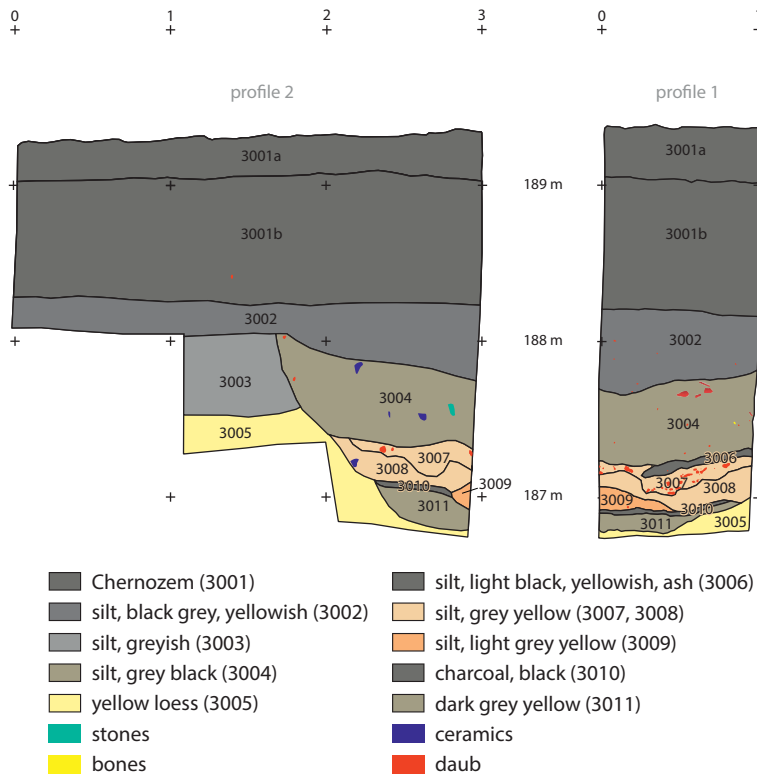


Fig. 6. Trench 3. Pit. Profiles 1 and 2.

Trench 4

The main target of exploration in trench 4 (16 × 8 m) was the magnetic anomaly that represents the ruins of wood-clay house 7 (Fig. 4B). During the excavation, we explored the east part of neighbouring wood-clay house 8, pits 4013 and 4016 in part, as well as the material assemblage between houses 7 and 8 (object 4006/4017).

Geophysical data (Fig. 4B)

Dwellings 7 and 8 are parallel and neighbouring buildings of the settlement's outer circle in the north part of the site and are approximately 1.5 m from each other. The next house anomaly to the north of house 7 is located beyond an 8 m wide gap in the house row, which might indicate a path. The buildings to the south of the researched objects are located densely only 1–2.5 m from each other. The north-west ends of these buildings have high anomalies and are located strictly in line, whereas the south-east ends of the buildings are represented only by weak anomalies. The anomalies of dwellings 7 and 8 are slightly shifted to the north-west, compared to other buildings. The shift of house 7 is more than 5 m. House 7 is represented by a distinct rectangular anomaly of 13.6 × 5.5 m. House 8 is also represented by a mostly distinct rectangular anomaly with an area 10 × 5 m. The south-east border of the anomaly is an exception – there the long edges of the object are continued by almost indistinguishable anomaly spots.

Stratigraphy (Table 3; Fig. 7)

The cultural layer within trench 4 is covered by sediments 26–40 cm thick, which contained small amounts of little fragments of daub, ceramics and animal bones. The upper level is black-grey soil (4001)

with a large amount of humus and a thickness of up to 35 cm. Below, directly above the cultural layers, it is yellow-grey (4003, 4003a, 4005).

The remains of dwellings 7 and 8 are represented by three stratigraphic layers. Two of them represent the daub of house construction. The upper layer of daub (4004 and 4015 – house 7, 4007 – house 8) has a thickness of up to 10 cm, while the lower, which is usually called “platform” (4014 and 4015 – house 7, 4023 – house 8), at some points reaches almost 20 cm. Some clay objects were built on the platform and also some other movable artefacts were found there (see below). The platform covered the third layer of the dwellings (upper part of contexts 4018 and 4022 – house 7, upper part of context 4023 – house 8), which is represented by a large number of finds (mostly ceramics) and clay objects. These artefacts and objects are located in the dark yellowish brown loess layer (4018 and 4022 – house 7, 4023 – house 8), 20–40 cm thick, which suffered from heavy bioturbation.

Table 3. The stratigraphy of trench 4. The division of archaeological (ARCH) and geological contexts (GEO).

Layer no.	House 7 area		Houses 7 and 8 vicinity		House 8 area	
	Context no.	Interpretation	Context no.	Interpretation	Context no.	Interpretation
GEO 1	4001	Natural humus	4001	Natural humus	4001	Natural humus
GEO 2	4003	Activities after house burning	4003a	Activities after occupation	4005	Activities after occupation
ARCH 1	4004 and 4015	Upper daub layer: collapsed roof and walls	4004 4014 4015 4019	Fallen daub during fire	4007	Upper daub layer: collapsed roof and walls
ARCH 2	4014 and 4019	Lower daub layer: platform	4007 4023		4023	Lower daub layer: platform
ARCH 3	4018 and 4022 (upper parts)	House ground floor	4002 4006/4017	Materials on the ancient surface	4024 (upper part)	House ground floor
GEO 3	4018 and 4022	Bioturbated loess	4002a 4006a	Bioturbated loess	4024	Bioturbated loess
GEO 4	4020	Loess	4020	Loess	4020	Loess

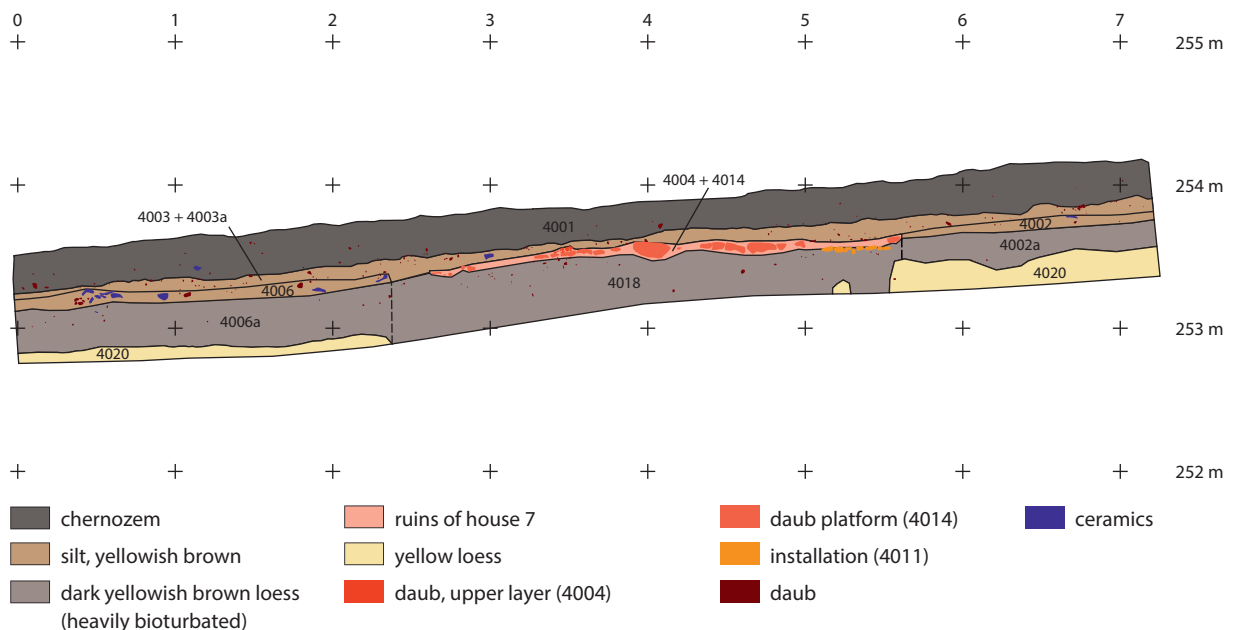


Fig. 7. Trench 4. The longitudinal profile (no. 2) displays the stratigraphy of house 7 (4004, 4014, 4011) and the position of artefacts outside the house (4002, 4006).

From an archaeological perspective, the space outside the dwellings is represented by artefacts located on the level of the ancient surface. The number of such artefacts is small within context 4002 and much bigger within context 4006/4017. The thickness of the layers is 4–12 cm. Bioturbated loess 16–35 cm thick was situated (4002b, 4006b) below. A layer of almost sterile loess (4020) all over trench 4 lies lower than the aforementioned archaeological contexts, 60–80 cm below the modern surface.

Trench 4 is located on a distinct slope of almost 5°, reaching a difference of 65 cm on the 8-m wide section of the trench. Profile 2 shows that layer 4002 was 10–15 cm higher than the lower point of installation 4011, which is connected to context 4018. Therefore we assume that, before the construction of house 7, some levelling of the ground floor was conducted, which was connected to the terracing of the area in the north part of the house.

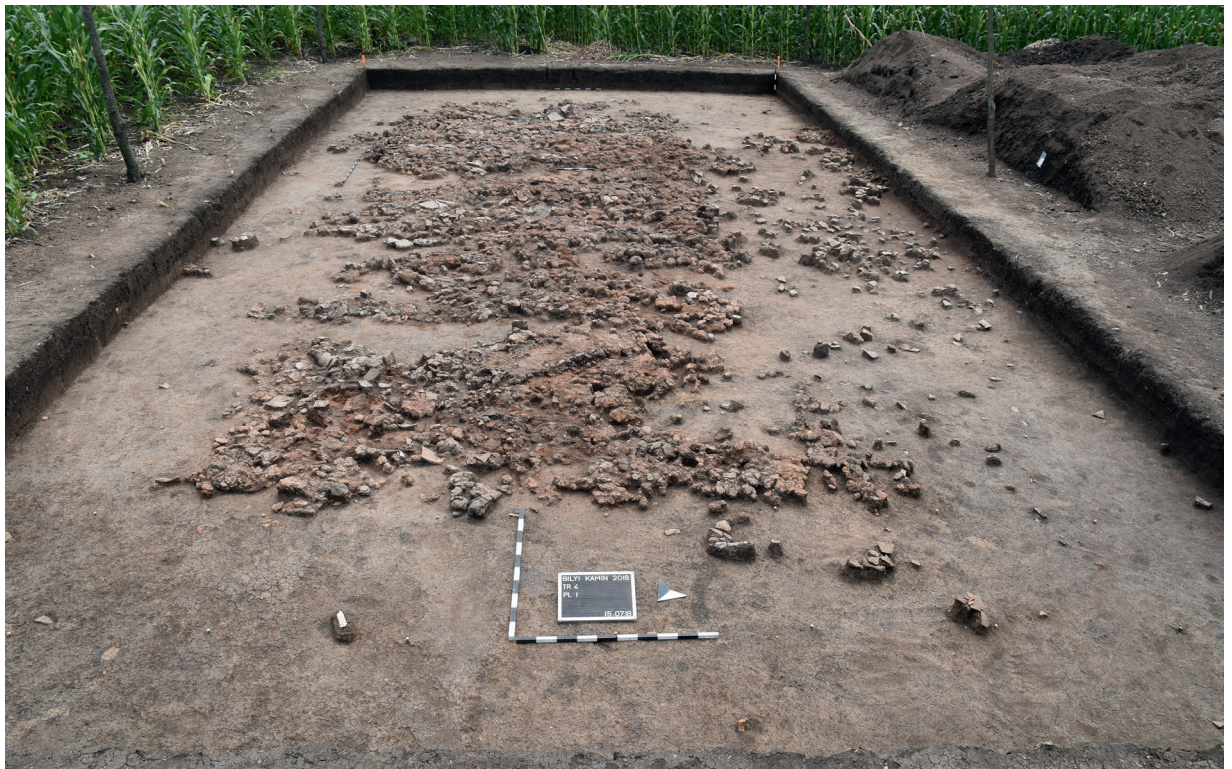
House 7

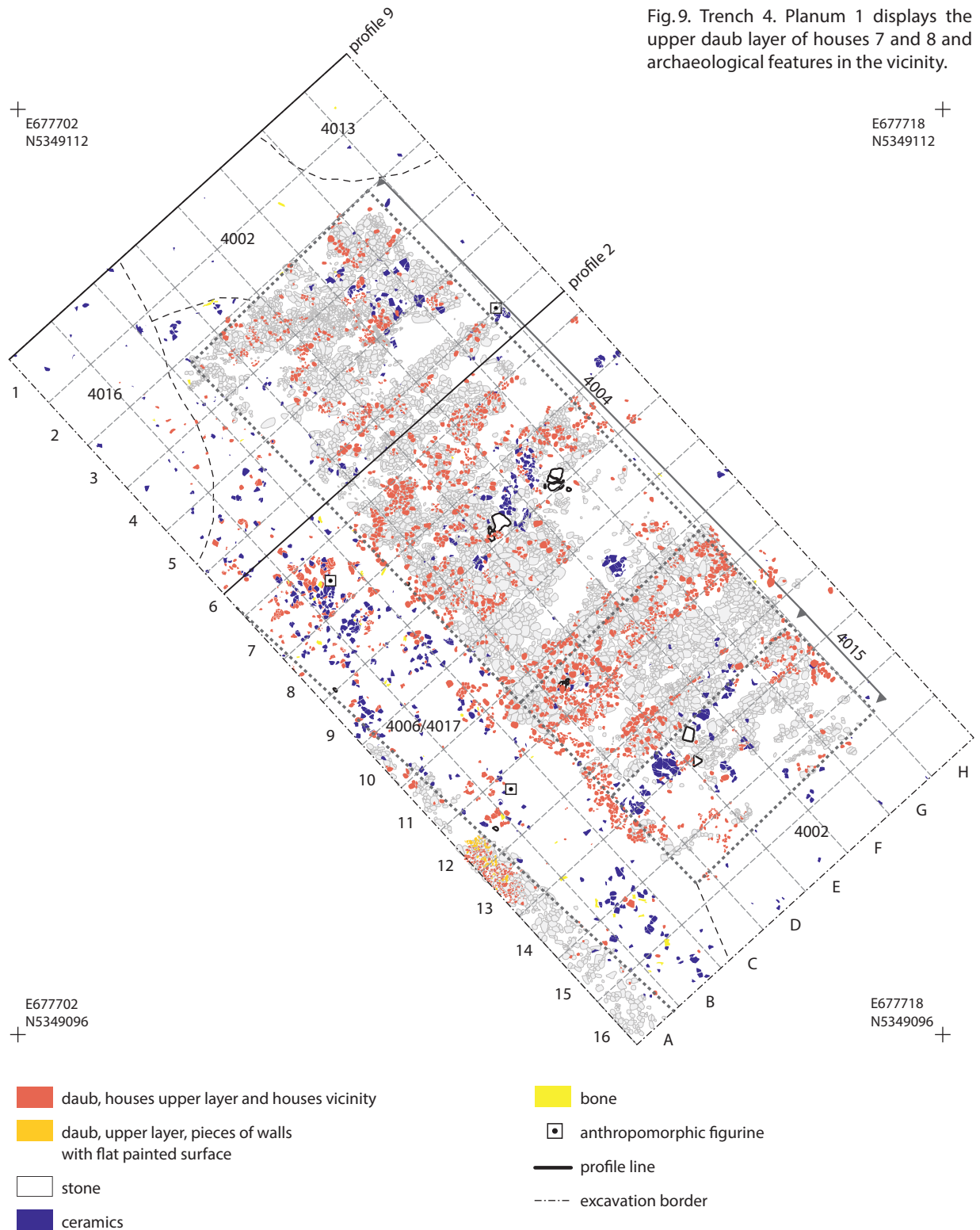
The upper layer of house 7 – objects 4004 and 4015 – contains small, amorphous fragments of daub with an admixture of chaff, which is spread over an area 13.2×5.5 m (Figs. 8–9). Some of them had the imprints of wooden constructions (Fig. 10). These are imprints of branches and split wood, directed both along and across the house. The upper layer is ruins of a loft as well as of the inner and outer walls of the building.

The lowest collapsed daub layer (platform) of the house covers an area 12.5×4.3 m (Fig. 11). It reflects the original house area. According to the constructive features, the platform divides into two parts along the width of the house – features 4014 and 4019.

The northern part, object 4014, which represents the main part of the house, has an area 10.4×4.3 m. The platform consists of massive fragments of daub, which are densely located all around the

Fig. 8. Trench 4 during the documentation of planum 1.





aforementioned area, except in some areas where the daub has not been preserved. This layer represents the floor of the upper store of the house. It was built in several stages. First, the wooden frame was covered with a layer of clay, 3–10 cm thick, with a medium amount of chaff admixture (4014a). During burning, these fragments hardened. Their surface was not generally even. This layer is covered by another, thin (up to 2 cm) one of clay mass with a large admixture of chaff (4014b). It appears that its task was to even layer 4014a. The third stage of construction is represented by a thin (2–5 mm) layer of clay (4014c) without visible organic admixtures. This layer had a flat

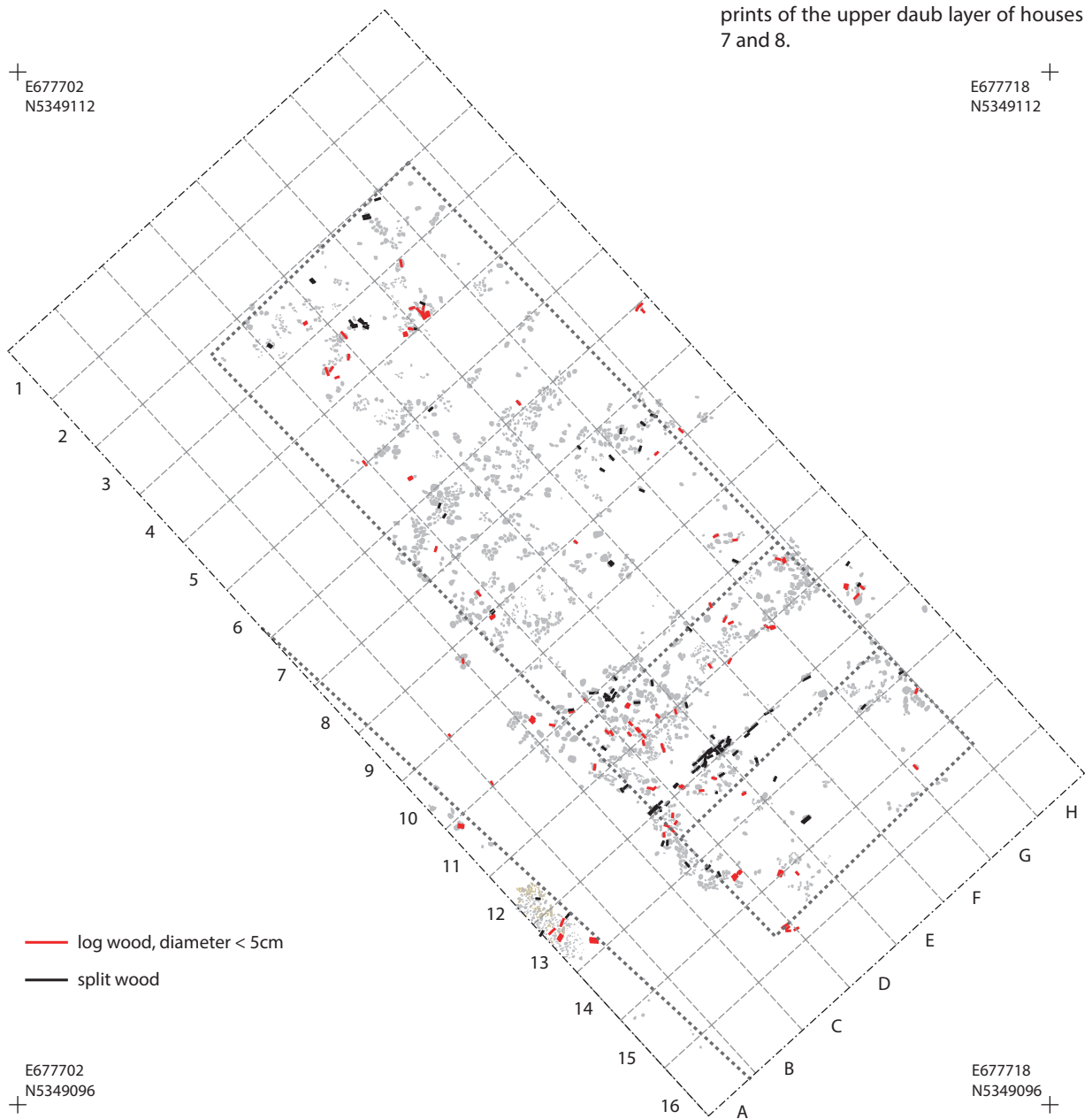


Fig. 10. Trench 4. Orientation of wood imprints of the upper daub layer of houses 7 and 8.

surface. Layer 4014c along with underlying layer 4014b is found in small amounts all around the surface of the main room of house 7. Some fragments of layer 4014c are also found under objects 4008 and 4021 (see below). In grid G/11, signs of platform repairs were found on the edge of the house.

On platform 4014, we found three objects: 4008, 4010 and 4021 (Fig. 11).

Object 4008 is a clay installation located in the central part of the house, 0.7 m from the north-west end. The main amount of installation fragments is located in grid E/4, parts in neighbouring sectors. The installation was greatly damaged as a result of cultivation. The maximum area over which fragments are spread is 1.5×1.5 m. The height of some parts of the installation is 2–5 cm.

The installation was built in one stage on the platform of the house of clay mass, presumably without organic admixtures. The fragments are hardened, which is the result of high-temperature burning. The surface of the installation is flat. Some parts of the surface are ornamented with incised lines grouped in concave stripes (3–5 in each group).

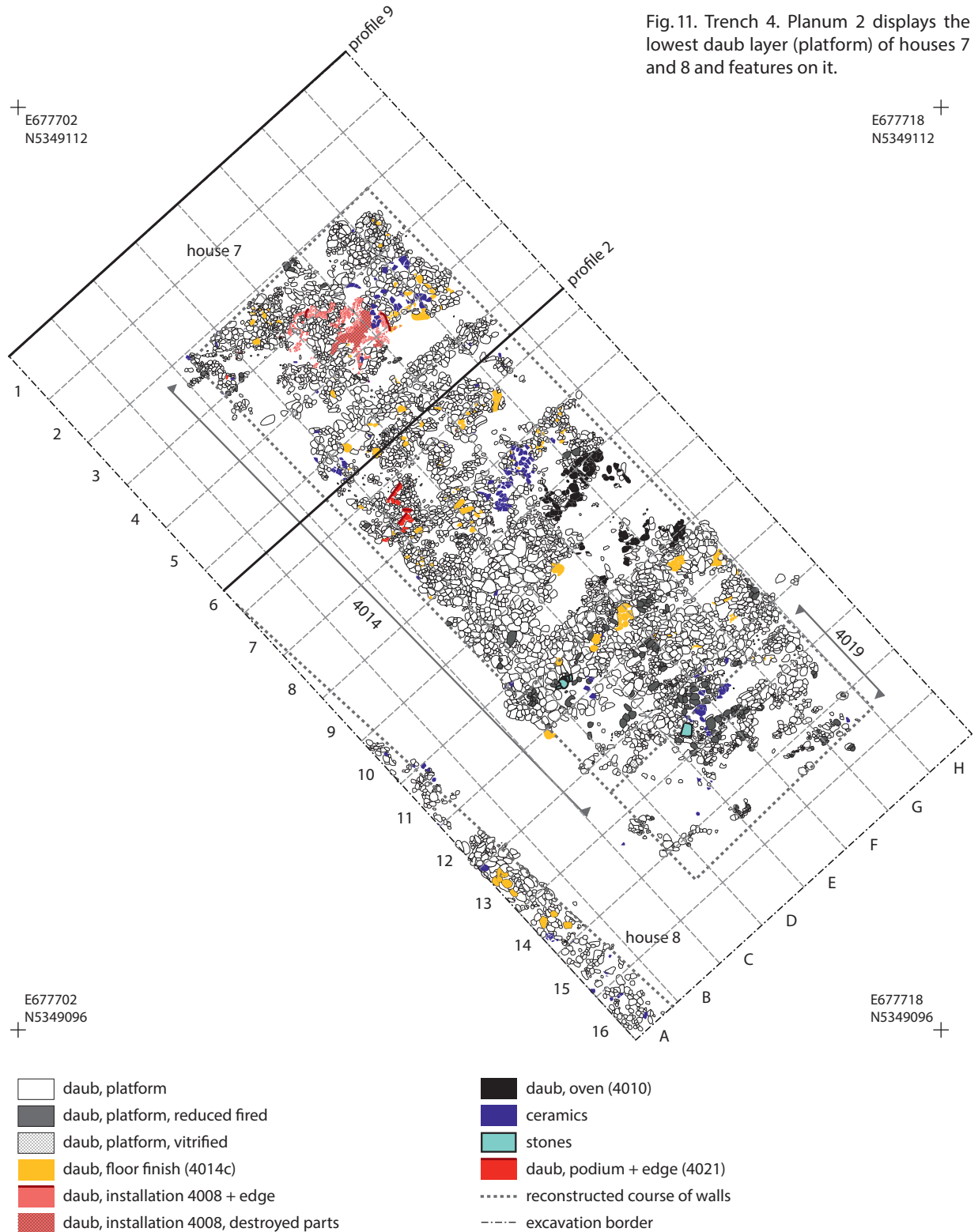


Fig. 11. Trench 4. Planum 2 displays the lowest daub layer (platform) of houses 7 and 8 and features on it.

The width and depth of the lines are up to 1 mm. A reliable reconstruction of the ornamentation is impossible, the stripes could have formed either concentric circles or wavy structures. We found traces of red paint in the incised ornamentation of the installation as well as on the surfaces of different parts.

The borders of the installation are found in the west and east parts. They are straight in outline and rounded in profile. We can cautiously assume that the installation was square with rounded corners. Moreover, the corners pointed in the direction of the long and short sides of the house.

Object 4010 is an assemblage of fragments of burnt clay with the admixture of sand. It represents the remains of the base of an oven located in sectors F–G/8–11. The length of the object along the north-east outer wall of the house is 2.2 m, the width 1.7 m. The assemblage is not preserved as one. On the intersection of lines 9 and 10, the ruins of the installation are represented only by small fragments of clay. The south part of the object consists of small amorphous fragments of burnt clay. Larger parts are located in the north part of the installation. Their surface is smooth. The maximum height of the installation is 19 cm. Traces of repairs to a level 3–6 cm thick are also noticeable. Here, we find the edge of the oven, located at right angles to the long axis of the house. It is built of clay with a chaff admixture. The main part of the installation is built both on the thin (3–5 cm) layer of the platform (4014a) and directly on the wooden frame. This is proved by the imprints of split wood in the lower area of the fragments, located at right angles to the long axis of the house.

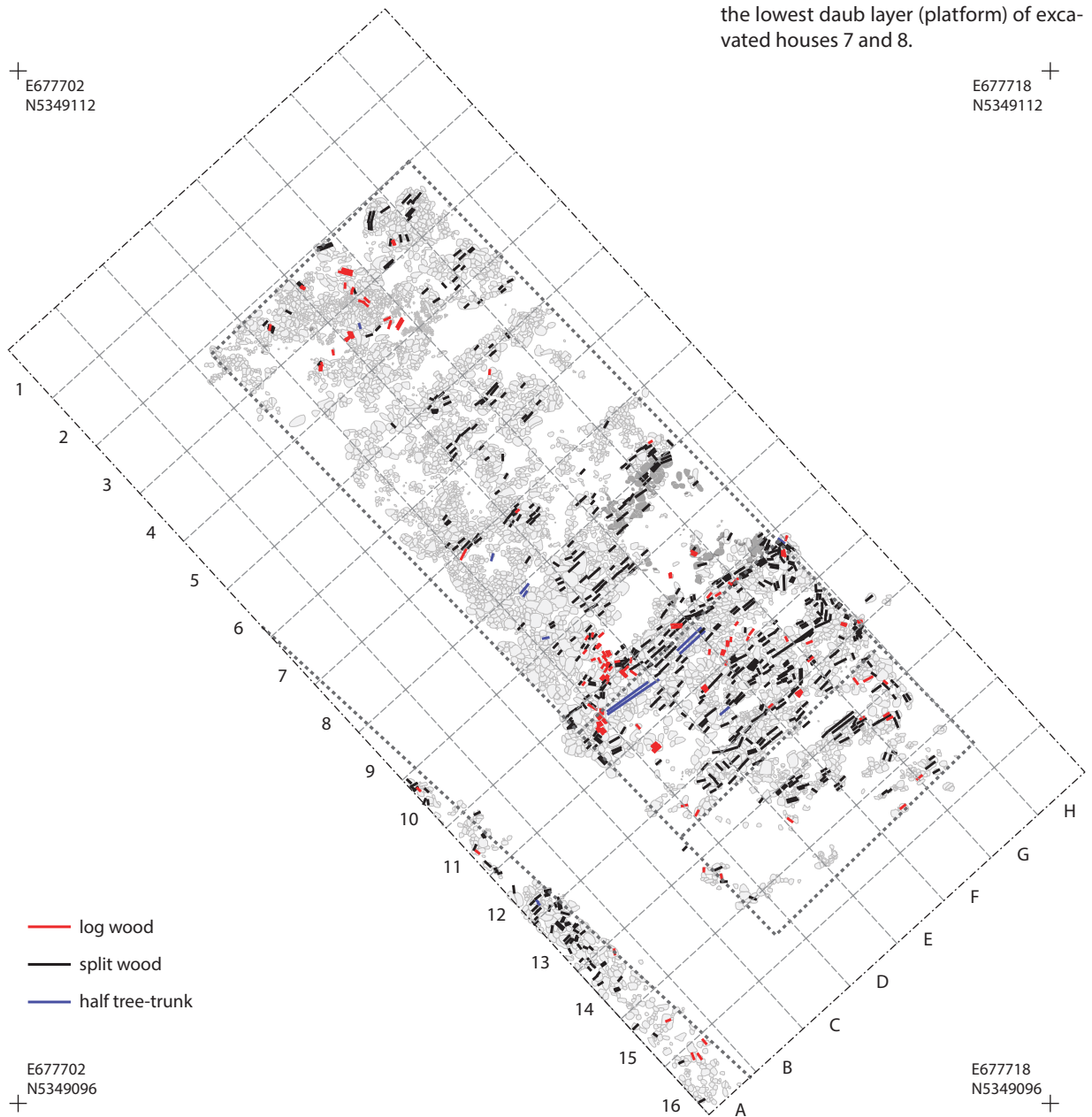
Object 4021 is represented by the smoothed edges of an interior fragment, which is made of clay with a chaff admixture. The borders of the installation are located inside grids C–D/7 without any system. One fragment is located in grid C/3. It appears that the object was damaged when the platform on which it was built (4014) fell. The height of the installation is 3–7 cm. The fragments appear to be the remains of a podium which was located along the south-west outer wall of the house.

A small amount of ceramics was found on the platform. One assemblage is located to the east of installation 4008 (Fig. 18,2), another to the north-west of object 4010; also, the remains of a small goblet were found not far from a grinding stone in sector D/11 (Fig. 10).

Another part of the platform – object 4019 (Fig. 11) – covers an area 2.1×4.3 m. It is represented by fragments of daub 2.5–4.5 cm thick which are spread less densely over the aforementioned area. In the south corner of the house, the daub is generally absent. The layer of platform 4019, consisting of clay and chaff, is built on the wooden frame in one stage, without smoothing with additional layers of clay. A collection of ceramics and the fragment of a grinding stone are located in the central part of object 4019 almost on the border with object 4014.

We assume that there was an inner wall of the house on the level of the upper store, which went along the edges of objects 4014 and 4019, dividing the building into two parts widthwise. The main part (4014) had solid flooring, whose surface was levelled with two layers of clay. Within the entrance area (4019) of the building with a thin floor, there was presumably a working place connected with the use of the grinding stone.

The imprints of the wooden constructions of daub (platforms 4014 and 4019 plus separate fragments of the building's upper layers [4004 and 4015]), suggest a division of the house into three parts widthwise (Figs. 11–12). The north-west and south-east parts are represented by the small number of imprints of wood (split wood) which are mostly located at right angles to the long axis of the house. The south-east part of the house is delimited by the imprints of wood and directly reflects object 4019. The third, central, part of the building is represented by a large number of imprints of wooden constructions (split wood and half tree trunks), which are located mostly at right angles to the long axis of the house as well. However, there is a large number of imprints located along the long axis of the building (logs, split wood), for instance, on the edges of the grids in lines 10 and 11. On the grids of line 11, we also see a larger numbers of imprints (logs, split wood) both in the direction of and at right angles

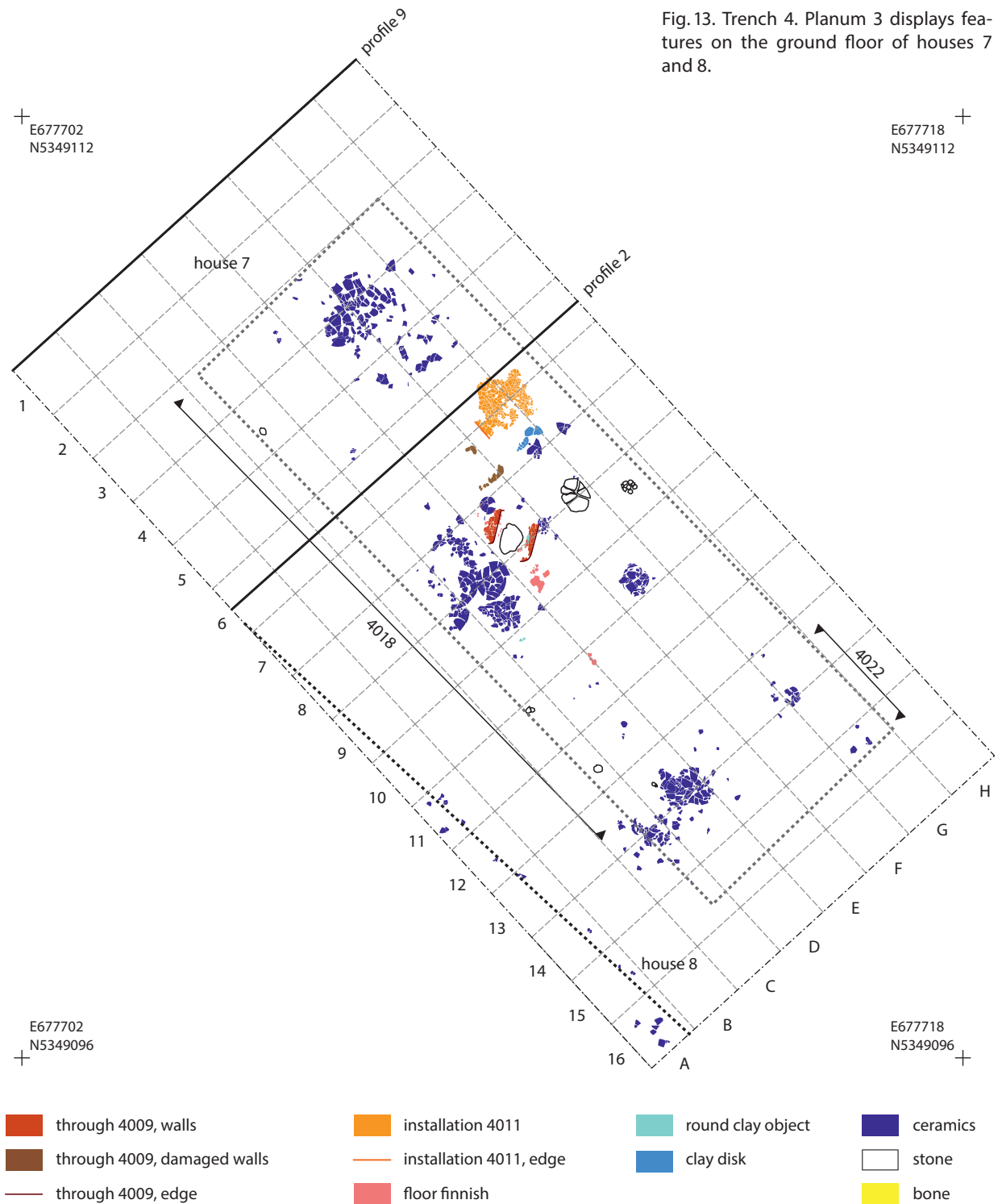


to the long axis of the building. The biggest concentration of daub in the upper layer (4004) is also located within the grids of line 11.

Judging by this, we assume the existence of an inner wall which went through the south-east edge of object 4010. This means that there were two rooms on platform 4014. In the small room (2.2 × 4.3 m), we find only a working place connected with the use of the grinding stone. Within the large room (8.2 × 4.3 m), we find an oven, a podium and the central installation. So, together with the entrance room to the south-east (4019) which was of light construction, the upper store of the house had three rooms.

On the ground-floor level were objects 4018 and 4022 (Fig. 13). No evidence of the existence of inner walls was found. Two separate objects built of clay were found on the earth floor: 4009 and 4011 (Fig. 13).

Object 4009 is constructed in a U-form (Fig. 14), resembling the trough of three walls: north, east and west. The trough is located in the central part of the house, in grids D/7–8. Its lengths are 60 cm (north-south line) and 70 cm (east-west line). A wooden frame made



of interlaced twigs, covered in clay with an admixture of chaff, provides the foundation of the walls. The height of the walls is approximately 19 cm, the width 4–6 cm. The east and west walls are well preserved while the north was destroyed by the platform falling and its parts are found in grid D/6. The south edges of the well-preserved walls are smoothed out. A granite grinding stone is located in the centre of the construction. The absence of a boundary in the south indicates that the working processes were conducted from that side. In the centre of construction 4009, around it and on the edge of grids D–E/11, we have found traces of levelling of the earthen floor with a layer of clay analogical to layer 4014c. It is possible that such levelling was present throughout the house.



Fig. 14. Trench 4. House 7. Clay U-shaped installation with grinding stone, situated on the ground floor (see feature 4009 in Fig. 13) of house 7.

The clay installation 4011 is located to the north of the trough, near the north-east outer wall of the building (Fig. 13). It is located on an area 1.0 × 1.1 m as densely packed small tiles with flat surfaces. It is made of clay without visible organic admixtures and consists of a single layer. The height of the installation is 2–4 cm. In the west part, we found the rounded (in profile) edge of the installation, located on a straight line parallel to the long axis of the house. This allows us to assume that the installation was rectangular in shape.

Broken tableware was found on the earthen floor in the north (Fig. 18,1), south (Fig. 18,6) and east corners of the building, as well as near the trough (Figs. 18,4.11.17), especially to the south-west (Figs. 18,3.5.8.15.16) of it. No less than 14 pots in total were found here, including biconical goblets, spherical and conical bowls, biconical vessels with wide and narrow necks, amphoras, pear-shaped and crater-shaped vessels. One big grinding stone is located 60 cm to the north-east of the trough and two small grinding stones (upper stones) are found in the south corner of the house. Along the perimeter of the outer walls of the building, there are stones which might have been used as elements of the building's construction. Near installation 4011, fragments of two clay discs were found which are identical to clay slabs from kilns (for example Видейко и др. 2015, 153 рис. 7; Рудь 2016, 68 рис. 4,2; Церна и др. 2017, 310 рис. 7,3). 30 cm below the ground floor, in a square D/3 a fragmented goblet was found.

House 8

Part of house 8 was excavated in the south-west wall of trench 4. The general stratigraphic sequence of the building remains is given in Table 3. It must be noted that the south-east part of the building remains is located 20 cm below the other parts. On the other sites, such a situation can be explained by pits under the building (for example Овчинников 2014, рис. 25.3). The deepest point of artefact occurrence in the south-east part of cluster 4006/4017 is located on one level (252.84–252.97 m a.s.l.) with the south-east part of building 8.

The upper layer of daub (4007) is represented by fragments of daub with an admixture of chaff (Fig. 9). These are spread unevenly on the excavated surface of the house. A large amount of daub is located in the central part of the house, but it is almost absent on the north-west and south-east. The remains of a destroyed wall are located in the central part (Fig. 9). The thickness of the preserved

fragments is 10–15 cm. The wall is built of clay with a small amount of organic admixture. The surface is smoothed with a thin (1–4 mm) clay layer without visible admixtures and painted, which means that the surface of the wall was smooth. Most of the wall fragments, which are fragile and of yellow colour, fell with their smoothed surface facing down. Parts of the inner corner of the wall, which also collapsed and fell on its smoothed surface, were identified.

The number of wood imprints (logged wood and split wood) on the daub of layer 4007 is small. Their direction is mostly across the house (Fig. 10).

The platform (4023) is found across the whole excavated area of the house (Fig. 11). However, thicker (up to 10–15 cm) pieces are spread in the central part, thinner (4–7 cm) ones in the north-west and south-east. The platform is made of clay with an admixture of chaff on a frame made of split wood. The direction of wood imprints on the side of the fragments facing down is different (Fig. 12): approximately 2/3 of the imprints are situated at right angles to the long axis of the house, while the rest are parallel. Layers of levelling, analogical to layers 4014b and 4014c of house 7, have been preserved on certain fragments (Fig. 11). Traces of repair works are also found. One broken conical table bowl (Fig. 18,13) and a goblet (Fig. 18,10) were found on the platform.

Stray potsherds and a stone were found under the platform (Fig. 13), in the upper part of layer 4024.

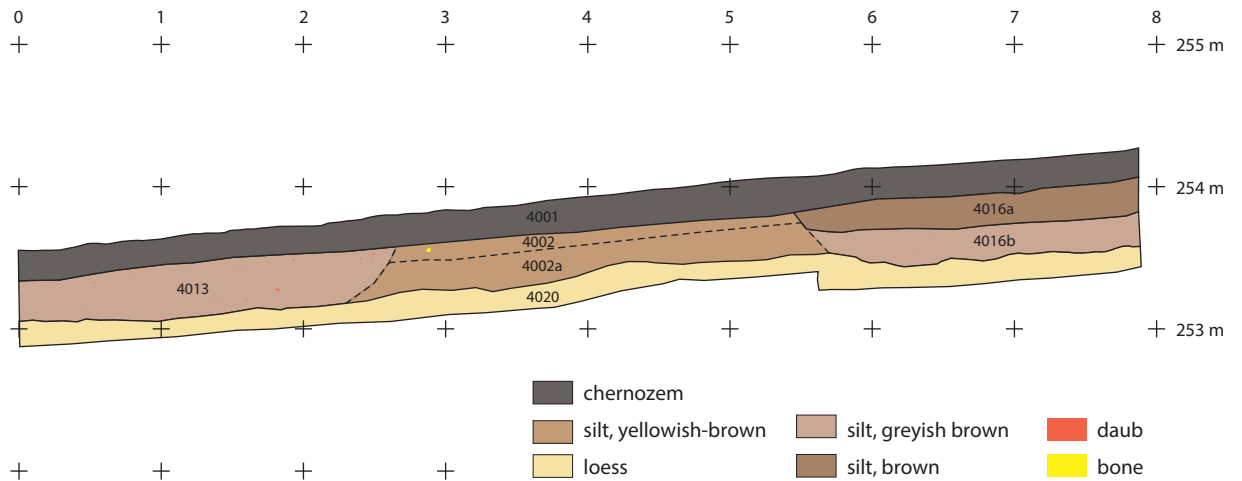
Vicinity of houses 7 and 8

The areas near the houses (Figs. 8–9) of trench 4 are represented by context 4002. It includes areas to the north, south and south-east of house 7, where occasional fragments of ceramics (Fig. 18,19) and bones are present. These finds mark the deepest level of the ancient surface near the entrance and to the right of house 7.

On the area 1.8–2.3 m wide between houses 7 and 8, the ancient surface is marked by object 4006/4017 (Fig. 9). It is a cluster of a large amount of ceramics (Figs. 18,9,18), bones, daub, several anthropomorphic figurines and tools, leading to the interpretation as a facility for the deposit of domestic waste. In the squares B–C/10–11, daub of the upper layer of house 7 covers the material (bones and sherds) of object 4006/4017. Therefore, the domestic waste of this object can be linked with the life of the inhabitants of house 7.

Near the north corner of house 7, there is pit 4016, and near the west corner pit 4013 (Fig. 9). The geophysical plan does not show these objects. Stratigraphically (Fig. 15), the pits were dug in the loess layer (4020), and the filling of the pits is covered by a layer of chernozem (4001). It is impossible to see clearly the level of the ancient surface (4002) between the pits. The artefacts of this part are located at a depth of 253.49 m a.s.l. near object 4013, at 253.69 m a.s.l. near object 4016. In profile 9, there are separate pieces of daub and a bone at this depth. They probably mark the level of the ancient surface.

Pit 4013 had a depth of no more than 30–35 cm; the walls were presumably sloped, and the bottom was flat (Fig. 15). The filling is everywhere the same – greyish brown soil with a small number of clay granules. The upper part of the pit contained small fragments of pottery. They were also located on the slopes of the pit sides in the south part of the object, on the border with cluster 4006/4017. Only a part of the pit was excavated, over an area 4.8 × 2.5 m. On the plan, its edge seems to be convex; it is possible that the overall shape was oval.



The depth of pit 4016 could not have been more than 40–45 cm. Stratigraphically, the filling of the pit can be divided into two layers (Fig. 15). The upper part of the pit is filled with brown soil (4016a), the lower with greyish brown soil (4016b). The lower layer of the pit is lacking in finds. Stray fragments of bones and ceramics are found in the lower part of layer 4016a. We assume that the first stage of pit filling was done in a natural way, while the second was connected with forming the cultural layer as the result of people's living processes, most likely those of the inhabitants of house 7. The contours of the pit are roundish. Pits 4013 and 4016 could have been dug out as a result of clay extraction for building houses.

Fig. 15. Trench 4. Profile no. 9 displays the stratigraphy of pits 4013 and 4016 to the north-west of house 7.

Trench 5, house 9 – stratigraphy and features

With test trench 5 (5 × 1 m), part of house 9 and the space to the east of it were explored. The house is represented by a rectangular anomaly with an area of 11 × 5 m, which is located 2.5 m to the south-west of house 8 (Fig. 4B). The main goal was to explore the edges of houses 8 and 9 as well as the space between them. However, the remains of house 8 are almost completely absent.

The stratigraphy within the trench is similar to that of trench 4 (Fig. 17). The layers of chernozem (5001) and yellow-grey soil (5003) cover the remains of the house, which is located 37–69 cm below the current surface. The upper daub layer (5004) of the house is found everywhere (3.3 × 1 m), except on the west side. The fragments are amorphous, 3–6 cm thick, made of clay with an admixture of chaff. Only one fragment from the west side had the imprint of split wood aligned along the house.

The daub of the upper layer covered two objects (5006, 5009) located on the platform (5005). Object 5006 is a cluster of small tiles with a smooth surface, the remains of an installation made of clay without visible organic admixtures (Fig. 16). We located its edge in the west part. The height of the installation at the level of the edge is 12 cm. Object 5009 is represented by massive amorphous fragments of daub, also without any admixture of chaff (Fig. 16). The thickness of the fragments is 10 cm. They have smooth surfaces. On the side facing down, the daub of both objects has the imprints of the daub layer (5005) on which they are built. We assume that object 5009 represents the ruins of an oven, 5006 the bakeware. It should be noted that the oven is located in almost the same part of this house as in house 7.

The platform (5005) of the house is indicated by fragments of daub 5–8 cm thick, made of clay with an admixture of chaff. According to

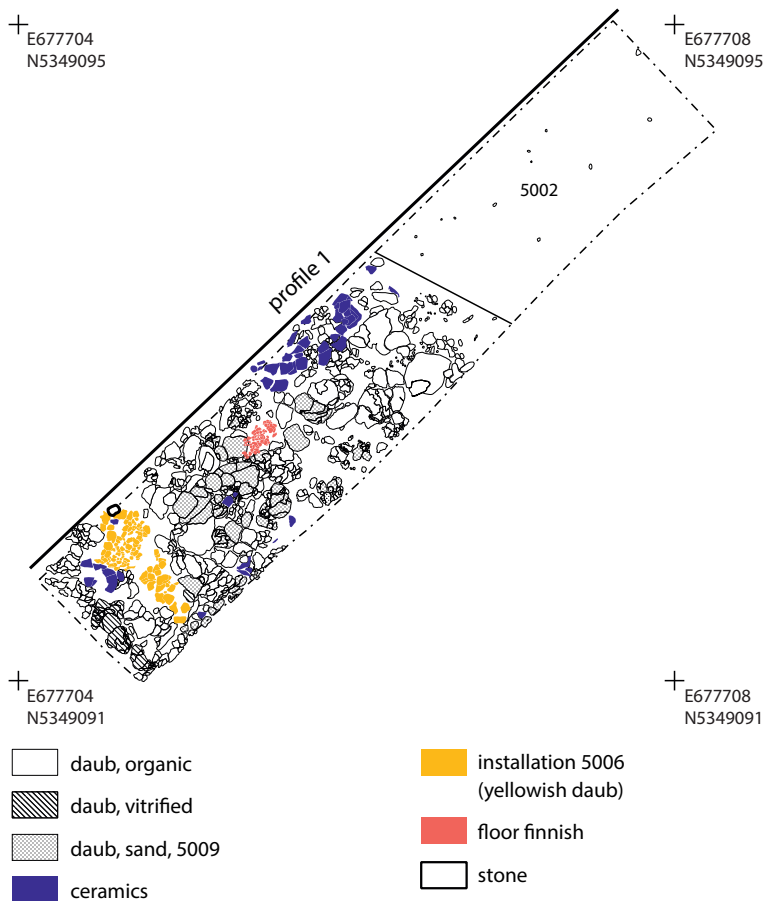


Fig. 16. Trench 5. Planum 2 displays the lowest daub layer (platform) of house 9 and features on it.

the imprints of wood, it was built on a wooden frame. We also found traces of a thin levelling layer of the platform (Fig. 16), which was also found in houses 7 and 8 (see above on layer 4014c). The following artefacts were found on the platform: fragments of ceramic tableware (Fig. 18,14), one flint tool and one stone. Below the platform, at ground floor level (the upper part of layer 5007), only stray fragments of ceramics (Fig. 18,7) were found.

The level of the ancient surface (5002) outside the house is represented by few artefacts of bones and sherds, 50–57 cm below the current surface. Several fragments of daub from house 8 were found in the east part of the trench.

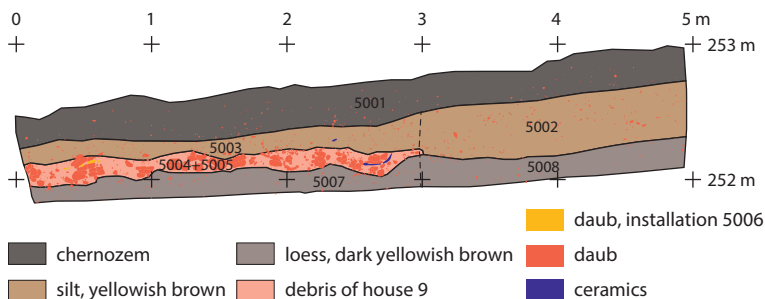


Fig. 17. Trench 5. Profile no. 1 displays the stratigraphy of house 9 (5004, 5005, 5006) and the placement of artefacts outside the house (5002).

¹⁴C dating

Nine bone samples from different excavation trenches at Bilyi Kamin were successfully radiometrically dated in the Poznan and Beta Radiocarbon Laboratories (Table 4; Fig. 19; supplementary material). Calibration and Bayesian modelling of these dates were

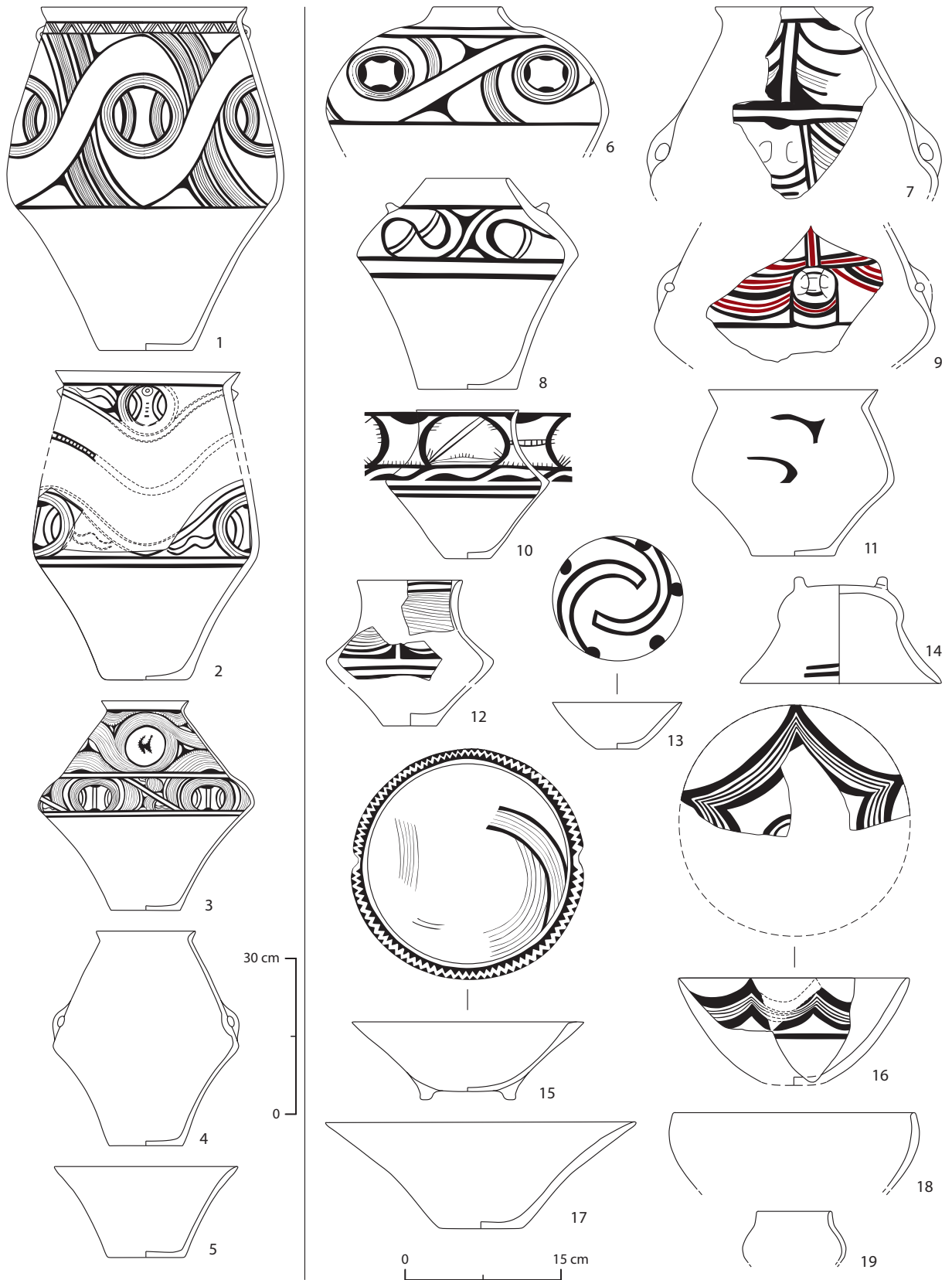


Fig. 18. Ceramics from trenches 4 and 5 and their find identifications. Features 4002 (19), 4003 (12), 4004 (2), 4006 (9, 18), 4007 (10, 13), 4018 (1, 3-5, 8, 11, 15-17), 4022 (6), 5004 (14), 5007 (7). Finds: 1) 4918; 2) 4846; 3) 4937; 4) 4908; 5) 4924; 6) 4903; 7) 5034; 8) 4922; 9) 4435; 10) 4887; 11) 4910; 12) 4012; 13) 4888; 14) 5022; 15) 41066 (also in fig. 14); 16) 4922 and 41021; 17) 4913; 18) 4441; 19) 4176.

performed using the software OxCal v. 4.3.2 (Bronk Ramsey 2009; Reimer et al. 2013).

In trench 3, three successive stages of pit filling were dated with the samples Poz-109322, Poz-109323, and Beta-510927. The modelling of these data resulted in a model whose overall probability of 76.5 is in an acceptable range. According to this model, the back-filling of the pit took place over a period between 3950–3860 and 3849–3785 BCE (68.2 %) or between 4032–3810 and 3949–3694 BCE (95.4 %). The highest dating probability falls in a range of 75 years between 3890 and 3815 BCE.

In trench 4, the use time of house 7 was dated with the four samples Poz-109324, Poz-109384, Poz-109450 and Beta-510929. These samples were found in different contexts in the lower and upper floors of house 7 and the exterior space next to the house. Sample Poz-109378, which was found in the layer above the house debris, probably dates to the time of the use of house 7.

After the exclusion of the outlier Beta-510929, the modelling of the dates resulted in a robust model with a probability of A_{model} 102. According to this model, house 7 was used over a period of 0–60 years between 3957–3878 and 3919–3847 BCE (68.2 %) or of 0–190 years between 4051–3775 and 3935–3781 BCE (95.4 %). The post-use phase of house 7 falls in the range between 3919–3847 and 3897–3766 BCE (68.2 %) or between 3935–3781 and 3936–3590 BCE. With the highest probability, the use of house 7 took place over a period of 35 years between 3910 and 3875 BCE. According to the highest probability, the house's post-use activities took place over a period of 25 or 85 years between 3875 and 3850 or 3790 BCE.

In trench 5, only one sample (Poz-109379) could be successfully dated due to a lack of suitable sample material. The sample originated from a waste disposal area beside the house and probably dates the use of house 9. The sample dates to the range between 3960 and 3806 BCE (68.2 %) or to 3968–3798 BCE (95.4 %). With the highest probabilities, the sample dates to 3950 or to the period between 3870 and 3820.

Summarizing the widely consistent results obtained in the different trenches, the settlement activities in Bilyi Kamin took place with the “highest” dating probability mainly during the 39th century BCE (Fig. 19). Considering a more reliable dating range of 68.2 % probability, a 200-year use of the site from the mid 40th until the mid 38th century is possible. The 2-sigma dating range falls between about 4000 and 3600 BCE.

Discussion

Settlement planning and integrative architecture

In Bilyi Kamin, for the first time, a megasite of the Chechelnyk group located west of the Southern Buh was systematically investigated by combining high-resolution magnetometry, targeted excavations and radiometric dating. Based on these new data, we are now much better equipped to discuss the significance of these large settlements and their relation to the already much longer intensively researched megasites of the Southern Buh-Dnipro interfluvium.

According to the results of the magnetic survey, the Trypillia settlement Bilyi Kamin extends over an area of nearly 100 ha in a remarkable topographical situation, reaching from the lower terrace of the River Rohizka up to the ridge of an elongated promontory running south-east to north-west. Overall, the settlement shows the

Table 4. Bilyi Kamin ¹⁴C dates.

Laboratory id.	¹⁴ C age (BP)	Deviation	N (%)	C (%)	Col. (%)	δ ¹³ C (‰)	δ ¹⁵ N (‰)	Find id.	Feature id.	Level	Find_x	Find_y	Trench id.	Material	Taxon	Bone element	Context	Remarks
Poz-109384	5010	35	1.0	8.7	8.6			4705	4017	4	B	16	4	b	Cattle	Sacrum	Material assemblage between the houses	
Poz-109450	5630	40	0.1	3.7				4833	4004	3a	E	6	4	b	Wild boar	Phalanx 3	House 1	Cremated?
Poz-109322	5100	40	0.8	4.3	1.5			3005	3004	7a	A	1	3	b	Cattle	Scapula	Pit filling, upper part	
Poz-109323	5135	35	1.9	6.1	2.4			3018	3004	8	A	1	3	b	Cattle	Phalange	Pit filling, middle part	
Beta-510927	5030	30				-20.3	11.3	3024	3004	9	A	1	3	b	Cattle	Rib	Pit filling, bottom	
Poz-109378	5070	35	2.6	9.2	2.2			4072	4003	2	E	3	4	b	Big mammal		Layer above house 1	
Poz-0	>0		0.2	3.6				4735	4004	3a	E	8	4	b	Domestic pig	Phalange	House 1, on the platform	Not suitable
Beta-510929	4670	30				-20.4	11.1	4838	4018	5	E	3	4	b	Cattle	Rib	House 1, ground floor	
Poz-109324	5020	40	1.1	4.9	3.2			4849	4018	5	F	4	4	b	Cattle	Rib	House 1, ground floor	
Poz-109379	5095	35	2.1	7.6	6.3			5001	5002	2	D	1	5	b	Cattle	Humerus	Ancient surface outside house	
Poz-0	>0		0.0	4.0				5044	5007	6a	B	1	5	b	Indet.	Indet.	House, ground floor	Not suitable

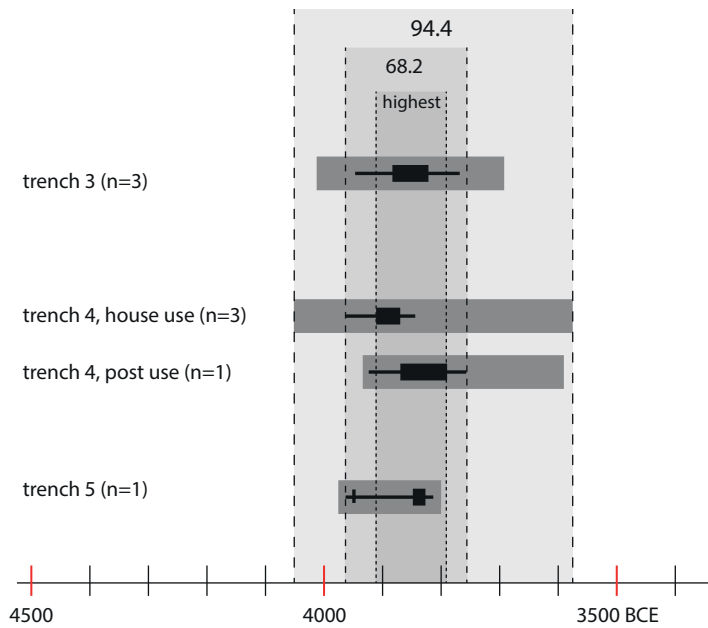


Fig. 19. Probability distributions of radiocarbon dates from Bilyi Kamin according to Bayesian modelling in OxCal differentiated according to the different excavation areas 3, 4 and 5. Details of the analysis are provided in the supplemental material.

“classical”, oval layout of Trypillia settlements with a concentric ring corridor and an enclosed space situated on the particularly steep area of the slope. However, an important difference from other settlement plans consists in the straight course of the north-east side.

For the planning of the settlement layout, the placement of a rectangular square (so-called “plaza”) on top of the promontory with three large buildings potentially played an important role. As could be shown by René Ohlrau, a single plaza per settlement with large megastructures which are regularly located to the north, north-east or east of the settlements represented a standard element of Trypillia settlements (Ohlrau 2019). These megastructures and the associated plaza most likely formed the architectural arena of central integrative institutions for decision-making, integrative ritual action and surplus consumption at the level of the entire settlement (Hofmann et al. 2019). At the Southern Buh-Dnipro interfluvium, megastructures of a second category also occur at regular distances in the ring corridor or on the periphery of many settlements and were used only by sections of the communities.

In Bilyi Kamin, three elongated, presumably roofed, megastructures with lengths between 36 and 64 m and widths between 8 and 11.5 m are situated on the plaza, measuring 420 × > 150 m. The partly staggered arrangement of these constructions might suggest that they were not built simultaneously but represent a sequence of successively used buildings. Within the concentric ring corridor, directly beside the central plaza, a fourth megastructure is also visible. This building, with regard to its positioning and probably unroofed construction, corresponds to the second category of megastructures that otherwise seem to be missing in Bilyi Kamin.

The straight form of the north-east side of the settlement is probably caused by the fact that the north-east flank of the promontory is much steeper than the south-west slope and unsuitable for the construction of houses. Thus the irregular layout of the settlement is likely the result of the decision to place the main plaza and the associated megastructures on top of the widely visible promontory. In this position, the building dominated the surrounding countryside and showed a clearly monumental character. With their prominent positioning, the megastructures of Bilyi Kamin show, as in Trypillia settlements so far, a unique emphasis on central social institutions.

Although the planned character of the settlement Bilyi Kamin is beyond question, we observe in different parts of the settlement different settlement layouts and building densities which might indicate a heterogeneous character of the population or changes in the development plan. A major focus of the settlement activities was located in the vicinity of the central plaza on top of the promontory. Here, at least four parallel rows of houses run along the north-east terrace edge and radial rows of houses lead from the inner concentric house ring towards the settlement centre. In contrast, in the area of the lowest Rohizka terrace, radial rows of houses are widely missing and the building density is overall lower.

Architecture and waste disposal

The results of examining houses 7–9 allow us to speak about certain traditions of house building on the Bilyi Kamin site. Those buildings share the features of the use of large amounts of clay, being of wooden construction and having two storeys. Excavated buildings show the same construction of the platform using levelling layers of clay. The ovens were located on the second-floor level of houses 7 and 9, in the central part, near the long side wall. This allows us to ultimately speak about the usage of the second floor of these buildings. The inner space of the second floor of the fully researched house 7 is divided into three parts. Interior objects are present only in the largest room, which was used as living space. There is an oven to the right of the entrance, a podium alongside the wall to the left of the entrance and the central installation at the far edge of the house. There is no evidence that the ground floor was divided into two parts widthwise, as has been observed in other Trypillia sites (Черновол 2013, 81). Interior objects are absent on the surface of the entrance area of the ground floor; however, we located a trough and an installation within the central part. The presence of working places on both floors tells us about a large number of working processes conducted in house 7. Above all, they are connected with food processing.

Both one- and two-floor buildings with ovens, clay installations, working places connected with food processing and weaving have been reconstructed for the Chechelnyk group settlements. One of the installations from Kyrylivka house 1 was also ornamented with incised lines, similar to the central installation of house 7 in Bilyi Kamin. Clay troughs were not found on the settlements of the Chechelnyk group until the Bilyi Kamin 2018 excavation. However, they were found at the settlements of the neighbouring Petreny (Черновол 2013, 78–79) and Tomashivka groups (Шмаглий/Видейко 2001–2002, 69; 76; 87; Черновол 2012, 190–191), mostly on the upper floors of the houses.

In the context of settlements of neighbouring Trypillia groups, the best excavated house in Bilyi Kamin (house 7) represents a typical example of their architecture, especially the interior, which has been documented by excavation of the building remains and is also represented in miniature form by ceramic models of houses (Шмаглий/Видейко 2001–2002, 88; Черновол 2008; 2013, 72–73; 2015, 53; Дяченко/Черновол 2009, 4). The division of the inner space of the house into the entrance and main rooms as well as the location of the central installation at the far edge of the house correspond to the house model from Cherkasiv Sad II (Полищук 1989, 46–48 fig. 16,9). Alongside the typical division of the upper floor into two zones (entrance and living room), house 7 is special insofar as it had a third room on the upper floor. Such rooms also observed elsewhere and located before the entrance, are usually interpreted as a lightly

constructed extension for economic activities or workshops (Черновол 2012, 68 рис. 1; Chernovol 2012, 200 fig. 8.8b).

A special characteristic of the Bilyi Kamin site represents the steep slope of the settlement with inclinations up to 35°. This is true in particular for the steep central part and the north-east part of the settlement, where the location of houses on the slope probably required either terracing of the building places or special construction of the dwellings. Evidence for a certain terracing of the building ground was found in the case of the completely uncovered house 7 and perhaps also in the case of house 9 (Fig. 7). Further verification of the question is required in cases of buildings in parts of the site with a greater steepness of the surface.

Differences in relation to other sites also concern perhaps waste disposal habits within the settlement: while in megasites east of the Southern Buh domestic waste was found mainly in pits near the ends of the houses, in Bilyi Kamin veritable waste layers were observed beside buildings 7 and 8.

Different trajectories of megasite development west and east of the River Southern Buh

Investigations in recent years have proved the existence of Trypillia megasites west of the River Southern Buh as well. However, since these settlements reached maximum sizes of about 100 ha, they are clearly smaller than the largest sites in the territory east of the Southern Buh. Thus, indeed, in terms of settlement size, the site Bilyi Kamin belongs to the uppermost class of settlement in the Southern Buh-Dniester region, but rather to the periphery from the point of view of the entire megasite phenomenon.

The chronological investigations have shown the simultaneity of the site Bilyi Kamin with some of the largest sites of the Southern Buh-Dnipro interfluvium between roughly 3900 and 3800 BCE (highest dating probability) or 3950 and 3750 (68.2 %) BCE. Accordingly, the Bilyi Kamin settlement is more or less contemporary with sites like Nebelivka (Nebbia et al. 2018) and the early phases 1 and 2 of Maidanetske (Dal Corso et al. 2019; Ohlrau 2019) but earlier than the main occupation phases of the largest Trypillia settlements Maidanetske (phases 3 and 4), Dobrovody and Talianky.

Since imported ceramics of the Tomashivka group have been found in Bilyi Kamin, so there can be no debate about the coexistence of large sites in both regions, which is confirmed by radiocarbon dating. However, several aspects remain questionable in the light of the absolute dates from Bilyi Kamin. The early end of the data from Bilyi Kamin raises the question of the end of the Chechelnyk group and the further development of Trypillia societies in the region also in relation to the chronology based on the analysis of the ceramic material. Should this dating be confirmed at other sites as well, this would indicate a decrease in population in this region for the next two centuries (3800–3600 BCE). Furthermore, the generally accepted assumption regarding the end of the Chechelnyk group after the Tomashivka group could be proved wrong.

¹⁴C dating of the nearby site Viitivka from around 3700 BCE shows exemplarily the persistence of Trypillia settlements in the region (Müller et al. in press). Unfortunately, the small amount of archaeological material from this settlement does not currently allow any stylistic assignment of this settlement to a regional group. On the other hand, the dating of the Bilyi Kamin and the clearly smaller site Viitivka (c.50 ha) might confirm that, in the area west of

the Southern Buh, the peak of population concentration in Trypillia giant settlements was already passed after 3800 or 3750 BCE. By contrast, this agglomeration process continued in the Southern Buh-Dnipro interfluvium until about 3600 BCE (Müller et al. in press).

As a consequence of both the possible population decrease in the Bilyi Kamin region and the more or less simultaneously occurring increase in the settlement activities in large settlements of the Southern Buh-Dnipro interfluvium, we should take into consideration that people from the region west of the Southern Buh were permanently moving to the north-east. This assumption might be supported by adaptations of Chechelnyk pottery style elements noticed earlier in Maidanetske (Шмаглей/Видейко 1990, 14, 15). Such imitations are present in at least 15% of investigated objects from Maidanetske (Рудь 2017, 39, табл.).

What factors might have led to such possible migrations is currently hard to evaluate. In the context of what was said before, we see that the question of synchronization of the Chechelnyk group with local groups on neighbouring territories and the character of mutual contacts, for instance with giant settlements located between the Southern Buh and Dnipro, requires further research.

The reasons for the observed regionally different trajectories can be manifold. We can see, among other things, differences in the social organisation of Trypillia settlements between both regions: in giant settlements of the Southern Buh-Dnipro interfluvium, it is most likely that effective political institutions existed to manage the social complexity within these large population agglomerations; the architectural expression of this egalitarian social organisation consisted in highly visible communal buildings for integrative actions and decision-making processes, evenly distributed in the public spaces of many settlements (Hofmann et al. 2019). Decisive for effective decision-making processes in giant settlements were obviously in particular social institutions below the level of the whole settlement and thus at the mid-level of quarters or districts. In Bilyi Kamin, so far only one building of this category is proved that otherwise seems to be missing.

The reason for overall smaller settlements west of the Southern Buh could be the absence of these intermediate levels of social integration and decision-making, as is indicated by the rarity of communal buildings in the ring corridor and other positions. In Bilyi Kamin, the monumental accentuation of the central megastructures in the landscape may instead indicate a greater importance of central institutions as a focal point for the entire settlement.

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