On the ‘pseudo-ditch’ system of the Late Neolithic Öcsöd-Kováshalom settlement complex on the Great Hungarian Plain

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ABSTRACT – The well-known Late Neolithic tell-like settlement of Öcsöd-Kováshalom on the Great Hungarian Plain gained a completely new context when a triple enclosure consisting of segments (hence the name ‘pseudo-ditch’) was discovered in 2018. Followed by two small excavation campaigns, this paper gives account of the construction stages, various digging and filling actions, of the chronology and of the structured deposits that marked the closing event of these long-lasting communal activities. A comparison with European Neolithic enclosures supports the interpretation on the diversity of the numerous ditch systems, and do not allow any generalizing views – it rather speaks for the freedom of local communities in their choices within their respective cultural frameworks.

KEY WORDS – Late Neolithic; Carpathian basin; pseudo-ditch system; site formation processes; geochemical analysis; chronological modelling

O sistemu ‘navideznih jarkov’ poznoneolitskega naselbinskega kompleksa Öcsöd-Kováshalom v Veliki madžarski nižini

IZVLEČEK – Znana poznoneolitska naselbina Öcsöd-Kováshalom v Veliki madžarski nižini je dobila popolnoma nov kontekst, ko so leta 2018 odkrili trojno ogrado, sestavljeno iz segmentov; zato tudi ime ‘navidezn jarek’. Po dveh letih manjših izkopavanj v članku predstavljamo gradbene faze in njihovo časovnico ter strukturni depozit, ki označujejo zadnje dogodke v dolgem skupinskem delovanju. Primerjave z neolitskimi ograjenimi prostori v Evropi podpirajo razlago, ki vključuje raznovrstnost številnih sistemov jarkov; ne dopuščajo pa posplošitev – govorijo le o svoabodnih odločitvah lokalnih skupnosti v njihovih kulturnih okoljih.

KLJUČNE BESEDI – pozne neolitik; Karpatska kollina; sistem navideznih jarkov; proces formiranja najdišča; geokemične analize; kronološko modeliranje

Introduction

In the central, flatland part of the Carpathian basin (so called Alföld, Great Hungarian Plain), mainly east of the Tisza River, tell settlements emerged in the first half of the 5th millennium cal BC. This region lies at the northern periphery of the south East European cultures building settlement mounds. The Alföld is known by these well-known tells, being excavated (and alas, only sporadically published) in the last 80
years - but little was known about the immediate and larger environment around these tells until recent times.

One of the phenomena discovered in recent decades is the ditch system around tell sites (Raczky et al. 2011; Gyucha et al. 2022). The Öcsöd-Kováshalom settlement, lying in the Middle Tisza region, has been excavated since the early 1980s, but the multiple and intersecting pseudo-ditches were discovered no earlier than 2018 (Füzesi et al. 2020a).

The pseudo-ditches consist of several pits forming discontinuous circles (Andersen 2015; Whittle et al. 1999). The internal chronology is one of their most important questions: due to the circular form of the enclosures they were apparently planned in advance, and yet the individual segments may have been traces of separate events in time (Lefranc et al. 2017).

The Öcsöd-Kováshalom settlement is now being interpreted together with its enclosure system. This paper summarizes an important stage of this interpretation process, the test excavations and analyses revealing much of the series of community events in the early centuries of the 5th millennium cal BC. We give a detailed description of the test excavations cutting the ditch system as well as results of the scientific analyses from samples taken. Our goal is to add new considerations to the interpretation of intersecting, pseudo-ditches in the Neolithic.

Archaeological research at Öcsöd-Kováshalom

The Late Neolithic Öcsöd-Kováshalom site is located on the Great Hungarian Plain, at the confluence of the Tisza and Körös Rivers. Its long research history can be divided into four phases. The first phase is marked by a collection of relevant data in the site catalogue of Nándor Kalicz and János Makkay’s extensive summary of the Linear Pottery Culture on the Great Plain (Kalicz, Makkay 1977:140: the site was registered as No. 207 Kunszentmártón-Érpart).

These early references facilitated intensive topographic research at the site in 1980, accompanied by coring for systematic stratigraphic study. This research revealed that Öcsöd-Kováshalom consists of a tell-like settlement surrounded by a horizontal settlement part with several intensively occupied areas along a one-time river bank. The appearance of this type of settlement was a novel observation in the area of the Tisza-Herápály-Csószhalom cultural complex of the early 5th millennium BC. The following excavations at the Öcsöd site were conducted as field schools of the Institute of Archaeology, Eötvös Loránd University (ELTE) until 1987, the first results of which were summarized in an international exhibition and accompanying series of publications (Raczky 1987; 1990; 1991).

A new research phase began in 2016, marked by the integration of the Öcsöd-Kováshalom site into the Late Neolithic settlement pattern of the Tiszazug micro-region at the Körös-Tisza confluence, and its evaluation within this extended interpretive context (Raczky, Füzesi 2016). Such an investigation became feasible only after the Hungarian Archaeological Topography project had published its results on the Tiszazug region (Kovács et al. 2017). Statistical analysis of the Tisz culture ceramic material showed the internal relationships of Öcsöd in another summarizing work (Füzesi, Raczky 2018). In addition, by discussing both the entangled everyday and symbolic activities of the tell-like settlement, we inferred a local network of relationships (Raczky et al. 2018).

In 2018, a completely new dimension could be explored in the Öcsöd-Kováshalom investigations: the start of geophysical surveys covering the entire settlement, and systematic core sampling for soil analysis. The magnetic survey by the Romano-Germanic Commission of the German Archaeological Institute (DAI-RGK), headed by Eszter Bánffy and conducted by Knut Rassmann, revealed a triple concentric ditch system around the central settlement mound and the neighbouring horizontal settlement units (Fig. 1; Füzesi et al. 2020a). The newly discovered ditches thus strengthen the physical connection between the central and outer settlement units, opening a new dimension under the visual horizon. Even more surprising was the discontinuous, segmented appearance of the ditches, so far unique in the Late Neolithic of the Tisza region. However, comparable ditch systems of settlements with numerous ‘entrances’ are known westwards, from Sopot and early Lengyel contexts in Transdanubia, from the late 6th and early 5th millennia BC. All of these seem to predate the classic ‘rondel’ versions without internal settlement features (Kreisgrabenanlagen) (P. Barna 2017:152–193; Kovářík 2018:440). The relationship between the two types of ditch systems is formally illustrated by the site Ligetfalva-Gesztenyési-dülő. Here, the two inner ditches have four symmetrically arranged ‘entrances’,
while the third outer ditch has nine irregularly distributed interruptions (P. Barna et al. 2021. Figs. 16, 19). More remote constructions similar to Öcsöd can be identified among the Central and Western European Rosheim-type ‘pseudo-ditch’ causewayed enclosures, from the early 5th millennium BC (Lefranc et al. 2017; Turek 2021.1678–1679). Regarding the possible internal and external connections of these constructions, the late Linearbandkeramik culture (LBK) pit enclosure excavated in Herxheim, Germany, shows a possible and at the same time very special example (Zeeb-Lanz 2016; 2019).

In this regard, the association between the Öcsöd-Kováshalom ditch system, and the central tell-like and peripheral single-layered parts of the settlement are important issues and raise questions. Can the triple enclosure be considered the long-standing result of a single communal decision, or does it represent successive ‘construction stages’ over a prolonged period? Furthermore, what temporal dynamics and choreographies characterize the digging and filling actions of the ditch segments? These questions have already been raised and discussed in connection with several other Middle Neolithic enclosure variants in Central

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Fig. 1. The Öcsöd-Kováshalom Late Neolithic settlement complex and the 2020–2021 test excavation trenches (compiled by A. Füzesi).

We opened an 8x2m trial trench across the western part of the innermost ditch in 2020, the first excavation results and stratigraphic-statistical analyses of which were published in the same year (Füzesi et al. 2020b). In 2021, again in cooperation with the ELTE Institute of Archaeological Sciences and the DAI-RGK, we cut across the northern part of the outer ditch with a 12x2m trench. By 2022, the dating of the radiocarbon samples taken from these two trenches was completed, as well as the geochemical analysis of the soil samples, carried out by Isabel Hohle. These data, put together, allow us to draw preliminary conclusions regarding segments of the Öcsöd circular ditch system.

Öcsöd-Kováshalom test excavation 2020

Archaeological features

In the summer of 2020, the southwestern section of the inner ditch was studied in a 2m wide trench. We were unable to fully excavate the area during the two weeks of fieldwork. Once we reached the subsoil and the contours of the cultural features became evident, we only continued the clearing in a 1m wide strip. The excavation was conducted in arbitrary levels of 20cm intervals. Within each level, the finds were kept separate per square meter. This way, 150 excavation units were identified, 92 of which were located in the northern, fully excavated, and studied part of the trench (Fig. 2.4–6).

The first archaeological feature, a structured deposit, has been recovered at the depth of 70cm, containing large fragments of several ceramic vessels, animal bones, and a considerable amount of mollusc shells (Fig. 2.3). This deposition may represent one of the final infilling events in the excavated ditch section, according to the post-excavation evaluation of the fill layers (Fig. 2.1). It can be interpreted as a concentrated and targeted event.

Two archaeological features have been isolated in the subsoil. One of these is a deep beehive-shaped storage pit cut in the inner, south-eastern side of the ditch. The section wall of our trench indicated that this feature was younger than the ditch, and it had two periods of accumulation, according to its fill layers. The lower part (P1) was dominated by yellow clay and charcoal pieces, while the upper part (P2) was mainly brown to light brown humus. The latter accumulation started with a massive charcoal layer containing daub fragments (Fig. 2.1–2).

The inner feature of the pseudo-ditch system showed a 315cm wide and 295cm deep, V-shaped cross-section in the excavated one-metre strip. The upper part of the ditch was probably widened several times. Its inner wall was stepped, and its outer wall was endowed with a two-meter-wide terrace, perhaps used for ditch maintenance. The structure and nature of the layers allow us to distinguish two phases in the filling of the ditch. The lower part (D1) was dominated by a maximum of 1.5m thick yellow clayey soil with several thin layers of larger daub fragments alternating in bands. Their stratification preserved the imprint of at least 10 distinct events. In contrast, the upper part (D2) was composed of massive layers of brown humus and its saline variety. The different nature and orientation of the two units suggest that the ditch had been filled after its use, from its inner side. This part of the ditch was covered by a layer strongly mixed with yellow clay, in which the structured deposit has been recognized (Fig. 2.1–2).

Archaeological material

The excavation yielded an extremely large quantity of finds, 17430 pieces weighing 194.4kg. The detailed spatial documentation allowed the analysis of different artefact type distributions. As the data have already been published in detail (Füzesi et al. 2020b), we present only three typical distribution patterns here (Fig. 2.4–6). Among the three dominant find types (pottery, daub, and animal bone), we have chosen animal bone. Their weight distribution shows the same trend as suggested by the fill layers. The lower part of the ditch (D1) was filled naturally, even if human agency is encountered. As a result, it contained limited archaeological material. In the upper part (D2) a high-intensity filling occurred in a relatively short time. Bone tools have been found only in this unit, their spatial distribution confirms the filling from the inner side, as they are scattered from the upper right part towards the lower left corner as seen in the figure (Fig. 2.4). The spatial distribution of the chipped stone artefacts further nuanced this picture. They allow us to distinguish several filling phases, with a higher number of chipped stones occurring...
ochre was found in the lower fill unit, while others occurred more frequently in the upper part. For example, most ochre was found in the latter (Fig. 2.6), although these were occasional deposits of tool stones and animal bones.

Fig. 2. The archaeological features of the 2020 trench and the distribution patterns of the find material: 1 identified features, 2 layers, 3 structured deposition (SD), 4–6 distribution patterns of bone (4), stone (5) and ochre (6) (compiled by A. Füzesi).
Geochemical analysis of samples from the 2020 excavations using X-ray fluorescence

Geochemical analysis using X-ray fluorescence in general

Soil is a very complex substance that consists of inorganic minerals, organic material and water (Wilson et al. 2008). X-ray fluorescence (XRF) analysis is one method for investigating the multi-elemental content of the soil. Conducting XRF analyses of anthropogenic sediments will reflect the total concentration of individual elements in the sample.

The significance of phosphorus as one indicator of anthropogenic impact is long accepted and discussed in archaeology (see for example Provan 1971; Salisbury 2012; 2016; 2020; Holliday, Gartner 2007). Anthropogenic phosphorus can originate from human impact like waste, barns, burials, excrement, fertilizers, etc. In its natural form, the presence of phosphate is quite stable in the soil, and thus the comparison with elevated proportion caused by human activities becomes interesting for archaeological research. But a range of recent studies shows that the content of several other elements, like carbon, nitrogen, calcium, potassium, magnesium, sulphur, copper, zinc, and other metals, are also indicators of (intensive) human activity. Their analysis helps in interpreting different activity zones and understanding compound archaeological features (Holliday, Gartner 2007;302, quoted after Cook, Heizer 1965.1–3; Eidt 1984.25–27; Woods 1982.1396–1399).

A major difficulty with determining phosphorus in soil lies in the fact that it has not yet been determined how individual soil phases are responsible for phosphorus retention in different archaeological soils and features. Phosphorus is therefore a somewhat problematic indicator of human occupation (Oonk et al. 2009,36, quoting Entwistle et al. 1998.53–68; 2000a.287–303; 2000b.171–188). As such, using the results from analyses of total phosphorus content should be treated with considerable caution, since it can be significantly higher than anthropogenic phosphorus (Holliday, Gartner 2007,314). Taking advantage of geochemical, multi-element analysis, other elements presenting in the soil – like calcium, magnesium or strontium – could support the interpretation of phosphorus, separating natural phenomena from anthropogenic influences (Oonk et al. 2009,36).

The use of XRF started in the DAI-RGK around 10 years ago, and the protocols developed at these times are basically still in use, although some parts have improved in the last few years, also due to better equipment. Currently, the RGK uses a handheld Niton XL3t (Thermo Scientific) in the field, which at the beginning was mostly used in the lab with a sample chamber and a helium flush for detecting light elements (see Gauss et al. 2013.2946–2947).

The Öcsöd samples first underwent the RGK standard protocol of drying in a cabinet dryer (at 40°C), mortaring by hand and filling in the soil into sample cups. Later, when receiving the 2021 Öcsöd samples, the RGK possessed new technical equipment: a planetary ball mill, a press for pressing tablets and a benchtop XRF (Spectro/Ametek Xepos, ed-XRF). Indeed, the Öcsöd samples were used for testing the new sample preparation protocol, and also comparing the different preparations and XRF devices.

With the Niton we used our standard procedure (see also Gauss et al. 2013.2946–2947), which means 150 seconds per sample with the mining mode. As the benchtop XRF was new, we tried to carry out a different series of measurements: powder samples in sample cups measured for 150, 300 and 600 seconds (helium), and compressed tablets measured for 150, 240 and 600 seconds, respectively (under vacuum). Unfortunately, no detailed evaluation of the tests and comparative measurements under the various parameters has been possible yet, although this is planned for the future.

After developing the customized protocol for the new mill and benchtop XRF, the 2020 and 2021 samples from Öcsöd were dried in the cabinet dryer, ground with the planetary mill (2-3 minutes max. 300rpm, 50ml cup with seven balls), filled into sample cups and measured with helium flush each 150 and 300 seconds.

During each measurements series the first, last and some in between (approximately every 10th measurement) served as measurements of certified reference materials (Nist 2709a (powder), Nist 2710a (powder and compressed tablets), NCS DC 78302 (powder and compressed tablets). These repetitive measurements were used to control the stability of both the XRF devices and to see if measurements could be reproduced over the time of the period of analyses.
Due to the differences in the results between the devices and normal variation, operating with the absolute values of element content does not seem to be practical. It seems to be more appropriate to operate with means of values and a more proportional evaluation, and to use the results for comparing higher/lower content.

**The samples from 2020**

From the 2020 excavation the RGK received 15 samples for analysis. The samples were taken along a continuous sediment column which offered a full series for the investigated ditch section. Additionally, two samples from the subsoil underneath the archaeological features were taken for comparison. As seen in all variants of measurement, the samples from the upper part of ditch D2 (53, 69, 85, 101, 117 and 124) have the highest phosphorus (P) content compared to the other samples (see the example in Fig. 3.2). While the amounts measured by the pXRF lie between approx. 2500 and 3200ppm, the powder samples measured with the benchtop XRF even have values from approx. 2700 and 3900ppm, while pressed pellets gave results over 4000ppm. All these values can be regarded as quite high, especially when you compare them with the values of the natural soil, where the P content is under 1000ppm.

The most striking argument for a high human impact and anthropogenic influence is the correlation of the high P values with other elements that are known as indicators of human activities and disposal, like Sr in the samples 85, 101, 117 and 124 and the K and Ca contents. But compared with the natural soil it has to be kept in mind that there are also comparably high values of Ca and K, and that is why higher levels of these elements in anthropogenic layers may also indicate admixture with the subsoils.

Interpreting geochemical data is not an easy task. It always requires context data as much as possible, as well as reference samples from the subsoils and the topsoil. Our observations coincide with the structural, stratigraphic and assemblage assessment of the ditch section. The lower part (D1) primarily displayed signs of natural refilling, while the upper part (D2) had contained indicators of a significant anthropogenic impact. Additionally, an inclusion of geochemical analyses in more comprehensive geoarchaeological studies in the future could be a step-change for a better understanding of soil formation and human impact.

**Relative and absolute chronology**

The finds included some impressive stone and bone tools and a zoomorphic figurine; however, decorated pottery also played a pivotal role in our analysis. The site of Öcsöd-Kováshalom, based on the old excavations in the 1980s, represented the end of the Middle Neolithic and the beginning of the Late Neolithic periods in Hungarian terminology. This is the late Szakálhát and early Tisza period, with intermingling Szakálhát and Tisza pottery style elements, the latter gradually replacing the former style. During the early excavations, which covered an area of 1243m², elements of purely Szakálhát pottery rarely appeared independently, without being mixed with other pottery styles in the archaeological features. A small number of such finds were found in the early horizon (Öcsöd A) assemblages and were absent in the Öcsöd B material. At the same time, the Tisza style developed gradually. In the early, transitional period, the Tisza I style was based on continuous and concentric main motifs, while later, in the Tisza II, meander motifs in panelled structures, the so-called textile style, became dominant (Raczky 1992; Füzesi, Raczky 2018).

Accordingly, the ditch section excavated in 2020, yielded mainly Tisza I-style material (Fig. 5.1–5). Besides, this transitional period was also characterized by ceramic sherds decorated with grooves arranged in bands (Fig. 5.5), painted black strips (Fig. 5.4), and tar-coating (Fig. 5.3). Tisza II elements were predominant among the finds from a storage pit of a later date (Fig. 5.11–13). A fragment of a cylindrical, flowerpot-shaped vessel with textile-style decoration was found at the bottom of the feature (Fig. 5.11). The typochronology, based on the decorated pottery, thus coincided with the stratigraphical position of the features.

The absolute chronology is based on ¹⁴C dating performed on eleven samples from the excavated finds. The model (Fig. 4.3) was generated by Norbert Faragó using the IntCal20 calibration curve (Reimer et al. 2020) and OxCal 4.4.4 software (Bronk Ramsey 2021). The laboratory results and locations of the samples used for the chronological analysis and the data used for modelling are shown in Fig. 4. Hereafter, we give absolute chronological data with a 68.2% probability. The individual dates are scattered within a relatively wide temporal horizon, ranging from 5028 (68.2%) 4951 to 4889 (68.2%) 4794 cal BC (Fig. 4.3). However, the stratigraphic position of the samples
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(Fig. 4.1) allowed us to construct a model with high accuracy. However, only eight of these 11 samples could be used. The results of samples 3, 4, and 6 could be excluded as outliers based on the preliminary modelling (Bronk Ramsey 2009; 2021), so the final model agreement index reported here is 152.3%. All three discarded samples came from the lower part of the ditch (D1), which proved to be younger than the fill above them, accurately dated with four samples (D2). There could be several reasons for the discrepancy,
which unfortunately cannot be identified after the event.

With our chronological model, we were able to significantly reduce the timeframe associated with each phase and event. The start of the complete sequence is estimated to be 5028 (68.2%) 4951 cal BC and the end is 4889 (68.2%) 4794 cal BC. The first accumulation phase in the lower part of the ditch (D1), according to two 14C measurements, ended 4951 (68.2%) 4915 cal BC, over 40–77 years. The upper part of the ditch (D2) was filled between 4951 (68.2%) 4915 cal BC and 4935 (68.2%) 4899 cal BC, representing 16 years. The structured deposit at the top of this sequence also

Fig. 4. The absolute chronology of the 2020 trench: 1 excavated units with 14C samples; 2 14C data; 3 OxCal model of the 14C data (compiled by N. Faragó and A. Füzesi).
dates to a similar period: 4926 (68.2%) - 4877 cal BC. The two samples from the storage pit indicate that it was buried over a 0–83-year period, between 4904 (68.2%) - 4846 cal BC and 4898 (68.2%) - 4821 cal BC.

Comparing these results with previous ^14C data and the chronological model from the Ócsöd site (as assembled by Zsuzsanna Siklósi), a high degree of agreement is observed in the formation dynamics of the two sampled locations. The backfilling of the ditch section excavated in 2020 directly followed a period of reorganization in the multi-layered settlement part. This activity was associated with a communal rite, recorded in a structured deposit (Raczky et al. 2018: 122-123) dated between 5056 (68.2%) and 4942 cal BC. The end of the first construction horizon (Ócsöd A) thus coincided with the abandonment and filling of the inner ditch (Füzesi, Raczky 2018). The great quantity of artefacts in the upper layer (D2) suggests a similar landscaping process close to the ditch, along its inner side. The evidence suggests that the settlement reorganization in the first decades of the 5th millennium BC covered a large part of the site.

### Archaeological features

In August 2021, a 2x12m trench was opened in the northern part of the outer ditch surrounding the settlement, near an abandoned farmstead (Fig. 1). The geophysical survey indicated several features superimposed on the ditch, which belonged to the sparsely used periphery of the Late Neolithic settlement. Following the method of the previous excavation, the finds were collected by the square metre, in arbitrary, 20cm thick levels. We identified 275 such units, almost all of which contained find material, assigned to the identified archaeological features (Fig. 8.1–5).

Similarly to the previous season, the first excavated phenomenon in 2021 was a structured deposit at a depth of 70cm, two meters away from the inner, southern side of the ditch. It contained large fragments of a sizeable Late Neolithic storage vessel in a 50x100cm area (Fig. 7.1). The deposit cannot be associated directly with the backfilling of the ditch; however, it was situated above an intact Neolithic cultural layer (Fig. 6.1–2). Both the 2020 and 2021 structured deposits can be interpreted as targeted, closing events between accumulation processes.

In a 9m section of the 12m long trench we identified six pits (P1–6), two ditches (D1, D2), and one well (W) dug into the subsoil, creating a complex superposition that could only be inferred from the section walls. In the northern section of the trench we recovered parts of five pits, three of which were regular beehive-shaped storage pits (P2–3, P6), one medium-sized irregular-bottomed pit (P5) and one large amorphous feature (P4) identified as a clay extraction pit. Their stratigraphic relationship enabled us to reconstruct a sequence for the establishment and infilling of each feature: the similarity of the finds suggests that they all date to the earliest, relatively short period of habitation. The large number of features indicates intensive settlement activity, at a distance of about 350m from the riverbed. An important observation concerning settlement structure is that all of them predate the ditch system. The layers of the filling (except for P6)
demonstrate that the features were filled up during several events. Layers containing larger amounts of ash and daub did not cover the entire surface of the larger pits (P5–6), *i.e.* they testify to small-scale depositions (Fig. 6.2).

The structure of the outer part of the pseudo-ditch system in its excavated 2m section differed significantly from the inner ditch recovered in 2020. Most notably, here we could distinguish two construction phases (D1, D2) with similar shapes and sizes, although only the later one (D2) could be observed in its entire width. The recovered part of the ditch displayed a V-shaped, slightly trapezoidal cross-section, with a width of 220cm at the top, 40–50cm (D1) and 30–45cm (D2) at the bottom, and a depth of 190cm (D1) and 205cm (D2). The outer, northern side was less steep, the earlier features promoted a slightly stepped appearance there. The inner, southern side of the later ditch was steep at the bottom and less inclined at the top. Both ditches were filled in several phases resulting in a layered structure. No significant difference occurred in the filling of the early ditch, and its layers predominantly consisted of yellow clayey humus. This suggests a faster accumulation rate than in the case of the later feature, the upper and lower parts of which showed differences similar to what has been observed in the inner ditch. The lower part of the sequence was brown humus interstratified with thin layers of yellow clayey sediment, while the upper part consisted of a single darker humus layer (Fig. 6.2).

The eastern section wall (C–D) showed that the large pit P1 intersected both ditches. Two burials (G1, G2) were excavated at a relatively shallow depth in the northern part of this round bottom pit. The burials were situated close to the partial skeleton (G3) excavated in the P6 storage pit. Of all three skeletons, only the legs survived in a highly fragmented condition. Their orientation may have been similar, with the legs in a flexed position indicating a W/SW-E/NE orientation (Fig. 7.2,4). According to their stratigraphy, the burials represent a relatively long period, G3 was found inside an early feature and was probably disturbed by the digging of pit P4. G1 and G2 were located in the upper part of a late feature (P1) (Fig. 6.1–2), their incompleteness can also be explained by later disturbance. However, other traces of disturbance could not be identified, thus it was probably a modest event or two that did not reach the section walls.

An unexpected feature, an 80x100cm spot of a well, has been recognized at a depth of about 90cm. The well did not reach the section walls of our trench but cut the D2 ditch. Unfortunately, it is unclear whether the well is younger or contemporaneous with pit P1, the southwestern edge of which it was cut, and if the pit was created to facilitate digging the well. The well tapered to a diameter of 65–70cm at a depth of 1.5m and retained its cylindrical shape down to the bottom (Fig. 6.1–2; Fig. 8 right side). It was filled with greyish-brown loose humus mixed with a large quantity of charcoal. The size and quantity of charcoal fragments soared between 4 and 5m in depth. The feature was cleared by hand to this depth (Fig. 7.5–6), following its steady cylindrical shape in the local clayey subsoil. The last 1m was excavated by a core drill due to the limited space and no finds were collected from these units, only soil samples. The presumed bottom of the feature was reached at a depth of 6m from the surface. Besides its peculiar shape and size, the well itself is also a unique phenomenon because no such feature had been known from the Öcsöd site, despite a long history of archaeological investigation. No wells have been found in the 1243m² area excavated relatively close to the riverbed, so the location of this feature in the later settlement’s periphery and its distance from the riverbed suggest that the water supply was provided separately and differently within each settlement unit.

Archaeological material

Although the 2021 trench was much larger, we encountered significantly fewer finds compared to the previous year. The 12 725 finds represent a 27% difference, while their 94.9kg total weight displayed an even greater 51.2% drop. This difference, considering the higher number of archaeological features and the greater volume of soil removed, indicates the peripheral nature of the location and the lower intensity of the former activities. In addition, this phenomenon also points to the differences in the depositional activities around the inner and outer ditches. The distribution of different artefact types was analysed based on detailed spatial documentation, similar to the previous operation. Due to a lack of space, only a few characteristic distribution patterns are presented here (Fig. 8).

Of the three dominant find types (ceramics, daub, and animal bone), ceramics showed a relatively uniform distribution despite their concentration at three lo-
cations, in pits P1 and P4, and the structured de-
position (Fig. 8.2). In the other pits and ditch D2, find
frequency increased mainly in their upper parts. The
spatial distribution of animal bones showed a similar
pattern, but the differences between units were more
pronounced for this find type: most finds occurred in
six of the units. Compared to 2020, significantly few-
er daub fragments were encountered, with strongly a

Fig. 6. The archaeological features of the 2021 trench (red double triangle – structured deposition, yellow
triangle – burial) (compiled by A. Füzesi).
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stones were found, most of these lay in pit P4, one came from the middle part of the well, and one from the upper part of pit P3. One of the two polished stone axes was found in the latter location as well. The other axe fragment was recovered from the upper part of ditch D2 (Fig. 8.3). Ochre was found in 18 units, which came to light only in the lower part of pit P4 and above ditch D2 in larger quantities (Fig. 8.4). Modest quantities of mollusc shells were found in almost all excavation units, with significant concentrations in the earliest storage pits (P5–6) and in feature P4 (Fig. 8.5).

chipped stones were concentrated primarily in the upper cultural layer. This layer, at a depth between 60 and 90 cm, partially disturbed by ploughing, can be considered the remnant of the last Neolithic occupation. A quarter of all chipped stones was recovered from the features, and these were evenly distributed among the features and layers that yielded a large number of finds (P1, P4, the upper part of D2, the upper part of the well; Fig. 8.3). Only seven grinding stones were found, most of these lay in pit P4, one came from the middle part of the well, and one from the upper part of pit P3. One of the two polished stone axes was found in the latter location as well. The other axe fragment was recovered from the upper part of ditch D2 (Fig. 8.3). Ochre was found in 18 units, which came to light only in the lower part of pit P4 and above ditch D2 in larger quantities (Fig. 8.4). Modest quantities of mollusc shells were found in almost all excavation units, with significant concentrations in the earliest storage pits (P5–6) and in feature P4 (Fig. 8.5).

concentrated distribution characteristic of rare finds, mainly in the middle layers of pits P4 and P6 (Fig. 8.1). Chipped stones were concentrated primarily in the upper cultural layer. This layer, at a depth between 60 and 90 cm, partially disturbed by ploughing, can be considered the remnant of the last Neolithic occupation. A quarter of all chipped stones was recovered from the features, and these were evenly distributed among the features and layers that yielded a large number of finds (P1, P4, the upper part of D2, the upper part of the well; Fig. 8.3). Only seven grinding stones were found, most of these lay in pit P4, one came from the middle part of the well, and one from the upper part of pit P3. One of the two polished stone axes was found in the latter location as well. The other axe fragment was recovered from the upper part of ditch D2 (Fig. 8.3). Ochre was found in 18 units, which came to light only in the lower part of pit P4 and above ditch D2 in larger quantities (Fig. 8.4). Modest quantities of mollusc shells were found in almost all excavation units, with significant concentrations in the earliest storage pits (P5–6) and in feature P4 (Fig. 8.5).

Fig. 7. The archaeological features of the 2021 trench (SD structured deposition, G burial, P pit, W well, D ditch) (compiled by A. Füzesi).
While the total number of finds was significantly lower compared to 2020, the distribution of the different artefact types attested to greater variation. The data series was further complicated by the co-occurrence of 13 archaeological features and their associated deposition. The majority of the finds were recovered from the two large amorphous pits, early P4 and late P1. Based on layer composition, broadly similar accumulation processes could be identified, but differences in the various artefact type concentrations suggest that the successive depictions focused on a particular set of artefacts. For example, daub fragments predominated in the lower part of P4, while pottery in the middle-upper part (Fig. 8.1–2). The smaller storage pits can only be mentioned for a few find types, the high concentration of mollusc shells in the earliest features is particularly interesting in this regard (P5–6; Fig. 8.5). The mosaic distribution of finds supports intermittent small-scale filling of the pits and separately implemented events. Of the ditch sections, the later structure contained a larger number of finds, although this was still limited compared to the inner ditch section excavated in 2020. Ditch D2 was backfilled similarly to the latter, with the majority of the finds in the upper part, which was deliberately buried after the ditch had lost its function. The common find types are distributed relatively even in the well, with a slight concentration in the middle (at a depth of between 4 and 5m). We distinguished three accumulation phases in the well, based on the backfilling and find distribution. In the lower part (5–6m depth), explored by core drilling, a series of collapses documented in the form of yellow clay, which probably occurred after the well became dry. The layers and finds in the middle and upper parts are similar, except that the abundance of the charcoal component in the greyish-brown humus increases downwards, as are the finds at depths of between 4 and 5m. This pattern suggests that the feature was filled in two stages after having lost its function.

**Geochemical analysis of samples from the 2021 excavations using X-ray fluorescence**

The DAI-RGK received 37 samples from archaeological features of the 2021 excavation for analysis. Additionally, five samples from different areas from the subsoil were also studied (Fig. 9). The sample collection strategy focused primarily on the excavated ditch section. The series of collected samples revealed the filling of the early ditch (D1) and the cultural layers above it in two stages. A third larger sampling was completed in the tube-like well, where a more than 3m thick stratum could be investigated. Additional samples were taken from pits P4, P6 and the structured deposition, six in total (Fig. 10.1).

The results from the XRF measurements (Fig. 10.2–3), especially concerning the P values, are quite comparable to the 2020 results. The highest values of phosphorous (contents between approx. 2700 and 4200 ppm) were mainly from the samples taken from the upper of the ditch D1 (152, 170) and the well (227, 228-230). The middle section of the well (250, 257 and 262), although with a smaller absolute value, showed somewhat higher results. Samples 235 and 248, taken from the earlier pits P4, P6, have conspicuously low values (below 1000ppm).

The elements of Zn and Sr have slightly elevated values compared to the subsoil and partly correlate with high P values, and thus underline the probably intense human impact and accumulation in these layers.

The analysis of the five subsoil samples from the 2021 campaign showed extreme differences for some elements, like Ca, Mg and Sr. This variability indicates a heterogeneity in the surrounding subsoil of the Öcsöd site, which is not surprising for alluvial sediments. However, a more detailed investigation is crucial to achieve a better understanding and interpretation of the results from the XRF analysis of the anthropogenic features. Geoarchaeological and pedological reports could also be useful, as the analysis of more subsoil samples enables the classification of natural processes and influences.

A detailed comparison of the 2020 and 2021 soil sampling may yield additional results later. However, some differences can be determined between the well and ditch system in advance, based on the quantity of chemical elements (K, Ca) and the various tendencies of accumulation (Mg, P, Ca, Rh, Sr). The evaluation of distinct details can help the reconstruction of site formation processes at the Öcsöd-Kováshalom settlement complex.

**Relative and absolute chronology**

The 2021 fieldwork resulted in an increase in the number of features and the complexity of the stratigraphic relationships between them, but also in the quality of the finds recovered. The typochronology of decorated
Fig. 8. The distribution patterns of archaeological material from trench 2021: 1 daub, 2 pottery, 3–4 stone artefacts, 5 ochre, 6 mollusc shells (compiled by A. Füzesi).
pottery covered periods of the Szakálhát and Tisza cultures (Figs. 12–13). Although the abundant find material excavated in the 1980s included several classic Szakálhát-style pottery sherds, no features dated to the classic Szakálhát period were found then (Füzesi, Raczky 2018).

Based on their stratigraphy, pits P2–P6 represent the earliest occupation in the northern periphery of the site. A significant amount of the pottery recovered there showed classic Szakálhát-style characteristics. Most distinctive are incised closed patterns, filled in with red pastose painting (Fig. 12.1–4,10–12). Although the red painting is rarely preserved, the curved lines suggest the running spiral and interlocking S motifs. The space between the incised lines on the coarse ware was filled in with finger and nail impressions (Fig. 12.5,9). The characteristic plastic decoration of the coarse ware can be seen by the fingertip-impressed applied ribs on the shoulder of a storage jar (Fig. 12.8). The material shows Szakálhát-style characteristics of the Middle Tisza region (Cserkeszöld–Kisasszony-dülő III: Füzesi 2020.Fig. 2.1–6, Fig. 7.2; Kunszentmárton-Bohonya: Kalicz, Makkay 1977.Tab. 149–151; Szentes–Ilonapart: Horváth 1994; Tiszaug–Railway-station: Füzesi et al. 2017). Among the features, only the large P4 and the latest P2 contained some fragments with panelled ornamentation typical of late Szakálhát and early Tisza (Fig. 12.6,13).

Szakálhát painted-incised fragments occurred (Fig. 13.2) in the fill of the earlier ditch (D1), but also classic Alföld Linear Pottery culture (ALPC) pottery (Fig. 13.1), which appeared in the microregion at the same time as the classic Szakálhát. Simple geometric motifs formed by incised parallel lines also appeared in the material of the 1980s, in all cases as stray finds. The majority of the fragments were decorated with complex patterns in panelled configuration, which was typical for Tisza style ceramics, as it appeared on the pots of the later ditch (D2), executed in varied quality (Fig. 13.3,5–7).

Similar ornamentation was observed in the material of the later features (P1 and well). The rows of interlocking lozenges (Fig. 13.9,12) were typical of the late settlement horizon (Füzesi, Raczky 2018.85, Fig. 27). The large, rectangular vessel, several pieces of which were found in the middle section of the well at a depth of 4–5m, is a special feature. The sides of the roughly shaped vessel were decorated with rectangular applied panels. The flattened edges of these were divided by finger-impressed ribs. The panels were filled with an incised meander pattern (Fig. 13.13). Characteristic Tisza pots were amphorae with a flattened spherical body and ring-shaped, variously decorated lugs on the belly (Fig. 13.14). This vessel group exhibited a higher proportion of black resin painting, rarely survived on the eroded fragments (Fig. 13.4), but it was nevertheless a characteristic decorative technique of Tisza I and II pottery (Raczky, Sándorné-Kovács 2009; Füzesi, Raczky 2018.80–81; Sebők 2022).

We completed our relative chronological observations with the 14C dating of 12 find samples. The sample from the well stood out among the dates. The 5757 (68.2%) 5667 cal BC date corresponds to the Early Neolithic Körös culture in the local chronology. Although a settlement of similar age existed in the south-southeastern part of the site (Raczky, Füzesi 2016.Fig. 5; Füzesi, Raczky 2018.Fig. 1.1, Excavation trench III), the well was much younger than that. Supposedly, multiple reasons rendered the charcoal sample unusable. The remaining 11 samples encompass a long time range between 5303 BC (68.2%) and 4799 BC (Fig. 11.2). However, nine of these samples provided stratigraphic positions (Fig. 11.1) that allowed us to create a more accurate age model. The two discarded samples were collected in the upper part of the culture-bearing layer, which was presumably disturbed several times over the intervening millennia.

Based on our chronological model, we were able to significantly reduce the time range associated with each phase and event. The model (Fig. 11.3) was generated by Norbert Faragó using the IntCal20 calibration curve (Reimer et al. 2020) and OxCal 4.4.4 software (Bronk Ramsey 2021). The laboratory results and locations of the samples used for the chronological analysis and the data used for modelling are shown in Fig. 11. Hereafter, we give absolute chronological data with a 68.2% probability. The results of samples 1, 11, and 12 could be excluded as outliers based on the preliminary modelling (Bronk Ramsey 2009; 1023), so the final model agreement index reported here is 77.1%. The start of the entire sequence is estimated to be 5363 (68.2%) 5266 cal BC, and the end is 4899 (68.2%) 4771 cal BC.

The first phase is represented by the completion of the Szakálhát pits infilling. Based on samples from the upper part of the P2 and P3 storage pits, this oc-
Fig. 9. Geochemical analysis of samples from the 2021 excavation using XRF. The samples were measured with the ed-XRF Spectro Xepos He with helium flush and calibration for powder samples in sample cups with 150 seconds measurement time for each sample. A sample plate with eight positions and sample rotation feature was used. Selection of elements, values in ppm (compiled by I. Hohle).
curred between 5297 (68.2%) 5265 cal BC and 5275 (68.2%) 5215 cal BC. The end of the Szakálhát period could be dated to 5246 (68.2%) 5137 cal BC. Previous 14C data rendered the classic Szakálhát assemblages between 5293–5068 cal BC, while the Tiszaug-Railway-station assemblage could be dated to 5023–4909 cal BC (Füzesi et al. 2017.33–34). Our recent samples date the Szakálhát features excavated in the northern part of Öcsöd-Kováshalom to the previously accepted period. This confirms our conclusion on the Tiszaug assemblage that the archaistic use of different stylistic elements (based on 14C dates much younger
than expected) was the result of different dynamics in the development of local communities and their relationship (Füzesi et al. 2017,34, Fig. 15). The finds in the Tiszauj assemblage were stylistically older but absolute chronologically the same age as the Tiszauj assemblage, excavated at Öcsöd-Kováshalom. The Szakálhát assemblage, excavated in 2021, confirms that the Neolithic communities living in the Kováshalom area underwent a similar development. However, the central nature of the settlement probably accelerated this process, and eventually, this site became part of the presumed Tiszauj pottery style core area.

The ditch system underlines the central function of the settlement. The temporal aspect of this function in the 2021 age model has been investigated directly by one date, and indirectly by three. Based on the latter, the lower culture-bearing layer, which the later (D2) ditch was dug into, accumulated in 87–128 years, between 5246 (68.2%) 5137 and 5118 (68.2%) 5050 cal BC. Its relationship to the earlier (D2) ditch is unclear, and unfortunately no animal bone suitable for dating was recovered from this feature. The single 14C date indicates that the backfilling of the D2 ditch was completed between 5118 (68.2%) 5050 cal BC, meaning that the excavated section of the outer ditch may have been in use for 68 years.

Based on the samples from the P1 feature and the upper culture-bearing layer, the later, Tiszauj features date to 4991 (68.2%) 4910 cal BC and 4906 (68.2%) 4836 cal BC. They are slightly older than the storage pit excavated in 2020, nevertheless, the dates fall in the late phase of the settlement (Fig. 11: Öcsöd B; Raczky, Füzesi 2016,34, Fig. 17,19-20). The 2021 model also confirmed that the triple ditch system, which defined the settlement structure based on the geophysical survey, was only present during a certain period of the site’s existence. After the infilling of this enclosure system, archaeological features testify to the intensive occupation in the first quarter of the 5th millennium BC, both in the interior and exterior settlement parts.

**Discussion. Dynamics of the pseudo-ditch system at Öcsöd-Kováshalom**

In addition to absolute chronological modelling, another crucial aspect of the investigation of the ditch systems is the interpretation of the relationship between archaeological finds and the features that contained them. According to a simplified, positivist assessment, artefacts determine the function of a feature through the activities that can be assigned to them. However, the relationship between artefacts and ditches is more complex. In some cases the finds are linked to the primary function of the ditch, to the activities carried out there. In other cases this link is missing, and so the artefacts represent the subsequent use of a broader place. Different parts of the ditches are affected by various accumulation processes, and the activities associated with them belonged to different temporal and functional horizons (Ridky et al. 2014,594). Although these complex relationships are difficult to assess, their investigation is essential for research into the use and afterlife of the ditches.

The interpretation is further extended by the fact that the human habitation and artefact formation processes behind each artefact type are also manifold. Ceramic sherds are broken items, daub fragments are remains of constructions, and animal bones and shells are ‘by-products’ of consumption. However, all artefacts represent human activity, even if it varies in direction, complexity and the amount of energy invested. To aggregate the data, human activity was quantified on a ratio scale. This does not include the investment of labour needed to dig the trenches. The primary reason for this is that the dimensions of the trenches could only be deduced from trenches 1 to 2 m wide, which would be incorrect even if extrapolated to individual ditch segments. Secondly, the extra investment of recutting also complicates the situation. We have thus estimated the extent and temporal dimension of the accumulation of archaeological material. The total of the finds belonging to each type was taken as 100%, and each find in a given type received a percentage value (Fig. 14.1). The following find types were encountered: pottery, animal bone, daub, chipped stone, and mollusc shell (100% each). This way, the previously presented trends in the artefact distribution patterns (Fig. 4.4–6; Fig. 8.1–5) became even more pronounced.

Using relative and absolute chronological data, we were able to assign the different filling layers and their finds to a time scale. Based on the extent of backfilling in the excavated features and activities associated with the deposited artefacts, we summed the volume of labour represented by the findings on a chronometer, and thus derived a taskscape with a temporal dimension (Fig. 14.2). Due to the differences in magnitude between each find material of the two excavations, the 2021 data were presented in two
On the ‘pseudo-ditch’ system of the Late Neolithic Öcsöd-Kováshalom settlement complex on the Great Hungarian Plain

Fig. 11. The absolute chronology of the 2021 trench: 1 excavated units with 14C samples, 2 14C data, 3 OxCal model of the 14C data (compiled by N. Faragó and A. Fűzesi).

<table>
<thead>
<tr>
<th>Lab Nr</th>
<th>Sample Name</th>
<th>14C Age [BP]</th>
<th>( \delta^{13}C ) AMS [‰]</th>
<th>Probability 68%</th>
<th>Probability 95%</th>
<th>C/N</th>
<th>C [%]</th>
<th>Collagen [%]</th>
<th>Material</th>
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<td>56003</td>
<td>1 - Öcsöd-Kováshalom 2021</td>
<td>6204</td>
<td>-19.8</td>
<td>cal BC 5213-5073</td>
<td>cal BC 5291-5051</td>
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<td>34.8</td>
<td>7.2</td>
<td>bone</td>
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<td>56004</td>
<td>2 - Öcsöd-Kováshalom 2021</td>
<td>6036</td>
<td>-20.9</td>
<td>cal BC 4988-4854</td>
<td>cal BC 5006-4841</td>
<td>3.2</td>
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<td>6.3</td>
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<tr>
<td>56005</td>
<td>3 - Öcsöd-Kováshalom 2021</td>
<td>6126</td>
<td>-23.0</td>
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<td>cal BC 5317-5208</td>
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<td>cal BC 4988-4801</td>
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OxCal v4.4 (Brook Ramsey 2021): 15 Atmospheric data from Reimer et al. (2020)
forms. One is scaled similar to the 2020 dataset, but a different logarithmic plot was also used to show the details (Fig. 14.2, left side). The model constructed highlights the cyclical intensity of human activity. In a significant proportion of the sites we identified at least two accumulation maxima, i.e. two intense depositional phases interrupted by less intense phases. Moreover, stratigraphic data suggest that in most cases high artefact concentrations were the result of deliberate human action (e.g., in the upper fill layer of the inner ditch – D2/2020, the later version, i.e. the re-cutting of the outer ditch – D2/2021), while the layers with few artefacts indicate natural accumulation and deposition, which were the results of spontaneous erosion processes (e.g., in the lower layer of the inner ditch – D1/2020, the earlier outer ditch – D1/2021). Intentional action was particularly prevalent in the structured deposits located in the upper part of both excavation trenches, referring to some kind of final act.

Our detailed observations on the ditches can be integrated into the research on European enclosures in many aspects. The ditch systems constructed in large numbers during the European Neolithic show a great variety in size and form. More than 100 LBK ditch systems are known and have been studied in Western and Central Europe (Haack 2022.69). Late Neolithic rondels with regular structures were constructed between 4900–4500 BC (Literski, Nebelsick 2012). Jaroslav Řídík has reported 154 rondels for the entire distribution area (Řídík 2019a. Tab. 4.1), with 30 specimens currently known from 24 sites in Hungary (Barna et al. 2016). Various ditch systems also occur in southeastern Europe (Parkinson, Duffy 2007. Fig. 2; Nikolova 2022). Local development of these structures started in the second half of the 6th millennium BC, and by the Late Neolithic mainly fortifications associated with tells became dominant (Raczky, Anders 2012). Extensive geophysical research in the northern Balkans and on the Great Hungarian Plain in recent decades has revealed many newly discovered constructions (Kalafatić et al. 2020). Such research focuses primarily on structural features, and thus their metric data have become known, similar to the Central and Western European examples.

Contrary to the structural characteristics, backfilling processes in the ditches have been investigated only in a small proportion of constructions. In this context, the idea that the lower part of the ditches, which yielded few finds, was filled by natural agents, while the upper part, rich in finds, was filled intentionally, became a convention in the literature (Haack 2022. 70). The idea emphasized the mix of natural and anthropogenic effects. In addition, the temporal factor was a dominant aspect of research models concerning the European Neolithic, several of which include elements related to the Öcsöd-Kováshalom model.

Although the backfilling of the Herxheim enclosure was carried out in different events, it took place almost simultaneously in a very short time. This process of fewer than 50 years can be dated to the latest phase of the LBK (Haack 2022.59–61; 2021.31–33). A detailed analysis of Complexes 2 and 4 showed that the depression with the superposition of assemblages was re-excavated.

Fig. 12. Selection of decorated ceramic material from the 2021 trench – Szakálhat style (1-2: P6, 3-8: P4, 9-10: P3, 11-13: P2) (compiled by A. Füzesi).
On the ‘pseudo-ditch’ system of the Late Neolithic Őcsöd-Kováshalom settlement complex on the Great Hungarian Plain

The backfilling of the inner ditch at Őcsöd-Kováshalom shows similarities with the models established in Kolín Rondel 1 (Czech Republic, Stroked Pottery Culture) and the rondel in Vychnice (Czech Republic, Stroked Pottery Culture). In the transect trench of the Kolín ditch, the finds were concentrated in the middle-upper part. The refitting of pottery fragments provided multiple connections in the upper part, indicating the contemporaneity of the fill (Ŕidký et al. 2014.582–586, Fig. 1). At the Vychnice site, find density in the fill was analysed in six adjacent sectors. In addition to the weight data of pottery and daub, the fragmentation of the former was also investigated. The size of the fragments revealed a dispersal pattern concentrated at the entrance to the ditch system: the average size of the sherds increased towards the entrance. The daub fragments were concentrated in a single layer in the upper part of the ditch, and their detailed analysis suggested that they belonged to a single burnt construction (Ŕidký et al. 2014.589–593, Figs. 7–9). Due to the different characteristics of the two excavations, one case (Kolín 1) confirmed the significance of the vertical, and the other (Vychnice) the horizontal patterning. In the Kolín model, the lower part of the ditch fill was almost devoid of finds, while the upper part was rich in artefacts. The infilling of the ditch, which had started naturally, was completed rapidly by human intervention, presumably after the original function of the ditch ceased. In the Vychnice model the finds concentrated at the entrance of the ditch emphasized the importance of the path as a transport route (Ŕidký et al. 2014.594). In both cases the finds in the ditches are not related to the original function of these constructions, and the change in the original concept of the ditch, along with the end of the function, preceded the large-scale filling. In the case of the inner trench at Őcsöd, horizontal differentiation is evident in the scatter pattern of the finds (Fig. 14.1), while vertical arrangement can be interpreted by considering the spatial position of the two excavation trenches. Trench 2020, which yielded a much larger number of artefacts, was located close to the entrance of a segment of the inner ditch, while Trench 2021 was located in the middle of a longer segment of the outer ditch (Fig. 1), suggesting that similar reasons to

Fig. 13. Selection of decorated ceramic material from the 2021 trench – Tisza I-II style (1-3: D1, 4-7: D2, 8-11: P1, 12-14: W) (compiled by A. Füzesi).

i.e. not only was backfilling taking place, but certain ditch sections were cut again, and thus several artefacts were deliberately re-arranged (Haack 2009. 34–35, Fig. 9). In the short period between the construction and the backfilling of the ditch system, cleaning and recutting as well as concentrated artefact accumulation were repeated in a cyclical manner (cf. Šridky 2019b.Fig. 6.15). A typical example of recutting was observed in the outer section of the ditch system at Őcsöd (Fig. 6.1), and the associated absolute chronological data are also comparable to Herxheim. Although the dating of the early (D2) ditch is based on its relative chronological position due to low find frequency, the modelled chronological data resulted in a restricted time range (Fig. 11.3), indicating that the construction and filling of ditch D2 occurred quite rapidly in the decades immediately preceding 5100 BC. The suddenly buried section was replaced by a new ditch, the backfilling pattern of which already showed the double (natural-anthropogenic) pattern typical of ditches in general.
those at Vychnice may have been behind the higher artefact concentration in the inner ditch.

Another important aspect of the model for the Öcsöd-Kováshalom ditch system is time. The $^{14}C$ data from the outer and inner trenches demonstrate differences much larger than expected. In the model of the 2020 trench, natural filling of the lower part of the ditch (D1) occurred between 5028 (68.2%) 4951 cal BC and 4951 (68.2%) 4915 cal BC, while the upper part (D2) was filled between 4951 (68.2%) 4915 cal BC and 4935 (68.2%) 4899 cal BC. Unlike the outer ditch, the early version (D2) was filled before 5100 BC based on stratigraphy, and the later ditch (D1) was also filled between 5118 (68.2%) and 5050 cal BC, i.e. the outer ditch became buried half a century before the inner ditch began to fill up (Fig. 14.2). Of course, the $^{14}C$ samples are indicative of construction time only indirectly, but the large time difference between the two sections demonstrates that the ditches, which are shown as concentric circles in the geophysical survey, did not exist synchronously. The chrono-stratigraphy of the infill for Kolín Rondel 1 also showed temporal differences between the individual trench sections. Based on radiocarbon data, the four concentric ditches started to fill back in several hundred years apart. The outer ditch had begun to fill around 4871 BC, the next one around 4604 BC, the third one around 4464 BC, and finally, the construction ceased to exist around 4400 BC (Řídký et al. 2014.586–588, Fig. 5). The Öcsöd case showed a similar significant temporal difference, but the two excavation trenches do not make it possible to reconstruct the temporal dynamics of the entire ditch system. Our preliminary data only confirm the complexity of the construction, operation and infilling of this monumental structure.

Pseudo-ditch systems were established in the first half of the 5th millennium BC in certain regions of Western Europe (Lefranc et al. 2017.Fig. 11.2). These constructions had specific formal features different from both the asymmetrical ditch systems of the LBK and the rondels of the Lengyel cultural complex. “Pseudo-ditches can be defined as enclosures formed of independent and discontinuous segments, oblong and morphologically varied, arranged along a predetermined path” (Lefranc et al. 2017.159). Already in our first publication we interpreted the Öcsöd ditches, consisting of independent segments, as the emergence of a pseudo-ditch system along the Tisza River (Füzesi et al. 2020a). In some irregular examples of the Lengyel rondels, the ditch system was also constructed from several segments of different sizes and structures (shape and depth) (Balatonmagyaród-Hídvegpuszta: P. Barna et al. 2019.128–130, Figs. 9–10), but these are mainly formal similarities to pseudo-ditch systems. The establishment and use of the pseudo-ditch systems were described by the Rosheim model (Lefranc et al. 2017.Fig. 11.1), and the essential element of these is that each segment was established and buried in different phases, i.e. the entire enclosure, perceived today as a unit, never existed at the same time. Such temporal differences have been demonstrated by the excavations of the ditch system at Öcsöd. In the chronological model of the 2020–2021 trenches, half a century passed between the complete filling of the outer ditch and the beginning of the investigated section of the inner ditch.

The data from the two segments of Öcsöd-Kováshalom do not yet provide clear evidence for the Rosheim type of this phenomenon, although the segmented nature of the ditch system suggested this parallel already at the time of the first publication (Füzesi et al. 2020a). The strong formal similarity was further confirmed by the chronological data from the two excavations. As such, the two sections explored so far can only be considered as a starting point for a detailed investigation of the Öcsöd-Kováshalom ditch system, which is known in its full structure from the geophysical survey. Based on the observations, the individual ditch segments showed differences in shape (the inner ditch had a V-shaped cross-section, and both versions of the outer ditch were trapezoidal). We reconstructed the backfilling processes of the excavated ditch segments individually and we compared them to different European models based on the backfilling/filling processes, and the intensity and duration of the artefact accumulation. The definition of the features as a pseudo-ditch system became evident from our observations, but no far-reaching conclusions can be drawn for the entire ditch system. Research on European prehistoric ditch systems uses a combination of stratigraphy, artefact distribution, ceramic typo-chronology and absolute chronology, similar to our analysis of the Öcsöd-Kováshalom ditch system (Fig. 14.2). A possible continuation of the Öcsöd research is also indicated by these studies, to investigate layers of space-and-meaning associations horizontally, similar to the ring sanctuary of Pömmelte (Spatzier. Bertemes 2018).
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Fig. 14. The depositional practices and sedimental processes in the 2020 and 2021 trenches: 1 distribution pattern of archaeological material (main types summarized by per cent), 2 the dynamism of site formation processes (absolute and relative chronology connected with material accumulation and ceramic style development) (compiled by A. Füzesi).
Conclusion

1. At the Öcsöd-Kováshalom settlement complex, the multi-layered central settlement part, the horizontal settlement units and the surrounding ditch system overlapped in time.

2. Based on the excavation data, the segments of the ditch system identified by geophysical imaging had different dynamics of formation, each having their own stories.

3. Radiocarbon data demonstrates that the outer ditch is older than the inner ditch, with 50 years’ distance between the complete burial of the former and the period of use of the latter.

4. The filling of the inner ditch happened simultaneously with the reorganization of the multi-layered central settlement part.

5. The filling of the ditches was a combination of natural processes and anthropogenic impacts, which can be distinguished by the characteristics of the fill layers, find frequencies and the duration of the process.

6. The geochemical XRF analyses of the 2020 and 2021 samples show indications for intense human impact through several anthropogenic layers which are comparable and consistent with other analyses of the refilling processes.

7. The two excavation trenches at the entire Öcsöd enclosure do not allow any generalizing views on the nature of the pseudo-ditch systems. Instead they support the interpretation based on the diversity of the numerous ditch systems in Neolithic Europe, speaking for the freedom of local communities in their choices within their respective cultural frameworks.

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References


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