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CONTENT – OBSAH

EDITORIAL

Whether on your screen or printed on paper, you are reading the last issue of the 2023 volume, thus creating a good opportunity to review the past year. You might object that, due to the delay in *Archeologické rozhledy* releases, this issue was published later in 2024 and my review is thus a little bit stale. However, as historians and archaeologists should know best, one needs some distance to fully contemplate past events – what was really important and what was just mundane triviality.

Looking back, the year 2023 for me was marked by conferences and workshops, since I took part in six such events throughout the year. Among them, the EAA Annual Meeting traditionally holds the most prominent position. In my opinion, this conference is unparalleled in the number of attendees, the spectrum of topics, and its impact on the archaeological community across Europe. Judging by the number of conferences, the year 2023 thus showed to me that archaeology has fully recovered from the COVID break and that personal contact is still irreplaceable in academia. The return of on-site conferences brings a grain of positivity to pessimistic visions of a future in which people communicate only online or just through VR goggles, as the hype after this latest gadget hit the market might suggest.

On the other hand, it is not possible, considering the number of events and one's busy schedule, to attend all of the interesting conferences, and scholars are often faced with hard choices. Therefore, I am happy that reports from conferences are submitted to the News section of our journal. Specifically in this issue, you can read a report by Luboš Chroustovský with a summary of the conference on the archaeology of music held in Würzburg on September 2023. I believe that such reports are useful for those who could not attend while also providing important feedback to conference organisers. In this respect, I would like to encourage authors to submit their reports in English to address the international audience.

Besides the conference report, I am sure that the research articles published in this issue will also interest the readers. Natalie Venclová and her colleagues provided a complex assessment of an old excavation in Nižbor (CZ), where a sunken hut with deposited human remains was revealed. The erudite pottery chronology assessment was compared to radiocarbon dating, which is still rather uncommon in La Tène archaeology. Further, spatial relations between the Nižbor site and the nearby oppidum of Stradonice led the authors to a GIS-based analysis that explores the potential river ford near the site.

The paper by Kateřina Pořádková and Lenka Kovačiková falls into the category of methodological studies and strives to refine a determination of the age of hunted mammals based on the acellular cement growths in their teeth. The authors present not only an analysis of recent reference samples but also a case study on archaeozoological finds from the early medieval hillfort in Netolice (CZ) to demonstrate the practical use of the method. I believe that the paper will speak to archaeozoologists as well as non-specialists searching for new insights into animal bone assemblages from their excavations.

An important new find – a hammering form for the production of early medieval *kaptorga* pendants – is presented in the paper by Naďa Profantová and colleagues. The find comes from the hinterland of the Kouřim – U Sv. Jiří hillfort (CZ) and represents just the

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second object of this kind known thus far. The paper, however, is not just a mere publication of a new find. The hammering form from Kouřim produced *kaptorgas* with the motif of a gryphon, so the paper thoroughly discusses how this Byzantine motif found its way into the heart of early medieval Central Europe.

Respecting the chronological order, the issue concludes with the paper by Karel Slavíček and colleagues on the 13th-century pottery kiln from Žďár nad Sázavou–Staré Město (CZ). The authors examine several questions concerning the formation of the excavated context and the pottery production at the site. To obtain answers, they use a wide spectrum of analytical methods including petrography, XRF analysis and 3D scanning, which makes the paper crucial in the context of medieval pottery studies in Central Europe.

Václav Vondrovský

RESEARCH ARTICLE – VÝZKUMNÝ ČLÁNEK

Paths to this and the next world: A La Tène sunken hut from Nižbor, Central Bohemia

Cesty na tento i onen svět: Laténská polozemnice z Nižboru ve středních Čechách

Natalie Venclová – Dagmar Dreslerová – René Kyselý – Michal Dyčka – Jiří Šebesta – Kateřina Pachnerová Brabcová – Jarmila Bíšková – Václav Matoušek

The article presents the assemblage of finds from a sunken hut in Nižbor opposite the Stradonice oppidum on the other bank of the Berounka River. The inventory from the sunken hut, which testifies to its contemporaneity with one of the phases of settlement at the oppidum in the Late La Tène period, was composed of common settlement finds of pottery and animal bones but also the skeletal remains of an older male. As such, it is a source for the study of excarnation, or the handling of the body of the deceased in the central European Late La Tène period following the end of burials at the so-called flat cemeteries. Radiocarbon dating of human and animal bones is important for establishing the chronology of the accompanying find assemblage, especially painted pottery in Bohemia. The location of the site near a probable ford over the Berounka River is the starting point for the reconstruction of the roads in the broader vicinity of the oppidum.

settlement – oppidum hinterland – excarnation – roads – ford – La Tène period – radiocarbon dating

Článek představuje nálezový soubor z polozemnice v Nižboru, ležící naproti oppidu Stradonice na druhém břehu řeky Berounky. Nálezy z polozemnice, které svědčí o její současnosti s jednou z fází osídlení na oppidu v mladší době laténské, tvořily kromě běžných sídlištních nálezů keramiky a zvířecích kostí také kosterní pozůstatky staršího muže. Jde tedy o pramen ke studiu exkarnace, resp. zacházení s těly zemřelých ve středoevropské mladší době laténské po ukončení pohřbívání na tzv. plochých pohřebištích. Radiokarbonové datování lidských i zvířecích kostí významně přispívá k řešení chronologie doprovodného nálezového souboru, zejména malované keramiky v Čechách. Poloha lokality u pravděpodobného brodu přes Berounku tvoří výchozí bod pro rekonstrukci cest v širším okolí oppida.

sídliště – zázemí oppida – exkarnace – cesty – brod – doba laténská – radiokarbonové datování

Introduction

Although the study of the hinterland of oppida in Bohemia has revived more attention in recent years (Kosoř site: *Venclová – Danielisová 2020* with refs.), the demand for quality data on this topic remains high. As such, this article presents another find assemblage as a contribution to the study of this issue. The work addresses not only the relationship between the population inside and outside the oppidum, but also serves as a basis for the reconstruction of the treatment of the bodies of the deceased after the end of burials at 'flat cemeteries' in the La Tène period, and for the reconstruction of fords and roads. The focus of the article is a previously unpublished find of a Late La Tène sunken hut from Nižbor

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in close proximity to the Stradonice oppidum. The find is significant for its location across the Berounka River directly opposite the oppidum at a likely ford to which a network of roads was connected, for its contemporaneity with a certain phase of the existence of the oppidum and the presence of human remains inside the hut.

The study based on the assemblage of finds from the sunken hut classifies the feature and movable artefacts and evaluates them from the perspective of relative chronology using a comparison with contemporaneous find assemblages in La Tène Europe. Osteological finds are analysed and radiocarbon dates from human and animal bones are used to establish the absolute chronology. All data are used to characterise the La Tène activities carried out at the site with regard to its position in the landscape, with special attention being paid to the interpretation of the deposition of human remains based on data from Czech and European settlement contexts. Hydrology, geology, and historical sources are used to evaluate possible routes using the ford across the Berounka River between the Nižbor site and the Stradonice oppidum. Subsequently, the network of potential communication corridors is reconstructed using the Cumulative Focal Mobility Network (CFMN) analysis based on data from the Archaeological Map of the Czech Republic (AMCR).

The La Tène period settlement site at Nižbor

The site is located in the village of Nižbor (Beroun district) in Central Bohemia. It lies on the left bank of the Berounka River at the portal of the Novohuťský bridge between the Berounská road and the Beroun–Rakovník railway line on parcel no. 506/2, besides building parcel no. 423/2 (50.0024000N, 14.0033136E; *Fig. 1*). It is located across from the Stradonice oppidum on the opposite side of the river at an elevation of 240 m above sea level. The excavations started by accidental find. On 9 February 1982, school children found human bones in a trench for a gas line running to the local glass factory, which their teacher Jana Leopoldová reported to the museum in Beroun. Václav Matoušek, an archaeologist at this museum, visited the site that same day, took over the finds, stated that the trench for the gas line had disturbed a sunken feature, and had the soil covering this feature removed. The next day, on 10 February 1982, he uncovered the eastern part of the feature. Due to the difficult conditions (the frozen ground had to be thawed), he could only document the situation and collect immediately threatened finds, especially human bones, visible in the wall of the trench. The gas line trench destroyed a large part of the feature, and the excavated soil was removed from the site, making it impossible to retrieve any other possible finds from it. On 23 March 1982, V. Matoušek and N. Venclová investigated the remaining western part of the feature (*Venclová 1982*; *Matoušek – Venclová 1985*).

Description of feature

The incomplete southern half of the sunken hut with a rectangular floor plan was preserved (*Fig. 2*). It had a flat bottom, slanted to nearly vertical walls, a posthole along the west wall, and another hole in the western half near the longer axis of the hut. The east wall of the hut was not preserved. Orientation of the longer axis was WWS–EEN. Two accumulations of human bones were discovered roughly in the middle part of the feature. The subsoil at the site was yellow to yellowish-brown gravel-sand (Berounka River terrace);

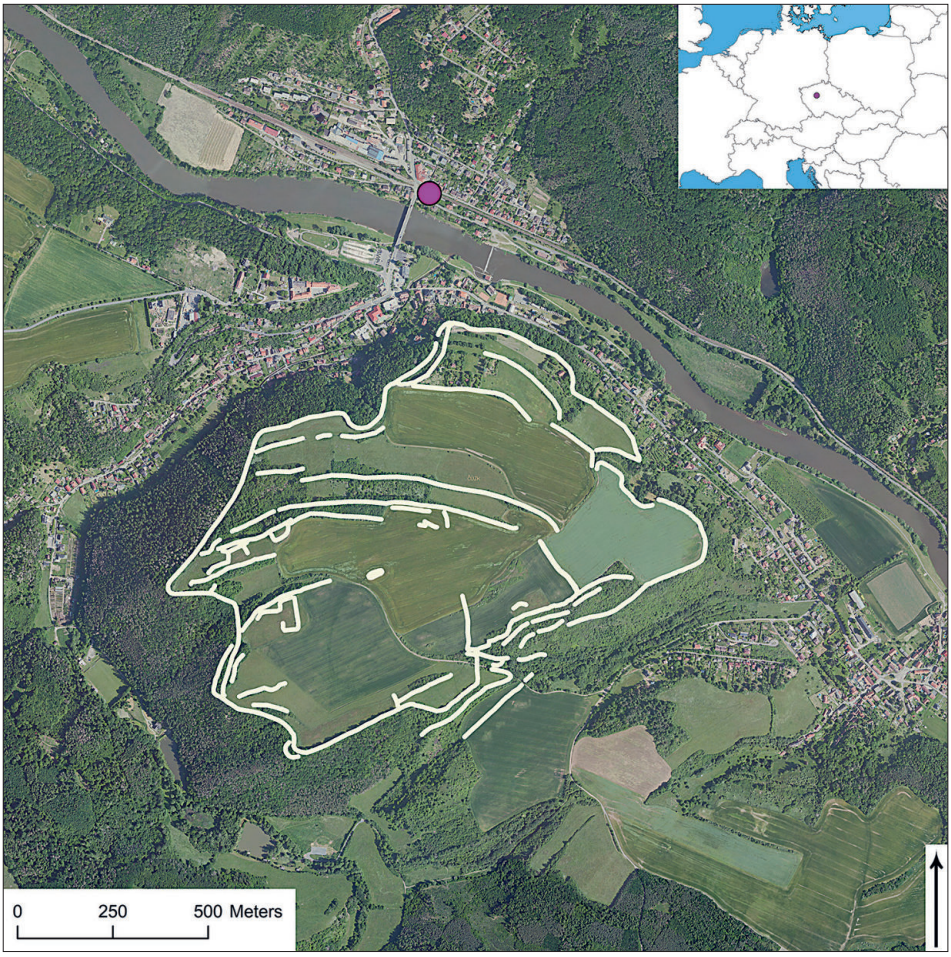

Fig. 1. Location of Nižbor site (violet) and Stradonice oppidum with its fortifications (white). Stradonice fortifications after *Kuna et al. 2014*.

the feature fill was brown sandy soil with stones. The maximal preserved length was 310 cm and depth 40–50 cm; the posthole had diameter of 54 cm at the mouth, 30 cm at the bottom, and was 30 cm deep. Estimate of original dimensions of feature is ca. 340 × 220 cm. Finds consist of pottery, human bones, and animal bones. Pottery is held in the Museum of Bohemian Karst in Beroun, anthropological material in the National Museum in Prague, and osteological material in the Institute of Archaeology in Prague.

Pottery description

The assemblage contains only 41 pottery fragments. Such a small number is perhaps the result of the incomplete preservation of the feature and the removal of most of the fill prior to the arrival of the archaeologist. Moreover, between the first and second phase of

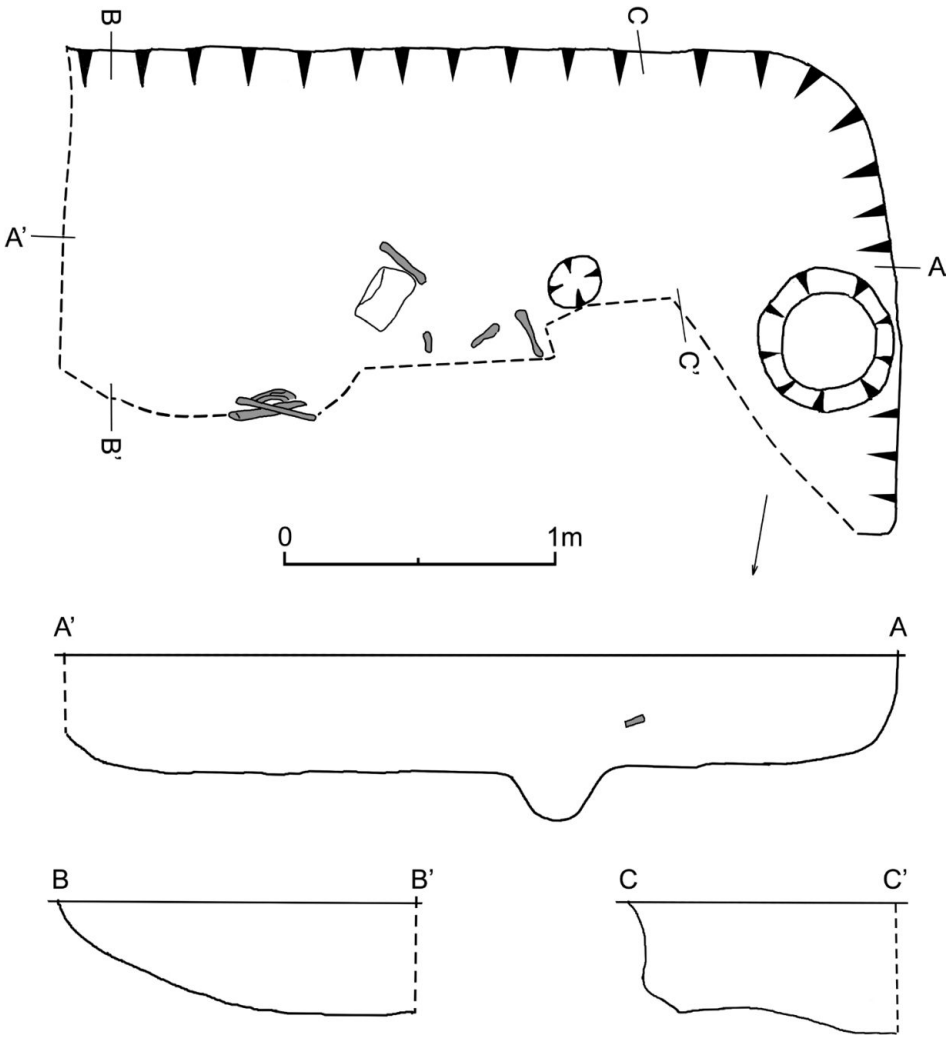

Fig. 2. Nižbor. Sunken hut excavated in 1982 (contents V. Matoušek and N. Venclová, graphics E. Čepeláková).

the excavation, the remaining uninvestigated part of the feature was freely accessible, thus raising the possibility that passers-by carried some artefacts away.

As the small potsherd count renders a statistical evaluation of the assemblage meaningless, it is necessary to work only with the presence/absence of individual pottery characteristics (*Tab. 1*). The assemblage contains fine wheel-turned pottery, wheel-finished pottery with a sandy fabric, one graphite fragment, and the remaining potsherds are from hand-formed pottery with a coarse fabric. Pottery forms include storage vessels, shouldered pots with curved neck, S-profiled bowls, and neckless bowls with slightly rounded profile. Grated surface was recorded in several cases, as was a grainy surface and tooled surface. The most remarkable decoration is painting accompanied by incised wavy line, and black

Context	No.	Pcs	Technique	Fabric	Form	Base	Surface	Decoration
9.-10.2.1982	1	2	1	1-fine	212		1-polished	302-painting 7-incision
hut-E part	2	1	1	1-fine	212		1-polished	
	3	1	3	5-coarse	120		2-smooth	
	4	1	3	5-coarse	130		2-smooth	201-black coating
	5	1	3	4-sandy	714		3-roughly smoothed	
	6	1	2	4-sandy	232		7-grated	201-black coating
	7	1	2	4-sandy			7-grated	
	8	1	3	5-coarse			2-smooth	201-black coating
	9	1	3	5-coarse			3-roughly smoothed	6-coarse combing
	10	1	2	4-sandy			83-grainy	
	11	1	2	9-graphite			2-smooth	
	12	6	3	5-coarse			2-smooth	
	13	2	3	5-coarse		1-flat	2-smooth	
	14	1	1	2-fine-grained			1-polished	201-black coating
23.03.1982	15	1	1	2-fine-grained	232		1-polished	
hut-W part	16	1	1	2-fine-grained			1-polished	
	17	1	2	4-sandy	222		83-grainy	
	18	1	2	4-sandy	232		7-grated	
	19	1	3	5-coarse	714		2-smooth	
	20	1	3	5-coarse	714		4-uneven	
	21	1	3	5-coarse	130		3-roughly smoothed	
	22	1	2	4-sandy	231		7-grated	
	23	4	2	4-sandy			7-grated	
	24	1	3	4-sandy			2-smooth	201-black coating
	25	1	2	4-sandy			83-grainy	
	26	2	3	5-coarse			11-tooled	
	27	3	3	5-coarse			2-smooth	
	28	1	3	5-coarse		1-flat	2-smooth	

Tab. 1. Nižbor. Pottery description (categories after *Venclová 1998*, 345–348, fig. 49–54). Technique: 1 – wheel-turned; 2 – wheel-finished; 3 – hand-made. Form: 120, 130 – storage jars; 212 – neckless pot, slightly rounded; 222 – S-profiled pot; 231, 232 – bipartite shouldered pots with curved neck; 714 – neckless bowl, slightly rounded. Numbers correspond to *Fig. 3* and *Fig. 4*.

coating, which appeared on several sherds. A round disk with a completed perforation but with unfinished edges was cut from a potsherd of a fine wheel-turned vessel (*Fig. 3*; *Fig. 4*).

Anthropological assemblage

The assemblage of human bones was found in two accumulations – one by a large stone roughly in the central part of the sunken hut, the other near the northern preserved edge

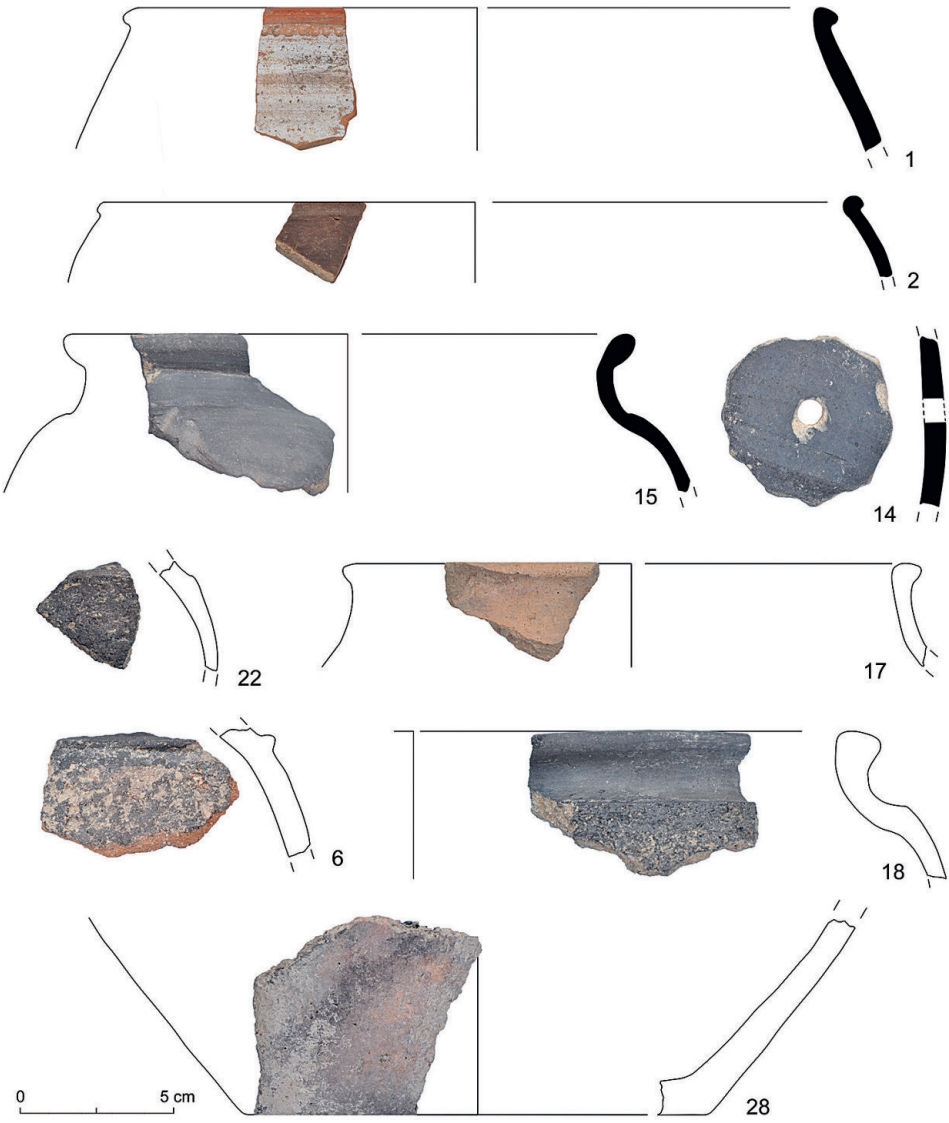

Fig. 3. Nižbor. Pottery (drawing and photo T. Jošková).

of the feature, in the wall of the gas line trench (*Fig. 5*). Other bones were apparently destroyed during the digging of the trench. The bones mostly laid on the bottom of the hut, though a few were found in the lower part of its fill. The anthropological evaluation of the bones was undertaken by *Chochol* (*1982*).

Bone finds are composed of one free tooth (second upper incisor from the left side), fragments of several ribs, the left clavicle and scapula, the humerus, the radius and ulna from the left arm, the sacrum, the left pelvic bone, both femurs, and the metatarsal of the big toe on the right foot. The assemblage did not include the skull or any of its fragments.

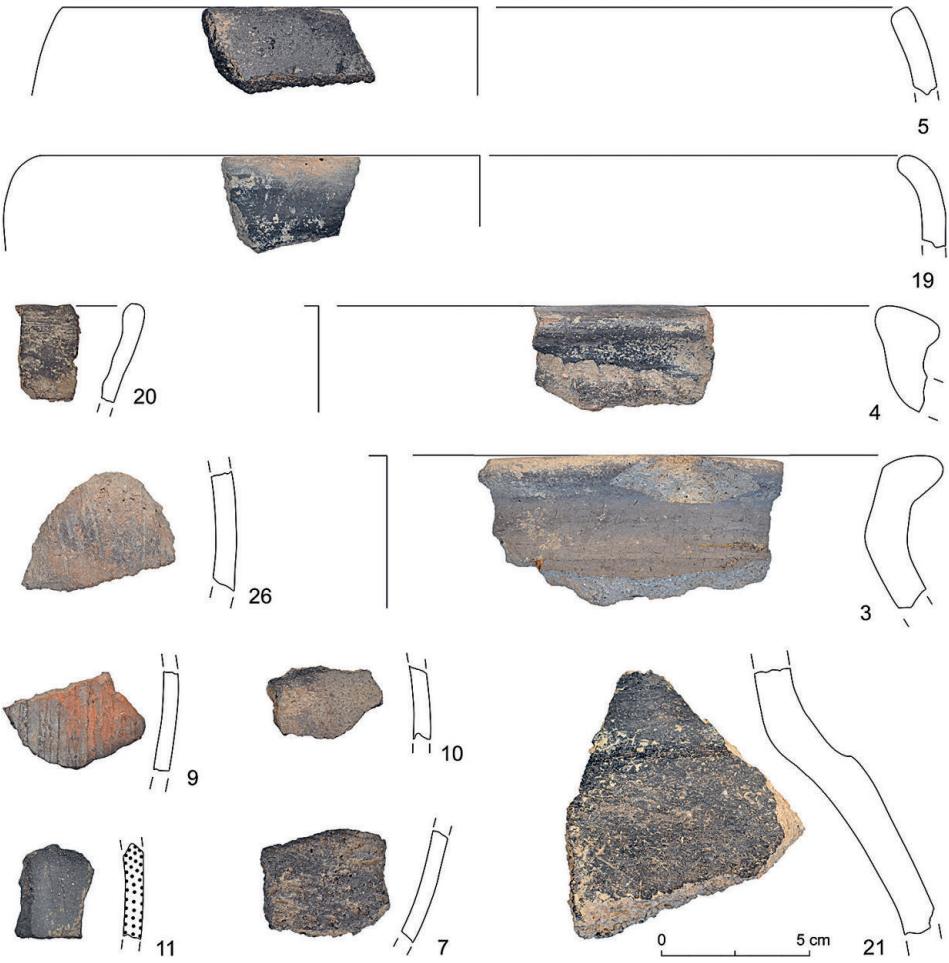

Fig. 4. Nižbor. Pottery (drawing and photo T. Jošková).

The bones are relatively gracile, with heads up to medium in size and distinctively modelled by the well-developed relief of muscle attachments. The remarkable intensity of the functional load is also attested by the exceptionally developed attachment edges on the humerus, the femur, the third trochanter, *crista iliaca*, and *adductor tubercle*. All of the bones bear marks of moderately advanced decalcification; the articular surfaces are bounded by an arthritic border. According to measurement results, the femurs are hyperplatymeric (index 68.1); body height was calculated at 160.7 cm as subaverage. Traces of possible violence were not detected on the preserved bones.

As such, these are bones belonging to the skeleton of a man who died at a higher age (maturus II, 50–60 years old), was relatively slim, short and quite small, but with a very muscular build. Partial bone and muscular atrophy (perhaps even a joint inflammatory process) set in at an advanced age. The bones are held today in the Anthropological Depository of the National Museum in Prague (inv. no. Ao 8349).

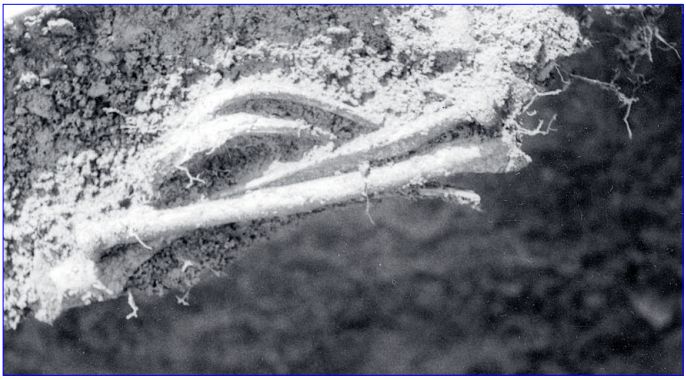

Fig. 5. Nižbor. Accumulation of human bones in the sunken hut (photo V. Matoušek).

Animal bones

The assemblage of animal bones was originally determined by *Peške* (*1982*), and *Kyselý* (*2024*) performed a detailed determination (see *Online Supplementary Material 1*).

The small assemblage collected manually from the analysed feature comprises 65 bones, 25 of which can be more precisely taxonomically determined. It certainly represents only a small part of the bone waste originally produced, but it is nevertheless a valuable source of information. In addition to sampling for radiocarbon dating (see below), the assemblage was evaluated using traditional two quantification methods to provide a taxonomic and anatomical determination (*Tab. 2*). At least six animal species were present in the assemblage: horse (*Equus caballus*), cattle (*Bos taurus*), goat (*Capra hircus*), pig (*Sus domesticus*), red deer (*Cervus elaphus*) and an undetermined bird.

Finds of three anatomically varied horse bones are interesting and probably come from adult individuals (or individual), with a proximal phalanx (*phalanx proximalis*) bearing a cut and chopping (*Fig. 6*; *Tab. 2*). These marks document the processing of the horse body, though not necessarily for food purposes. The horse documented at Nižbor was small (measurements of bones in *Online Supplementary Material 1*), which is consistent with horse size in the given period (*Peške 1994*; *Kyselý – Peške 2022*). A mandible of a small ruminant featuring an unusual morphology of the third molar was identified as belonging to an adult goat (*Fig. 7*). Goats are not frequently identified in La Tène assemblages in the Czech Republic, and Central Europe generally (see e.g. *Beech 1995*; *Kyselý 2002*; *Saliari – Trebsche 2023*). The well-known difficulty in discerning between sheep and goat is only a minor factor in their low numbers. The only evidence of wild animals in the assemblage was a fragment of pelvis, a fragment of metapodium, and part of a fragmented (perhaps lengthwise chopped) distal part of the radius of an adult deer. The presence of the proximal bones of legs points to hunting, while the large deer pelvis suggests the catch of an adult male. Birds are represented by three bone fragments of juvenile individuals (or individual) of an unspecified species, all corresponding in size to domestic fowl. Other categories of animals (e.g. dog or fish) are not documented at all. In contrast to the bones of juvenile birds, mammal bones belong to adult or subadult individuals. This applies to horse, cattle, sheep/goat and pig, and does not indicate a selective supply of more culinary interesting juvenile animals or parts of their bodies (see e.g., mandibles of adult goat and pig; *Fig. 7*; *Online Supplementary Material 1*).

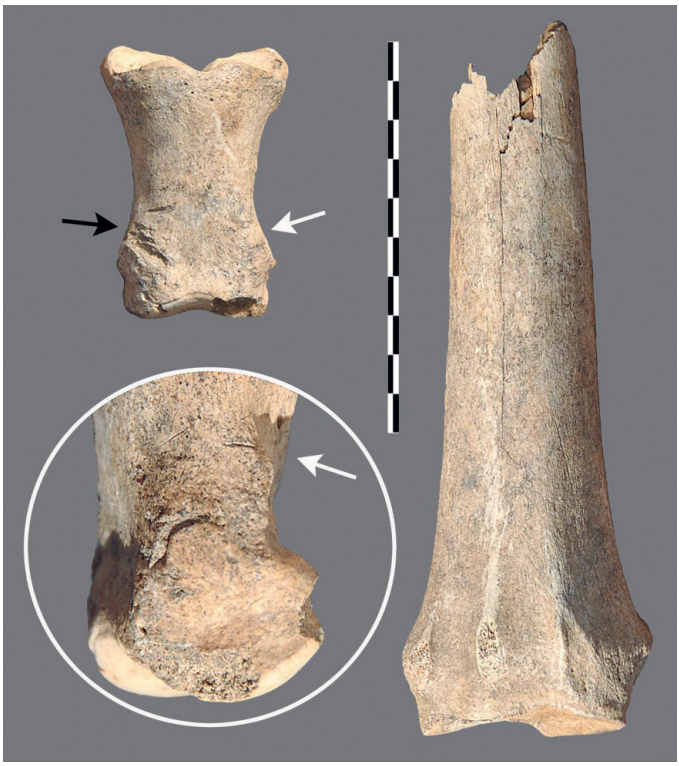

Fig. 6. Nižbor. Horse (*Equus caballus*) bones. Right – radius; left – proximal phalanx with chops (black arrow) and two cuts from the lateral side (white arrow and detail in circle) (scale: 1 unit = 1 cm; photo R. Kyselý).

Fig. 7. Nižbor. Find determined as right mandible of goat (*Capra hircus*). Above – lateral aspect, below – view of the occlusal surfaces of teeth of the same mandible (see morphology of third molar) (scale: 1 unit = 1 cm; photo R. Kyselý).

While the overly small assemblage does not allow to reconstruct the subsistence strategy of local inhabitants reliably, we can state that the determined taxonomic composition is in agreement with the spectrum known from other Late La Tène collections, including the Stradonice oppidum itself. At Stradonice (*Kyselý 2012*) as well as Radovesice (*Peške 1993*), Mšecké Žehrovice (*Beech 1998*), Závist (*Čižmář 1989*; *Motyková et al. 1990*),

	Incisivus inferior	*Molar 2 superior*	*Costa*	*Os incisivum*	*Maxilla*	*Mandibula*	*Metapodium*	*Radius*	*Radius + ulna*	*Metacarpus*	*Pelvis*	*Femur*	*Tibia*	*Talus*	*Metatarsus*	*Tarsometatarsus*	*Phalanx I*	*Indet.*	**Σ**
	number of finds (NISP, N)																		
Equus caballus			1					1									1		**3**
Bos taurus				1	1			1		1			1	1	2				**8**
Ovis/Capra	1	1	2	1				1					1		1				**8**
Sus domesticus						1											1		**2**
Cervus elaphus							1		1		1								**3**
Capra hircus						1													**1**
Unspecified mammal																		24	**24**
Unspecified bird								1				1				1			**3**
Medium mammal			2															1	**3**
Large mammal															1			9	**10**
	weight [g]																		
Equus caballus			47					120									37		**204**
Bos taurus				16	7			25		23			22	45	90				**227**
Ovis/Capra	1	4	4	1				6					9		9				**34**
Sus domesticus						76											5		**82**
Cervus elaphus							9		51		139								**199**
Capra hircus						56													**56**
Unspecified mammal																		24	**24**
Unspecified bird								1				1				1			**3**
Medium mammal			9															8	**17**
Large mammal															9			42	**50**

Tab. 2. Nižbor. Taxonomic and anatomical determination of animal bones and their quantification according to number of finds (NISP, N) and weight.

southwest Bohemia (*Kyselý 2004*), Moravia (*Čižmář – Čižmářová 2013*, 188–189), and elsewhere in the Czech Republic and neighbouring regions (e.g. *Saliari – Trebsche 2023*), hunting was merely a supplemental component. Bones from cattle, pig and sheep/goat are the most numerous. Horse could have had a combined function – its occurrence is quite variable in the La Tène period. Generally, it is represented regularly, albeit usually at a lower percentage than cattle, pig, and sheep/goat. In this sense, the Nižbor assemblage is not exceptional.

The analysis offers no indication that the local residents had a subsistence strategy that differed from the standard at that time, i.e. they were not dependent on hunting, did not have supply of 'better cuts of meat', and were not strongly supported by horses or dogs.

Chronology of the find assemblage

Relative chronology

The only type of find that can be used to establish the relative chronology of the assemblage are sherds of ceramic vessels. All of the characteristics of the pottery assemblage from Nižbor, i.e. the sandy fabric of wheel-finished strongly profiled pots with grated or a grainy surface, storage vessels with characteristic rims and a black coating belong to the later phase of the La Tène period, or in general to LT C2–D1 (*Venclová et al. 2013*, 104–107; *Venclová – Danielisová 2020*; LT D chronological system as used by *Danielisová 2020*). This dating is not challenged even by a perforated disk cut from a potsherd of a wheel-turned vessel, which has numerous parallels at La Tène settlements from the LT C–D1 period (*Venclová et al. 2013*, 63, with refs.).

Painted pottery deserves closer attention. Two fragments of one wheel-turned, neckless vessel with a slightly thickened rim from brick-red fine material with a grey core have been preserved. The rim is painted in red, while below it and on the shoulders the surface is covered with white paint into which a small wavy line is incised or rather scratched (*Fig. 8*).

The shape of the vessel is not clearly determinable, as the slight curvature of the body allows it to be reconstructed either as a beaker or as a deep bowl/terrine. A remarkable feature of the Nižbor vessel is the incised wavy line below the rim, an element already observed by *Píč* (*1903*, 88, tab. XLIX: 7) in the assemblage of painted vessels from the Stradonice oppidum. *Břeň* (*1966*, 88–89; *1973*, 111) described the engraved wavy line just below the rim of painted beakers or bowls, as well as bottle or vase forms, as typical for Bohemia and Moravia. The heavy occurrence of parallels to the Nižbor vessel at Stradonice, both of a beaker and globular form, was confirmed by the analysis of finds from A. Stocký's excavation from 1929 as well as from older assemblages from the site (*Venclová – Valentová 2012*, 61, obr. 109; *Valentová 2013*, 43, tab. 14–23). Only isolated finds of neckless painted vessels with an incised wavy line or without it have been found in Bohemia away from Stradonice and also at Staré Hradisko and elsewhere in Moravia (*Jansová 1963*, 338, obr. 3: 1; *Meduna 1980*, 98–99; *Ženožičková 2009*, 38; *Venclová – Valentová 2012*, 60; *Valentová 2013*, 43–44; *Čižmář 2015*, obr. 11: 6). In the case of a single painted vessel with an incised wavy line from Manching (*Maier 1970*, 38, č. 792), *Cumberpatch* (*1993*, 80) did not rule out its origin in Bohemia.

Maier (*1970*, 9, 37–38, 101–103) designated painted vessels of a globular shape as '*bol Roanne*' after pottery from the Roanne site in Auvergne, France. Globular bowls occur at the site from horizon 5, i.e. in 40–30 BC (*Lavendhomme – Guichard 1997*, 146, 154, 204) and they were produced there and elsewhere in Gaul until the beginning of the 3rd century AD (*Grand 1995*, 178–179). The term was adopted especially in Czech literature for a type of vessel from the very end of the Late La Tène period, or the Augustan Age, to which the assumption of this late absolute dating of the respective find assemblages was also adapted (*Meduna 1980*, 98–99; *Drda 1981*, 206). In the meantime, however, the absolute dating of the end of the La Tène period (the end of LT D1 phase) shifted back substantially to roughly 50 BC (*Danielisová 2020*, 113–117, with refs.), i.e. before the Augustan Age. In Central Europe, vessels of this type (painted globular bowls) have been regarded as a very late element and were placed in LT D or not earlier than

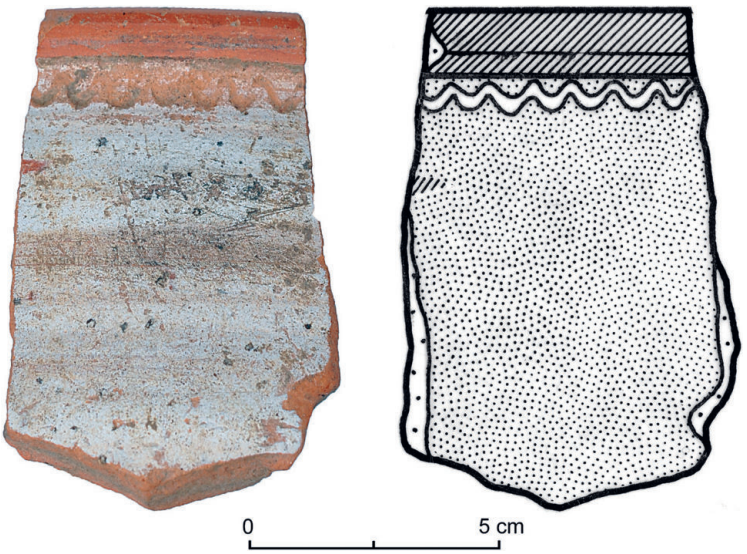

Fig. 8. Nižbor. Painted pottery fragment (photo T. Jošková).

the horizon of Nauheim fibula (Stradonice, horizon 2 to 4: *Rybová – Drda 1994*, 97–99, 131–132).

However, *Maier* (*1970*, 106) already expressed reservations about the exclusively late dating of '*bol Roanne*' vessels, assuming, based on La Tène finds from Manching, that some variants of this form could be the predecessors of classic Augustan vessels. French research also views these vessels as a continuation of the Gallic (i.e. pre-Augustan) tradition (*Mennessier-Jouannet – Deberge 2017*, 616). In Western European archaeology, the term is used exclusively for painted bowl-shaped vessels of the Gallo-Roman period and should not be applied at all to La Tène pottery, as that leads to chronological errors.

Neckless vessels with a slightly thickened rim and with red and white stripes include, though, not only hemispherical bowls, but also beaker-shaped, vase-shaped, and ovoid vessels. They appear from LT C2 and were apparently produced earlier than bowl-shaped and terrine-shaped forms (e.g. *Guichard et al. 1991*, 217, fig. 6: 3; *Kaenel 1991*, 242–243; *Mennessier-Jouannet – Deberge 2017*, 252–253). The incised wavy line below the rim (as it appears on the vessel from Nižbor) is found in the Stradonice assemblage on bowls (refs. above) as well as on pots, beakers and bottles, or on vessels of an undetermined form (*Břeň 1973*, tab. VI: 1–6; *Venclová – Valentová 2012*, obr. 54: 587291; *Valentová 2013*, 44–45, e.g. tab. 14: 104580; tab. 15: 104584, 104590). A slightly thickened rim and neckless body also characterise the painted '*gedrungene Tonnen*' in the Manching assemblage (*Maier 1970*, 31). This suggests that small fragments of such vessels cannot be labelled unconditionally as globular bowls, which, for that matter, also applies to the painted vessel from Nižbor.

La Tène style pottery painted red and white, mostly in bands, appears in well-dated Western European contexts rarely in LT C1, i.e. in the second half of the 3rd century BC (*Mennessier-Jouannet – Deberge 2017*, 252–253, 267–268), in large numbers in LT C2, i.e. in the first half of the 2nd century BC (*Kaenel 1991*, 242–243; *Loughton 2005*, 156; *Deberge et al. 2007*, 173, 197) and subsequently in LT D. This also applies to Central

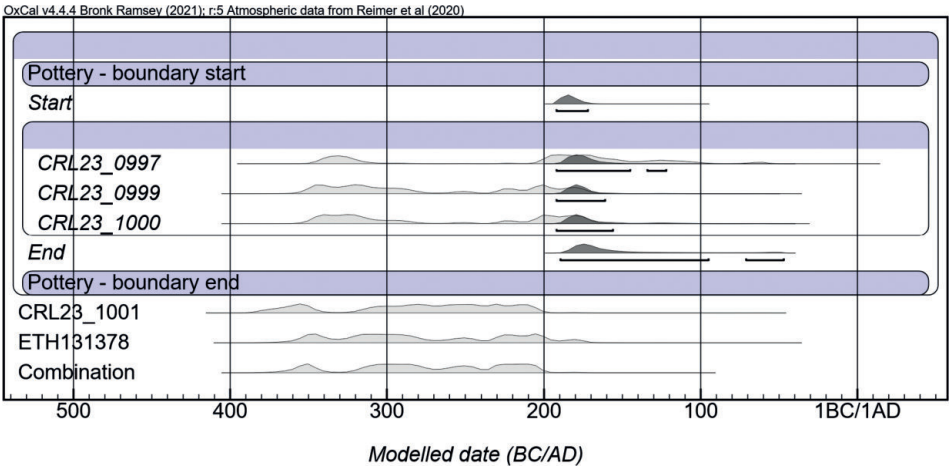

Fig. 9. Nižbor. Model setting and probability distributions for the start and end of the site. Modelled in OxCal v4.4 using the IntCal20 calibration curve (*Bronk Ramsey 2009*; *Reimer et al. 2020*).

Europe, where it is present in settlement assemblages dated to LT C2–D1, e.g. at the Manching oppidum (*Geilenbrügge 1992*, 104–107, 120–121) and other oppida and settlements (*Venclová – Valentová 2012*; *Valentová 2013*), and also to Southeast Europe (*Dragan 2014*). This dating also fits the painted vessel and the entire pottery assemblage from the sunken hut in Nižbor, where the beginning is considered to be in the LT C2 phase, i.e. shortly after 200 BC according to the current assumptions (*Danielisová 2020*, 116, tab. 2; *Wimmer 2022*). In summary, painted neckless vessels previously labelled '*bol Roanne*' were produced in La Tène Europe during the Late La Tène period and can be regarded as predecessors and models for Augustan Age vessels, as was also the case with bottle-shaped and vase-shaped forms. The variant with an incised wavy line below the rim seems to be a local product whose origin can possibly be assumed at the Stradonice oppidum.

Absolute chronology

Human rib and three herbivore bones (*Tab. 3*) excavated in the hut were used for radiocarbon dating. Graphitised samples of bone collagen were measured at the Czech Radiocarbon Laboratory (CRL) using the accelerator mass spectrometer MILEA (*Kučera et al. 2022*). A control measurement of the same human bone sample was performed at the ETH Zurich laboratory (*Tab. 3*). The program OxCal 4.4 along with the IntCal20 calibration curve for terrestrial samples of the Northern Hemisphere were used to determine the age of samples and modelling (*Bronk Ramsey 2009*; *Reimer et al. 2020*).

The very broad resulting intervals (*Fig. 9*, light grey) are a consequence of the plateau on the radiocarbon calibration curve. According to the archaeological analysis, the La Tène pottery found with the sampled bones can be dated to the first half of the 2nd century BC (see above). This refinement significantly narrows the dating intervals of all three animal bones (*Fig. 9*, dark grey; *Tab. 3*) to ca. 190–150 cal BC.

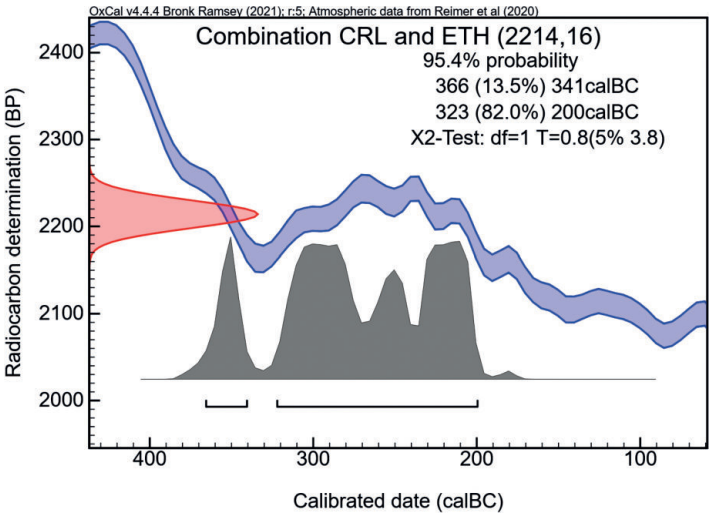

Fig. 10. Nižbor. The combination of radiocarbon measurements from the same human bone obtained at the CRL and ETH Zurich laboratories. Calibrated in OxCal v4.4 using the IntCal20 calibration curve (*Bronk Ramsey 2009*; *Reimer et al. 2020*).

The combination of measurements from the same human bone (*Fig. 10*) obtained in two independent laboratories falls on the very upper limit of the modelled posterior distribution of animal bones; the measurement from ETH Zurich overlaps, but this overlap is not statistically significant. The minimum difference between the radiocarbon dating on the 95% probability level and the lower limit for the pottery chronology (ca. 190 BC without considering uncertainty of the lower limit estimation) is 0 years for the ETH measurement, 10 years for the CRL measurement, and 8 years for the combined measurements. Given the estimated age of the individual (50–60 years), regeneration of bone collagen was already very slow (*Ubelaker et al. 2015*; *Handlos et al. 2018*) and thus the collagen may have appeared to be approximately 25 or more years older than the death of the individual. The overlap in the dating of the individual and the pottery is possible.

Because the site is located on the banks of the Berounka River, freshwater sources might form a significant portion of the inhabitants' diet. Therefore, the freshwater reservoir effect (FRE; *Bíšková et al. 2023*, 48–49) must be considered when dating human bones. FRE causes a decrease in ^{14}C activity and leads to an apparent increase in sample age, e.g. due to an admixture of fossil carbon originating from carbonates dissolved in the water. Fossil carbon is assimilated by aquatic organisms and further transferred within the food chain (*Olsen et al. 2010*; *Philippsen 2013*). The local influence of the FRE for archaeological samples can be calculated as the difference of ^{14}C activities of the remains of herbivores with samples of fauna that (also within the food chain) could incorporate fossil carbonates into their tissues (*Svyatko et al.* 2022; *Bíšková et al. 2023*, 48). The difference, so-called freshwater reservoir offset (FRO), between the herbivores and combined human radiocarbon dates was $\Delta FRO = 65 \pm 26$ (CRL-23_0997), $\Delta FRO = 31 \pm 26$ (CRL-23_0999), and $\Delta FRO = 42 \pm 26$ (CRL-23_1000). Assuming only that the sheep/goat (CRL-23_0997) and human died at the same time, the ΔFRO result indicates the presence of FRE, which cannot be validated based on the finding situation. FRE was not proven when comparing the man to the other two herbivores. The results of the stable isotope study of C and N do not imply that the man consumed more freshwater fauna.

Sample	Lab code	Radiocarbon age (BP)	Calibrated age (95% probability)	Modelled posterior interval (95% probability)
bone, *Capra/Ovis, metatarsus dextra*	CRL-23_0997	2149 ± 21	351–57 BC	193–123 BC
bone, *Bos taurus, radius sinistra*	CRL-23_0999	2183 ± 21	359–167 BC	193–162 BC
bone, *Equus caballus, radius dextra*	CRL-23_1000	2172 ± 21	356–124 BC	193–157 BC
bone, *Homo sapiens, costa*	CRL-23_1001	2227 ± 21	380–203 BC	
	ETH-131378	2199 ± 22	361–176 BC	
	Combination	2214 ± 16	366–200 BC	

Tab. 3. Nižbor. Radiocarbon measurements from bones. Calibrated in OxCal 4.4 software using IntCal20 (*Bronk Ramsey 2009*; *Reimer et al. 2020*).

Determination of $\delta^{13}C$ and $\delta^{15}N$ stable isotope ratios (IRMS) from human and three herbivore bones was performed in the CRL laboratory (*Tab. 4*; *Fig. 11*). The isotope values of herbivores from Nižbor (N = 3, $\delta^{13}C$ = -21.03 ± 0.7‰; $\delta^{15}N$ = 5.32 ± 1.4‰; *Tab. 4*) correspond to the fact that the animals were fed C3 plants and are within the variability of faunal isotopic signals from other studies in the Czech Republic (*Le Huray – Schutkowski 2005*; *Drtikolová Kaupová 2023*). The $\delta^{13}C$ values of the human individual do not indicate increased consumption of meat or freshwater food ($\delta^{13}C$ = -18.37‰; $\delta^{15}N$ = 8.52‰). The average difference between the values of the human and the fauna group was 2.7‰ for $\Delta^{13}C$ and 3.2‰ for $\Delta^{15}N$.

Sample	Lab code	δ13C	δ15 N	%C	%N	C/N
bone, *Capra/Ovis*	CRL-23_0997	-20.61	4.45	38.42%	15.07%	2.97
bone, *Bos taurus*	CRL-23_0999	-20.43	7.4	38.28%	15.32%	2.92
bone, *Equus caballus*	CRL-23_1000	-22.04	4.11	36.69%	13.90%	3.08
bone, *Homo sapiens*	CRL-23_1001	-18.37	8.52	37.91%	14.23%	3.11

Tab. 4. Nižbor. Results of measuring contents of stable isotopes C and N.

Published data from the La Tène sites of Kutná Hora–Karlov and Radovesice were used for the comparison of $\delta^{13}C/\delta^{15}N$ values (*Le Huray – Schutkowski 2005*). The man from Nižbor belongs to the more poorly nourished segment of the population, his values are even among the lowest of the entire comparative group (N = 88; *Fig. 11*).

Settlement activities at the site

The only feature found is a rectangular sunken hut with a posthole in the middle of the shorter wall, or on the longer axis of the feature. This is a common type of settlement feature occurring frequently at LT B–D settlements (*Venclová et al. 2013*, 49–52, with refs.). According to the vessel sherds in the fill, activities related to the preparation, consumption

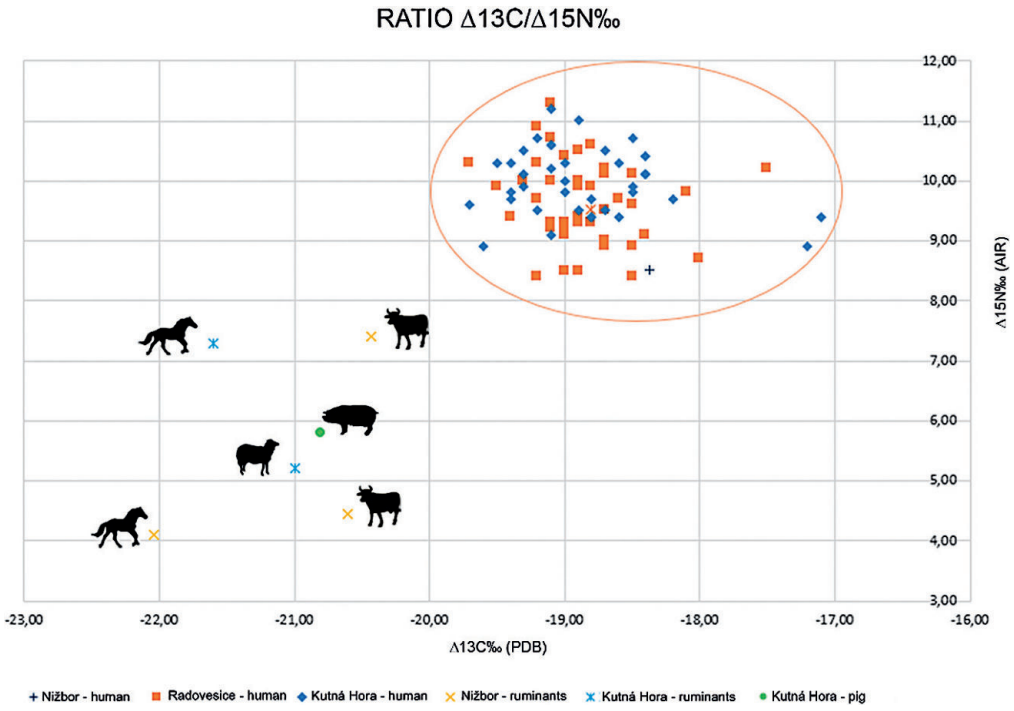

Fig. 11. Comparison of isotope values of C and N in humans and fauna from Nižbor and other La Tène sites in the Czech Republic (after *Le Huray – Schutkowski 2005*).

and storage of food (kitchen, table and storage pottery) occurred in the local settlement area. Another activity is the production of textiles, or spinning, as shown by a spindle whorl made from a potsherd. Animal bones can be considered the remains of meat consumption, but also of other activities (bone and skin processing). They suggest the cattle, pig, and sheep/goat husbandry occasionally accompanied by hunting (red deer). Horses, as well as other documented domesticates, are regularly present in the given period. Bone finds did not suggest anything other than a normal diet. As the feature fill was not subjected to flotation, botanical macroremains as primary evidence of crop cultivation were not identified. Cambisols with low production potential (with only 20 of 100 points on the productivity scale; *BPEJ Catalogue*) occur in the vicinity of the site.

Striking at first glance is the location of the sunken hut on the bank of the Berounka River opposite Hradiště Hill, i.e. across the river from the Stradonice oppidum, with both sites being in view of the other. The distance of the hut from today's river bank is ca. 50 m, from gate C in the northern rampart of the oppidum ca. 350 m, and 970 m from the highest point of the oppidum (elevation 380 m above sea level). Unfortunately, the Nižbor sunken hut is the only feature known from the site and no other La Tène finds were recorded there. We do not know if the sunken hut was a single, isolated feature (with a specific function?) or if it was part of a settlement. The dating of the finds documents the contemporaneity of the Nižbor feature with the early phase of occupation at the oppidum, which occurred during LT C2 (*Rybová – Drda 1994*; *Danielisová 2020*).

Deposition of human skeletal remains

A completely different, non-profane type of activity at the site is undoubtedly demonstrated by the parts of the human skeleton in the Nižbor sunken hut. The bones were found at the bottom of the sunken hut, with single bones in the lower part of the fill, in two accumulations. One of them was a non-random cluster of long bones and ribs (*Fig. 5*), which indicates the intentional deposition of (selected) dry bones. As the bones were heavily disturbed, or partially destroyed by the digging of the gas trench, it is impossible to determine with certainty whether the bones of an older man without signs of violence reached the hut in their entirety or whether only part of the skeleton was deposited.

Finds of human bones are not unusual in La Tène settlement context. A great deal was learned from the results of the processing of large assemblages of human skeletal remains from the Manching oppidum (*Lange 1983*; *Hahn 1992*; *2013*). The bone composition at this site corresponds to the average population. Any injuries that were found reflected duelling rather than war battle, and no evidence of cannibalism was identified. The quantity of individual bones and their fragments in the fill of the features was interpreted as a consequence of excarnation: the dead were kept outside the oppidum and only after a period of time some bones were brought back and deposited in pits, huts or ditches. Skulls could have been buried elsewhere. This manner of handling the dead was interpreted by the authors as a multistage or secondary burial following excarnation.

The phenomenon of excarnation and multistage burial has been studied by a wide range of authors. The exposure of the deceased is thought to have taken place outside the settlement, where the bodies were left until they were reduced to dry bones, i.e. months or even years. This process need not have left any traces if the bodies were set outside on scaffolding or, on the other hand, in sheds or other covered spaces, while evidence is provided of deposition in pits (*Carr – Knüsel 1997*; *Jud 2008*, 155). An example of the latter alternative is the remains of two bodies deposited in a circular pit together with an animal skeleton and dozens of intentionally broken vessels in Nové Dvory in Bohemia (*Šumberová – Valentová 2011*). The long exposure of the bodies before subsequent cremation, followed by burial in graves, is assumed according to the situation in the Late La Tène cemetery of Lamadelaine in Luxembourg (*Metzler-Zens – Méniel 1999*, 405–409).

Finds of human bones at settlements are mostly regarded as the final phase of multistage burial, when the bones of ancestors were incorporated into profane life. Today, this interpretation is broadly accepted by researchers (*Carr – Knüsel 1997*; *Veit 2016*), who acknowledge that with the deposition of human bones at settlements, it is inappropriate to talk about extraordinary or special behaviour (*Trebsche 2013*), because this is essentially a common and proper burial rite, or a ritual norm of the late phase of the La Tène culture, the beginnings of which can already be found in the LT A phase.

Human remains in the settlement context can be divided into several groups – complete skeletons, incomplete skeletons, skulls or their parts, pelvic bones, scattered bones (single or in groups), and multiple skeletons. The skeletal remains of small children found at settlements are a separate phenomenon (*Waldhauser 2010*; *Fitzpatrick 2011*; *Trebsche 2020*, 424–438). As for adults, both parts of skeletons and whole skeletons of probably only selected people, e.g. members of the elite (*Jud 2008*, 157), or, on the contrary, foreigners, enemies or excluded persons, could be brought to the settlement (*Fitzpatrick 2011*, with refs). A close relationship between the deceased and the residents of the houses near

which their bones were deposited is not ruled out (*Jud 2008*, 158). It is thought that the bones or parts of the skeletons missing from the settlements could have been scattered on the fields as fertiliser, or as part of the cult of harvest and regeneration of life (*Carr – Knüsel 1997*; *Kaliff – Oestigaard 2004*, 99). Other interpretations – a reflection of war (conflict) events, building sacrifices, anthropophagy, etc. are certainly possible in some cases, but are neither convincing nor clearly documented (*Venclová et al. 2013*, 97–98; *Salač 2014*, 441–442).

Burials in settlement contexts are known in Czech prehistory from the Neolithic (*Rulf 1996*). Human remains from the La Tène period have been found at settlements of all types (*Salač 2014*, 441, with refs.), often in LT A. They can be deposited in storage pits, on the grates of pottery kilns or in cisterns and other features (*Rousseau 2011*; *Trebsche 2013*, 392–400; *2016*; *2020*, 424–434; *Egri – Rustoiu 2016*). In the later part of the La Tène period, from LT B, they occur in unenclosed settlement agglomerations as well as at ordinary settlements, as examples from Bohemia and Europe show (*Waldhauser 1993*, 307–315; *Čižmář 2000*; *O'Brien 2014*; *Holodňák 2015*). A detailed study of human bones at the Late La Tène settlement of Basel-Gasfabrik (*Jud 2008*) made it possible to distinguish primary deposition (intentional burial of skulls or large parts of skeletons) and secondary deposition (in the upper layers of fills). Numerous human bones come from oppida (Bohemia and Moravia: e.g. *Čižmář 1989*, 106–107; *Drda – Rybová 1997*; Manching in Bavaria: *Wendling 2019*, with refs.) and other hillforts (e.g. Danebury in Britain: *Fitzpatrick 2011*, with refs.; *O'Brien 2014*).

A special case is the deposition of human remains in ritual areas located in a settlement context. They are square enclosures surrounded by a ditch similar to grave enclosures at cemeteries (from which they are probably derived; see *Trebsche 2020*, 442, 463; *Mangel et al. 2023*), but located within La Tène settlements. They occur mainly in Central Europe from LT B1 to LT C1 (*Čižmář et al., forthcoming*). The enclosures could but need not contain graves; human bones might be deposited in ditches or sacrificial pits. An example is the settlement agglomeration of Roseldorf in Lower Austria, which provided three areas (*Kultbezirke*) with a total of seven quadrangular enclosures. Of these, at least five contained human bones usually accompanied by intentionally damaged weapons, selected animal bones, and other extraordinary finds (*Holzer 2019*; *Trebsche 2020*, 442–450). Other features of this type have been recently identified in Němčice in Moravia, where at least five quadrangular ditch enclosures were found. Investigated enclosure 525 contained two cremation graves and skull fragments, and other human bones were found in its ditch along with fragments of weapons and animal bones (*Čižmář et al., forthcoming*).

Human remains are relatively rare in sunken huts. In addition to the Nižbor find, these include a complete male skeleton in Hut 74 from LT C1 in Bratislava–Devín. It is interpreted as a manifestation of a ritual act – a burial in a hut after the end of its use (*Styk – Repka 2021*). Another example is the skeleton of an old female in Hut 816 in Prellenkirchen in Lower Austria from LT C1–D1 (*Trebsche 2020*, 430). Examples from Western Europe include Late La Tène sunken huts in Basel-Gasfabrik, Switzerland (*Jud 2008*, 152), or in Montmartin, France (*Rousseau 2011*, 123).

The find situation in Nižbor can probably be interpreted as the deposition of a skeleton or its parts in a sunken hut that was no longer used and probably more or less empty. The fact that the sunken hut was cleaned out could be reflected in the small number of

finds in the feature. It is unclear if the two determined accumulations of several bones are original (intentional) or are the result of the recent damage of the sunken hut and its fill. It is likely that the bones were covered with at least a thin layer of soil (the bones were deposited not only on the bottom, but were also occasionally found in the lower part of the fill), because they do not show signs of chewing or degradation.

According to present research, human bones in the settlements are the result of post-mortem manipulation with the remains as part of the last stage of multistage burial; the corpses were previously temporarily kept outside the settlement for several months or years, though where such a place was in the case of the Nižbor skeleton, we can only guess. Given the relatively good preservation of the bones, it must have been a covered space rather than an exposed one.

The ford and its use

Directly across the river, opposite the Nižbor hut, is the mouth of the Habrový (or Habrovský, Otročínský) Stream, the valley of which lines the northwest and west side of the oppidum. According to A. Rybová and P. Drda, a road ran from this valley to gate C situated in the northwest corner of the oppidum fortification (*Fig. 1*), and could have then continued across the ford on the Berounka River. This interpretation is supported by a map printed in 1840 (*Rybová – Drda 1994*, 16, Fig. 5, Note 6). The valley of Habrový Stream leads to today's bridge and, on the opposite bank of the Berounka River, the current road running to the north and northeast.

The course of the assumed path connecting the Nižbor site with the Stradonice oppidum assumes the existence of a ford over the Berounka, which provides quite good conditions for crossing, at least in some parts of the year: it is a small river in the summer, and in rivers of this size it is often difficult to cross only the main river channel, which is about 5 m wide. The disadvantage of fords is that they are viable only when the water level is low; hence, the existence of seasonal ferries cannot be ruled out (*Bolina – Klimek – Cílek 2018*, 63–70, 217–220). According to the 1907 French army manual, the appropriate water depth for river crossings for infantry is 1 m, for cavalry accompanied by horse-drawn wagons (which were allowed to get wet) 1.3 m, for other wagons and artillery 0.7 m (cited after *Dumont 2011*, 49). While it can be assumed that the conditions were somewhat different in the Late La Tène period due to smaller horse size, modern data at least serves as a basis for considerations about the characteristics of fords in general.

The probability of the existence of a ford between the mouth of the Habrový Stream (and the Stradonice oppidum) and Nižbor is supported by the geomorphology and geology of the Berounka valley in the area. The valley of the Habrový Stream was formed by the erosion of loose rocks at the fault between the valley of the Habrový Stream and the valley of the Žlubinecký Stream on the opposite bank of the Berounka River. The fault is mapped in the Blovice lithostratigraphic unit composed of greywacke, siltstone and slate. According to the geological map, the northern part of the Blovice lithostratigraphic unit is less resistant to erosion than its more southern part located beneath the Habrový Stream. The resistant positions of the bedrock normally reduce the depth erosion of the Berounka River, and this created more favourable conditions for a wider riverbed and a shallow flow. Today, the river is regulated and the water level is raised by a weir located 100 m below

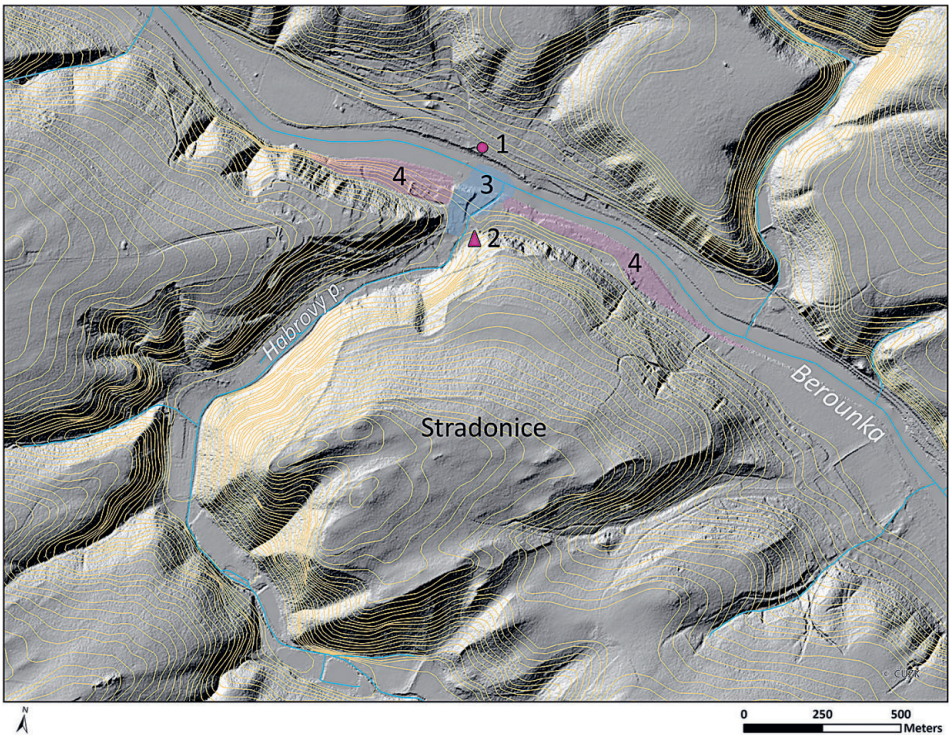

Fig. 12. Digital Terrain Model of the Czech Republic (DMR 5G) showing Stradonice oppidum and position of the hut at Nižbor. 1 – hut; 2 – gate C of Stradonice oppidum (after *Rybová – Drda 1994*); 3 – alluvial fan of Habrový Stream; 4 – alluvial sediments of Berounka River (contents J. Šebesta, graphics Č. Čišecký).

the current mouth of the Habrový stream which is here at the altitude of ca. 223–224 m. The original riverbed can be considered 2–3 m lower, i.e. around 221 m above sea level. The stream at the mouth creates an alluvial fan, which is subsequently flooded by the stronger flow of the Berounka and creates a 100- to 140-m-wide floodplain (i.e. accumulation of eroded sediments) on the right bank. The floodplain is also formed above the alluvial fan, which means that the flow of the Berounka River does not have sufficient erosion power to carry away the entire alluvial fan, but only floods it. Simultaneously, this process creates a partial damming of the river causing the deposition of sediments in the form of a floodplain before its accumulation.

The Digital Terrain Model of the Czech Republic (DMR 5G) makes it possible to follow the original bed of the Habrový Stream), which is now abandoned (*Fig. 12*). Currently, the new straight channel runs somewhat further south and is clearly of anthropogenic origin. As older maps of the 1st and 2nd Military Survey (e.g. Sheet 123 of the 1st Josephine Military Survey; *Fig. 13*) show, there was a small island in the Berounka River right at the head of the lower edge of the flooded alluvial fan, across which the path of a possible ford is marked. It can be assumed that the current Habrový Stream bed was created when the path to the ford drew off the original bed and changed its flow towards the southeast.

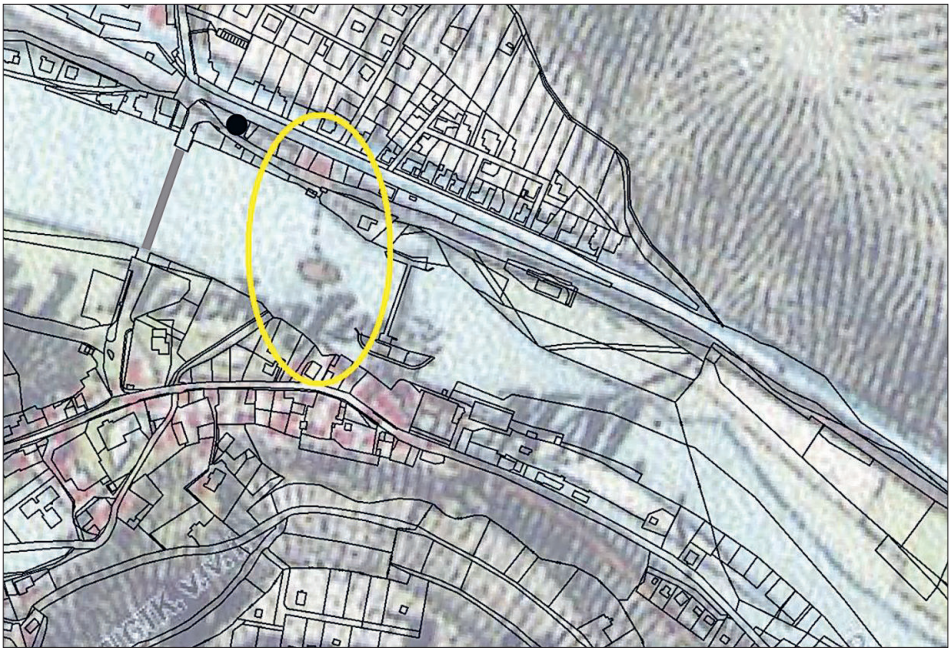

Fig. 13. Nižbor. Position of ford that uses residuum of the alluvial fan of Habrový Stream on map from 2nd Military Mapping in 1836–1852. Black point – the Nižbor site (drawing J. Elznicová).

Road network

According to the historical reconstruction of medieval and modern roads in the western part of Central Bohemia (*Bolina et al. 2018*, 359, 362, obr. 5.1.2.11), the watershed of the Loděnice Stream and the left-bank tributaries of the Berounka River (Hýskovský, Žlubinecký and Vůznice streams) in the northern direction was used. However, the precise routes are not documented but it can be assumed that from the Stradonice oppidum and in the immediate vicinity of the Nižbor hut, advantageous routes could have run to the north even in the La Tène period. They could head, among others, for Mšecké Žehrovice (LT C2–D1 homestead contemporaneous with the Stradonice oppidum and the feature in Nižbor; *Venclová 1998*) and further towards northwest Bohemia with many documented settlements from this period.

These assumptions must be placed in the context of the settlement network in the La Tène period. The immediate contemporary neighbour of the Nižbor site, just across the river, was the Stradonice oppidum. Located a bit further to the southeast of Nižbor, above the left bank of the Berounka River, was the promontory hillfort at Žlubinec (a doubtful La Tène dating; *Křivánek 2011*). The La Tène, and also pre-La Tène settlement of the region was only sporadic.

To reconstruct the position of the studied site in the LT B–LT D period in a broader sense, the settlement pattern should be considered within the Křivoklát Protected Landscape Area and its surroundings (principally Beroun, Kladno, Praha-západ and Rakovník districts in Central Bohemia). An overview of La Tène sites was recently presented

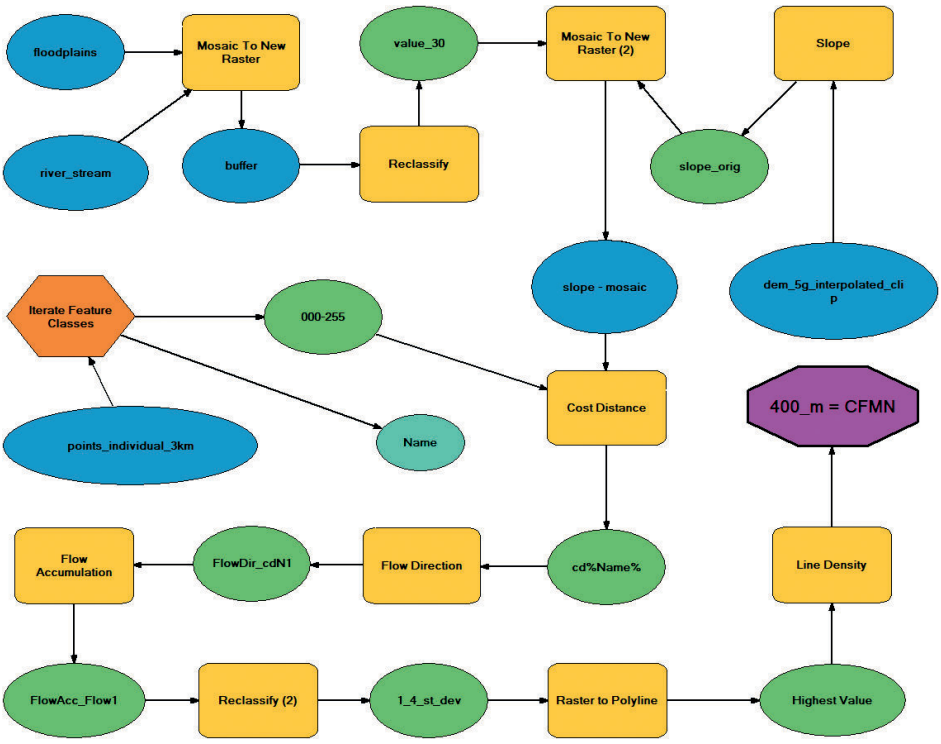

Fig. 14. Model Builder (ArcGIS 10.8.1) syntax of the Cumulative Focal Mobility Network (CFMN) analysis.

(*Dreslerová et al. 2022*) based on current archaeological records (*AMCR database*). Hence, in a 50 km radius around Nižbor, 344 positive confirmations of human activity can be found between LT B and LT D. For the needs of this study, the site location was refined by merging the immediately neighbouring ones into clusters, which are further treated as one site with positive confirmation of occupation in LT B–LT D. A total of 149 sites were thus studied in relation to Nižbor.

The following questions were asked: Was the Nižbor settlement easily accessible from sites other than its immediate neighbours and, if so, from which ones? Was it located at a convenient fording point? Which areas beyond the immediate riverine valley could have been linked with one another through Nižbor with ease?

Knowing the principal distribution of settlements in the LT B–D period, the spatial interpretation of Nižbor's position can be studied in terms of landscape connectivity using the Cumulative Focal Mobility Network (CFMN) analysis, which has been developed for more than a decade. This method calculates directional-less movement in the artificial environment from a multitude of source points (grid of 256 equally spaced points in a 50 km radius around Nižbor) by means of the interpretation of slope model using hydrological tools (*Fábrega-Álvarez 2006*; *Murrieta-Flores 2012*). The resulting x-number of models, representing the most convenient paths to the selection of points, are then merged and analysed with the Density tool to find the highest number of overlaps (for the syntax, see *Fig. 14*). In practice, these are the corridors for the most convenient movement throughout

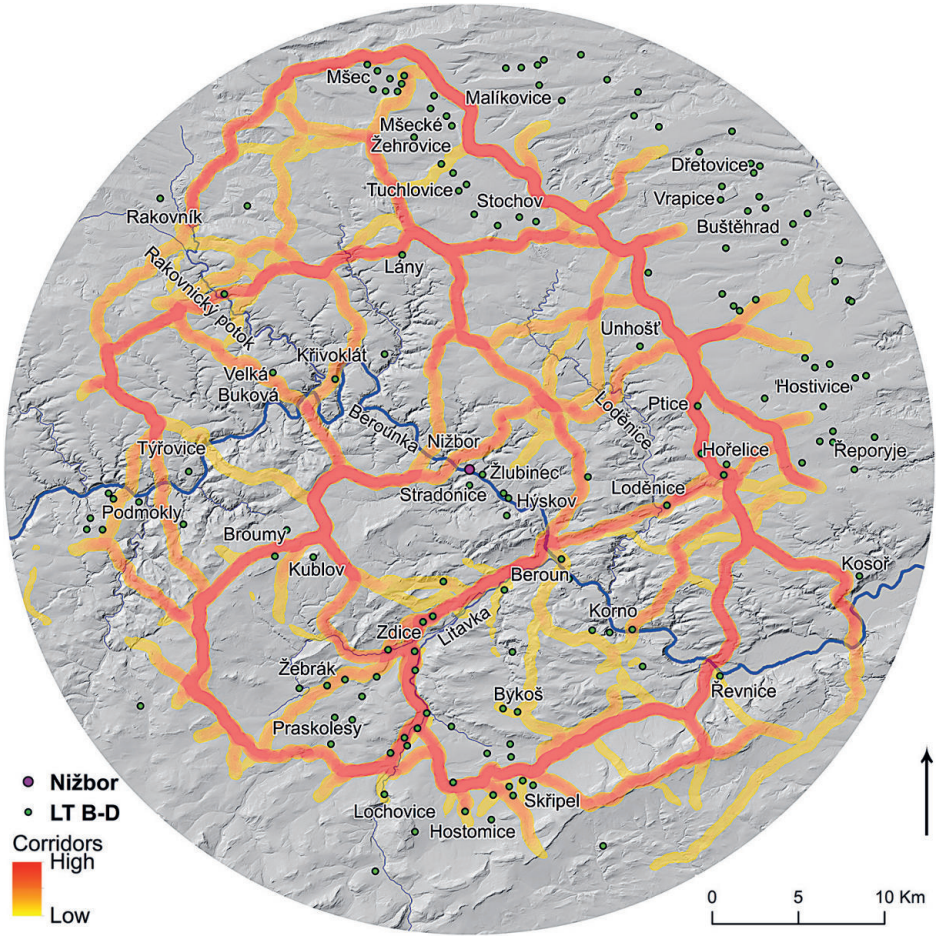

Fig. 15. CFMN analysis results with Nižbor site in middle representating the most convenient movement corridors in the study area. The warmer the colour, the greater the amount of overlaps of calculated paths.

the landscape (*Bellavia 2001*; *Verhagen 2010*; *Déderix 2016*). In other words, the analysis can be described as an ideal model of connectivity and accessibility of various locations in the terrain and of optimal pathways – natural corridors of movement – leading across the entire landscape (*Verhagen et al. 2013*; *Stančo – Pažout 2020*).

The 5th generation Digital Terrain Model of the Czech Republic (DMR 5G) was used for the analysis. It was reclassified to an 8 m cell size and cleared of modern infrastructure developments (*Novák et al. 2022*). It was combined with the Model of Potential Floodplains in the Czech Republic (*Novák 2017*), which served as a further buffer for the movement. All analyses were calculated in ArcMap 10.8 software (see *Online Supplementary Material 2* for details).

According to the results, Nižbor was highly accessible from the concentration of settlements around Mšec, Mšecké Žehrovice, Tuchlovice and Stochov in the north (*Fig. 15*). A potential connection was also good with the cluster of settlements located near Unhošť,

Hostouň and Buštěhrad to the northeast. Nižbor's river crossing was on a convenient path when travelling from the area of these sites to the west, where LT B–D sites like Broumy and Kublov are known. From there, a convenient connection was available to Podmokly, Hradiště nad Berounkou, Čilá, and Skryje sites. Getting there was far easier using the Nižbor river crossing than following the Berounka valley, and the same can be said about the connection to the LT B–D settlements at Křivoklát and Velká Buková.

However, the greatest concentration of sites in the studied area was defined by the polygon created by today's villages of Žebrák, Osov and Zdice. No convenient path to connect these with Nižbor appeared in our analysis; they are separated from Stradonice and its environs by terrain difficult to cross even today. Instead, these sites apparently formed a part of a cluster of La Tène sites around the Litavka Stream, the left bank of which served as a corridor to the northeast river crossing at Beroun. Beyond that, the calculated nexus can be followed further to Loděnice, Hořelice, Třebonice, Rudná, and Hostivice on the outskirts of today's Prague (roughly following the modern routes no. 200 and E 50).

From a spatial perspective, the location of the Nižbor settlement can be clearly perceived as linked to the Stradonice oppidum. This suggests that fording took place somewhere near Nižbor and this was further confirmed by CFMN analysis. Like the oppidum itself, Nižbor was located on the convenient path connecting principal La Tène sites northwards and westwards. A settlement should not be a surprise there, as the site itself formed an important crossroads between calculated pathways and a potential route via the Berounka River itself. However, the main communication hub and also an area with the greatest density of archaeological sites belonging to the LT B–D period in the studied region, bypassed Nižbor some 8 km southwards, crossing the Berounka River on the outskirts of the present city of Beroun. Other river crossings of similar importance can be defined further downstream near Řevnice and Kosoř.

Conclusion

If we adopt the model of the economic hinterland of oppida as a sphere with a radius of 5 km, or a distance of a one-hour walk (*Venclová – Danielisová 2020*, with refs.), then the Nižbor site was undoubtedly part of the Stradonice hinterland. The sunken hut on the bank of the Berounka River and its assemblage of finds document common settlement activities at the site. The human skeletal remains deposited in the abandoned or cleared hut are an exception.

Based on the absence of earlier finds to which it could be connected, the building of the sunken hut on the bank of the Berounka River opposite the Stradonice oppidum was probably related to the beginning of the oppidum, i.e. to the first half of the 2nd century BC, or in 190–150 BC. The hut could have been part of a site (but also an isolated feature) functioning as a guard post at the ford (ferry?) and road. Remains of a man, which were found in the hut, testify to the physical work of the individual with an otherwise average to subaverage diet. It would be tempting to see him as ford guard or ferryman, although it is beyond verification. We can regard the assumed ford across the Berounka as a link in the road connecting the Stradonice oppidum with the northern parts of Bohemia. A reconstruction of the roads shows, though, that the main Late La Tène routes probably avoided the Stradonice oppidum.

The Nižbor hut could also be interpreted as an 'excluded' place outside the walls of the oppidum. The man, whose bones were deposited here, might hold a specific position in the La Tène community, either in a positive or negative sense. However, the reconstructed settlement activities at the site, including a common diet documented by isotope analysis, do not testify to the unusual life of the local resident(s).

The discovery of the sunken hut in Nižbor containing human remains is a welcome source for the study of burial rite in the Late La Tène period after the end of incarnation at cemeteries. Human bones in La Tène settlement contexts demand appropriate attention. As recent more detailed research suggests, this is a relatively common but not very well understood phenomenon. At the same time, it was again demonstrated (cf. *Dreslerová et al. 2023*) that even for seemingly well typologically dated La Tène samples, it makes sense to use radiocarbon dating, despite the fact that a large part of this period is blurred by the so-called 'small La Tène plateau'.

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NATALIE VENCLOVÁ, Institute of Archaeology of the CAS, Prague, Letenská 4, CZ-118 00 Praha 1, Czech Republic; venclova@arup.cas.cz

DAGMAR DRESLEROVÁ, Institute of Archaeology of the CAS, Prague, Letenská 4, CZ-118 00 Praha 1, Czech Republic; dreslerova@arup.cas.cz

RENÉ KYSELÝ, Institute of Archaeology of the CAS, Prague, Letenská 4, CZ-118 00 Praha 1, Czech Republic kysely@arup.cas.cz

MICHAL DYČKA, Institute of Archaeology of the CAS, Prague, Letenská 4, CZ-118 00 Praha 1, Czech Republic dycka@arup.cas.cz

JIŘÍ ŠEBESTA, Czech Geological Survey, Klárov 3, CZ-118 21 Praha 1, Czech Republic; sese@seznam.cz

KATEŘINA PACHNEROVÁ BRABCOVÁ, Nuclear Physics Institute of the CAS, Husinec-Řež 130, CZ-250 68 Řež, Czech Republic; brabcova@ujf.cas.cz

JARMILA BÍŠKOVÁ, Nuclear Physics Institute of the CAS, Husinec-Řež 130, CZ-250 68 Řež, Czech Republic; Department of Archaeology and Museology, Faculty of Arts, Masaryk University, Arna Nováka 1, CZ-602 00 Brno, Czech Republic; jarmila.nedbalova@gmail.com

VÁCLAV MATOUŠEK, Contemporary European Cultural History, Faculty of Humanities, Charles University, Pátkova 2137/5, CZ-182 00 Praha 8, Czech Republic; vaclav.matousek@fhs.cuni.cz

RESEARCH ARTICLE – VÝZKUMNÝ ČLÁNEK

Cementochronologie v archeozoologii: Přiblížení věku a sezóny lovu zvěře z raně středověkého hradiště Na Jánu v Netolicích prostřednictvím analýzy zubního cementu

Cementochronology in archaeozoology: Exploring the age and hunting season of game from the early medieval hillfort Na Jánu in Netolice through dental cementum analysis

Kateřina Pořádková – Lenka Kovačiková

Cementochronologie zaměřená na analýzu přírůstků acelulárního cementu v zubech lovených savců dovoluje relativně přesně zhodnotit jejich stáří a stanovit období v roce, kdy byli uloveni. Obě informace mohou přiblížit využívání přírodních zdrojů živočišného původu a načasování jejich dostupnosti nebo dovolují pochopit sezónní dynamiku aktivit tehdejších společností spojených s konkrétními místy. Studie nejprve představuje výsledky ověření metody cementochronologie na referenčním materiálu, tj. na zubech recentních jelenů lesních (*Cervus elaphus*)*, srnců obecných* (*Capreolus capreolus*) *a prasat divokých* (*Sus scrofa*)*, kteří dlouhodobě patří mezi nejčastěji lovenou zvěř ve střední Evropě. Následně přináší výsledky aplikace metody na vybrané nálezy týchž druhů zvířat z raně středověkého hradiště Na Jánu v jihočeských Netolicích.*

cementochronologie – zubní cement – zvířata – sezonalita – lov – archeozoologie

Cementochronology, which is focused on the analysis of acellular cement growths in the teeth of hunted mammals, allows assessing their age and determining the period in the year when they were caught relatively accurately. Both information can approximate the use of natural resources of animal origin and the timing of their availability or allow us to understand the seasonal dynamics of the activities of the past societies associated with specific places. The study first presents the results of verification of cementochronology on reference material, i.e., the teeth of recent red deer (*Cervus elaphus*)*, roe deer* (*Capreolus capreolus*)*, and wild boar* (*Sus scrofa*)*, which belong among the most common hunted game in Central Europe over a long period. Subsequently, the study brings results of the method being applied to selected finds of the same animal species from the early medieval hillfort Na Jánu in Netolice, located in South Bohemia.*

cementochronology – dental cement – animals – seasonality – hunting – archaeozoology

Úvod

Studium známek růstu na zubech dovoluje stanovit věk a přiblížit životní historii daného jedince (*Mitchell 1963*; *1967*; *Klevezal 1996*; *Azorit et al. 2002*). Stanovením věku volně žijících savců v době jejich smrti a období v roce, kdy k ní došlo, se zabývá cementochronologie (*Tooth Cementum Annulations* – TCA; např. *Naji et al. 2015*; *2016*). Ta spadá do širší rodiny skeletochronologických či sklerochronologických metod, jež se věnují studiu struktur nebo růstových markerů (*growth marks*) uchovaných v mineralizovaných tkáních obratlovců. Ty vznikají v průběhu života jedinců jako fyziologická odezva na působení

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vnějšího prostředí, např. na změny nutričních vlastností krmiva v různých ročních obdobích, kvalitu a tvrdost potravy, fotoperiodicitu, klimatické podmínky nebo reprodukční aktivitu jedince (*Lieberman 1994*). Příkladem jedné ze studovaných struktur je zubní cement, jehož růst je u savců ovlivněn ročním rytmem. Analýza cementu má potenciál přímého a věrohodného posouzení biologického věku, neboť zubní cement se vytváří nepřetržitě po celý život jedince, zřídkakdy podléhá remodelaci či resorpci a je relativně stabilní vůči postmortálním změnám (*Wittwer-Backofen 2012*; *Naji et al. 2016*). Nejen biologové, ale i další badatelé, kteří se zaměřují na studium divoké fauny, pracují s mikroskopickými růstovými vrstvami cementu zubů uhynulých nebo usmrcených zvířat a data o jejich věku a době ulovení jim poskytují alespoň hrubou představu o demografickém složení populací.

Detailní pozorování a posuzování jednotlivých struktur zubu umožnil rozvoj zobrazovacích technik (*Buikstra 2022*). První snahy o poznání zubního cementu sice spadaly do 17. až 19. století, ale byly zatíženy jeho častými záměnami za kost. Až vývoj mikroskopie a zlepšování histologických postupů vyústily v roce 1830 v první identifikaci nebuněčného a buněčného cementu (včetně cementocytů) a stáli za ní J. E. Purkyně, M. Fränkel a A. A. Retzius (*Foster 2017*). *Magitot* (*1878*) a *Black* (*1887*) ve druhé polovině 19. století poukázali na korelaci mezi tloušťkou cementu a věkem člověka, což následně potvrdili i další autoři (např. *Kronfeld 1938*; *Gottlieb 1943*). Vztah mezi počtem vrstev cementu a stářím jedince byl studován jak na zubech lidí známého věku shromážděných při stomatologických zákrocích (*Stott et al. 1982*), tak na zubech jiných druhů savců, a to bez ohledu na zeměpisnou šířku jejich výskytu, typ dentice (brachyodontní, hypselodontní), potravní strategii (býložravci, masožravci, všežravci) nebo biorytmus (*Naji et al. 2015*; *Buikstra 2022*). Zájem zoologů o růst zubního cementu zesílil ve druhé polovině 20. století a soustředil se na vybrané taxony suchozemských savců, např. losy (*Sergeant – Pimlott 1959*), jeleny (*Mitchell 1963*; *1967*), soby (*McEwan 1963*) nebo na více živočichů současně (*Klevezal – Kleinenberg 1967*). Zvolený přístup se ukázal zvláště vhodný pro odhad věku starších zvířat, kdy nedostačují ostatní metody, např. analýza abraze dentice. Postupem času přibyla data vztahující se k různým skupinám zvířat (*Klevezal 1996*) i množství studií zabývajících se odhalováním zdrojů chyb (*Medill et al. 2009*; *Wittwer-Backofen 2012*). S rostoucími požadavky na rozlišení mikrostruktury cementu se rovněž zvýšily nároky na kvalitu vzorkovacích protokolů i zobrazovacích metod (*Edinborough et al. 2021*).

Cementochronologie spojená s archeologií má kořeny ve druhé polovině 20. století, kdy od 70. let sílil zájem o studium lovecko-sběračských komunit v paleolitu (např. *Spiess 1979*; *Gordon 1988*; *Pike-Tay 1991a*; *Livraghi et al. 2022*). Pro toto období, kdy byl lov klíčový při získávání obživy, existují i dostatečně reprezentativní soubory zvířecích kostí a zubů. S ohledem na dlouhou životnost zubního cementu si někteří badatelé uvědomují, že jeho přírůstky neposkytují pouze údaj o věku kořisti, ale že také přispívají do debaty, v jaké sezóně se ji podařilo získat a v jaké části roku paleolitičtí lovci nahromadili kosti ulovených zvířat na konkrétním místě (*Spiess 1976*; *Stutz 2002a*). Významnou skupinou savců, u nichž je sezonní růst cementu nejlépe zdokumentován, jsou kopytníci (*Burke – Castanet 1995*; *Livraghi et al. 2022*). V posledních letech se zvyšuje zájem o cementochronologickou analýzu osteologického materiálu datovaného do mladších období, než je paleolit (*Greenfield et al. 2015*; *Gourichon – Parmigiani 2016*; *Schmaus et al. 2020*). Kromě načasování osidlování různých míst lze hlouběji nahlížet do života tehdejších lidských komunit ve smyslu organizace lovu, pastvy zvířat, provádění rituálů apod. V tomto tématu, které rezonuje v řadě archeologických studiích (*Rendu 2010*; *Naji et al. 2016*;

Azorit et al. 2022; *Livraghi et al. 2022*), tkví potenciál, zvláště je-li provázáno s dalšími metodickými přístupy, např. analýzou mikroabraze zubů nebo s rozbory věkových profilů rekonstruovaných na základě stavu dentice (*Rendu 2007*).

Cement, jehož důležitou funkcí je ukotvení hlavních kolagenních vláken periodontálních vazů (Sharpeyova vlákna) k povrchu kořene zubu a vedle toho má také funkci adaptivní a reparační, obsahuje 65 % minerální složky (hydroxyapatit), 23 % organické složky (kolagen typu I a III, glykolipidy nebo glykoproteiny) a 12 % vody (*Bosshardt – Selvig 1997*; *Berkovitz et al. 2018*, 197). Pokrývá kořeny zubů a přesahuje na sklovinu v místech, kde na ni doléhá epitel dásně. Kromě skloviny je spojen se zubovinou-dentinem (*Berkovitz et al. 2018*, 195). Poloha cementu mezi dentinem a periodontálními vazy z něj sice činí součást samotného zubu, funkčně ale náleží k jeho závěsnému aparátu (*Bosshardt – Selvig 1997*). Jedná se o nejméně mineralizovanou tvrdou zubní tkáň, která zlepšuje fixaci zubu v kosti zubního alveolu. Mezinárodní klasifikace vymezuje čtyři druhy cementu (*Jones 1981*), které se liší podle přítomnosti či absence cementocytů nebo kolagenních vláken. V cementochronologii mají význam především dva z nich – acelulární cement (bezbuněčný, primární, fibrilární) a celulární cement (buněčný, sekundární). Oba přirůstají postupně a je u nich detekovatelné střídání období pomalejšího a rychlejšího růstu. Obvykle celulární cement překrývá acelulární cement, může však docházet i k opačnému uspořádání. Kromě toho se mohou oba druhy cementu také střídat (*Berkovitz et al. 2018*, 197).

Kořen přiléhající k dentinu pokrývá acelulární cement s vnějšími kolagenními vlákny (*AEFC – Acellular Extrinsic Fibre Cementum*). Tento druh cementu se nachází především v prvních dvou cervikálních třetinách kořene, v jeho apikální třetině může chybět. Veškerý kolagen, jež obsahuje, je odvozen ze Sharpeyových vláken periodontálních vazů (*Berkovitz et al. 2018*, 199). Bezbuněčný cement přibývá kontinuálně s roční periodicitou a během roku se tak v závislosti na rozdílném stupni mineralizace, na orientaci krystalitu nebo kolagenních vláken utvoří přírůstková (inkrementální) linie složená ze světlé a tmavé vrstvy, kterou lze pozorovat pod mikroskopem (*Pike-Tay 1991a*; *Lieberman – Meadow 1992*; *Lieberman 1993*; *Naji et al. 2015*; *2016*). Stupeň zbarvení linií se obvykle nemění, s výjimkou prvního světlého přírůstku, který může dosahovat slabší intenzity (*Burke – Castanet 1995*).

Celulární cement s vnitřními kolagenními vlákny (*CIFC – Cellular Intrinsic Fibre Cementum*), obsahující buňky cementocyty, je soustředěn blíže apikálnímu konci kořene a je charakteristický silnou růstovou vrstvou s dutinami (*Grue – Jensen 1979*; *Foley 1986*). Cementocyty se diferencují z mezenchymových buněk zubního folikulu přilehlých ke kořenovému dentinu (*Klepáček – Mazánek et al. 2001*, 24) a absence Sharpeyových vláken ukazuje, že úlohou buněčného cementu není upevňování zubu (*Berkovitz et al. 2018*, 199). Oproti nebuněčnému cementu se ten buněčný ukládá rychleji a je méně mineralizovaný. Rychle rostoucí cementový přírůstek se zpravidla vyvine během 8–10 měsíců v roce a zbývající část roku je reprezentována pouze slabě. V některých případech může být pomalu rostoucí vrstva cementu klidovou linií, stejně tak jako úzké mineralizované vrstvy v kortikální kosti, což je příznačné pro periodické snížení aktivity osteoblastů (*Beasley 1987*; *Spiess 1990*; *Beasley et al. 1992*).

Složení a tloušťka cementu nejsou konstantní, ale liší se v závislosti na jeho umístění, druhu a věku savce (*Sequeira et al. 1992*). U některých druhů je šířka cementové vrstvy kolem 20 μm, u jiných až několik milimetrů (*Hillson 2005*, 193). Rozdíly v šířce vrstvy cementu u různých druhů savců zdokumentoval již v polovině 19. století *R. Owen*

(*1840–1845*) ve své studii *Odontography*. Silnější vrstvy se objevují u savců, jejichž zuby jsou vystaveny vyššímu mechanickému opotřebení, příkladem jsou sloni, mnozí hlodavci nebo kopytníci, zvláště pak ti, jejichž zuby mají vysoké korunky (*Klevezal – Kleinenberg 1967*, 13–24; *Klevezal 1996*; *Červený et al. 1999*, 250; *Hillson 2005*, 195). Přestože se ukazuje, že opotřebení zubních korunek kopytníků v důsledku konzumace abrazivní potravy může vést k nárůstu objemu kořenů, potažmo mít dopad na utváření cementu, ve snaze objasnit tento mechanismus, např. ve vztahu k nepřežvýkavým kopytníkům, zůstává nadále mnoho nejasného (*Pérez – Barbería et al. 2020*; *Ackermans et al. 2021*).

K ukládání cementu dochází nejen v průběhu vývoje samotného zubu, ale po celý život jedince. Opotřebovaný nebo odumřelý cement na kořeni zubu zůstává, nevstřebává se a postupně se na něm vrství další vitální tkáň (*Stutz 2002a*; *Rendu 2010*; *Yamamoto et al. 2016*). O původu, diferenciaci a dynamice buněk tvořících cement zatím neexistuje příliš mnoho informací (*Berkovitz et al. 2018*, 197). Je ale známo, že tvorba zubního cementu – cementogeneze, je ovlivněna různorodou aktivitou cementoblastů a dostupností organických a anorganických látek. Růst cementu podmiňují jak faktory endogenní, např. genetika, tak exogenní, např. podmínky prostředí jako je nadmořská výška, vlhkost, teplota (*Lieberman 1994*; *Wittwer-Backofen et al. 2004*). Na průběh cementogeneze do určité míry působí také fyziologické a biomechanické procesy související s potravním chováním savců, jež mohou zapříčinit změny ve struktuře cementu a růstu linií. Experimentální studie *D. E. Liebermana* (*1993*; *1994*) zaměřené na zubní cement u koz domácích prokázaly změny v koncentraci minerálů a orientaci vláken kolagenu při podávání rozdílného krmiva. Nejsilnější vrstvy, které se ukládají rychleji, jsou nazývány růstovými zónami – *growth zones* (GZ). Oproti tomu, nejužší a hypermineralizované vrstvy cementu jsou označovány jako *annuli* nebo zimní pruhy – *winter bands* (*Lieberman – Meadow 1992*; *Stutz 2002a*). Počet přírůstků vyjadřuje individuální věk, kdy růstová zóna (GZ) a *annulus* odpovídají jednomu roku. Charakter nejvzdálenější vrstvy, která má spojitost s obdobím smrti, dovoluje provést odhad sezóny, kdy nastala (*Naji et al. 2015*). Zubní cement přirůstá nejrychleji během tzv. vegetačního období, které zahrnuje měsíce květen až říjen, kdy je nabídka potravy nejširší (*Burke – Castanet 1995*). Pomalejší růst cementu je spojen s tzv. vegetačním klidem a se zúžením potravní nabídky. V ideálním případě jsou linie cementu dobře viditelné. Setkat se lze ale i s některými odchylkami, např. s nahloučením více zimních vrstev dohromady, s jejich nevýrazností (*Matson 1981*) nebo nepravidelnostmi, které vznikají při opravných apozičních procesech, často v apikální oblasti kořene zubu (*Grue – Jensen 1979*).

Problémy s validací provází cementochronologii už od konce 60. let 20. století, přičemž mezi nejčastěji zmiňované patří absence informací o úmrtním věku zvířat, která byla vytipována jako referenční. Proto na různých pracovištích začala postupně přibývat srovnávací data, což mělo pozitivní dopad na standardizaci metody (*Buikstra 2022*). Drtivá většina studií obsahujících výsledky analýzy cementových přírůstkových linií v kořenech zubů zvířat je zahraniční provenience a příspěvky spojené s faunou na území České republiky jsou prozatím vzácné (např. *Nývltová-Fišáková 2007*; *Schindlerová – Přichystal – Kyselý* 2022; *Kapustka et al. 2023*).

Cílem této studie je představit možnosti využití metody cementochronologie ve vztahu k archeozoologickým nálezům a s pomocí vlastního šetření posoudit, zda jsou přírůstky acelulárního cementu na zubech recentních savců dostatečně viditelné, aby bylo možné s jejich pomocí určit věk a období smrti (ulovení) zvířat, a následně uplatnit stejný

pracovní postup na zuby některých volně žijících savců doložených v archeologickém záznamu z období raného středověku.

Materiál a metody

Experimentální část studie provedla první autorka tohoto příspěvku v Laboratoři archeobotaniky a paleoekologie (LAPE) na Jihočeské univerzitě v Českých Budějovicích v roce 2017 v rámci své diplomové práce (*Pořádková 2017*). Nejprve byla metoda vyzkoušena na recentním osteologickém materiálu a poté aplikována na archeozoologické nálezy.

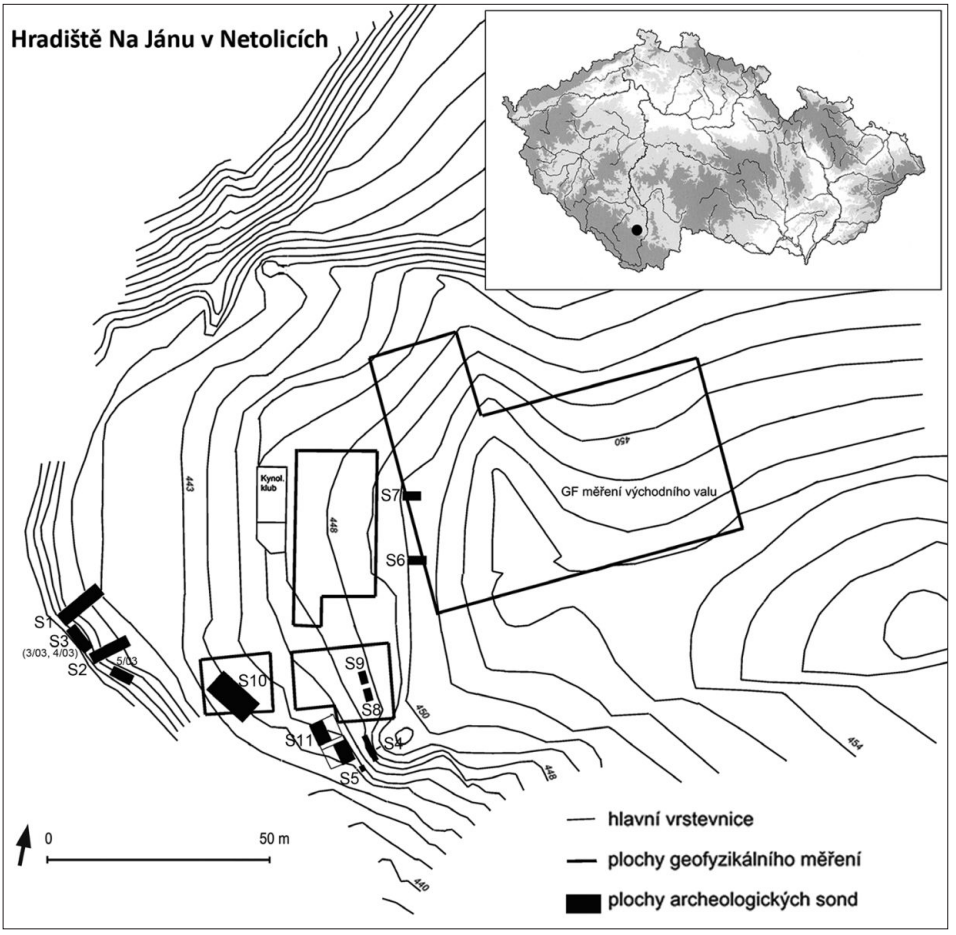
Vytvoření referenční zoologické sbírky

Referenční sbírka (*Tab. 1*) obsahovala 12 pravých polovin dolních čelistí jelenů lesních (*Cervus elaphus*, n=5), prasat divokých (*Sus scrofa*, n=3) a srnců obecných (*Capreolus capreolus*, n=4) ulovených převážně na území Jihočeského kraje – v Hluboké nad Vltavou, Staré Oboře a Kubově Huti. Čelisti byly získány kostrováním. Nejprve byly zbaveny svalů a krve (24–48 hodin). Přetrvávající zbytky svaloviny byly odstraněny biologickou macerací ve studené vodě. Zároveň byly shromážděny údaje o věku jedinců a termínu, kdy byli uloveni (s touto fází přípravy pomohl zaměstnanec Lesů České republiky, s. p.). Při stanovení věku jelenů a srnců byla vizuálně hodnocena míra opotřebení posledního laloku třetí stoličky dolní čelisti. Kromě toho byl sledován poměr krčků a výšek korunek řezáků, včetně úhlu, který svírají s osou dolní čelisti. Vývoj chrupu a intenzita opotřebení jednotlivých zubů byly posuzovány i při stanovování věku prasat divokých. Metodické postupy, na něž je odkazováno, jsou blíže popsány v literatuře (např. *Kolář 2002*). Poskytnuté věkové odhady byly ještě porovnány s výsledky získanými archeozoologickou praxí, při níž byl kladen důraz na vývoj a stupeň obroušení třenových zubů a stoliček (*Matschke 1967*; *Grant 1982*; *Brown – Chapman 1991a*; *Komárek et al. 2001*, 62–83; *Tomé – Vigne 2003*). Jelikož nebyl znám přesnější údaj, kdy došlo k lovu srnců (*Tab. 1*) a k jejich čelistem se vztahoval jen údaj odpovídající rozmezí několika let (2012–2015), nemohla být hodnocena sezonalita. Přestože jsou v literatuře (např. *Burke – Castanet 1995*; *Azorit et al. 2002*) většinově uváděny výsledky hodnocení zubního cementu na semihypsodontních zubech přežvýkavců, které se vyznačují středně silnou vrstvou cementu (*dentes mesocementoses*), byla v této studii věnována pozornost také méně často publikovaným (např. *Clarke et al. 1992*) brachyodontním zubům prasat divokých s charakteristicky malým množstvím cementu (*dentes oligocementoses*), u nichž je třeba počítat s rizikem snížené viditelnosti přírůstkových linií.

Z pravé poloviny referenčních dolních čelistí jelenů lesních, srnců obecných a prasat divokých byly s pomocí vrtací soupravy Proxxon FBS 240/E vyjmuty první stoličky (M_1), protože tento zub je považován za jeden z nejvhodnějších pro cementochronologickou analýzu (*Mitchell 1967*).

Výběr archeozoologických nálezů

Soubor archeozoologických nálezů vybraných za účelem cementochronologické analýzy (*Tab. 1*) sestával ze zubů horních i dolních čelistí jelena lesního (*Cervus elaphus*, n=4),



Obr. 1. Raně středověké hradiště Na Jánu v Netolicích s umístěním jednotlivých sond v prostoru hradiště.

prasete divokého (*Sus scrofa*, n=2) a srnce obecného (*Capreolus capreolus*, n=1), aby byla pokryta širší škála zvěře z této lokality. Zuby získané z výplně čtyř sond (S4/2007, S7–S9/2007) zkoumaných při archeologickém výzkumu na hradišti Na Jánu v Netolicích (*Obr. 1*) lze na základě keramiky datovat do 11. až 12. století (*Hausteinová 2015*, 20). Jihočeské raně středověké hradiště, které se nacházelo na skalnatém vršku nad stejnojmenným městem, nedaleko u potoka Rapačov, představovalo v minulosti významný strategický bod na trase dálkových obchodních cest a důležité správní centrum oblasti. Jak ukázal archeologický výzkum, hradiště pochází z 10. století, z doby upevňování přemyslovské moci v jižních Čechách (*Beneš et al. 2010*). Archeologický a s ním provázaný bioarcheologický výzkum započal roku 2000 a pokračoval i v dalších letech (*Hrubý – Lutovský 2000*; *Beneš – Hrubý 2001*; *Beneš et al. 2010*; *Hojerová 2016*). Co se týče průkaznosti lovu v této lokalitě, pak kosti zvěře, např. jelena lesního, srnce obecného, prasete divokého, medvěda hnědého nebo zajíce polního tvoří ve výše zmíněných sondách zhruba 10 % a tento podíl je výrazně nižší než podíl kostí domácích zvířat. Mezi nejčastěji prokazované

REFERENČNÍ ZOOLOGICKÝ MATERIÁL						
Jedinec	**Druh**	**Strana**	**Anatomie**	**Velikost**	**Věk**	**Doba ulovení**
A	Jelen lesní (*Cervus elaphus*)	pravá	mandibula	celá	5 let	9/10 2014
B	Jelen lesní (*Cervus elaphus*)	pravá	mandibula	celá	3,5 roku	10/11 2014
C	Jelen lesní (*Cervus elaphus*)	pravá	mandibula	celá	7 let	25.09.2015
D	Jelen lesní (*Cervus elaphus*)	pravá	mandibula	celá	2,5 roku	9/10 2014
E	Jelen lesní (*Cervus elaphus*)	pravá	mandibula	celá	9 let	04.11.2015
F	Prase divoké (*Sus scrofa*)	pravá	mandibula	celá	20 měsíců	6/2014
G	Prase divoké (*Sus scrofa*)	pravá	mandibula	celá	20 měsíců	6/2014
H	Prase divoké (*Sus scrofa*)	pravá	mandibula	celá	20 měsíců	6/2014
I	Srnec obecný (*Capreolus capreolus*)	pravá	mandibula	celá	2 roky	blíže nespecifikováno (2012–2015)
J	Srnec obecný (*Capreolus capreolus*)	pravá	mandibula	celá	3 roky	blíže nespecifikováno (2012–2015)
K	Srnec obecný (*Capreolus capreolus*)	pravá	mandibula	celá	3 roky	blíže nespecifikováno (2012–2015)
L	Srnec obecný (*Capreolus capreolus*)	pravá	mandibula	celá	3 roky	blíže nespecifikováno (2012–2015)
ARCHEOZOOLOGICKÉ NÁLEZY						
Jedinec	**Druh**	**Strana**	**Anatomie**	**Velikost**	**Věk**	**Popis místa nálezu**
A	Jelen lesní (*Cervus elaphus*)	pravá	mandibula	fragment	38–55 měsíců	Netolice, sonda S7/2007, vrstva 7006, sáček 490
B	Jelen lesní (*Cervus elaphus*)	levá	maxilla	fragment	24–63 měsíců	Netolice, sonda S7/2007, vrstva 7006, sáček 492
C	Jelen lesní (*Cervus elaphus*)	levá	maxilla	fragment	26–42 měsíců	Netolice, sonda S9/2007, vrstva 9006, sáček 450
D	Jelen lesní (*Cervus elaphus*)	pravá	maxilla	fragment	11–12 měsíců	Netolice, sonda S8/2007, výplň mezi kameny, sáček 447
E	Prase divoké (*Sus scrofa*)	levá	maxilla	fragment	20–24 měsíců	Netolice, sonda S8/2007, vrstva 8004, sáček 461
F	Prase divoké (*Sus scrofa*)	pravá	maxilla	fragment	36–60 měsíců	Netolice, sonda S8/2007, vrstva 8006, sáček 448
G	Srnec obecný (*Capreolus capreolus*)	levá	mandibula	fragment	20–29 měsíců	Netolice, sonda S4/2007, vrstva 9002, sáček 460

Tab. 1. Přehled referenčního zoologického materiálu a archeozoologických nálezů z hradiště Na Jánu v Netolicích vybraných pro analýzu zubního cementu.

patří zbytky jelenů (2–5 % určených nálezů), prasat divokých (3 %) a srnců (nejvýše 2 %; *Hausteinová 2015*, 32–33, 42).

Určení věku zvířat z archeologických situací

S ohledem na celkově nízký podíl kosterních pozůstatků volně žijících zvířat v osteologickém souboru z Netolic a jejich horší zachovalost (fragmentaci), nemohly být pro jednotlivé druhy použity morfologicky ani stranově totožné zuby. Především bylo hlídáno, aby se nejednalo o totožné jedince. Mléčné zuby byly záměrně vyřazeny, protože mohou vykazovat velký počet markerů, které nemusí mít spojitost s věkem zvířete (*Burke – Castanet 1995*). U jelenů a srnců byly vybrány druhé a třetí stoličky trvalého chrupu, přičemž ojediněle byl do analýzy zařazen také čtvrtý třenový zub jelena, a u prasete divokého byly zvoleny třetí stoličky (*Tab. 3*). Výběr typově i ontogeneticky odlišných zubů kladl vyšší nároky na určení úmrtního věku zvířat, který byl u každého zubu posuzován zvlášť (u některých jedinců pomohly při určení věku i další zuby z čelisti), a vycházel především z intenzity opotřebení korunek (*Tab. 1*). U jelena lesního byla využita metoda skórování (*Brown – Chapman 1991a*) v kombinaci s poznatky obsaženými ve studii *Komárek et al.*

Jedinec/ číslo vzorku	Druh	Zub	Studovaná část kořene	Řez	Počet tmavých linií	Počet světlých linií	Poslední linie	Prořezávání zubu a formování kořene	Odhad věku (cement)	Období lovu (cement)	Shoda (věk) – odchylka max. 6 měsíců	Shoda (období lovu)
A	Jelen lesní (*Cervus elaphus*)	dens molaris I inferior	cervikální	longitudinální	3	3	světlá	12 měsíců	4 roky	vegetační období (podzim)	ne	ano
B	Jelen lesní (*Cervus elaphus*)	dens molaris I inferior	cervikální	longitudinální	3	3	světlá	12 měsíců	4 roky	vegetační období (jaro/léto)	ano	ne
C	Jelen lesní (*Cervus elaphus*)	dens molaris I inferior	střední	transverzální	3	3	světlá	12 měsíců	4 roky	vegetační období (podzim)	ne	ano
D	Jelen lesní (*Cervus elaphus*)	dens molaris I inferior	cervikální	longitudinální	2	1	nelze určit	12 měsíců	3 roky	neurčeno	ano	nelze srovnat
E	Jelen lesní (*Cervus elaphus*)	dens molaris I inferior	cervikální	longitudinální	9	8	tmavá	12 měsíců	10 let	vegetační klid	ne	ano
F	Prase divoké (*Sus scrofa*)	dens molaris I inferior	střední	longitudinální	–	–	–	–	–	–	–	–
G	Prase divoké (*Sus scrofa*)	dens molaris I inferior	střední	longitudinální	2	1	tmavá	4–6 měsíců	2,5 roku	vegetační klid	ano	ne
H	Prase divoké (*Sus scrofa*)	dens molaris I inferior	cervikální	longitudinální	2	1	tmavá	4–6 měsíců	2,5 roku	vegetační klid	ano	ne
I	Srnec obecný (*Capreolus capreolus*)	dens molaris I inferior	střední	longitudinální	2	2	světla	4–6 měsíců	2,5 roku	vegetační období (jaro)	ano	nelze srovnat
J	Srnec obecný (*Capreolus capreolus*)	dens molaris I inferior	střední	longitudinální	2	2	světla	4–6 měsíců	2,5 roku	vegetační období (podzim)	ano	nelze srovnat
K	Srnec obecný (*Capreolus capreolus*)	dens molaris I inferior	střední	longitudinální	3	3	světlá	4–6 měsíců	3,5 roku	vegetační období (podzim)	ano	nelze srovnat
L	Srnec obecný (*Capreolus capreolus*)	dens molaris I inferior	střední	longitudinální	3	2	tmavá	4–6 měsíců	3,5 roku	vegetační klid	ano	nelze srovnat

Tab. 2. Výsledky cementochronologické analýzy referenčního zoologického souboru.

Jedinec/ číslo vzorku	Druh	Zub	Studovaná část kořene	Řez	Počet tmavých linií	Počet světlých linií	Poslední linie	Prořezávání zubu a formování kořene	Odhad věku (cement)	Období lovu (cement)	Shoda (věk)
A	Jelen lesní (*Cervus elaphus*)	dens molaris III inferior	střední	transverzální	2	2	světlá	26–33 měsíců	4–4,5 roku	vegetační období (podzim)	ano
B	Jelen lesní (*Cervus elaphus*)	dens premolaris IV superior	apikální	longitudinální	2	1	tmavá	26–33 měsíců	4–4,5 roku	vegetační klid	ano
C	Jelen lesní (*Cervus elaphus*)	dens molaris II superior	střední	transverzální	1	1	světlá	26–33 měsíců	3–3,5 roku	vegetační období (podzim)	ano
D	Jelen lesní (*Cervus elaphus*)	dens molaris II superior	střední	longitudinální	–	–	–	–	–	–	–
E	Prase divoké (*Sus scrofa*)	dens molaris III superior	střední	transverzální	1	0	tmavá	1,5–2 roky	2,5–3 roky	vegetační klid	ne
F	Prase divoké (*Sus scrofa*)	dens molaris III superior	střední	transverzální	2	1	tmavá	1,5–2 roky	3,5–4 roky	vegetační klid	ano
G	Srnec obecný (*Capreolus capreolus*)	dens molaris III inferior	apikální	longitudinální	2	1	tmavá	1 rok	3 roky	vegetační klid	ano

Tab. 3. Výsledky cementochronologické analýzy archeozoologického souboru z hradiště Na Jánu v Netolicích.

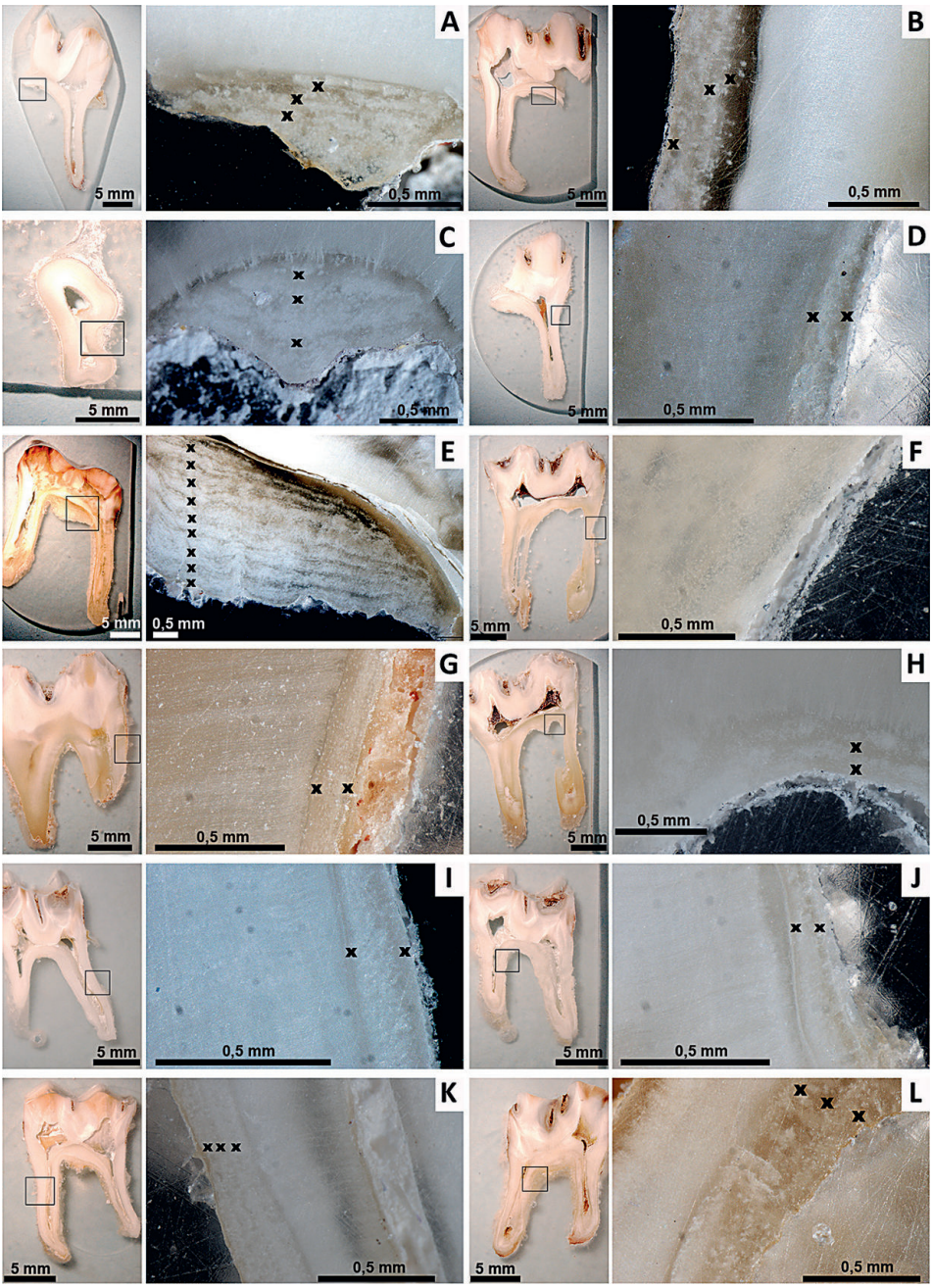
(*2001*, 62–83). Stoličky prasat divokých byly odlišeny od stoliček prasat domácích na základě jejich délko-šířkových rozměrů (*Evin et al. 2014*) a věk dožití byl stanoven podle *Matschke* (*1967*) a *Grant* (*1982*). Při odhadu věku srnce obecného byly využity metodické práce *Tomé – Vigne* (*2003*) a *Komárek et al.* (*2001*, 62–83).

Příprava řezů zubů v laboratoři, zobrazení vzorků a jejich hodnocení

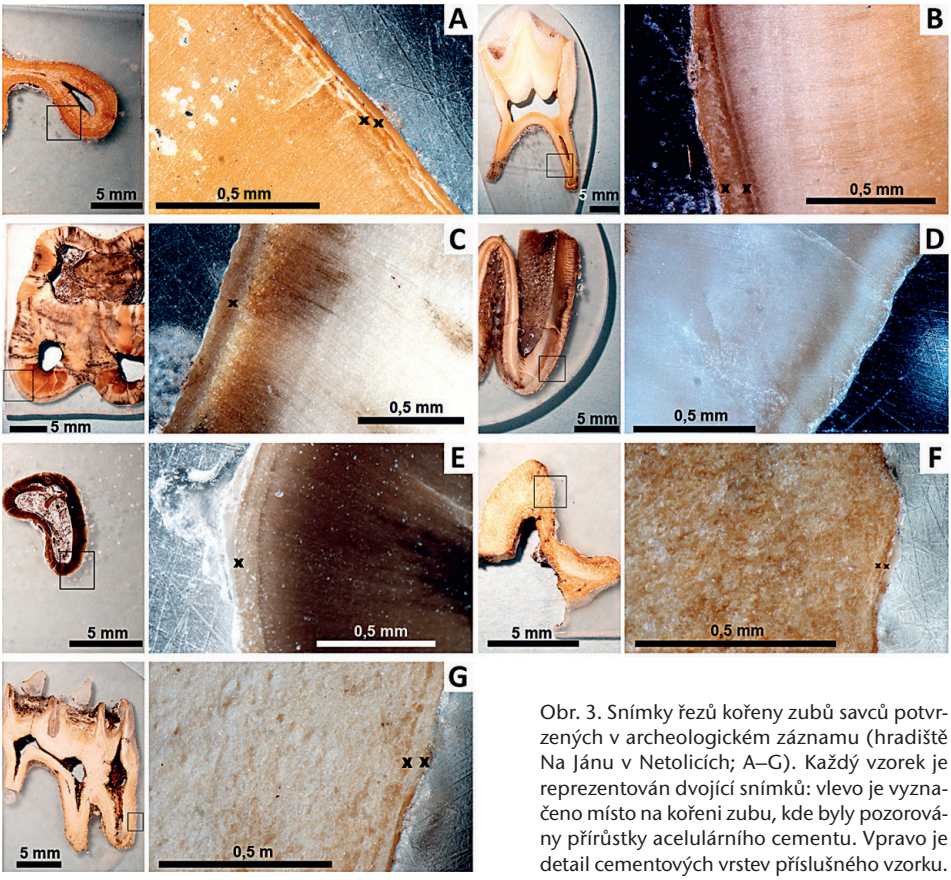
Při přípravě vzorků byl akceptován postup publikovaný v *Naji et al.* (*2015*). Z čelistí vypreparované i z nich již uvolněné zuby bylo nutné zafixovat, aby se při řezání nerozpadly. K tomuto účelu byly zhotoveny formičky kapkovitého tvaru. Do každé z nich byl vložen zub, který byl zalit dvousložkovou metylmetakrylátovou pryskyřicí (Dentacryl®). Po zatuhnutí při pokojové teplotě byly vzorky vyjmuty z forem a nařezány na tenké plátky na rotační pile IsoMet 1000 na Antropologickém oddělení Národního muzea v Praze. Aby byla získána co největší plocha pro pozorování inkrementálních linií cementu (*Naji et al. 2015*), byla většina řezů zuby vedena longitudinálně (bukolinguálně), resp. procházela středem korunky a celým kořenem. V případě zoologických nálezů bylo takto uříznuto 11 zubů z 12 (*Tab. 2*). U jediného zubu z této série (vzorek C, *Tab. 2*) byl aplikován transversální řez kořenem (ortogonálně k jeho ose), protože do pryskyřice byl ponořen pouze kořen (korunka se rozpadla už při mechanickém uvolňování zubu z alveolu kosti). K řezu byl vybrán nejširší kořen, jelikož se u něj předpokládalo nejlepší zachování cementu i větší plocha pro pozorování. Navzdory tomu, že je v některé literatuře zmiňováno, že odečty linií cementu v transverzálním řezu kořenem mohou být zatíženy chybou (*Morris 1972*), muselo být k tomuto postupu přistoupeno převážně u archeozoologických nálezů, a to ve čtyřech ze sedmi případů (*Tab. 3*). Důvodem je, že se některé zuby prasete a jelena nedochovaly v kompletním stavu nebo se na jejich korunkách objevily znatelné praskliny a hrozilo, že se v dalších krocích laboratorní přípravy rozpadnou. Při vytváření preparátů bylo vždy pracováno s největšími kořeny. Tloušťka výbrusů činila 2 mm a při jejich navazujícím leštění byly použity brusné papíry různých zrnitostí (od nejhrubších po nejjemnější). Výsledné řezy byly zkoumány pod binokulárním mikroskopem Nikon SMZ 1500 (zvětšení 50x–100x). Výběr vhodné oblasti zubu s liniemi acelulárního cementu na jednotlivých preparátech byl proveden v prostředí programu NIS Elements AR 3.2.

Po zhotovení preparátů řezů kořeny zubů bylo přikročeno k vyhodnocení linií. U každého vzorku byl zaznamenán celkový počet tmavých linií (období odpočinku) a počet světlých linií (období růstu a aktivity). Zapsán byl také vzhled poslední linie cementu (*Tab. 2* a *3*). U posledních přírůstků některých vzorků byla posuzována jejich šíře ve snaze blíže vymezit období v roce, kdy živočich zemřel. Tmavá linie v jakékoliv šířce odpovídala zimnímu období, méně než polovina a polovina světlé linie jarnímu a letnímu období a ukončená světlá linie podzimu (*Schmaus et al. 2020*).

Při stanovení věku zvířat z inkrementálních linií cementu bylo nutné ještě zohlednit (přičíst) délku období, kdy se formují kořeny jednotlivých zubů (např. *Mitchell 1967*). Protože se načasování vývoje, např. prořezávání a mineralizace, liší u jednotlivých stoliček i třenových zubů, a stejně tak se tyto zuby vyvíjejí odlišně u jednotlivých druhů zvířat, byly využity a kombinovány různé studie – jelen lesní (*Mitchell 1967*; *Brown – Chapman 1991a, b*; *Hillson 2005*, 235–236), srnec obecný (*Carter 1997*; *Komárek et al. 2001*, 82; *Tomé – Vigne 2003*), prase divoké (*Matschke 1967*; *Bull – Payne 1982*; *Hillson 2005*, 233–234).



Obr. 2. Snímky řezů kořeny zubů recentních savců (A–L). Každý vzorek je reprezentován dvojící snímků: vlevo je vymezeno místo na kořeni zubu, kde byly pozorovány přírůstky acelulárního cementu, vpravo je detail cementových vrstev příslušného vzorku.



Obr. 3. Snímky řezů kořeny zubů savců potvrzených v archeologickém záznamu (hradiště Na Jánu v Netolicích; A–G). Každý vzorek je reprezentován dvojící snímků: vlevo je vyznačeno místo na kořeni zubu, kde byly pozorovány přírůstky acelulárního cementu. Vpravo je detail cementových vrstev příslušného vzorku.

Výsledky

U srovnávacího zoologického materiálu bylo možné pozorovat linie acelulárního cementu u 11 vzorků z 12 (*Obr. 2*) a u archeozoologických vzorků u 6 ze 7 (*Obr. 3*). Větší náchylnost kořenů menších zubů vůči oděru, která je někdy zmiňována v literatuře (*Mitchell 1967*), se potvrdila u referenčního zubu prasete divokého (vzorek F; *Obr. 2*), kdy zřejmě došlo k poškození vrstvy cementu při preparování zubu z alveolu dolní čelisti. V případě archeozoologických nálezů nebylo možné sledovat linie na řezu druhé stoličky horní čelisti jelena lesního (vzorek D; *Obr. 3*), a to z blíže nezjistitelných důvodů.

Na longitudinálních řezech zubů referenčních zoologických vzorků byly linie viditelné jak v cervikální (n=5), tak střední (n=6) oblasti kořene, a to v závislosti na tom, kde byly pod zvětšením lépe dohledatelné. Ojedinělý transverzální řez (n=1) procházel střední partií kořene (*Tab. 2*). U archeozoologických nálezů byl častěji proveden transversální řez kořeny, a to buď v jejich střední (n=5) nebo apikální části (n=2). Ani u jedné skupiny vzorků nebylo zjištěno, že by umístění řezu znemožnilo odečítat inkrementální linie. Doplňme, že počty vzorků v obou souborech jsou nízké a řezy při přípravě preparátů rozdílně vedené, což neumožnilo testovat vliv oblasti pozorování na čitelnost přírůstků cementu.

Stanovení věku v době smrti zvířete

Přesnost metody (*accuracy*), kterou definujeme jako blízkost odhadu věku a výsledku analýzy přírůstků cementu (např. *Christensen-Dalsgaard et al. 2010*), byla nejprve zjišťována u referenční skupiny 11 zvířat (*Obr. 2*), tj. jelenů ve věku 2,5 až 9 let (n=5), srnců ve věku 2,5–3,5 roku (n=4) a prasat divokých ve věku 20 měsíců (n=2; *Tab. 1*). Za shodné byly považovány ty případy, kdy se věkové určení nelišilo o více než šest měsíců. Do tohoto rozsahu náleželo osm vzorků z jedenácti (*Tab. 2*). Po rozšíření tolerance na 12 měsíců vzrostl počet shodných případů na deset z jedenácti (*Tab. 2*). Zaměříme-li se na jednotlivé druhy zvířat, pak lze shrnout, že se shodovaly věkové údaje u vzorků srnců a prasat divokých (maximální odchylka 6 měsíců). O něco více rozdílných případů bylo shledáno u jelenů, kdy z pěti jedinců souhlasil věkový údaj u dvou z nich (odchylka nejvýše 6 měsíců). V případě akceptování odchylky jednoho roku u zubů jelenů vzrostl počet shodných pozorování na čtyři z pěti (*Tab. 2*). Největší odchylka (tři roky) provázela vzorek C (*Tab. 2*), u něhož byl aplikován transverzální řez kořenem. Odlišný metodický postup tak mohl negativně zapůsobit na konečný výsledek.

Mezi zvěří, jejíž kosterní pozůstatky byly nalezeny na hradišti v Netolicích a jejíž věk byl stanoven podle prořezávání a opotřebení dentice, se vyskytovali roční až pětiletí jeleni, jeden srnec ve věku 20–29 měsíců a dvě prasata divoká ve věku 20–24 měsíců a 3–5 let (*Tab. 1*). Porovnání těchto věkových údajů s věkem zjištěným cementochronologickou analýzou (*Tab. 3*) přineslo závěr, že odhady úmrtního věku se shodovaly u pěti vzorků ze šesti. V této souvislosti je třeba kriticky dodat, že úmrtní věk zvířat v archeozoologické praxi, běžně odvozovaný od stavu dentice, je zvláště u starších jedinců vyjadřován rozmezím zahrnujícím i několik let (např. *Tomé – Vigne 2003*). Širší věkový interval tak může v některých případech ukrýt i větší odchylku v počtu odečtených linií acelulárního cementu. U jednoho prasete divokého (vzorek E; *Obr. 3*) byl odklon větší – 10–12 měsíců. I když se jedná o vzorek řezaný transverzálně, nemusí být výběr řezu jednoznačnou příčinou neúspěšného stanovení věku, protože stejným způsobem byly vzorkovány i další zuby.

Stanovení období v roce, kdy došlo k usmrcení zvířete

Údaje o sezonalitě recentních sudokopytníků (referenční vzorky) jsou shrnuty v *Tab. 2* a na *Obr. 2*. Uspořádání linií cementu na kořenech prvních stoliček jelenů (*Tab. 2*) prozrazuje, že z pěti jedinců byli tři uloveni v období aktivity (dva na podzim – vzorky A, C, jeden na jaře až v létě – vzorek B, jeden v průběhu zimy – vzorek E; *Obr. 2*) a u jednoho jedince (vzorek D; *Obr. 2*) bylo obtížné poslední linii odlišit, a tudíž nelze období v roce prokázat. Tato zjištění, s výjimkou vzorku B (*Obr. 2*; *Tab. 2*), jsou ve shodě s údaji, které byly k dispozici ještě před zahájením experimentu (*Tab. 1*). Dvě prasata divoká, u nichž se podařilo zobrazit oblast zubního cementu, byla ulovena v zimním období (*Tab. 2*). Tento výsledek je zcela v rozporu s původními údaji odkazujícími na červen (*Tab. 1*). U srnců sice nebyly předem známy informace, kdy došlo k jejich ulovení, výsledky cementochronologické analýzy ale odkazují na různá období v roce – na jaro (vzorek I; *Obr. 2*), podzim (vzorky J–K; *Obr. 2*) i zimu (vzorek L; *Obr. 2*).

Divocí savci, jejichž kosti a zuby byly objeveny při archeologickém výzkumu na hradišti Na Jánu v Netolicích (*Tab. 3*; *Obr. 3*), byli uloveni převážně v období vegetačního klidu – v zimě (vzorky B, E–G; *Obr. 3*) nebo v závěru období aktivity – na podzim

(vzorky A, C; *Obr. 3*). V zimě byl uloven srnec a obě prasata divoká, obdobím lovu jelenů byl podzim a zima.

Diskuze

Lov zvěře byl v raném středověku záležitostí převážně privilegovaných vrstev, sporadicky je ale doložen také u dalších skupin obyvatel, které měly zakázáno lovit. Ačkoliv v živočišné složce potravy převažovalo maso hospodářských zvířat, zvěřina představovala vítané zpestření jídelníčku (*Žemličková 2012*, 57; *Dreslerová et al. 2013*; *Maliniak 2015*; *Kovačiková et al. 2019*). Lov měl symbolickou hodnotu, byl ukázkou reprezentace, přinášel maso, kůže, kožešiny, paroží i zábavu, při které byla prokazována síla a odvaha. Lovecké umění patřilo k základům výchovy urozených (*Petříčková 2000*; *Žemlička 2005*; *Zelenka 2014*; *Dvořáková 2015*; *Kyselý 2015*).

Podíváme-li se na lovené druhy na našem území, pak v osteologických souborech z raného středověku převažují pozůstatky jelena lesního (53,3 %), prasete divokého (23,7 %), srnce obecného (8,6 %) a zajíce polního (7,5 %). Vzácněji jsou doloženi los evropský, pratur, bobr evropský, medvěd hnědý nebo zástupci menších šelem (*Kyselý 2005*, *Tab. 9*). Co se týče raně středověkého jihočeského hradiště Na Jánu v Netolicích, byly zde lovenými druhy (podle počtu nálezů kostí a zubů) jelen lesní, zajíc polní, veverka obecná, prase divoké, srnec obecný, medvěd hnědý a pratur (*Hausteinová 2015*).

Z propojení archeozoologických dat s výsledky analýzy přírůstků zubního cementu se dozvídáme, že zájem o jelenovitou a černou zvěř se zvyšoval v nepříznivé části roku. K naháňce jelenů, jejichž úmrtní věk se pohyboval mezi 2,5 až 4,5 lety, docházelo hlavně na konci vegetačního období a v období vegetačního klidu, kdy byli v nejlepší kondici a jejich maso obsahovalo více tuku (*Almond 2011*). Podzimní termín koresponduje také s obdobím jejich říje od poloviny září do druhé poloviny října. Díky výrazným hlasovým projevům samců byli lovci schopni jeleny lépe dohledat a skolit je (*Andreska 1980*; *Pike-Tay 1991b*, 48; *Goldberg 2020*, 131). Jedenapůlroční až dvouletá prasata divoká a tříletý srnec v Netolicích byli uloveni během vegetačního klidu. Úspěšnosti zimní štvanice pomáhala sněhová pokrývka, která dovolovala snazší vystopování zvěře, jež se obtížněji pohybovala krajinou (*Andreska 1980*). V deštivých podmínkách byla prasata divoká dohledávána také podle otisků bláta na kmenech stromů, o které se otírala (*Cummins 1988*, 98).

Historické prameny přinášejí jen skromné informace o hájení zvěře v obdobích, kdy je nejzranitelnější, nebo o načasování honů. Kupříkladu biskup Řehoř z Tours, kronikář merovejské dynastie, zapsal, že ačkoliv na jeleny a srnce mohli lovci vyrážet po celý rok, největší množství výprav bylo soustředěno do září a října (*Goldberg 2020*, 51). Lze rovněž dohledat, že zatímco srnci mohli být v raném středověku loveni celoročně a pouze v období, kdy měly samice mláďata, bylo doporučeno je hájit, k nahánění prasat docházelo v užším intervalu, od konce září do února (*Cummins 1988*, 88, 97). Jelikož tehdejší omezení vycházela především z vlastních potřeb aristokracie než ze snahy zvěř ochránit, napovídá to rozprostření loveckých aktivit do širšího časového období (*Maliniak 2015*).

Výsledky cementochronologické analýzy pro raně středověké hradiště Na Jánu jsou koncentrovány do jedné části roku a s představou celoročního lovu se míjí. Je ale třeba kriticky uznat, že datový soubor není příliš početný a až jeho rozšíření by mohlo přinést detailnější vhled do tohoto tématu, k němuž pro naše území prozatím neexistují obdobně zaměřené studie.

Již několik desetiletí se ukazuje, že metoda cementochronologie zaměřená na rekonstrukce životní historie zvířat má v archeologii potenciál (např. *Pike-Tay 1991a*; *Lieberman* 1994; *Burke – Castanet 1995*). Přesto je nadále ověřována její využitelnost a přesnost při určování věku dožití zvířat na recentním zoologickém materiálu (*Burke – Castanet 1995*; *Klevezal 1996*; *Pérez-Barbería et al. 2014*; *Azorit et al. 2022*). Přihlédneme-li k antropologickým závěrům, pak některé z nich naznačují, že analýza přírůstků zubního cementu dosahuje vyšší přesnosti u jedinců v mladém a středním věku, zatímco výsledný věk u skupin starších jedinců zůstává podhodnocen (*Huffman – Antoine 2010*; *Lanteri et al. 2018*; *Zazvonilová et al. 2022*). K tomuto nesouladu, diskutovaném taktéž v zoologicky zaměřených studiích (*Keiss 1969*; *Christensen-Dalsgaard et al. 2010*; *Veiberg et al. 2020*), se přidávají i naše zjištění týkající se dvou vzorků nejméně pětiletých jelenů v referenčním zoologickém souboru, u nichž jsou konečné počty inkrementálních linií nižší. Jedním z vysvětlení je, že zpomalováním růstu zubu se stávají linie cementu kompaktnějšími směrem k vnějšímu povrchu, což může působit problémy při jejich odečítání (*Grue – Jensen 1979*). Nepravidelné narůstání vrstev cementu mohou zapříčiňovat i fyziologické změny, které se odehrávají ve stárnoucím organismu (*Klevezal – Shishlina 2001*). Získané výsledky také ukázaly, že počet linií cementu u mladších jelenů (2,5 a 3,5 roku) je mírně nadhodnocen oproti jejich skutečnému stáří. Také v tomto případě se jedná o situaci popsanou v odborné literatuře (např. *Miller et al. 1988*; *Christensen-Dalsgaard et al. 2010*).

Navzdory uvedenému lze u většiny námi zkoumaných zubů konstatovat, že se analýza pozorovatelných linií cementu ukázala jako vhodná pro stanovení úmrtního věku současné spárkaté zvěře (shodovalo se osm z jedenácti případů, tj. 72,7 % při odchylce nejvýše 6 měsíců). V souvislosti s jelenovitými kopytníky lze v literatuře dohledat širší rozptyl hodnot reflektujících přesnost metody. Nebudeme-li ji vyjadřovat pouze na úrovni jedné věkové skupiny, ale pro více různověkých jedinců dohromady, může nabývat hodnoty 50 % (*Keiss 1969*), 63 % (*Aitken 1975*), 69 % (*Veiberg et al. 2020*) nebo 66–74 % (*Boertje et al. 2015*). Obvykle však přesahuje 60 % a při přijmutí odchylky jednoho roku může vzrůst na více než 80–90 % (*Aitken 1975*; *Matson 1981*; *Hamlin et al. 2000*; *Boertje et al. 2015*; *Veiberg et al. 2020*). Prokazatelně existující rozdíly v hodnotách přesností mohou být odrazem různých vzorců aktivit, potravních nebo klimatických faktorů (*Mitchell 1967*; *Christensen-Dalsgaard et al. 2010*), mohou se lišit u jednotlivých typů zubů (*Boertje et al. 2015*) nebo věkových skupin (*Hamlin et al. 2000*). U nepočetné kolekce archeozoologických vzorků v této studii je přesnost o něco vyšší (pět ze šesti případů, tj. 83,3 %) než u zoologických vzorků. V literatuře se hodnoty úspěšnosti této metody pohybují mezi 70 až 90 %, v závislosti na stupni postmortální destrukce zubu (*Burke – Castanet 1995*; *Ábelová 2005*; *Nývltová-Fišáková 2007*; *Jiménez-Manchón et al. 2023*). Diagenetické změny cementu tak mohou srazit hodnoty přesnosti i k 50 % (*Martin 1998*) nebo analýzu znemožnit (*Kapustka et al. 2023*).

Období ulovení mohlo být komparováno pouze u referenčních vzorků jelenů a prasat divokých a shodovalo se ve třech ze šesti případů (50 %), což neodpovídá příliš dobrým výsledkům. Nabízí se proto otázka, jak přesnost metody do budoucna zvýšit. Antropologické studie pojednávající o korelaci mezi chronologickým a odhadovaným věkem akcentují nezbytnost standardizace pracovních postupů i opatrnost při výběru zubů (*Naji et al. 2016*; *Colard et al. 2018*; *Bertrand et al. 2019*; *Zazvonilová et al. 2022*). Příprava preparátů našich vzorků byla provedena v roce 2017 dle *Naji et al.* (*2015*), v posledních letech ale doznal laboratorní protokol některých změn a obdobně přibývají práce zabývající se

výběrem vhodného umístění řezu kořenem zubu nebo evaluací kvality cementu (*Rendu et al. 2022*; *Pubert et al. 2022*), čemuž je potřeba přikládat váhu v navazujícím výzkumu. V našem případě mohl být transverzální řez kořenem referenčního vzorku C důvodem špatné čitelnosti linií, čemuž lze v budoucnu předejít sjednocením vzorkovací strategie. Zároveň se otevírají nové zobrazovací, přístrojové a programové možnosti (např. *Kaur et al. 2015*; *Newham et al. 2021*), které přesnost odečtů zvyšují, ve srovnání se staršími postupy limitovanými nemalou měrou zkušenostmi a znalostmi hodnotitele (*Keiss 1969*; *Pike-Tay 1991a*; *Christensen-Dalsgaard et al. 2010*).

Zubní cement dokáže dlouhodobě přetrvat v archeologickém záznamu bez výraznějšího poškození, což dokládají početnější datasety shromážděné už pro období paleolitu (*Rendu 2007*; *2010*; *Livraghi et al. 2022*). Jak je zřejmé i z našich dat, ač z mladšího období (vzorek D), zcela zásadní roli hrají podmínky prostředí, v nichž se archeologický nález dlouhodobě nacházel, i to, jak s ním bylo nakládáno před samotným uložením do země. Cement je nejméně mineralizovaný ze všech zubních tkání a děje tafonomického rázu zasahují do jeho periferní nebo vnitřní mikrostruktury. Zvětrávání, dekalcifikace, permineralizace nebo působení vysokých teplot mohou vést k jeho destrukci a ve finále ovlivnit výsledek histomorfologické analýzy (*Stallibrass 1982*; *Naji et al. 2015*; *Bertrand et al. 2019*). Při zvětrávání dochází k poškození vnitřních organických a anorganických komponent zubu. Ty jsou od sebe odděleny a poté destruovány fyzikálními a chemickými činiteli v dané lokalitě (*Behrensmeyer 1978*). Také *post mortem* vyplavování kolagenu a diagenetický růst krystalů apatitu mohou vytvořit strukturu, která napodobuje sezónní přírůstky cementu a je třeba ji včas odhalit vhodně zvolenou zobrazovací technikou (*Stutz 2002b*). Sezónní přírůstky cementu lze sice pozorovat u spálených nálezů zubů, pokud ale teploty překročí 600 °C, nemusí být odečty linií dostatečně spolehlivé a vypovídající (*Gocha – Schutkowski 2013*). Limitující jsou rovněž biologické faktory. Přírůstkové linie mohou být narušeny půdními mikroorganismy a plísněmi (*Bertrand et al. 2019*). Jejich nepravidelnost způsobuje fyziologický stres ještě za života organismu, např. říje, březost, porod nebo odstav (*Grue – Jensen 1979*; *Penezić et al. 2020*; *Cerrito et al. 2020*). Projevit se ale mohou také změny klimatu, např. chlad, kdy je rychleji spotřebováván vápník, což může vést k hypomineralizaci (*Cipriano 2002*), nebo omezená dostupnost krmiva, kdy se méně opotřebovávají zuby a klesá kompenzační depozice cementu (*Saxon – Higham 1968*; *Stallibrass 1982*; *Lieberman 1993*). Nelze vynechat ani další modifikace spočívající ve zmenšení povrchu cementu či jeho nepředvídatelném růstu, ať už kvůli onemocnění závěsného aparátu zubu (*Kagerer – Grupe 2001*; *Broucker et al. 2016*) nebo patologické resorpci kořenů (*Yawaka et al. 2003*). V neposlední řadě jsou zajímavým fenoménem změny průběhu linií acelulárního cementu u zvířat v zajetí (*Cipriano 2002*), někdy provázené slabší viditelností (*Grue – Jensen 1979*). Navzdory tomu, že může u savců v lidské péči popsané riziko existovat, pozvolna přibývají práce, které se na tuto skupinu zvířat orientují (*Taylor et al. 2021*; *Jiménez-Manchón et al. 2023*).

Pracujeme-li při analýze s tenkými výbrusy zubů, lze některé makroskopické i mikroskopické změny detekovat a vhodnou volbou dalších postupů (např. způsob zobrazení) se vyvarovat analytických chyb. V horších případech je žádoucí poškozené vzorky z analýzy vyřadit (*Naji et al. 2015*). Ačkoliv cementochronologie přináší řadu výhod, nikdy se studovaný zub nedochová v původním stavu, protože dojde buď k odstranění některého z kořenů, nebo rozříznutí celého zubu, což je potřeba dopředu uvážit a zkoumané nálezy před analýzou dostatečně zdokumentovat.

Závěr

U většiny referenčních zoologických i archeozoologických vzorků (89,5 %) byly linie acelulárního cementu dobře viditelné. Úspěšnost odhadů individuálního věku, posuzovaná na základě shody počtu inkrementálních linií cementu s úmrtním věkem odhadnutým podle opotřebení dentice (v toleranci půl roku), byla vyšší u archeologických vzorků (pět ze šesti) než u vzorků referenčních (osm z jedenácti). Informace o sezóně ulovení jelenů a prasat divokých, ukrytá v jejich prvních stoličkách, se u jelenů shodovala ve třech případech z pěti s termíny lovu, které byly známy ještě před cementochronologickou analýzou; u prasat se zcela lišila. Depozice cementu v kořenech zubů spárkaté zvěře z raně středověkého hradiště Na Jánu v Netolicích byla u jelenů, srnců i prasat divokých přerušena v podzimních nebo zimních měsících, což naznačuje období smrti zvířat, popřípadě soustředění loveckých aktivit do klimaticky nepříznivé části roku.

Při hodnocení lovu v raném středověku jsme obvykle odkázáni na písemné prameny nebo interpretace některých archeologických nálezů. Detailní studium vybraných zvířecích zubů proto představuje další alternativu, jak se dozvědět více o samotných úlovcích i o chování člověka během roku. Ačkoliv nízké množství vzorků zahrnutých do této studie nepřináší nijak rozsáhlé výsledky, a to hlavně z důvodu nedostatku vhodných archeozoologických nálezů z hradiště v Netolicích, podařilo se dosáhnout několika závěrů, které mohou být nadále rozvíjeny, například navýšením datového souboru nebo pokročilejším testováním hypotéz. Zároveň se utváří prostor pro eliminaci metodických a analytických chyb a pro adaptaci nových poznatků z obdobně zaměřených studií. Třebaže není cementochronologická metoda příliš časově náročná ani finančně nákladná, její podstatnou nevýhodou je již zmíněná destruktivita, což v případě odontologického materiálu z archeologických nalezišť znamená, že zůstává nevratně poškozen. Jelikož jsou přírůstky cementu studovány především u lovené fauny, jejíž kosterní pozůstatky nejsou v archeozoologických souborech časté, je třeba dostatečně uvážit, zda je analýze podrobit či nikoliv. Obecně lze však využití této metody označit za doplňkové a její závěry je vhodné podpořit výsledky dalších analýz, např. dentálního mikroobrusu, stabilních izotopů apod.

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Cementochronology in archaeozoology: Exploring the age and hunting season of game from the early medieval hillfort Na Jánu in Netolice through dental cementum analysis

Cementochronology became a useful tool for determining the individual age and hunting season of the game (seasonality) recorded in archaeological contexts. We can observe interest in this method not only among biologists but also among environmental archaeologists for the reason, that root cementum, which is formed continuously throughout the life of the animal, is not subject to remodelling and resorption. Therefore, it is relatively resistant to postmortem changes. The study of microscopic cementum increments of dead or killed mammals brings data not only about the age and hunting season but can offer at least a rough idea of the age structure of the prey incorporated into past human subsistence or contribute to the debate in which season the bones of the hunted animals were accumulated at a particular archaeological site. In addition to the timing of the settlement of various places, we also get information about the organisation of hunting, animal grazing, ritual activities, etc.

The aim of this study was to present the potential of cementochronological method in relation to archaeozoological findings and with the help of our own analysis to assess whether acellular cementum increments on the teeth of recent mammals are sufficiently visible for determination of the age and period of animal death. Subsequently, we applied the same workflow to the teeth of some wild mammals documented in the archaeological contexts dated to the Early Middle Ages. The reference collection comprised 12 right lower jaws of red deer (*Cervus elaphus*, n=5), wild boar (*Sus scrofa*, n=3), and roe deer (*Capreolus capreolus*, n=4) caught mainly in the South Bohemia region, and a set of archaeozoological finds comprised the teeth of the upper and lower jaws of red deer (*Cervus elaphus*, n=4), wild boar (*Sus scrofa*, n=2), and roe deer (*Capreolus capreolus*, n=1). Archaeolozoological findings were obtained from four pits (S4/2007, S7-S9/2007) excavated at the hillfort Na Jánu in Netolice, which were dated to the 11th–12th century AD.

Regarding the results, acellular cementum layers could be observed in 11 out of 12 samples in the comparative zoological material and in 6 out of 7 in the archaeozoological samples. For the purposes of method validation, the value of the number of dental cementum lines of each recent species of animal was compared with the age estimations obtained by gamekeeper. As for archaeological teeth, the data obtained by us were compared with the estimations of age at death gathered during the archaeozoological analysis, i.e., according to tooth eruption and wear.

Our research shows that the cementochronology has the potential to be used in archaeology, although its reliability in determining the lifespan and season of animal death on recent zoological and archaeozoological material must be further verified. It is possible to summarize that for most of

the teeth of recent fauna examined in this study, the accuracy for determining the age at death is 72.7 % (8 out of 11 cases). For a small collection of archaeozoological samples, the achieved value is even slightly higher (5 out of 6 cases, i.e., 83.3 %). Two samples of red deer in the reference zoological collection, where the numbers of acellular cementum layers on the teeth of individuals older than five years were lower, points to the statement that the analysis of cementum increments achieve higher reliability in young and middle-aged individuals and remains underestimated in groups of older individuals. As for the early medieval South Bohemian hillfort Na Jánu, the bone remains of hunted species such as red deer, roe deer, and wild boar were identified. By connecting the archaeozoological data with the results of the analysis of tooth root cementum, we found that the game was hunted probably in the colder part of the year (autumn–winter). For example, deer hunting mainly occurred when they were in the best condition and their meat contained more fat. The autumn period also corresponds to their rut period from mid-September to the second half of October. Analysis of dental cementum increments can be thus described as supplementary and it is advisable to support this method by other analyses, e.g., dental microwear, stable isotopes, etc.

KATEŘINA POŘÁDKOVÁ, Archeologický ústav, Filozofická fakulta JČU, Branišovská 1645/31a, CZ-370 05 České Budějovice, Czech Republic; Laboratoř archeobotaniky a paleoekologie, Přírodovědecká fakulta JČU, Branišovská 31, CZ-370 05 České Budějovice; Czech Republic; katerina.poradkova@gmail.com
LENKA KOVAČIKOVÁ, Laboratoř archeobotaniky a paleoekologie, Přírodovědecká fakulta JČU, Branišovská 31, CZ-370 05 České Budějovice, Czech Republic; lenka.kovacikova@gmail.com

RESEARCH ARTICLE – VÝZKUMNÝ ČLÁNEK

The die for the production of the hammered kaptorgas from Kouřim, central Bohemia: An example of the local adoption of a Byzantine motif

Tepací forma na výrobu tepaných kaptorg z Kouřimi ve středních Čechách: Příklad lokálního osvojení byzantského motivu

Naďa Profantová – Daniel Dvořáček – Tomáš Kmječ

Kaptorgas were small trapezoidal boxes with lids worn by women and girls in early medieval central Europe as magic or protective amulets. The paper presents a new find of a bronze cast die for hammering the front side of kaptorgas, which was excavated at the Nad Dolnicí settlement site located in the hinterland of the important central Bohemian hillfort of Kouřim. The die was used to produce type 1A kaptorgas with a motif of a four-legged eared gryphon with an indication of a wing and a tail ending in a floral decorative element. Although kaptorgas with this particular motif have not been recorded in Bohemia, it has analogies in Bulgaria and Poland. Based on the stylistic assessment of this originally Mediterranean motif and the chronology of type IA kaptorgas in Bohemia, the die can be dated to the 10th and beginning of the 11th century. X-Ray fluorescence analysis and elemental mapping of the object's surface show that it was made from bronze with a significant lead admixture and a small admixture of zinc. The die is discussed in terms of the spread of Mediterranean motifs and their adaptation by local craftsmen.

kaptorga – goldsmithery – die/ hammering form – Bohemia – Early Middle Ages – stronghold hinterland – Byzantine influence

Kaptorgy byly malé lichoběžníkové schránky s víčkem, které nosily ženy a dívky v raně středověké střední Evropě jako magické či ochranné amulety. Tento článek představuje nový nález lité formy z bronzu sloužící k vytepávání přední strany kaptorg, která byla nalezena na sídlišti Nad Dolnicí nacházejícím se v zázemí významného středočeského hradiště Kouřim. Forma sloužila k výrobě kaptorg typu IA s motivem čtyřnohého gryfa s ušima, naznačeným křídlem a ocasem zakončeným rostlinným dekorativním prvkem. Přestože kaptorgy s tímto konkrétním vyobrazením nebyly v Čechách nalezeny, má motiv analogie v Bulharsku nebo Polsku. Na základě stylistického vyhodnocení tohoto původně středomořského motivu a chronologie kaptorg typu IA v Čechách lze tuto formu datovat do 10. a počátku 11. století. Rentgenfluorescenční analýza a prvkové mapování povrchu předmětu ukazují, že byl vyroben z bronzu s výraznou příměsí olova a malou příměsí zinku. Nález tepací formy je diskutován z hlediska šíření středomořských motivů a jejich adaptace místními řemeslníky.

kaptorga – zlatnictví – tepací forma – Čechy – raný středověk – zázemí hradiště – byzantský vliv

Introduction

Kaptorgas were characteristic of Bohemia, Moravia, Poland, northern Germany and areas inhabited by eastern Slavs. These small trapezoidal pendant boxes, likely linked to magic with apotropaic and protective functions, accompanied women and girls to the netherworld as part of their grave goods (*Štefan 2005*; *Profantová – Šilhová 2010*). The contents of boxes are very important for interpretation. With the current state of knowledge, it seems that kaptorgas spread over the territory of Bohemia in the 9th century, while a notable

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increase in their appearance in other areas occurred slightly later in the last third of the 10th century. In this paper, we introduce a new find from the Kouřim – Nad Dolnicí site, which represents a die or hammering form for the production of kaptorgas. It is the first evidence of such a tool in the territory of the Czech Republic.

Although the testimonial value of the find is limited by the ambiguous archaeological context, it has the potential to broaden our knowledge of two crucial issues of early medieval archaeology in central Europe. First, it indicates local production of kaptorgas outside the Prague area, where we reasonably – albeit without direct proof – consider such production (*Profantová – Daněček 2017*; *Frolíková-Kaliszová 2023*). Second, the die, as will be discussed further in this paper, is a product of Byzantine inspiration. Mediterranean influences on the material culture of Bohemia and Moravia in the 10th and early 11th century have not been studied in depth and are rather underrated in the current literature.

We will start our analysis with a formal analysis of the artefact and the stylistic assessment of the decorative motif. Material composition analysis and geographically wide-based comparison follow. Furthermore, we will discuss how the originally foreign motifs were adapted in the local Bohemian milieu.

The site and the find context

The settlement site of Kouřim – Nad Dolnicí (49.99428N, 14.98397E) is located in central Bohemia, Czech Republic. It lies on a small promontory with a size of 3.8 ha and elevation from 270 to 280 metres above sea level. Water at the site comes from a small stream running north-east into the small Výrovka River. The promontory is elevated about 20 metres above the Výrovka (*Fig. 1*).

The settlement was probably part of the closest surrounding area of the Kouřim – U Sv. Jiří hillfort (*Fig. 1: B*), as it was located only 400 metres from its southernmost fortification. Another even closer settlement linked to the hillforts is to have been located right outside of the fortification forming its southern bailey (*Fig. 1: E*). Based on surface prospections that produced finds of iron slag, metallurgy and metal-smithing could also have taken place here (*Tomanová 2012*, Fig. 31 and 43). Therefore, two relatively contemporary production areas related to the U Sv. Jiří hillfort can be considered, though their chronological succession cannot be ruled out.

In 2012, the Kouřim – Nad Dolnicí settlement site was researched by a systematic surface prospection in a square grid (*Fig. 1*). The campaign revealed finds dated generally from the 10th to the first half of the 13th century (*Dvořáček 2021*). The pottery corresponds to production from the second half of the 10th century to the turn of the 13th century. Notably, a variant of an imported Prague chalice-shaped rim from the second third of the 10th and the11th century was identified (*Dvořáček 2021*, fig. 7: 10, 8: 11). A larger amount of iron slag (151 pcs, 2 641 g) indicating the craft or production-oriented character of the settlement was recorded.

The production character of the settlement is also supported by other metal finds, particularly early medieval belt fittings: a small cast strap-end with tendril decoration from the 8th–9th century (length 34 mm, *Fig 2: 4*) and somewhat later gilded belt-hole guards with a raised middle, possibly with a filling liner (length 19.2 mm, *Fig. 2: 3*). The latter fitting does not have an intact hitch. It could mean that it was unfinished, or it was meant

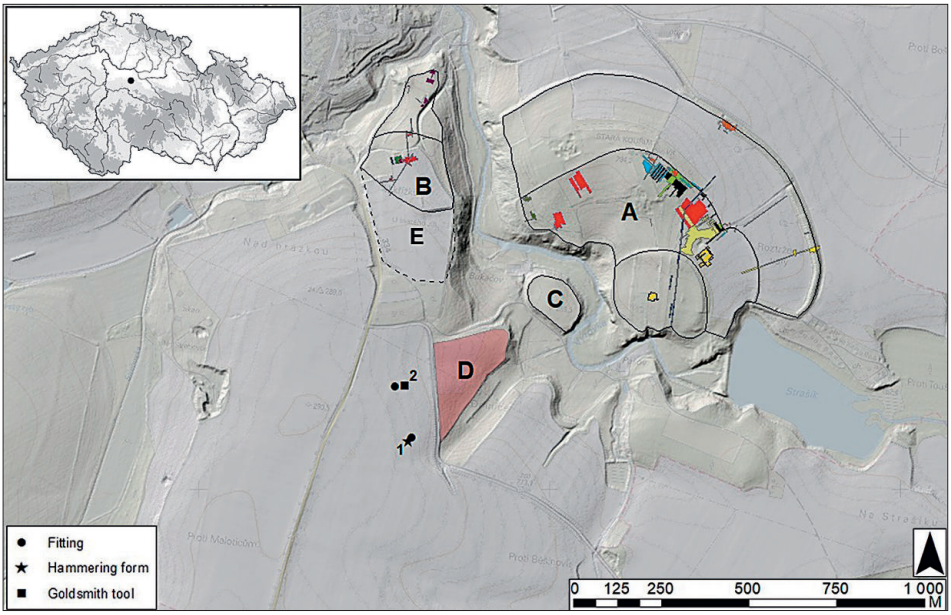

Fig. 1. Topographic situation of the Kouřim area with the main hillforts and position of the key finds from the Kouřim – Nad Dolnicí settlement. A – Stará Kouřim hillfort; B – Kouřim – U Sv. Jiří hillfort (position of trenches marked); C – Kouřim – Sv. Vojtěch hillfort; D – Kouřim – Nad Dolnicí settlement; E – assumed bailey of the Sv. Jiří hillfort; pink area – extent of systematic surface prospection in 2012.

to be glued to the leather, but this arrangement has not yet been documented. Unfortunately, belt decorations from the second half of 10th to the 11th century are not well known, since they were not placed in graves. Therefore, the dating of the gilded fitting remains rather loose, probably generally the 9/10th–11th century.

From chronologically later finds, temple-rings with S-shaped terminals of a medium and large diameter should be mentioned. A significant find is a massive bronze goldsmithing punch with a narrow working edge and traces of use[1] (length 101 mm, inv. no. A 15999, *Fig. 2: 5*). The only analogy from 8th–9th century is a much more delicate punching tool from nearby Tismice hillfort in the Kolín district (*Profantová et al. 2020*, fig. 46: 4) that could be dated to the interval from the end of the 8th century until the end of the 11th century. However, due to the find of the die, the simultaneity of the two items is probable. Goldsmithing production can also be assumed by the semi-finished temple-ring with an S-shaped terminal made of thick copper alloy wire (*Fig. 2: 1*) and a lump of amber (*Fig. 2: 2*, weight 2.12 g, 17 × 12 mm). The find of a lead cast, originally of a circular shape (length 26 mm, weight 9.9 g) could also be linked to metal casting and hammering.

The die that is the focus of this paper was found during metal detector prospection at the end of the year 2022 in the less-surveyed western part of the settlement area (*Fig 1: 1*). The artefact is currently deposited with other finds from Kouřim – Nad Dolnicí in the collection of the Regional Museum in Kolín (Inv. no. A 15991).

[1] Our thanks to L. Barčáková for the important information.

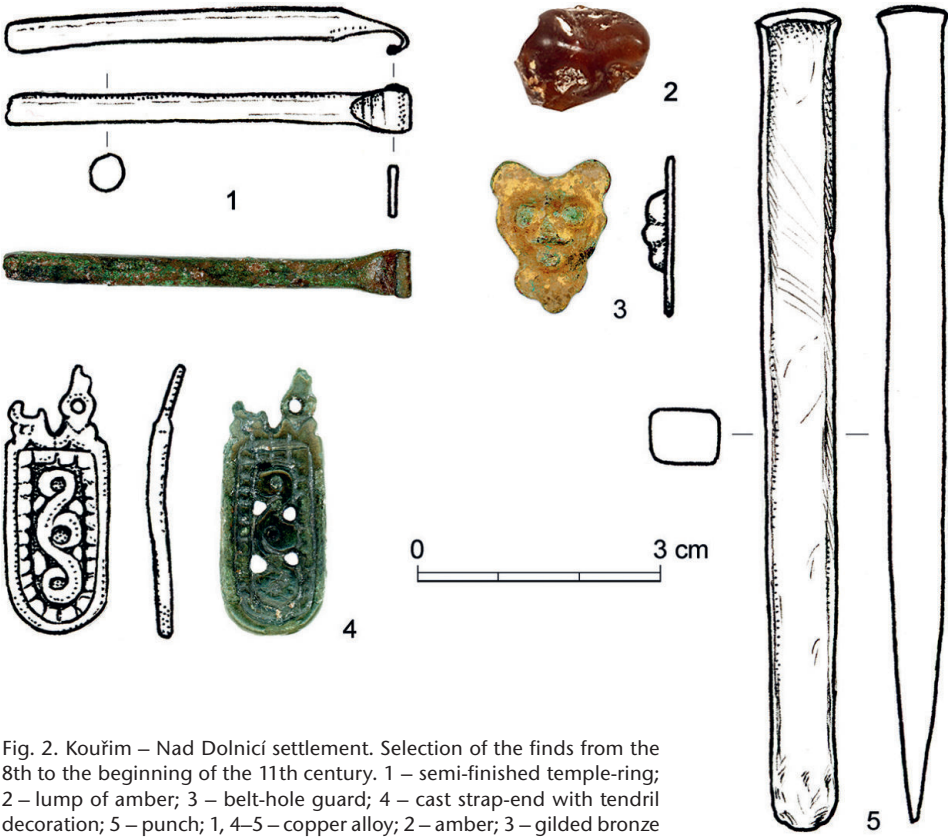

Fig. 2. Kouřim – Nad Dolnicí settlement. Selection of the finds from the 8th to the beginning of the 11th century. 1 – semi-finished temple-ring; 2 – lump of amber; 3 – belt-hole guard; 4 – cast strap-end with tendril decoration; 5 – punch; 1, 4–5 – copper alloy; 2 – amber; 3 – gilded bronze (drawing and photo by L. Raslová).

Description and analysis of the die

The die has a trapezoidal shape (*Fig. 3*) and has a maximum width of 36.7 mm, an upper edge of 28 mm, a height of 32 mm, and a thickness of 3 mm. The artefact weighs 26.9 g. A trapezoidal cast fitting with double relief framing and a smooth strip in the upper part is decorated by the motif of a four-legged gryphon with something akin to a collar on its neck. One of its forelegs is bent, and the hind legs are perpendicular and seemingly shorter (artistically not as well made). The claws are visible on all four legs. The eye is prolonged and there are two visible ears on its head. The wing is disproportionally small, incised folded and blends in with the ornament to form a triangle. Its tail is threaded behind its hind legs and finished by a floral palmette, where the edge leaves are coiled. The artistic depiction is complimented by the two separate areas with punched backgrounds. The thigh of the front leg and the triangle on the body symbolise the folded leg.

The artefact is a die for the production of technological type IA kaptorgas (*Profantová – Šilhová 2010*) belonging to the group with engraved animal decoration on a punched background. Such kaptorgas are mostly associated with a Prague workshop (*Profantová – Daněček 2017*, especially fig. 4, also *Frolíková-Kaliszová 2023*, 135ff).

Fig. 3. Die/hammering form from Kouřim – Nad Dolnicí (drawing and photo by L. Raslová).

X-ray fluorescence analysis

The surface of the die was analysed at the Institute of Physics of the Czech Academy of Sciences using the EDAX Orbis Micro-XRF Analyzer energy dispersive x-ray fluorescence micro-spectrometer (ED XRF, the size of the measuring point was ~30 μm), which allows the detection of the chemical elements from sodium to uranium (Na-U) during measuring in a vacuum and without the covering of the sample. Due to the uniqueness of the item, an area elemental analysis of the surface was chosen. The non-standard semi-qualitative calculations of the concentration of the elements were used for the determination of the mean chemical composition.

The values of the resulting relative weight concentrations of the detected elements/oxides were normalised to a total of 100%. Due to the corrosion of the surface, it is necessary to consider the analysis of the composition of the alloy to be only indicative; iron and tin are overstated (*Tab. 1*). The alloy is on the basis of copper alloyed with lead, tin and zinc. The other chemical elements can probably be ascribed to the contamination of the oxide surface layers. This corresponds to the presence of phosphorous (P) and other elements such as iron and silicon.

Elem	SnL	FeK	CuK	ZnK	PbL
Wt%	48.9	1.2	36.3	0.7	13
At%	38.3	1.9	53	0.9	5.8

Tab. 1. Estimate of the average concentrations of the detected elements in the upper part of the die.

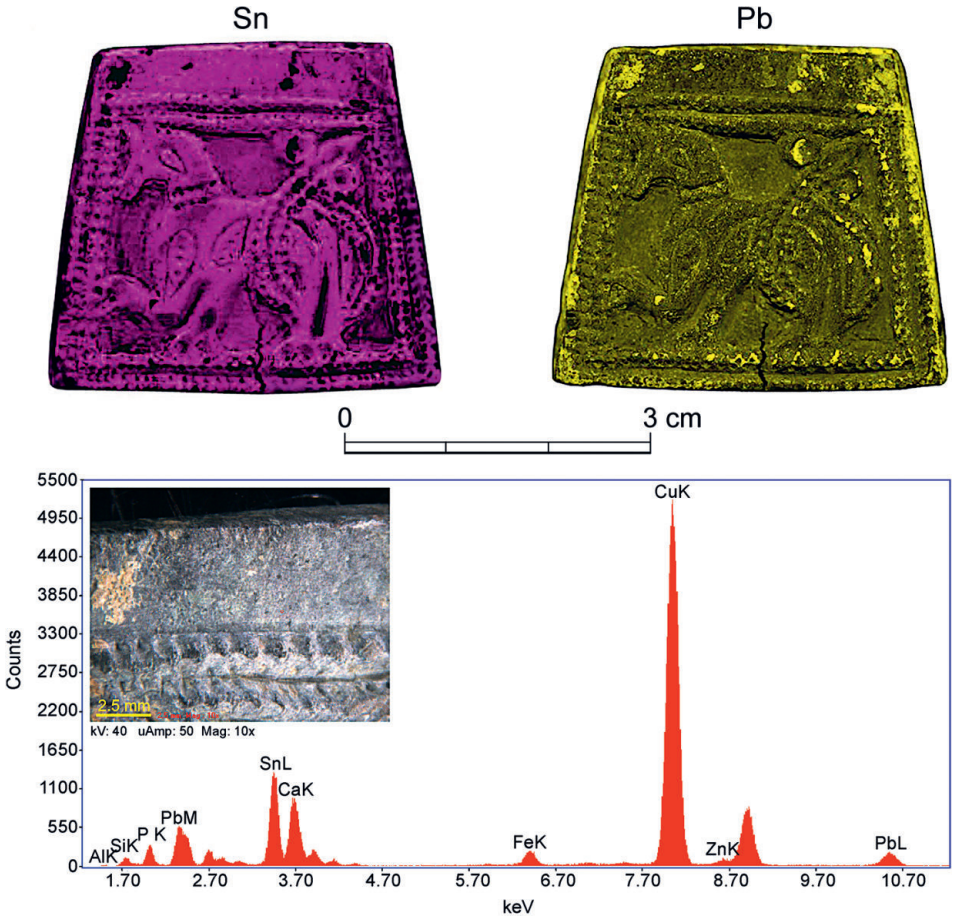

Fig. 4. Map of the surface of the hammering form according to the presence of Sn and Pb. The higher brightness represents the higher relative presence of the chemical element. XRF spectrum of the material composition of the die and the place of measurement.

Surface mapping

Representation of the specific chemical elements was measured from the obverse side with a measuring trace with a diameter of ~30 μm and the spacing between measuring points of about 100 μm (area ~72 × 52 mm, in the matrix 552 × 400 points). The representation of the chemical elements was observed on the lines of aluminium (Al), silicon (Si), phosphorous (P), lead (Pb – lines L and M), iron (Fe), copper (Cu), and zinc (Zn) (*Fig. 4*; *Tab. 2*).

Tab. 2. Estimate of the average concentrations of the detected elements on the surface.

Elem	SnL	FeK	CuK	ZnK	PbL
Wt%	33.7	1.8	34.3	0.6	29.6
At%	28.2	3.2	53.5	1	14.2

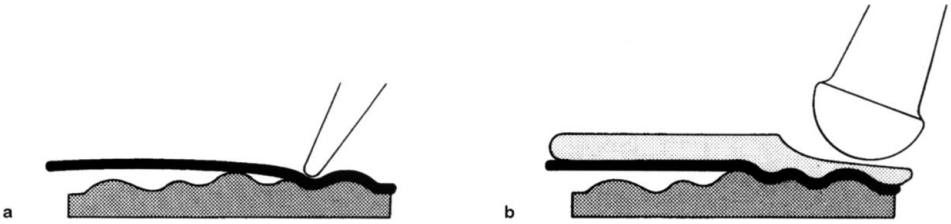

Fig. 5. a – pressed sheet production with the sheet (black) into the raised relief (grey) of the die with a point or punch; b – pressing the sheet into relief using a lead sheet (light grey) and round-faced hammer (after *Armbruster – Eilbracht 2006*, fig. 6.)

There is a significant fluctuation in the representation of tin and lead, and the share of other chemical elements is comparable in the point analysis and in the average composition of the surface. In the case of the high content of tin, we are more inclined to agree with the interpretation that there is a link to the corrosion of the surface rather than to the idea of deliberate tin-plating of the hammering form, similar to the case of the die from Tismice dated to the 8th century (cf. *Profantová et al. 2020*, 242, Tab. 8).

The hammering die was made from bronze with a significant lead admixture (close to 14%) and a small admixture of zinc; the amount of copper is strongly understated due to the corrosion. As far as we know, the only comparable artefact – the Polish die from the grave in Brześć Kujawski – has never been subjected to detailed material analysis.

Stylistic assessment and interpretation

The classification of the artefact as a hammering form for kaptorga production is supported by its size and trapezoidal shape. The robust character of the object and its weight probably rule out other possible functions. Moreover, the upper area of the artefact remained without decoration, since in the case of a finished kaptorga the decorated lid would go over it. During production, the box was put on the die and the relief was hammered into the metal sheet of the future kaptorga (*Fig. 5*).

With regards to the lack of the detailed context of the find, we have to proceed from a broad comparison and the stylistic assessment of the find.

Comparison

Based on its size, the die from Kouřim was used to hammer products that belong to the group of larger trapezoidal kaptorgas with a base over 30 mm. Kaptorgas from Dobrovíz (Praha-západ distr., 40 mm), Dobroměřice (Louny distr., 34 mm), Prague – Lumbe Garden (grave 16, 38 mm), and probably also Čelákovice (Praha-východ distr., 30 mm) are representatives of the group found in Bohemia (*Profantová et al. 2011*). The height of the Kouřim die corresponds to the complete kaptorga from Žatec and is similar to the one from Debrno (Mělník dist., 30 mm), Dobrovíz (Praha-západ distr., 36 mm), Prague – Lumbe Garden (grave 16, 31.5 mm), and to the iron kaptorga excavated in grave 31 at the cemetery in Klecany I (*Profantová et al. 2015*, 168, Tab. 12.3). The decorative framing that appears on the die is also common for kaptorgas from Bohemia, e.g. Dobrovíz (*Fig. 6: 6*),

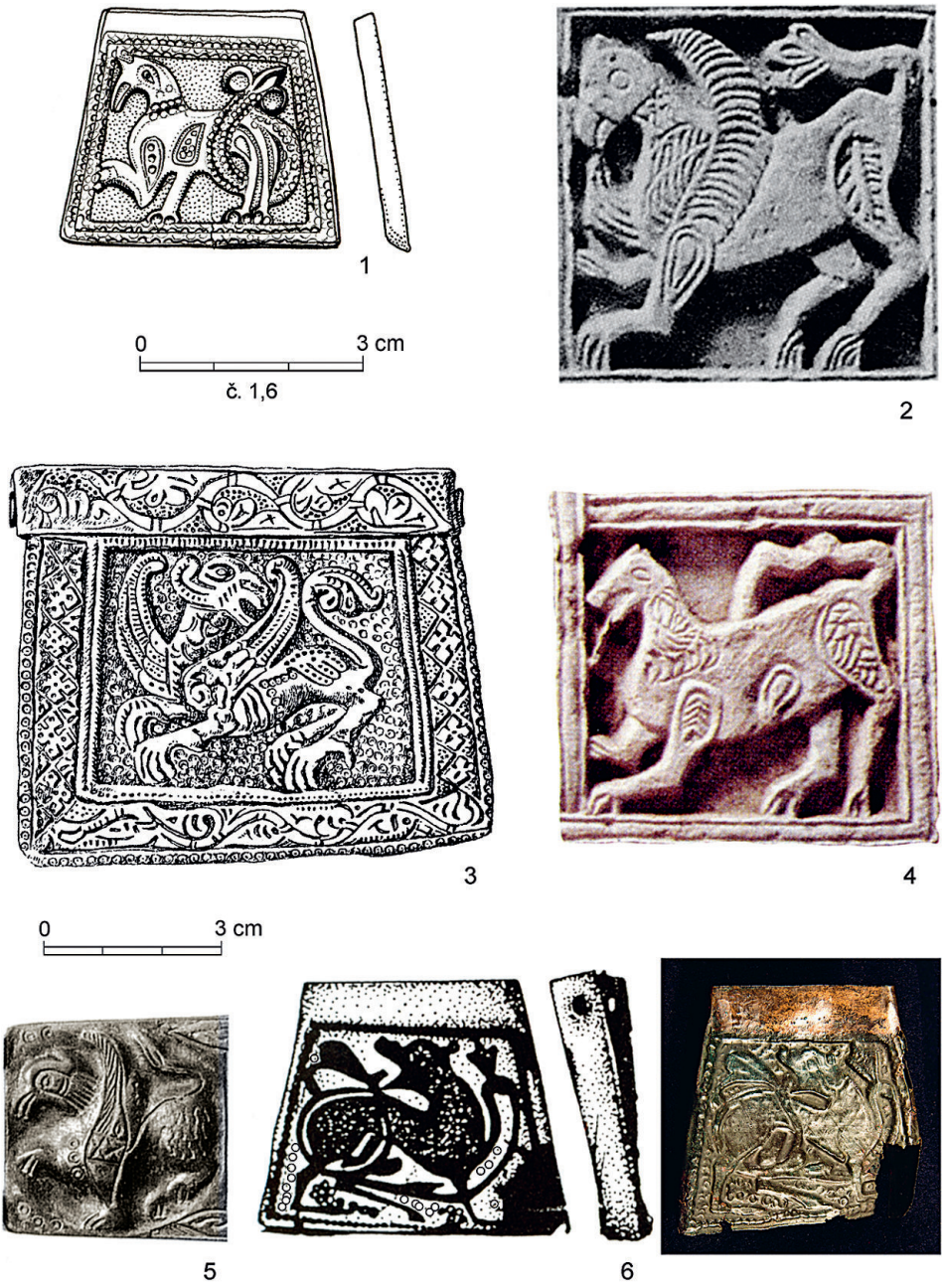

Fig. 6. Different stylisations of the gryphon motif in the 9th–11th/12th century. 1 – Kouřim; 2, 4 – Aquilea, stone choir screen (9th century); 3 – Chełm Drezdenecki, hoard find (11th century). 5 – Paderborn, buckle (detail, 9th century); 6 – Dobrovíz (10th century). 1, 5 – Cu alloy; 2, 4 – Stone; 3 – Ag. 1. Drawing L. Rasl-ová. 2, 5 – After *Bálint 2010*, Abb. 148; 3 – After *Ślęski – Tabaczyński 1959* and *Sztyber 2006*, Tab. II; 4 – After *Knific – Nabergoj 2016*, p. 98; 6 – After *Profantová – Šilhová 2010*, fig. 8, photo: Marie Opatrná, National Museum Prague, inv. number H1-96955.

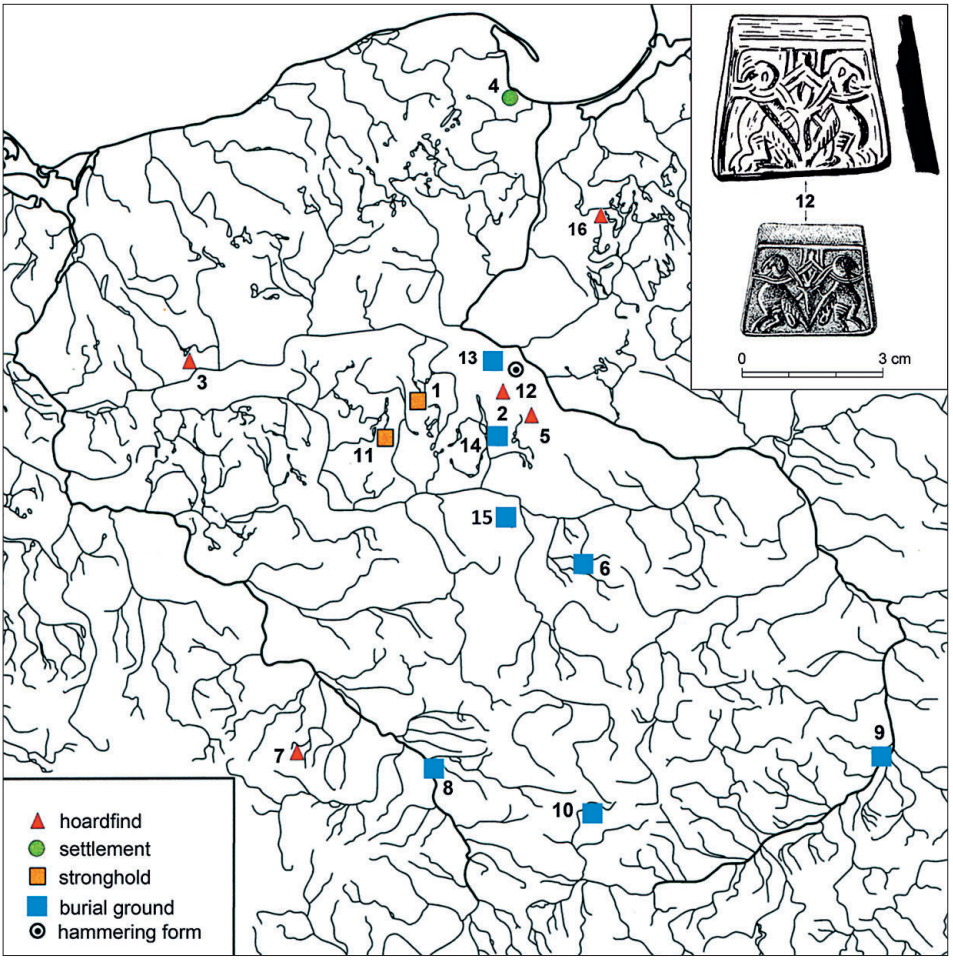

Fig. 7. Kaptorgas of type IA in Poland and the die from Brześć Kujawski. 1 – Biskupin; 2 – Borucin; 3 – Chełm Drezdenecki; 4 – Gdańsk; 5 – Maszenice; 6 – Lutomiersk; 7 – Opole; 8 – Ostrów Lednicki; 9 – Radzików II; 10 – Sandomierz; 11 – Strzemieszyce Wielkie (Dąbrowa Górnicza); 12 – Brześć Kujawski; 13 – Bodzia (imports from eastern Europe); 14 – Dziekanowice; 15 – Kwiatków; 16 – Olbrachtówek /Prabuty (map after *Sztyber 2006*; *Czonstke – Koperkiewicz 2013*; die from Brześć Kujawski after *Profantová – Daněček 2017*, Fig. 4: 3).

Kováry–Budeč, (Kladno distr., *Váňa 1990* – colour photo), and Silesia, as documented in Opole – Groszowice (G. 38, *Wachowski 1975*, fig. 18: 48; *Sztyber 2006*, tab. XV; *Kurasiński 2021*, Fig. 10: 3). In the case of luxurious kaptorgas, the framing is made from granulation, e.g. Prague-Lumbe Garden, grave 16 (*Ottenwelter et al. 2014*, Fig. 4/57), and sometimes only the upper part (where the lid fits) was separated by relief as on the kaptorga from Žatec and Stehelčeves (Kladno distr., *Profantová – Šilhová 2010*, fig. 11: 3; 17: 3). To date, double lining of the decorative field is very rare, as is found only on the kaptorgas from the grave in Dolní Věstonice (Břeclav distr.), where the lining was made by strips of filigree (*Štefan 2005*, fig. 2:1), and on the kaptorga from Radslavice in Moravia (*Kouřil – Procházka 2018*, 60, Fig. 10: 2). In Poland, a double border was recorded on a kaptorga

from Borucin (*Sztyber 2006*, tab. 1; *Sztyber 2008* with photo). In contrast, the kaptorga from Chełm Drezdenecki has a differently designed wide border decorated by a floral motif (*Fig. 6: 3*; *Kryda 2021*, fig. 9), similarly to the other two kaptorgas from the hoard.

The only cast hammering form of the same shape comes from Brześć Kujawski in Poland (*Fig. 7*; *Kostrzewski 1962*, 256, fig. 225; *Profantová – Šilhová 2010*, 304; *Profantová – Daněček 2017*, fig. 4: 3). With a size of 42 × 33 mm, it is slightly wider than the die from Kouřim (*Fig. 3: 2*). It was also made of copper alloy. It has a plain border with a decorative field and depicts a pair of animals attached to the tree of life. According to the interpretation by *Gąssowska* (*1979*, 138), it is a composite figure with the bodies of dogs with the heads of birds sitting back-to-back, supposedly a symbol '*originating from India and Sasanian Persia*', but also used in Byzantine art. The authors of the published image recognised only birds with obvious predatory attributes (large beaks and claws). The hammering form from Brześć Kujawski was found in male inhumation grave no. 160 interpreted as the grave of a goldsmith even though it did not include any other tools, which surprised even the authors of the publication (*Kaszewska – Kaszewski 1971*, 382, 424, T VIII: 2). The hammering form was positioned near the left shoulder of the deceased, so it was not right by his hand. The grave with the die belongs to the same group as grave 16, which contained the silver pendant made of a part of the 'cross denarius' minted in Gniezno in the last quarter of the 11th century. The importance of this burial ground is also supported by the grave of a military elite member equipped with a sword and an axe. Goldsmith's grave no. 160 was dated to the second half of the 11th century and is later than the die from Kouřim. S. Tabaczyński already remarked on the likely connection of the hammering form with the Bohemia milieu (*Śląski – Tabaczyński 1959*; *Kaszewska – Kaszewski 1971*).

Both hammering forms from Kouřim and Brześć Kujawski produced kaptorgas of the IA type according to N. Profantová, or the type III,[2] which, however, occurred rarely in Bohemia (*Profantová et al. 2015*, fig. 7.34). Type IA is the most popular type in Bohemia with finds of 23 or 24 kaptorgas (*Fig. 8*; *Profantová – Daněček 2017*). Most of them were made of silver, and only eight or nine were made of a copper alloy.[3] These kaptorgas are made from two sheets and they easily opened and have separately made lids (see *Fig. 6: 3* with lid, *Profantová – Šilhová 2010*, with the reconstruction of the production, fig. 8). Finds of type IA are also recorded in Poland, but these kaptorgas are not as numerous in this area and come from the 11th century or later (*Fig. 7*; *Sztyber 2006*; *Sztyber 2010*; *Kurasiński 2021*, fig. 4; 8 and 10).

Trapezoidal kaptorgas are among items produced as more demanding jewellery and their decoration was, at least in Bohemia, highly individualised. According to the typology by *Profantová* and *Šilhová* (*2010*, fig. 12), the positives produced by the Kouřim die would have belonged to group 1 or 2 – engraved animal motifs or those in semi-relief or,

[2] Type IB kaptorgas (in animal style of decoration) were found at the 'U Libuše' burial ground at the Stará Kouřim hillfort (*Fig. 1: A*); a less opulent type IA kaptorga is still missing among the finds from the Stará Kouřim hillfort. The Late Hillfort period (11th–12th century) burial ground near the Church of St. George no longer contains such amulets (*Šolle 1981*). The U Sv. Jiří hillfort (*Fig. 1: B*) was established in the last third of the 10th century.

[3] Although the another kaptorga from Hostivice (Praha-západ distr.) has not yet been published, it was most likely made of bronze.

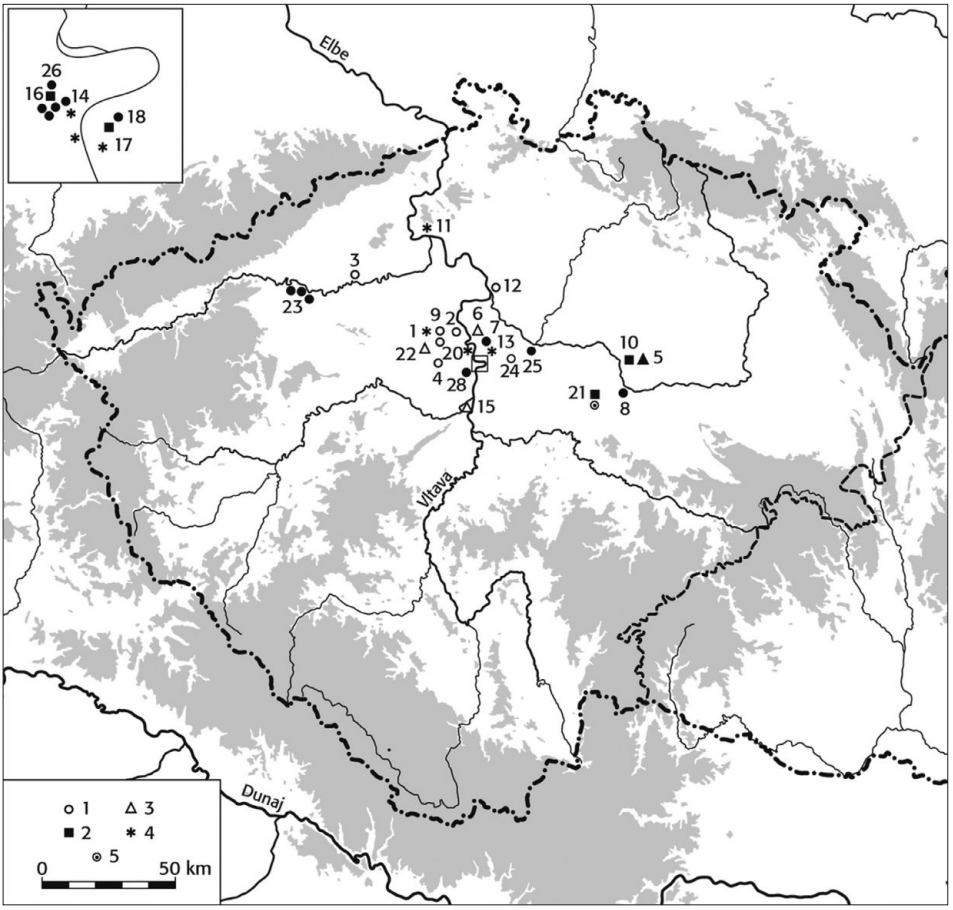

Fig. 8. Map of construction-based types of kaptorgas in Bohemia (I–IV): 1 – type IA (most numerous); 2 – type IB with sculptural animal motifs (made in Prague workshop); 3 – rare types II, III, IV, VI; 4 – indeterminable; 5 – bronze die. Filled in mark indicates that the find was made of silver. After *Profantová – Šilhová 2010*, fig. 14, filled in. Mentioned sites and sites with type IA: 2 – Debrno; 3 – Dobroměřice; 4 – Dobrovíz; 6, 7 – Klecany I and II; 8 – Kolín; 9 – Kováry-Budeč; 10 – Libice nad Cidlinou; 12 – Mělník; 14 – Prague-jízdárna; 16 – Prague-Lumbe Garden; 18 – Prague-Václavské nám.; 20 – Žalov; 21 – Kouřim – hillfort and Kouřim Nad Dolnicí; 23 – Žatec (3 pcs); 25 – Čelákovice; 26 – Prague-Střešovice, Triangl; 28 – Hostivice.

technically speaking, pressed ones. This is a less luxurious group of these amulets/jewellery compared to kaptorgas decorated with sculptural motifs of horses accompanied by filigree and granulation. Pressed animal motifs are known only from Dobrovíz (*Fig. 6: 6*), while a more primitive form was documented in Žatec (*Profantová – Šilhová 2010*, fig. 11: 3), and then with only symmetrical floral motifs in a similar composition in Kováry – Budeč, Kladno distr.[4] Besides kaptorgas, a pressed animal motif is known from a similarly

[4] The location of kaptorga no. 125/83 is not known today, though a similar piece from the same site is in a private collection. Photo *Váňa 1990*, colour photo, also *Štefan 2005* (drawing).

Fig. 9. Veliko Tarnovo, Bulgaria. Model or die with relief gryphon, lead. After V. *Pletnyov 2004*, tab. 4: 49 (courtesy of the Varna Museum).

made plaque with added engraving from a rich grave in Želénky near Duchcov dated to the 9th century (*Profantová 2020*, fig. 6).

Motif of gryphon in Byzantium and its spread

The antique motif of the lion or gryphon reached its early medieval peak of popularity in Byzantium from the 5th to the 13th century. The gryphon motif appeared in a monumental version (decorated choir screens, thrones, etc.) in toreutics and metal decorations, ivory and silk, not to mention wood, which did not remain intact. The motif of a gryphon was continuously used as protection of the ruler from Late Antiquity to the Middle Ages by the Byzantine Empire and its culture sphere (e.g. *Daim 1990*).

From this epicentre, it spread in different waves northeast and northwest to central Europe, most often through the Balkans and the Carpathian Basin. The Byzantine style can be observed for instance in a depiction of a walking gryphon on the stone altar from the Basilica Santa Maria in Aquilea dated to the first half of the 9th century. There are very interesting details of the emphasised belt on its neck and tail ending in a trefoil (*Fig. 6: 2*; *Bálint 2010*, Abb. 148: 7). Also, a panther on the choir screen of the same church is depicted in very similar fashion (*Fig. 6: 4*; *Knific – Nabergoj 2016*, 98). In both cases, the beasts have ornamentally decorated thighs on their separated legs and similarly stylised claws.

The standing gryphon of the highest quality with a prominent wing made of vitreous enamel on the small plates of a diadem from the treasure trove of jewellery found in Preslav (Bulgaria) as a Constantinople import (e.g. *Atanasov 1999*, fig. 4) shows the popularity of the motif in the first half of the 10th century in Byzantium. However, more interesting from our point of view is that a lead rectangular model/die with a relief gryphon with a crescent-like wing and tail that turns into leaves while the reverse side remains smooth also comes from Bulgaria, specifically the vicinity of the later centre Veliko Tarnovo. The artefact was dated to the 10th century (*Fig. 9*). This motif was unique even for Bulgaria before 2004, when the find from Veliko Tarnovo was published (*Pletnyov 2004*, 232, tab. 4: 49). In any case, decorations with the gryphon motif were hammered in Bulgaria.

Fig. 10. Woven silk cloth with gryphon motif in a medallion of Byzantine origin, also with the decorative belt on neck (8th–11th century). Clothes played a key role in spreading the motifs along the Silk Road and in the Mediterranean (collection of Victoria and Albert Museum, London, UK, accession no. 764-1893; https://collections.vam.ac.uk/item/O93151/woven-silk-unknown/)

A classical hunting gryphon is depicted on red silk from the time of the wedding of Theophanu with Emperor Otto II in the year 972 (*Schneidmüller 2000*, 685, Abb. 438), and an incomplete gryphon in a medallion was found on other fabrics (*Fig. 10*: head in a medallion; pair of gryphons: e.g. Constantinople, 11th century, *Daim (ed.) 2010*, 172, no. 61, and *Stiegmann – Wemhoff 1999*, 536, with photo, similar characteristic tear shape on the leg).

On various metal and stone objects, the depiction of a gryphon appeared continuously. This involves 5th/6th–7th-century Byzantine buckles, 7th-century metal vessels like the one from Nor-Bajazet in Armenia (*Bálint 2010*, 385, Abb. 145: 1, Russian Novyj Bajazet, hoard find of silver vessels. Here too the gryphon's tail ends in a floral component), 8th-century gold belt fittings from Vrap in Albania, 10th-century vitreous enamels and other decorations as well as toreutics from the 12th century (*Fig. 6: 5*). Noteworthy among later decorations is the motif of a gryphon with a wing similar to Kouřim on the oblong area on the fields separated by tendrils on the bracelet from the 11–12th century, which is now part of the collection of the Benaki Museum in Athens (*Yeroulanou 2010*, 48, Pl. 28–27). We can assume that it is later than the gryphon depiction from Kouřim.

The Germanisches National Museum in Nüremberg holds in its collection an ivory comb with a motif of two gryphons, in this case already combined with Christian iconography directly symbolising Christ himself. The comb comes from the site of Markt Erlbach and dates to the 9th/10th century (*Wamser 2004*, 416 and photo).

In the 10th century, the gryphon motif reappeared in the Carpathian Basin, mostly on Byzantium-influenced ancient Hungarian decorations (engraved gilded bag fitting from

Tiszabezdéd, *Fodor 1996*, 182–183, with photos) or direct Byzantine imports (bracelet from Szarvas with an animal without wings in medallion, *Ballók 2010*, 178, Pl. 7; also *Bálint 1989*, Abb. 100: 2).

The gryphon motif in Bohemia and the surrounding territories in the 8th–10th century

As forms of stylised of gryphon depictions spread from Byzantium in different directions, it is difficult to determine the specific route by which they reached the craftsmen working in Bohemia. From the 8th century onwards, the Carpathian Basin was evidently the most important transmitter of Byzantine motifs into the Bohemian environment, and although there is no record of the gryphon motif from the 9th century, this direction remained determinative at least until the end of the millennium. However, mediation through Dalmatia and northern Italy should be also considered (*Profantová et al. 2020*, fig. 21; *Profantová 2023*). In this context, it is worth mentioning that Stará Kouřim produced a find of a bronze encolpion with the motif of the Virgin Mary with Greek letters engraved on the reverse side, which may have been imported from the Balkans (*Profantová – Stolz 2007*).

A new hoard find with three gilded fittings with a gryphon depiction was discovered in the year 2022 in NW Bohemia; unpublished, it can be preliminarily dated to the 10th century. Depictions of gryphons are documented again from the second half of the 10th century and the beginning of the 11th century. In this period, they were used on kaptorgas. Much more commonly, gryphons were adapted on later Romanesque tiles since the second third of the 11th century (*Boháčová 2003*, 205–208).

The stylisation of the gryphon on the die from Kouřim partially corresponds to the earlier stylistic circle; the motif is of the Byzantine type, which also appeared in the Carpathian Basin. Similar bordered emphasis on the thighs, for instance, is found on the animal on the strap-end from Benepuszta dated to the 10th century, even though it was made in the niello technique and also differs from the Kouřim gryphon in other details (*László 1971*, Abb. 180–181; *Fodor 1996*, 338 in colour). A wingless variant is known from grave 550 at the Birka cemetery, but the stylisation of the animal is not as skilful, even if it is placed on a gilded background (*Hedenstierna-Jonson 2012*, Fig. 4). A different engraved depiction comes from the fitting of a rider's bag from Tiszabezdéd (*Fodor 1996*, 182–183, with photos). Stylisations from the ancient Hungarian/Magyar milieu are also different from the gryphon on the Kouřim die. Other stylised openwork animals with striking tails appeared on the round braid decorations from the 10th century also from the Carpathian Basin.

The artisan who produced the hammering form from Kouřim evidently skilfully managed the front part of the gryphon, which appears rather rigid and heraldic-like. Nevertheless, he did not leave enough room for the hind legs and their appearance is thus not well rendered; however, the great emphasis on the tail executed similarly to the frame of the scene lends a certain dynamic and style to the depiction. It is particularly the threading of the tail that links it to another zoomorphic depiction on the kaptorga from grave 3 at the Dobrovíz cemetery in central Bohemia dated to the 10th century. The mythical beast of Dobrovíz is probably a lioness, as it has no mane and wings. However, its head is turned and its tail is woven behind a hind leg. The legs are so thin, especially the right front one,

that they could not support the animal, and the stylisation is completed with a floral stalk (*Fig. 6: 6*; *Profantová – Šilhová 2010*, fig. 11: 1). The scene is supplemented with relief rings at the bottom, which were probably stamped in places in only three quarters of the ring,[5] and one of the lower corners of the kaptorga and the lid are now missing.

A silver kaptorga deposited after 1056 in the hoard from Chełm Drezdenecki (*Fig. 6: 3*; *Śląski – Tabaczyński 1959*, 16, tab. 1: 1; colour photo with all kaptorgas: *Kryda 2021*, fig. 9) connects it with the Kouřim form of the hind leg stylisation, but here the overall stylisation of the gryphon is different in detail. The animal has two massive wings and the head is turned towards the back. This kaptorga was made in the first half of the 11th century, so it is later than the Kouřim one. A kaptorga with a lion from Opole-Groszowice in Silesia was found in a grave with six small temple rings and glass and amber beads (*Fig. 7: 7*; *Wachowski 1975*, fig. 18: 48). It probably belongs to the circle of Bohemian production or production inspired from Bohemia. The Mediterranean influence is highlighted by the use of a palm tree motif. However, the depiction is the simplest and executed in below-average quality. The high quality of the Kouřim die is highly evident when compared to the kaptorga from Dąbrowa Górnicza-Strzemieszyce Wielkie (*Tokaj 2009*), where the motif differs. The gryphon, if the depicted beast is truly a gryphon, has its head turned towards the back (*Kurasiński 2021*, fig. 8).

In addition to the main motif, the assessment of supplemental decoration may also bring important information. The accessory circular or triangular stamps used on the Kouřim die are already known from the early appearance of the fittings with a gryphon in the Carpathian Basin at the end of the 7th century and at the beginning of the 8th century (*Bálint 1989*, Abb. 86; *Profantová 2018b*). In Bohemia, however, such elements accompanied only depictions of a lion, not a gryphon (*Profantová 2018a*, Abb. 6: 1) and also some floral motifs in the later 8th century (*Profantová et al. 2020*). During the 9th century, we can see them only in the southern and western parts of Europe, specifically on a part of a Byzantine buckle from Paderborn (*Fig. 6: 5*); Czech gombiks from the end of 9th–10th century have only dots on their background (*Košta – Barčáková 2023*). Repoussé circles were used on the kaptorga with a lioness from Dobrovíz (*Fig. 6: 6*) in the second half of the 10th century. Complementary engraving appears on the unpublished circular phalera from the area of Hasištejn Castle in northwest Bohemia dated to the 11th–12th century.

Discussion

Byzantine footprint in the material culture of early medieval Bohemia

Byzantine inspiration for the hammering form from Kouřim is suggested by more than just the decorative motif. The models for the kaptorgas of the main IA type were most likely Byzantine golden reliquaries, for instance the St. Zacharias reliquary from the 6th century (*Profantová – Šilhová 2010*, 292; *Ross 1962*, Pl. XXVII). The provenance of the die is also corroborated by the tradition of interactions that can be documented in our milieu on the small artefacts from the onset of the culture with Prague-type pottery in

[5] The published drawing does not fully correspond to the photo of the rings and the remaining part of the border.

the 7th century (bronze die from Jíkev: *Profantová 2016*). The role of the intermediary of Mediterranean influences there was probably mostly played by the Avar Empire – 'Byzantium on the Danube' according to the meaningful metaphor of *Breuer* (*2005*). Mediation through northern Italy can be also considered (*Bálint 2019*). Our understanding of the adaptation of Byzantine motifs in Bohemia is hindered by the cremation funeral rite, which limited the availability of male metal decorations in the archaeological record. Only a few are known mostly from settlements and hoard finds. Even so, we can prove both direct imports (Černošice, Domoušice: *Profantová 2021*; *2023*) and the strong impulses for the local production of the metal decorations of belts and horse-harnesses. Before the middle of the 9th century, the spectrum of impetuses was significantly expanded by Carolingian influences.

The Mediterranean influence became less pronounced and immediate, with the exception of the use of ivory on the pendant from the well-known Kolín grave and some female granulated jewellery originating directly from the south or being of intermediated Moravian origin. This turn corresponds to the historical interpretation of the change in the orientation of the Bohemian milieu toward the Carolingian Empire. Nevertheless, evidence in the material culture of the 10th century, especially its second half, remains in the shadow of this expansion. In connection with Byzantian influence, we can mention only two gold coins and one silver coin (*Profantová 2008*; *Profantová et al. 2012*; *Mařík 2018*, fig. 6). Silk headbands or clothes appear repeatedly in the graves of elite men and women (Kouřim, one grave; Klecany I, two graves; Prague Castle, multiple graves; *Profantová 2008*, fig. 6). Silk comes to Bohemia from Byzanz, i.e. the Eastern Mediterranean. Rarely found cauri mussels, which are currently known from six Bohemian sites (latest *Lutovský – Špaček 2020*, 57: 4 graves in Zeleneč; also *Profantová 2018b*, 113, fig. 11: 9, 10) were more likely intermediated through Hungary rather than imported via a direct contact with Byzantium.

From the point of view of Byzantine imports, the greatest attention has been paid to reliquary crosses from the late 10th to 12th century, some of which bear Greek inscriptions (e.g. *Horníčková 1999*; *Profantová – Stolz 2009*). Stará Kouřim hillfort also produced a late 10th- or 11th-century encolpion imported from the Balkans with a secondary Greek inscription referring to the Byzantine environment (*Profantová – Stolz 2007*). Many patterns were available for a variety of stylisations on kaptorgas in central Europe, some of which were probably on silk (*Fig. 10*). The central motif of the gryphon on kaptorgas has been interpreted in Polish literature (e.g. *Kóćka-Krenz 2014*; *Zawol 2018*, 474–476, 489) as a Christian symbol for the dual nature of Christ, divinity and humanity; the guardian of the souls of the dead and the peace of paradise. While we can find applicable parallels in the Christian context, e.g. Aquilea (*Fig. 6*; the latter is also preferred by some Polish authors for the gryphon and lion from Chełm Drezdenecki or Opole-Groszowice), we can work with just as many references to non-Christian settings (symbol of good, the guardian of the ruler). This corresponds to most of the depictions, with the exception of the kaptorga from Radslavice – Zelená Hora in Moravia with the motif of Christ's baptism in Jordan from the end of the 11th century (*Kouřil – Procházka 2018*, 60, Fig. 10: 2). Also, a kaptorga with a Christian motif of the '*Dextera Domini*' was found in Polish Dziekanowice (*Wrzesiński – Wyrwa 2011*).

Nevertheless, most of the animal motifs on 10th-century kaptorgas can be convincingly linked to pre-Christian symbolism. In one case, the motif of two doves by the tree of

life, adapted from Byzantine silk, was applied on the Hostivice kaptorga from the late 10th century. This originally Christian motif changed its meaning by replacing the doves with two birds of prey, which were more conventional for a secular milieu (*Profantová – Daněček 2017*). Given the wide dating interval of their use, both interpretations are equally likely, except perhaps that the later part of the interval is more Christian and the earlier part pre-Christian (with a lack of clear and direct references to Christian symbolism).

Dating

Given the context of the find (or rather its absence), the die from Kouřim can only be based on stylistic assessment and other indications. The style of decoration corresponds to a relatively wide interval from the turn of the 10th century to the end of this same century. The vast majority of finds of Bohemian kaptorgas come from this period. They come from burial complexes, i.e. from contexts that allow more reliable dating considerations than in the case of the Kouřim finds. For instance, the newly excavated kaptorga from the Žalov – Na Panenské cemetery is small (18.3 mm × 14.96 mm) and decorated with granulation (*Dvořáček 2023*). The grave with this kaptorga was radiocarbon dated to the interval 772–950 cal AD at 95% probability.

Also, two complete kaptorgas from Kováry–Budeč (*Fig. 7: 9*) – the only examples from 29 Czech kaptorgas found in a settlement context – are reliably dated to the 10th century (*Profantová – Šilhová 2010*; *Štefan 2005*, fig. 5: 5). Although the interval to which we date the Kouřim – Nad Dolnicí settlement is too wide (9th/10th century – mid-13th century) to allow for more precise dating, it does not cast doubt on our 10th-century dating by stylistic analysis and regional context.

Conclusion

The hammering form from Kouřim represents unique and the earliest evidence of the production of kaptorgas. It is the first find of this type in the Czech Republic and the second in Europe. The die bears the well-made motif of a four-legged gryphon, a motif of the Byzantine type. Thus, this hammering form belongs to artefacts that put the permanency of the Byzantine (Mediterranean) influence in central Europe in concrete terms. It documents how the Mediterranean motifs spread over long distances, often through textile models and the adaptation of such motifs in the Bohemian milieu, e.g. in the case of kaptorga from Hostivice. Kaptorgas with a gryphon motif could be products made by 'barbarian/local' craftsmen using common (Byzantine?) technology, as F. Daim proposes in his typology (type 4, *Daim 2010*, 61).

Besides the die itself, its context is also important. The settlement of Kouřim – Nad Dolnicí also revealed other proof of jewellery production: a goldsmithing tool, a lump of amber, and a semi-finished earring from thick wire. Given the quality of the jewellery, it is obvious that the artisan worked for the elite from the Kouřim political centre. The Nad Dolnicí settlement, however, remained untouched by the power struggles of the second half of the 10th century and the relatively loose dating of the hammering form makes it impossible to decide whether the local goldsmiths worked for the Stará Kouřim hillfort or the later U Sv. Jiří hillfort.

The die is also the first direct proof of the assumed significance of Kouřim as a centre of crafts, more specifically jewellery making, as the model for hammering gombiks from Stará Kouřim hillfort (*Šolle 1966*, grave 110, Pl. XXIII: 2) likely cannot be interpreted in this way.

Generally, finds of kaptorgas are sparser in the Kouřim and Kolín area than in the broader Prague area/Lower Vltava region, an image perhaps caused by the uneven excavations of inhumation burial grounds in Bohemia, as kaptorgas are often found in graves due to their protective role during the passing of females to the netherworld. The technique and motif of the die from Kouřim show it was produced outside the circle of the 'Prague workshop' (*Profantová – Daněček 2017*; *Profantová 2022*; *Frolíková-Kaliszová 2023*) and thus document that goldsmithing of a high quality also developed in Bohemia in the 10th century independently of the Prague centre.

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NAĎA PROFANTOVÁ, Institute of Archaeology of the CAS, Prague, Letenská 4, CZ-118 01 Praha 1, Czech Republic; profantova@arup.cas.cz
DANIEL DVOŘÁČEK, Regionální muzeum v Kolíně, Karlovo náměstí 8, CZ-280 02 Kolín, Czech Republic; Institute of Archaeology of the CAS, Prague, Letenská 4, CZ-118 01 Praha 1, Czech Republic dvoracek@arup.cas.cz
TOMÁŠ KMJEČ, Institute of Physics of the CAS, Na Slovance 2, CZ-182 00 Prague 8, Czech Republic; Department of Low Temperature Physics, Faculty of Mathematics and Physics, Charles University Prague, V Holešovičkách 2, CZ-180 00 Prague 8, Czech Republic; kmjec@mbox.troja.mff.cuni.cz

RESEARCH ARTICLE – VÝZKUMNÝ ČLÁNEK

A pottery kiln from the second half of the 13th century in Žďár nad Sázavou – Staré Město (Czech Republic): Technological analysis of its batch

Hrnčířská pec ze druhé poloviny 13. století ze Žďáru nad Sázavou – Starého města: Technologická analýza vsádky

Karel Slavíček – Kateřina Těsnohlídková – Martin Košťál – Dominika Václavíková – Kristýna Trnová

This study investigates a medieval pottery kiln and its fill excavated at a 13th-century settlement site near the Žďár Cistercian monastery. The short 30–40 year lifespan of the settlement provides valuable insight into how pottery was made and appeared in a chronologically specified timeframe of the mid-13th century. The kiln was a single-chamber type, either with an open-topped or domed superstructure with a very narrow stoking channel in terms of height. Technological analysis of the pottery inside the kiln points to consistent production techniques utilising a combination of coiling and early rotational devices with rapid firing practices. The interpretation of the forming technique is backed by 3D scanning, which quantifies the wall thickness variability over various vessel body parts. Cross-analysis with settlement finds shows a uniform ceramic morphology and technological nuances, with petrographic data suggesting both local and external material influences. The study enhances the understanding of the socio-economic dynamics during medieval colonisation based on the case of the Žďár region and provides a benchmark for regional ceramic research.

Middle Ages – Bohemian-Moravian Highlands – Žďár nad Sázavou – pottery kiln – pottery production – petrography – XRF analysis

Tato studie zkoumá středověkou hrnčířskou pec a její výplň odkrytou v rámci sídliště ze 13. století poblíž cisterciáckého kláštera ve Žďáru. Krátká 30–40letá existence sídliště poskytuje cenný vhled do způsobu výroby a vzhledu keramiky v chronologicky vymezeném časovém horizontu poloviny 13. století. Pec byla jednokomorová buď s otevřenou, nebo klenutou nástavbou s výškově velmi úzkým topným kanálem. Technologický rozbor keramiky uvnitř pece ukazuje na konzistentní výrobní postupy kombinující výrobu z válečků s ranými rotačními zařízeními a s rychlým výpalem. Interpretace techniky tvarování je podpořena 3D skenováním, které kvantifikuje variabilitu tloušťky stěn na různých částech nádoby. Srovnání se sídlištními nálezy ukazuje na jednotnou morfologii keramiky a technologické nuance, přičemž petrografická data naznačují jak místní, tak vnější materiálové vlivy. Studie rozšiřuje poznání socioekonomické dynamiky během středověké kolonizace na případu Žďárska a poskytuje východisko pro regionální výzkum středověké keramiky.

středověk – Českomoravská vysočina – Žďár nad Sázavou – hrnčířská pec – hrnčířská výroba – petrografie – XRF analýza

Introduction

Staré Město, the predecessor of today's town of Žďár nad Sázavou, was among newly founded settlements in the bordering area between Bohemia and Moravia colonised in the 13th century. One of the significant archaeological discoveries at the site was a pottery kiln

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and its batch. Such archaeological contexts are quite rare and generally only five medieval kilns have been excavated in the region (*Zatloukal 1998*, 28–30; *Nekuda 2000*, 110–112; *Kochan et al. 2021*; *Zimola 2021*, 102–117; *Duffek et al. 2022*). The discovery of a pottery kiln in a fully excavated settlement allows for a comparison between the kiln's contents and the finds from settlement contexts. This is made more efficient due to the short-term occupation of the site. A comprehensive interdisciplinary approach involving natural science analyses and experimental archaeology aims to assess the kiln and the pottery found inside, not only within the context of typo-chronology but also the *chaîne opératoire* and regional geology. Since the pottery workshop was part of a settlement with multiple homesteads, ceramic consumption and production can be also examined. Specifically, we will address these questions:

1. Kiln reconstruction and functionality:
   To what extent are ethnographic and archaeological analogies, along with archaeological experimentation, relevant to the reconstruction of the original appearance and function of the kiln?
2. Associated artefacts and workshop layout:
   Is it possible to link archaeological artefacts found in the vicinity of the kiln to pottery production?
   If so, how was the pottery workshop spatially organised during that period?
   How extensive might its production or on-site ceramic consumption have been?
3. Kiln contents and usage:
   Does the ceramic assemblage represent the last firing batch, its remnants, or flawed vessels? Alternatively, could the pottery vessels or their fragments have been reutilised for levelling the kiln floor?
   Does this represent a single-event failure, such as a botched firing, or the abandonment of the kiln followed by its one-off or gradual fill?
4. Local ceramic production:
   What was the local pottery production in terms of raw material provenance, morphology, and production technology?
5. Comparative analysis:
   How does the pottery found in the kiln fit into the context of all ceramic finds on the plot and, more broadly, on the site?

Staré Město site and the kiln

The Staré Město site is located on the northern edge of the town of Žďár nad Sázavou in the central part of the Czech Republic (49°34'11.858"N, 15°55'51.684"E). Today, the site is partly covered by the buildings of a satellite housing estate and partly situated on field parcels along the road from the Klafar spring towards Starý Dvůr. Based on records in the *Cronica Domus Sarensis*, the existence of the settlement is dated to the early period of the nearby Cistercian monastery. The settlement is assumed to have been established in 1252–1257 and abandoned in 1262–1276. Subsequently, the settlement is believed to have been relocated to today's centre of Žďár nad Sázavou. If this were the case, Staré Město would have been inhabited for just a single generation. However, we cannot rule out a slightly

longer existence, although archaeological research, which has essentially uncovered the entire area of the settlement, suggests short-term inhabitation without the superposition of archaeological features (see, for example, *Ludvikovský et al. 1964*, 188–194; *Richter 1982*, 254; *Zatloukal 1999a*, 201–203; *Geisler 2004*; *2005*; *2006*).

The site was more closely investigated by M. Richter, who conducted the first extensive excavations (*Richter 1974*, 231–240). Further excavations were carried out by the Institute of Archaeological Heritage Brno under the supervision of M. Geisler in the 1990s, and particularly in 2004–2006 due to the construction of a satellite housing estate (*Zatloukal 1999a*, 193–207). Thus, most of the settlement area has been excavated, but only some parts have been evaluated and published thus far – materials from the 1990s campaign by *Zatloukal* (*1999a*) and pottery from the 2004 excavation season by *Těsnohlídková* (*2021*, 205–257). The entire site is now being comprehensively assessed as part of D. Václavíková's doctoral thesis. The publication and preliminary evaluation of the kiln structure were included in the doctoral thesis of K. Těsnohlídková and in a study in the *Přehledy výzkumů* journal (*Těsnohlídková 2021*, 278–280; *Těsnohlídková 2022*, 61–109). The current state of knowledge on medieval ceramic production in the region was summarised by *Čapek et al.* (*2022*, 138–146).

The remnants of a pottery kiln (feature no. K 1548) were excavated in 2006. However, this feature was not identified as a pottery kiln in the field documentation. It was only in 2020, during a more detailed processing, that it was possible to interpret the original purpose of the kiln. Subsequent research has helped to identify additional potential structures associated with pottery production, thereby defining a probable pottery workshop at the site. In addition to pottery production, a stonemason's workshop and ironworking, encompassing both smelting and blacksmithing, was documented at the site. These crafts were undoubtedly associated with the emerging Cistercian monastery (*Malý – Gonda 2017*, 36; *Kovář 2006*, 65; *Geisler – Malý 2005*, 107–110). The non-agricultural activities confirm the market character of the Staré Město settlement.

Relic of pottery kiln

The pottery kiln had a simple, single-chambered construction embedded into the sandy ground (cf. *Procházka 2015*, 217; *Čapek – Preusz 2019*, 323, tab. 2). The base dimensions of the kiln were 1.2 × 0.95 m with a preserved depth of 0.5 m (*Fig. 1*). The structure had a rectangular layout with rounded corners orientated NNE–SSW. The walls were vertically inclined to slightly embedded, with the floor slightly sloping towards the firing hole. The walls and the floor of the kiln were fired to red, grey, and black shades, with the fired layer on the walls being around 2 cm thick and thinner on the floor. The stoking channel, in the form of a sunken tunnel, connected the main kiln structure with the front kiln pit, which was, however, not identified during the excavation. Channel dimensions were larger by the kiln and decreased towards the front kiln pit. At the kiln's mouth, the pit was 30–40 cm wide and approximately 20 cm deep, while it was about 10 cm wide at the exterior side (*Fig. 2*; *Geisler 2006*, 35).

The fill of the structure was, besides soil, composed of small stones, charcoal, bricks, and fragments of ceramic vessels deposited in at least two layers. Above the fired floor was a continuous carbonised layer with a thickness of 1–3 cm. The structure did not contain any daub or other elements indicating the kiln's construction. Given the relatively low

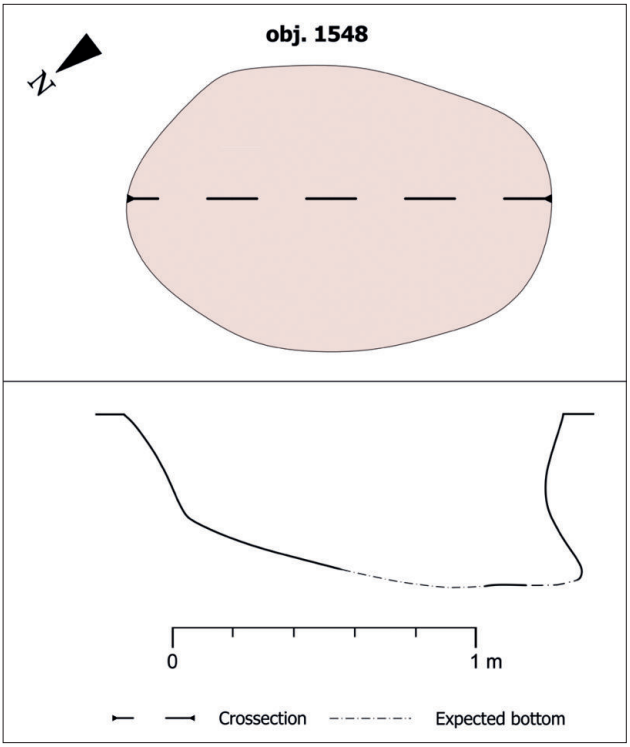

Fig. 1. Pottery kiln, feature no. 1548 (after *Geisler 2006*, fig. 23–24, modified).

firing quality of pottery at the site, the daub might not have been adequately fired and thus not preserved. Several bricks found in the uppermost part of the fill are likely unrelated to the structure's construction and are of a more recent age given the fact they were not in direct contact with medieval pottery. Moreover, finds of medieval bricks are rare at the site. No traces related to the separation of fill and fuel were identified (*Geisler 2006*, 35).

Settlement context of the kiln

Based on preliminary evaluations, the site encompassed 14 dwelling plots organised in two parallel rows. The pottery kiln likely belonged to the dwelling situated roughly in the middle of the southern row adjacent to a stonemason's workshop and seemingly to an ironworking area (*Fig. 3*). The problem is that the 'pottery' plot was located at the border of two separate excavation areas. Each was documented using a different method; hence, there is a possibility of discrepancies between the plans or that some structures might have been overlooked on the peripheries of the research areas or beneath accumulated layers, much like the front kiln pit (*Zatloukal 2000*, 53–56; *Geisler 2005*).

Several other structures were adjacent to the identified kiln K 1548, predominantly settlement pits surrounded by postholes (*Fig. 4*). The kiln and features K 1546, K 1549, K 1550, K 1551, K 1553, K 1563, K 1565 and K 1566 along with the adjacent postholes might constitute a pottery workshop or specialised production area. There was also a well nearby (feature K 1570).

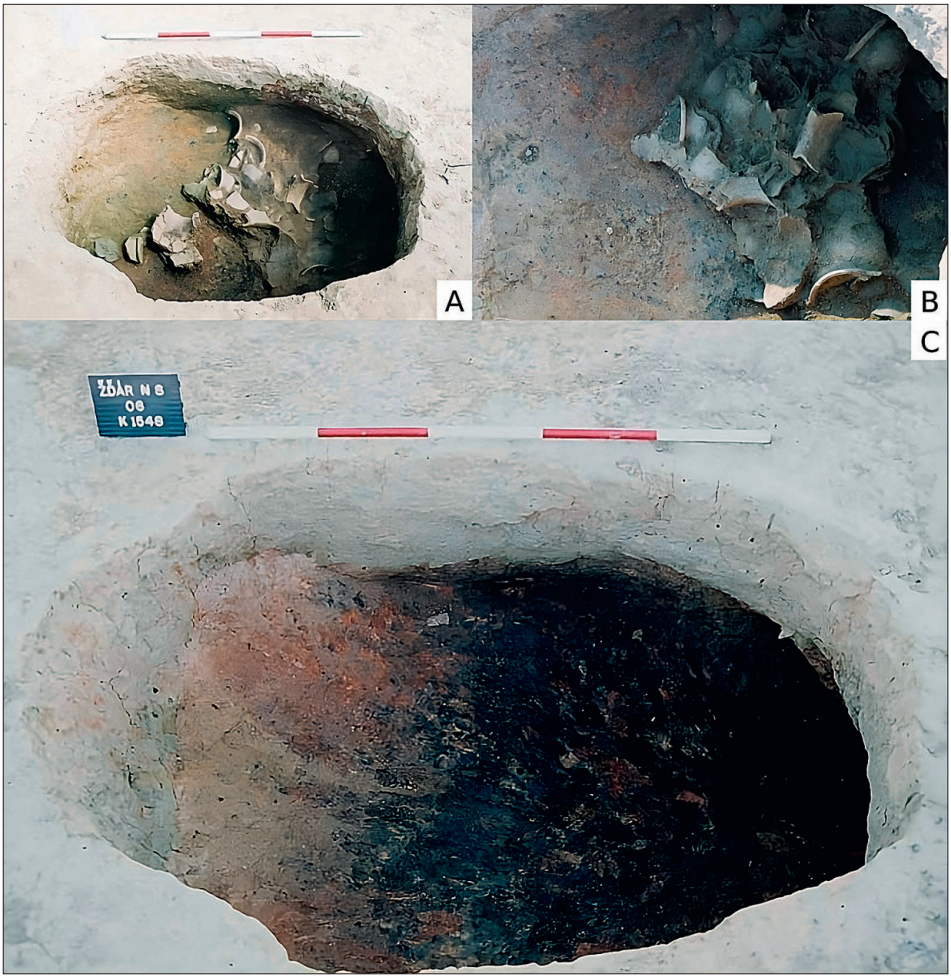

Fig 2. Photographic documentation of the pottery kiln from the excavation report (modified after *Geisler 2006*, tables 12, 14, 16): A – layer of broken ceramic vessels; B – fragments of pottery in the front part of the kiln; C – scorched kiln bottom after excavation.

The surrounding pits formed two distinct clusters in relation to the kiln. The first cluster located in immediate proximity to the kiln consists of features K 1546, K 1550, K 1551, and K 1553. Pit K 1546 directly correlated with the kiln and likely had a structural connection with it. A part of the K 1546 fill was composed of regularly laid out stones, suggesting the presence of a wall or masonry. This wall might have been part of the structure providing roofing to the working area before the kiln. None of the other features in this cluster had any clear structural components and their specific functions thus remains ambiguous. Similarly, the purpose of the second cluster comprising three features situated approximately 5 m from the first cluster – K 1563, K 1565, and K 1566 – could not be discerned. In conjunction with postholes, these three pits formed a rectangular layout hinting at a light above-ground structure.

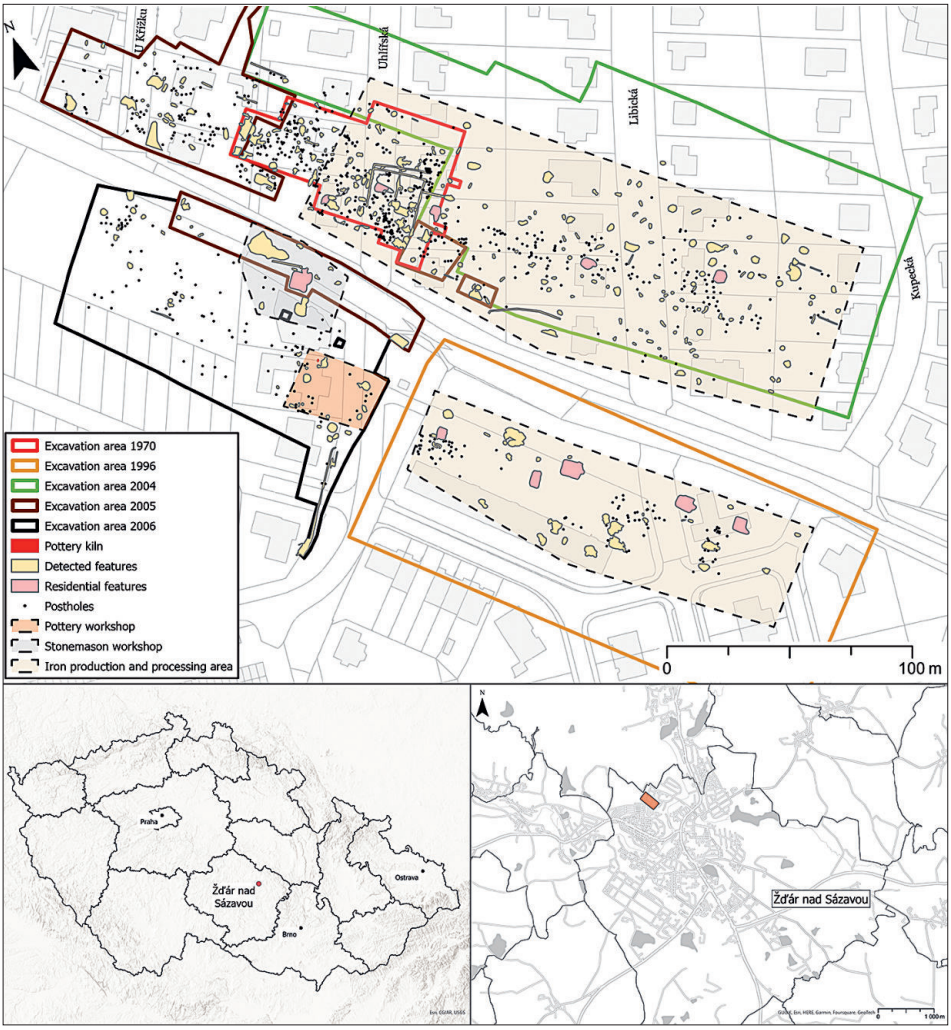

Fig. 3. Location of the Staré Město site and spatial context of the pottery kiln.

To identify a specific residential structure or basement affiliated with the pottery workshop is challenging. This is a complex issue particularly due to disruptions caused by recent construction work on the site (K 1514). Moreover, structures such as K 1521 and K 1512 might pertain to the stonemason's workshop situated roughly 20 metres to the northwest.

Adjacent to the relics of a wooden cellar (K 1521) lies a square-like feature (K 1522). It was interpreted either as a pit or cistern with an assumed timber lining. The low share of waste pits in the fill, combined with the square layout and wooden structure, raises the possibility that the structure was used for clay storage. Such depots are known from later medieval periods and subrecent ethnography parallels (*Buko 1990*, 90–91; *Richter – Krajíc 2001*, 68). The pit was sunk deep into the bedrock, reaching a depth of 2.2 m, but it could result from the over-excavation of the pit. Given its location, this feature seems to be more

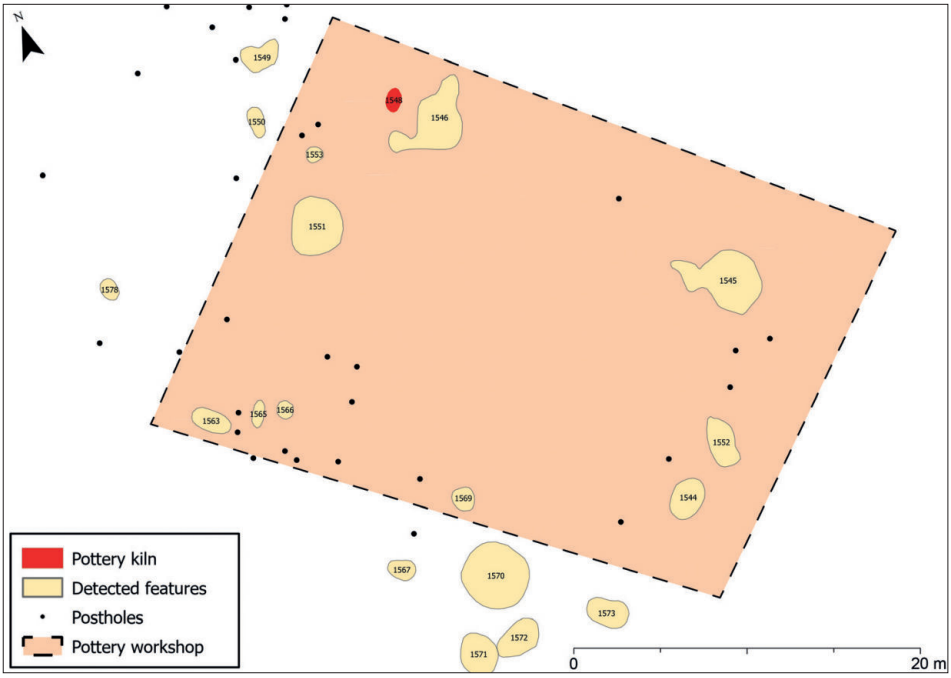

Fig. 4. Detail of the pottery workshop with kiln (f. 1548) and other associated archaeological features.

closely associated with the stonemason's dwelling, where it might have functioned primarily as a cistern.

Geological setting of the site

From a geological perspective, the site falls within the Moldanubian Zone. According to lithostratigraphic division, rocks of the Moldanubicum are generally split into monotonous and varied groups (*Mísař et al. 1983*; *Franke 1989*; *Vrána et al. 1995*; *Cháb et al. 2008*). The monotonous Ostrong unit represents former sediments, likely of a flyschoid complex. It is represented mainly by muscovite, muscovite-biotite, and biotite-sillimanite paragneiss and migmatite occasionally with cordierite, gneiss, and less often quartzite, erlan, orthogneiss, and eclogite. The varied Drosendorf unit primarily consists of paragneiss and bodies of metamorphosed sediments such as metaquartzite, graphitic gneiss, marble, dolomite, and erlan. It also includes amphibolite and orthogneiss. The varied Gföhl unit then contains rocks such as orthogneiss, granulite, leucocratic migmatite, serpentinite, amphibolite, peridotite, eclogite, and skarn.

More specifically, the Staré Město site falls within the Strážek Moldanubicum subregion (*Fig. 5*). The Strážek Moldanubicum belongs almost entirely to the varied group (*Mísař et al. 1983*). In the immediate vicinity of the area of interest, there are mainly migmatite to orthogneiss, less paragneiss, granite, and granodiorite to quartz diorite. Bodies of carbonate rocks – erlans and crystalline limestones – are located about 2 km west of the area of interest. They are also present in the form of smaller bodies in the broader surroundings

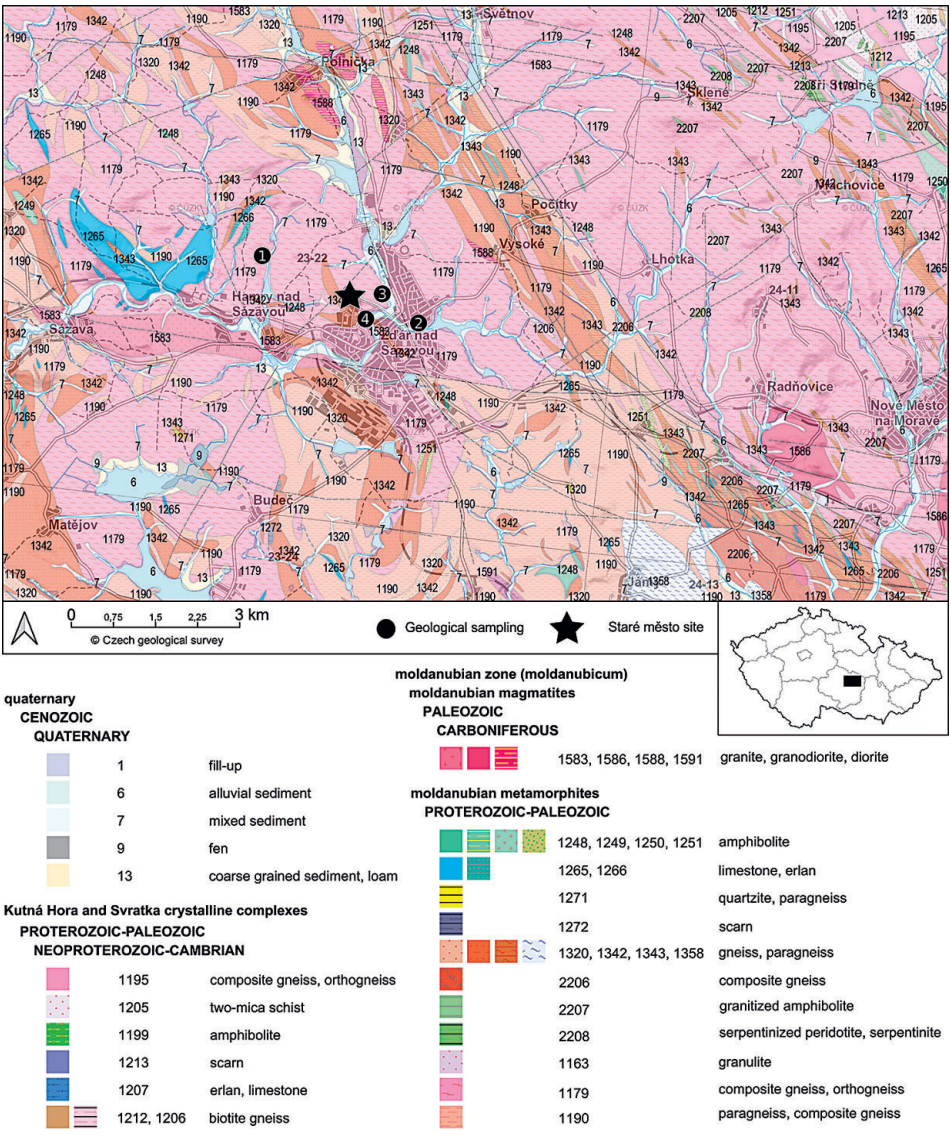

Fig. 5. Geological map of the area surrounding the site with marked locations of geological sampling (1–4; Czech geological survey 2023, modified).

of the site along with small bodies of amphibolite, serpentinite to serpentinised peridotite, skarn, and quartzite. In the vicinity of Nové Město na Moravě (10 km to the east), there are bodies of magmatite corresponding to granite to quartz syenite.

Approximately 8 km to the north and northeast, the rocks already belong to the Kutná Hora-Svratka crystalline complex. The rock spectrum here is primarily represented by two-mica paragneiss to orthogneiss, biotite gneiss, two-mica mica schist, accompanied by smaller bodies of amphibolite, carbonate rock, and quartzite.

Analysed material

The analysed material consisted of a pottery assemblage retrieved from the kiln. The first assessment categorised the material into two main components: first, complete or partially preserved vessels that were directly linked to the kiln (16 specimens); and second, fragments, which could not be reassembled into (nearly) complete vessels and other fragments that likely entered the kiln in an already fragmented state reflecting activities around the kiln during its operation or its subsequent decay or filling (629 fragments).

The selection of analysed ceramic samples took into account the presence of different ceramic groups and classes within the kiln (*Tab. 1*; *Fig. 6*). Since some of the applied methods are destructive and the number of findings was limited, it was decided not to sample complete or partially preserved vessels. Nine fragments of vessel bellies were selected, which, based on macroscopic comparison, could likely belong to the preserved vessels. Seven were from sandy ceramic classes, and two were graphite tempered. Additionally, five fragments from vessels represented only by broken pieces in the assemblage were analysed. These comprised two rim fragments of bell-shaped lids (ceramic class – CC 2 and 3), a fragment of a kettle (CC 3), a bottle fragment (CC 3), and a piece of either a jug or kettle (CC 4). The final sample was a fragment of a brick found in the kiln's infill.

Four sediment samples were collected to define the petrography of alluvial sediments from river streams in Žďár nad Sázavou (*Fig. 5*). The first of these (sample 22) was derived from the sediment of an unnamed watercourse flowing north to south between Dívka and Mikšovec ponds, less than 2 km west of the Staré Město site. This stream feeds into the Sázava River, from which samples 24 and 25 originated. Sample 25 was taken from the Sázava riverbed upstream of its confluence with its left-bank tributary Staviště. Sample 24 was collected further downstream past the confluence. Sample 23 was taken from the Staviště Stream bed.

For a comprehensive evaluation of ceramic production at the site, results from previous analyses of pottery from settlement contexts were also utilised (*Čapek – Slavíček 2022*). Initially, these were revised in light of new insights from the kiln contents, followed by a comprehensive discussion.

Methods

The pottery was evaluated using a unified descriptive system designed for pottery produced in the area of the Bohemian-Moravian Highlands in the 13th and first half of the 14th century. This system builds upon the most widely used approaches for medieval pottery from Brno and South Bohemia, facilitating potential comparisons and connecting with previously evaluated ceramic collections at the site. Modifications were made only to accommodate the concentration of intact and fragmentarily preserved vessels. The morphological analysis of the ceramics adheres to contemporary standards for describing medieval pottery (*Čapek – Těsnohlídková 2020*; *Těsnohlídková 2022*, 81–85, 91–107).

The technological analysis was grounded in the determination of ceramic classes and groups, with an expanded description of characteristics that respect the operational sequence. It focused most closely on post-forming technology markers, which are most effectively observed on well-preserved vessels. They make it possible to examine the relationship

ID	Accession number	Vessel type	Ceramic class (CC)
1	66/06-349/112	Pot	3
2	66/06-349/112	Pot	3
3	66/06-349/112	Pot	3
4	66/06-349/112	Pot	3
5	66/06-349/112	Pot	3
6	66/06-349/112	Pot	3
7	66/06-349/112	Pot	9
8	66/06-349/112	Pot	10
9	66/06-349/112	Pot	3
10	66/06-349/33	Pot-lid	2
11	66/06-349/34	Pot-lid	3
12	66/06-349/50	Flagon with a stirrup handle	3
13	66/06-349/22	Bottle	4
14	66/06-349/37	Jug	4
15	66/06-349/15	Brick	x

Tab. 1. Analysed samples.

between forming traces on various parts of the vessel. Forming traces were described at six specific points: on the inner parts of the rim and neck, on the inner body separately above and below the maximum belly diameter (if there was a difference), on the inner and outer base, and around the circumference of the base. Potential traces preserved on the external body of the vessels were also recorded. Similar traces appeared on all vessels, and they were therefore evaluated together, with any peculiarities being noted.

Chemical composition analysis of the ceramics was conducted using a Rigaku NexCG energy dispersive fluorescence spectrometer (ED-XRF). This spectrometer is equipped with a 50 W Pd tube and a silicon drift detector (SSD) capable of resolutions up to 145 eV. To counter element quantification errors from matrix-based discrepancies, a specialised calibration library for ceramics and soils was utilised, employing standard reference materials from various international institutes. The samples were prepared as pressed powder pellets. The total carbon content was determined through loss on ignition (LOI) using the exposure of powdered samples to 550 °C for five hours following the method outlined by *Heiri et al.* (*2001*).

Standard thin sections (30 μm) were analysed by an Olympus BX 51 polarising optical microscope. The thin section analysis followed the procedures described in *Quinn* (*2013*). Inclusion abundance was expressed as a semiquantitative score using the adjusted guidelines of *Sauer* and *Waksman* (*2005*).

The obtained element concentrations (*Supplementary material 1*) and semi-quantities of rocks and minerals (*Supplementary material 2*) were statistically evaluated by principal component analysis (PCA) using the FactoMiner package in R (*Lê et al. 2008*). The PCA results were further used for hierarchical clustering (*Husson et al. 2010*).

The ceramic assemblage was documented using oblique lighting photography and Reflectance Transformation Imaging (RTI). A Nikon D750 camera with a 60mm Nikkor f/2.8 G ED AF-S Micro lens on a vertical stand was utilised for both methods. Images were colour-calibrated using a calibrated scale. To analyse technological and use-wear traces on the vessels, RTI method involved calculations with Relight software and visualisation with RTI Viewer.

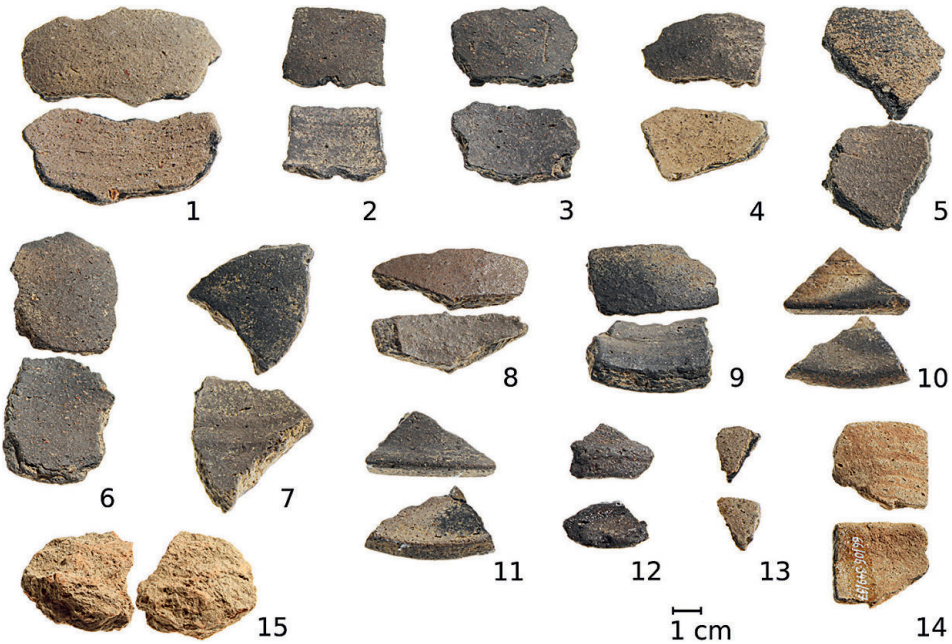

Fig. 6. Samples selected for archaeometry.

Several pottery vessels were virtualised using an Artec Leo 3D scanner,[1] offering a resolution of 1 mm or lower. Out of 16 partially or fully preserved vessels, the three best-preserved ones were documented. The scanner's consistent accuracy enabled the tracing of shaping marks across the entire profile of the vessel, even in the challenging conditions of repositories. On the other hand, spatial data might be lacking on vessels with complex profiling, particularly beneath the neck, where the scanning beam has limited reach. The raw data from the 3D scans were processed with ArtecStudio 16 software.

The vertical cross-sectional plane method was applied for a detailed morphometric description of vessels. This approach provides insights into the thickness variation of the vessel's vertical profile and allows for conventional graphical shape representation. Restoration additions were excluded from these virtual cross-sections. Virtual cross-sections were created using Blender software. The process involved segmentation and extraction using the modified Mesh Boolean Node function. This method intersects a cross-sectional plane with the vessel, yielding the required data. Data processing included the automated export of individual cross-sections and semi-automatic removal of virtual artefacts.

A single virtual cross-section per plane is not enough for precise morphometric analysis (cf. *Thér – Wilczek 2022*). Therefore, 180 vertical cross-sections were employed, equating to one section per degree of a circle. The rotation axis, situated at the centre of the

[1] Data was acquired using technological equipment obtained for the purpose of the research project 'The Formation of Multi-Ethnic Complex Societies in Early Medieval Moravia. Collective Action Theory and Interdisciplinary Approach (GX21-17092X)'.

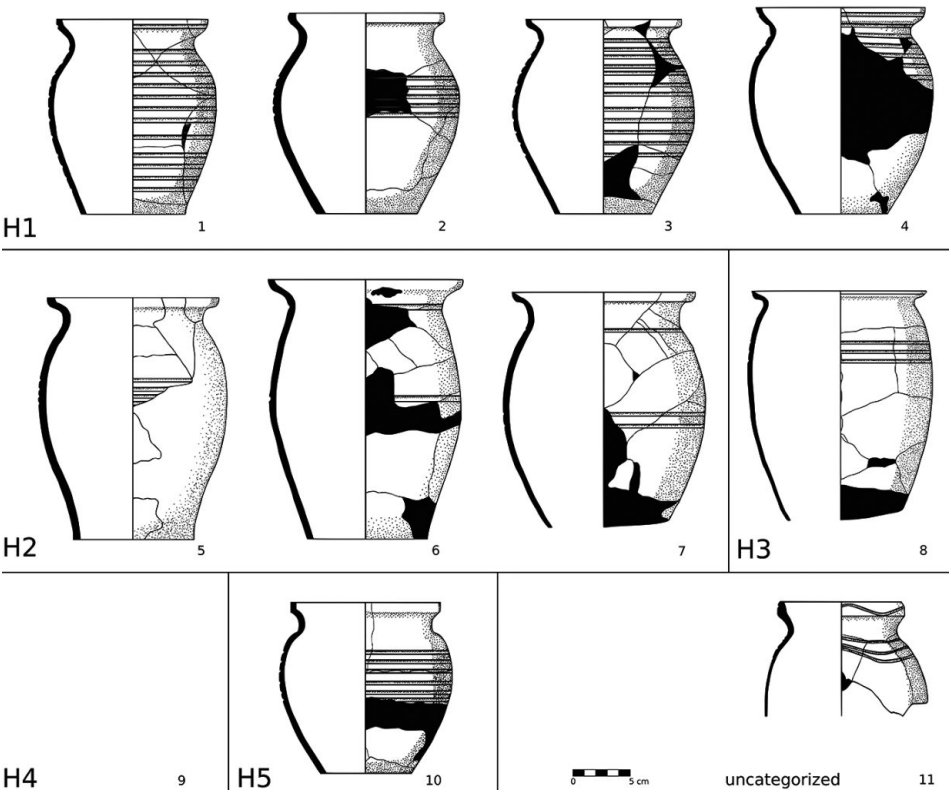

Fig. 7. Types of pot torsos found in the kiln and their affinity to ceramic classes (CC): 1 – 66/06-349/1 (CC 4); 2 – 66/06-349/2 (CC 2); 3 – 66/06-349/3 (CC 3); 4 – 66/6-349/6 (CC 3); 5 – 66/06-349/7 (CC 3); 6 – 66/06-349/8 (CC 3); 7 – 66/6-349/10 (CC 3); 8 – 66/06-349/9 (CC 10); 9 – 66/6-349/5 (CC 3); 10 – 66/6-349/4 (CC 9); 11 – 66/6-349/14 (CC 3).

vessel's base exterior, was used to adjust these planes. This axis is also crucial for converting metric data from 3D space to a single planar projection, enhancing the accuracy and interpretability of the morphometric data.

To accurately estimate wall thickness in the vertical cross-sections, a measuring line perpendicular to the vessel wall's current direction was employed at each point. This technique accounts for the vessel's profile variability, enabling more precise data categorisation by determining the elevation of measurement points. Due to significant restoration on many scanned vessels negatively affecting shape integrity, only three specimens were chosen for this analysis (66/06-349/1, 66/06-349/4, 66/06-349/2).

Data processing for each cross-section involved categorising each measuring line according to specific vessel parts, as defined by *Procházka* and *Peška* (*2007*): v3 (from the rim edge to the narrowest part of the neck), v4 (from there to the maximum belly diameter), and v6 (from the maximum belly diameter to the bottom). To address potential artificial outliers produced during line measurement rendering, the interquartile range (IQR) method was employed. This approach ensures a more accurate and reliable representation of the vessel wall thickness across different sections.

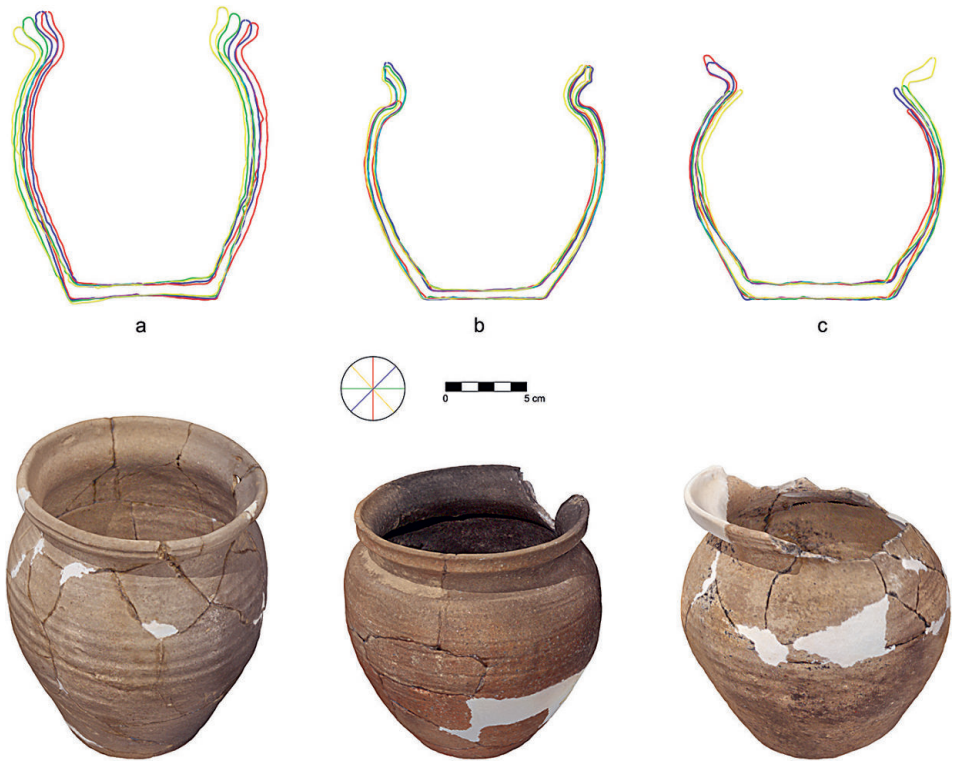

Fig. 8. 3D scans of pots. a – 66/06-349/1; b – 66/06-349/4-var2; c – 66/06-349/5. – Cross-sections along the vertical axis show the irregularity of shape and overall visualisations, respectively.

For the visual interpretation of the kiln construction, polygonal modelling methods were utilised (see *Saldaña 2015*, 149 in detail). It was based on technical drawings and analogous archaeological situations. This interpretation aims to present a basic idea of the technological form of the studied object rather than to create an exact model of the past situation, which is fragmentary, entropic, and heavily transformed in the archaeological record.

Results

Ceramic analysis of complete and partially preserved vessels

A total of 16 pots were identified in the category of complete and partially preserved vessels (*Fig. 7*). Twelve of these were preserved at 60–95%, while the remaining four were 30–40% intact but had complete necks or bases with parts of the body. Only eight vessels provided a full set of measurements (*Tab. 2*). Three allowed for 3D wall thickness analysis (*Fig. 8*), though gypsum restoration limited this method. All specimens were reconstructed from multiple fragments; none were found intact. Photos show they were already partially broken upon excavation, suggesting breakage occurred during the deposition, likely during the filling of the archaeological context (*Fig. 2: A, B*).

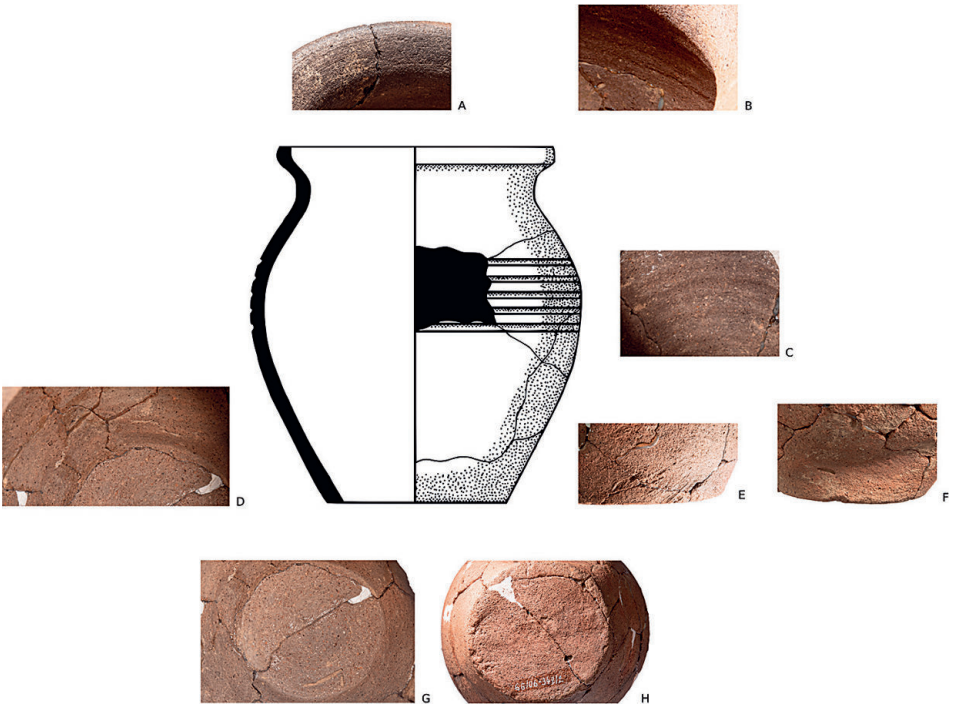

Fig. 9. Technological traces on pot 66/06-349/2 (CC 2) and their location: A – traces of rapid rotation on the neck and rim; B – wall undulations appear inconclusively as depressions/rings in the sub-neck area; C – clear depressions evidencing coiling below the maximum body diameter; D – depressions in the wall above the bottom in combination with lines and hollows at joint locations; E, F – technological traces above the bottom caused by manipulation with the vessel: E – 'scratching' likely formed by the removal of the partially attached bottom from the base using an unspecified tool; F – indentations caused by manipulation with the insufficiently dried vessel, also visible on the inner side; G – inner side of the bottom with traces of rotation, a distinctly separated coil is apparent above the bottom; H – outer side of the bottom with evidence of attachment and cutting off of the bottom around its perimeter; the imprint of a wooden board and a thin layer of dusting are visible on the bottom surface.

Sandy pottery was highly predominant (88%). Twelve vessels were assigned to CC 3 (medium-grained sandy) and two to CC 2 (fine sandy) class. The remaining two vessels contained graphite: one with matte grains (CC 9) and the other with shiny grains (CC 10; *Tab. 3*). In addition to sandy temper, most of the vessels contained small red grains (clay pellets). Traces of burnt organic matter appeared on vessel surfaces regardless of their affinity to pottery classes. Large temper grains or holes from these grains were less frequent (up to ca. 5 mm).

Traces of grooves from papillary lines or a fine tool predominated on the rim and neck (*Fig. 9: A, B*). These were found on 13 of the 16 observed vessels. There were also traces of temper displacement on one of the CC 3 vessels. On three CC 3 vessels, we observed no grooves on the rim and neck, which is likely related to the state of preservation and susceptibility of the pottery to surface abrasion.

Flat features on the vessel bodies most frequently manifested as depressions were evident in 11 instances. These depressions were noticeable mostly on the lower parts of the

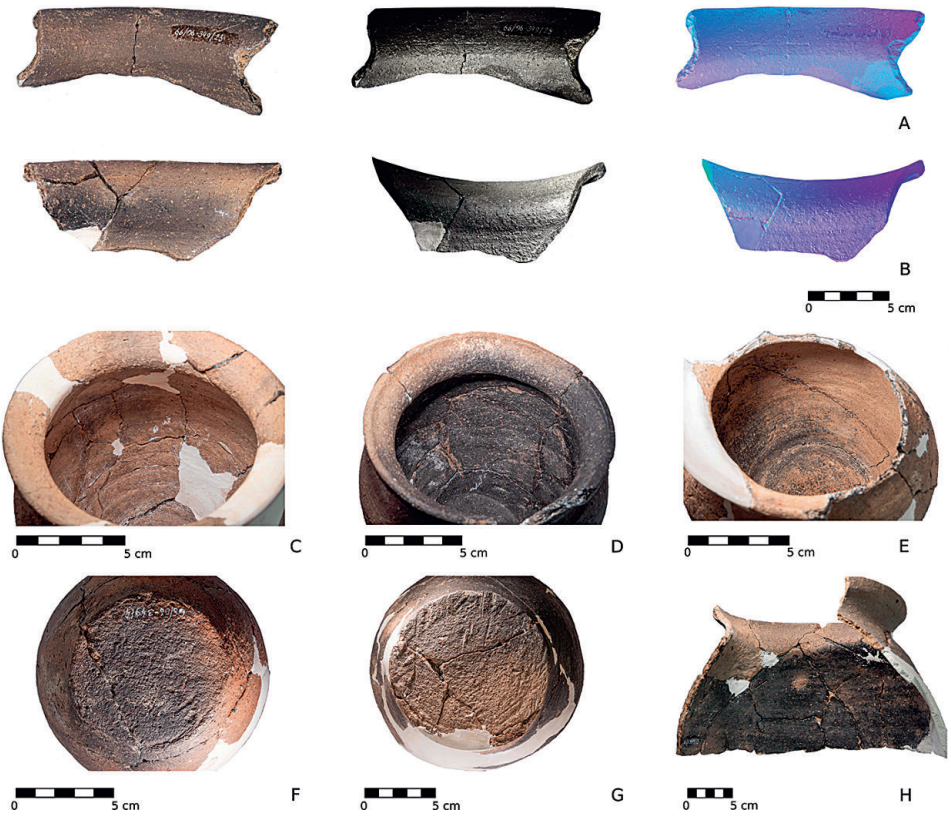

Fig. 10. Detailed documentation of forming markers: A, B – quick rotation marks on necks, from left to right: photograph, Reflectance Transformation Imaging (RTI), RTI normal map, vessels 66/06-349/23a (CC 10) and 66/06-349/23b (CC 3); C, D, E – marks on the inner wall surface, vessels 66/6-349/3 (CC 3), 66/6-349/4 (CC 9), and 66/6-349/5 (CC 3); F – traces of dusting and fixation of bottom to the board preserved around the bottom rim, vessel 66/6-349/4 (CC 9); G – traces of dusting and cutting off the board, vessel 66/6-349/7 (CC 3); H – oxidised surface of the rim and upper part of the neck, while reduced firing remained inside due to another pot inserted inside, vessel 66/6-349/13 (CC 13).

vessel bodies (*Fig. 9: C–F*; *Fig. 10: C, D*). Depression/ring markings were documented in nine instances. They appeared more often on the upper half of the vessels and were accompanied by distinct depressions in the lower body sections (*Fig. 9*; *Fig. 10: E*). There were visible lines at the joints of the coils in five cases, in six instances recesses indicating their joining, and twice we recorded that the wall was uneven (*Fig. 10: C, D*). From the exterior, six vessels displayed signs of being compressed due to handling when the clay was not sufficiently dry. The compression was so pronounced that it was noticeable from the inside, in one instance even producing a crack in the inner wall (*Fig. 9: D, F*).

Concentric rings were found on the inner bases of three vessels, suggesting that the base was smoothed during faster rotation. In individual cases, there was a raised centre, a dip in the middle, or evidence of a blade shift during rotation. All inner bases were modified during faster rotation based on their appearance (*Fig. 9: G*). The external base offers insights into how the vessel was attached to the potter's turntable. The outer surface of the

Accession number	Type of pot	Ceramic class	Preservation (%)	Rim type	Neck type	Rim decoration	Body decoration	Maximum belly location	Pot height	Rim to transition of neck and belly	Rim to maximum belly	Bottom to maximum belly	Maximum difference of heights within pot	Rim diameter	Neck diameter	Maximum belly diameter	Bottom diameter	Maximum difference of diameters within pot	Body fragment thickness
60/06-349/6	H1	3	70	VZ.2.2	A		grooves	upper third	186	26	87	99	8	148	112	160	83	11	4–6
60/06-349/1	H1	2	95	V.2.4	A	1 groove	12 grooves	upper third	168	29	79	100	15	132	104	148	90	2	4–6
60/06-349/3	H1	3	90	S.1.1	A		12 grooves	upper third	171	32	80	91	5	135	117	150	85	1	4–6
60/06-349/2	H1	2	95	S.2.2	A		5 grooves	upper third	181	32	78	104	6	134	108	165	90	2	6–9
60/06-349/15	H1	3	60	S.1.1	A		3 grooves	upper third	x	29	86	x	12	125	99	145	x	4	4–9
60/06-349/10	H2	3	70	S.1.1	A/B		4 grooves	half	x	35	105	x	5	160	130	178	x	10	6–8
60/06-349/8	H2	3	85	S.2.2	A		1 groove	half	223	30	105	126	15	175	141	150	106	10	4–6
60/06-349/7	H2	3	80	S.1.1	A		5 grooves	half	212	26	88	126	8	160	136	180	108	10	4–6
60/06-349/9	H3	10	90	S.1.1	A		2 groove	upper third	x	24	100	x	5	190	168	200	x	10	6–8
60/06-349/12	H3	3	60	S.1.1	A		1 wave, 3 groove	upper third	x	32	90	0	6	190	24	220	0	10	4–9
60/06-349/5	H4	3	80	VZ.2.2	A		5 grooves	half	150	28	80	73	3	140	15	152	88	5	3–6
60/06-349/4	H5	9	95	VZ.1.9	B		2 waves, 5 grooves	upper third	138	27	57	85	4	127	13	143	77	0	7

Tab. 2. Description of the decoration and metric values (in mm) for complete and fragmented pots.

base was rougher, likely achieved by dusting, which was clearly evidenced in four instances. Around the external perimeter of the base were traces of attachment to the board (four instances), traces of being cut from the board (four instances), or the effect of an inset base, suggesting the clay was pulled over and attached to a board (*Fig. 9: E, H*). In two cases, a faint and relatively worn impression of a wooden board was observed (*Fig. 9: H*). These features were only present on sandy vessels. Both vessels of the graphite classes had marks on their bases worn away by abrasion. The only feature observed around the base was a prominent coil above the base present on three vessels – two sandy and one graphite.

The varying dimensions among the vessels point to imperfect centring during the wheel shaping process. Across all ceramic classes, the common deviations were 5–15 mm in height and 5–10 mm in diameter. Wall thickness showed notable variation, particularly between the maximum belly diameter and the bottom (index v6 in *Fig. 11*), and from the neck to the rim (index v3). The section between the belly and neck, however, shows more uniformity. The variation in thickness for indices v3 and v6 ranged between 50 and 80%. Asymmetry studies on three pots revealed different degrees of deviation from the rotational axes (*Košťál – Slavíček 2023*). The most asymmetric pot showed a deviation of up to 15% at the neck and 8% at the maximum belly diameter (*Fig. 11: A*). The other two pots were more symmetric, with deviations below 5% at both measured points (*Fig. 11: B, C*).

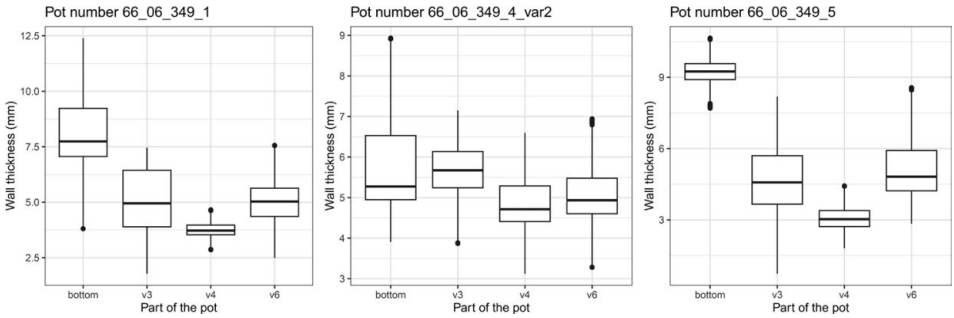

Fig. 11. Boxplot showing the variability in vessel wall thickness visualising data obtained by 3D scanning (indices of vessel parts: v3 represents the section from the rim's edge to the narrowest part of the neck, v4 spans from the narrowest part of the neck to the point of maximum belly diameter of the pot, and v6 covers the area from the maximum belly diameter down to the bottom of the vessel).

The vessels from the kiln were not significantly overfired; however, they bore traces of both oxidising and reducing firing (*Tab. 4*). Every vessel exhibited both characteristics to varying degrees. The oxidising marks indicated that during the later stages of the firing process, an oxidising atmosphere was in effect, and parts of the vessel with oxidising traces were left exposed. The reduced areas either did not reach the necessary temperature or were covered by another vessel, hidden within the fuel, or leaning against the kiln wall (*Fig. 10: D, F, H*).

The study identified five distinct pot types based on their shapes and dimensions (*Figs. 6–7*). Type 1 features bulbous pots with the widest part in the upper half, Type 2 includes slimmer pots with a central maximum belly diameter, and Type 3 consists of slimmer pots with a maximum belly diameter in the upper half. Types 4 and 5 are smaller and more bulbous, with a maximum belly diameter in the middle and upper half, respectively. All types have a smooth neck-to-body transition, except Type 5, which has a sharply angled neck. Of the pots preserved at 60% or more, twelve could be classified (*Tab. 2*).

Dimensional analysis focused on height, proportions, and diameters was key for classification (*Tab. 2*). Heights varied from 14 cm on Type 5 to 21–23 cm on Type 2 pots. Rim diameters also differed. The smallest Type 1 diameter was 13.5 cm on average with a deviation of 10%. The largest Type 3 diameter was 19–20 cm. Base diameters were all in the range of 8–11 cm for all types.

Ceramic analysis of fragmentary collection

Among the 629 fragments from the kiln, two lower fragmentation categories predominated, covering fragment surface areas up to 9 cm² and 9–36 cm². They were evenly distributed, with 48% (302 pieces) for the former and 47% (298 pieces) for the latter. Larger fragments with surface areas of 36–81 cm² accounted for 4% (26 pieces), and those of 81–144 cm² comprised only 1% (3 fragments). In 53 cases, it was possible to join two to three fragments, in nine cases four to five fragments, and there was one instance each of joining six to seven and eight to nine fragments. It can be assumed that not all fragments were successfully reattached, particularly due to the relatively poor firing quality and the fragility of the sherds.

Ceramic class (CC)	Kiln – complete vessels and torsos	Kiln – fragmentary assemblage	Settlement
1	2	–	–
2	8	10	13
3	41	71	75
4	3	1	–
5	< 1	–	–
6	< 1	–	–
7	3	–	–
8	1	–	–
9	13	< 1	6
10	11	< 1	6
11	1	–	–
12	17	–	–
13	–	–	–
14	–	18	–

Tab. 3. Representation of individual ceramic classes in the ceramic assemblage from the kiln and the settlement (values in %).

In the fragmentary material, the CC 3 class was predominant and comprised 71% of the assemblage (*Tab. 3*). Another sandy class, CC 2, accounted for 10% of the fragments. One per cent of the collection was the sandy oxidised class CC 4. Graphite classes were represented only by individual pieces, cumulatively constituting 1% of the assemblage. Mica ceramics were not found within the kiln. Overfired fragments representing the remaining 18% were classified as CC 14. Generally, it can be summarised that fragments of sandy ceramics predominated, making up 99% of the collection compared to 1% of ceramics macroscopically identified as graphite-tempered.

Technological traces observed on the fragments correspond to the characteristics of the complete vessels presented above. Within the material of both sandy and graphite ceramics, we identified large temper pieces up to 5 mm or pores after they popped out. Evidence of burnt fibres or pieces of organic inclusions, especially on the inner walls, is also available. Small red grains (around 1 mm) appeared quite frequently as well.

Traces of forming were only observable on sandy fragments and, as with the complete vessels, these features evidenced a production method combining coiling with rotation. Depressions were the most frequently observed feature (on 30 fragments), followed by indentations (8 fragments), lines, or ambiguous depressions/rings (5 fragments each). In one instance, depressions were accompanied by lines, and in another by papillary grooves. Features on the bottoms were described on eight sandy fragments: five had pronounced ridges above the base; in two instances, there were traces of the vessel's attachment to the potter's board around the perimeter, and one sherd had traces of the vessel's base being cut from the board. All described instances bore apparent traces of dusting.

Firing conditions were determined for 485 fragments (after mending; *Tab. 4*). Of these, 102 exhibited signs of slight overfiring, which could have also originated from normal non-defective firing in the kiln. Of the seven fragments of graphite pottery, five were reduced during firing and two had an oxidative final phase of firing (one on both sides and one on the exterior only). Among the 386 fragments of sandy ceramics, 80% showed signs of the oxidative final phase of firing; 60% were on both sides (231 fragments), 12% on the exterior (48 fragments), and 8% on the interior (30 fragments). Reductive firing was

Type of firing	Kiln – complete vessels and torsos	Kiln – fragmentary assemblage	Settlement
Oxidative final phase	100	64	70
Reducing firing		14	21
Oxidising firing			2
Combined firing		1	3
Black core		3	1
Sandwich effect			1
Unintentionally smoked			1
Slightly overfired		18	1

Tab. 4. Representation of different firing types of sandy and graphite pottery in the assemblage from the kiln and the settlement (values in %).

Rim type	Kiln – Complete vessels and torsos	Kiln – Fragmentary assemblage	Settlement
Simple			5
Simple edged		21	11
Collar			11
Oval		8	4
Folded		13	1
Roof-shaped	75	18	13
Everted	25	37	44
Everted-low		3	11

Tab. 5. Representation of rim types for sandy graphite pottery (values in %).

identified in 14% cases (53 fragments), a weak black core was present in 4% of cases (17 fragments), and 2% were determined to have mixed firing conditions (7 fragments).

Vessel shapes were determined based on characteristic fragments, with a total of 65 instances where the shape could be discerned. Among sandy ceramics, 41 fragments were identified as pots and seven as bell-shaped lids. In six cases, the fragments likely belonged to jugs, while in four cases the vessel form remains unidentified. One instance involved a low bowl, flat lid, or potsherd. For graphite ceramics, pots were determined in three cases and for overfired ceramics in six cases (*Tab. 5*; *Fig. 12*). Bell-shaped lids were formed with rim types POZ.4.1 (twice), 4.3, and 5.2, with one having a measurable diameter of 150 mm (CC 3). A preserved handle had a diameter of 15 mm. The collection also included one fragment of a flat lid POP.2, which could belong to a low bowl or potsherd (*Těsnohlídková 2021*, appendix 28). The rims of pots were classified concerning the ceramic class and for those where the preserved part was higher than 15% of the original circumference. The largest ceramic class 3 was represented by 29 rims: eight simple-edged and everted low rims each, five basic variants of everted, three roof-shaped, three folded, one oval, and one collar rim. Three rims were recorded in the sandy class CC 2: two roof-shaped and one folded. The only preserved rim of graphite pottery (CC 9) was an everted low subtype 3. For the overfired pottery, six rims were determined: two everted and roof-shaped each, one folded and one oval. The diameters of the pots were in the range of 120–180 mm, and the preserved parts of 14 out of 39 rims exceeded 15% of the vessel's neck circumference, with eight instances above 25% and one rim above 50%.

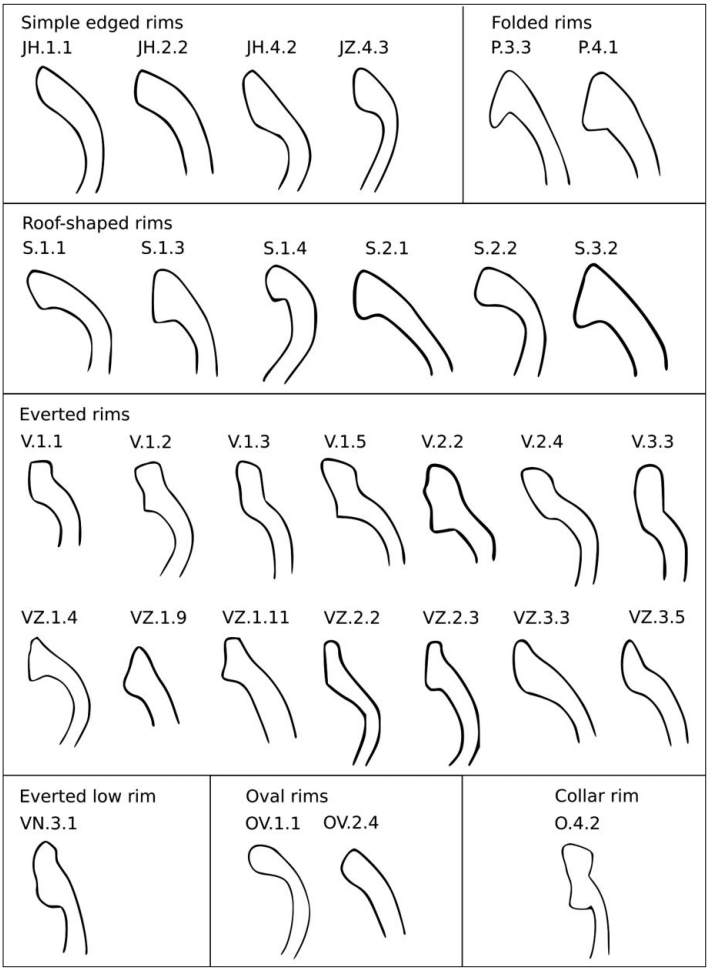

Fig. 12. Typology of pot rims represented in the ceramic assemblage with the designation of ceramic class.

Decorations were preserved on 35 belly fragments of sandy pottery. They were decorated exclusively by grooves, except for one fragment decorated by incisions. Decorations on the rims were found in nine instances on sandy pottery (1–3 grooves, wavy lines) and once on graphite pottery (wavy line with a groove). Decorations predominated on everted rims, with four cases each on everted and low everted rims, and in one case on low rims. One collar rim was also decorated.

The preserved bases were highly fragmentary. More than 15% of the original circumference was preserved in only three cases, which belonged to the CC 3 class. Two bases had a diameter of 100 mm and one 120 mm.

Ceramic petrography

Significant petrographic homogeneity characterises the majority of the samples. The exception is represented by graphite pottery sample 8 and sample 15, which comes from

a brick and serves as a reference sample. This homogeneity is articulated not only through the statistical evaluation of the semi-quantitative values of the petrographic analysis but also through the chemical composition (*Figs. 13*, *14*; *Tabs. 6*, *7*). The homogeneity of the main fabric produced by the kiln is slightly disrupted by sample 5, which is coarser compared to the rest.

Samples 1–4, 6, 7 and 9–14

Gneiss is the most abundant rock type among aplastic inclusions occurring as common to frequent. Granitoids and metaquartzite occur occasionally or commonly across the samples. In terms of minerals, quartz and biotite are frequent and abundant (*Fig. 15: A, B*). Muscovite is less commonly found, appearing from trace to occasional amounts. Alkali feldspars and plagioclase are also present (common to frequent), with the latter being slightly more abundant than the former in general. A few accessory minerals were also identified. Amphibole was found only in samples 3 and 4, and occurred occasionally. Garnet was identified in sample 11. In addition, plant remains were detected in samples 1, 3, 6, 7, 9, 11, and 12 (*Fig. 15: D*).

All samples have a weakly parallel or parallel microstructure. Aplastic particles are poorly sorted, and their grain size distribution is bimodal. The matrix is homogeneous and non-calcareous. The base clay body includes up to 5% of silt or fine-sized grains of minerals. The important feature is the presence of short fragments of biotite flake stacks. All samples were intentionally tempered with sand-sized rock fragments and minerals that are mostly subangular or subrounded. Mineral temper content varies in the range of 5–15 % (compare *Fig. 15 A and C*). Most of the samples have oxidised layers on both inner and outer surfaces, while the core has remained reduced (*Fig. 15: A–C*). One sample was completely oxidised (no. 13) and one completely reduced (no. 3). Four samples have a smoked outer surface from the reducing phase in the final stage of the firing process (nos. 4, 7, 10, 11). Biotite mostly exhibited medium, sometimes strong pleochroism.

Sample 5

Among rock fragments, gneiss is the most abundant. Granitoid occurs commonly and metaquartzite is occasional (*Fig. 15: E, F*). Minerals are represented by abundant quartz and biotite. Muscovite is occasional. Plagioclase and alkali feldspars are both frequent. Accessory minerals are represented with common garnet and occasional amphibole. The clay body includes occasional plant remains.

The microstructure of sample 5 is unparalleled. Poorly sorted aplastic inclusions appear to have unimodal size distribution. These inclusions are equant, subangular to subrounded and quite abundant (up to ~30% of the sample). The outer surface layer is oxidised, while the core and inner surface remain reduced. Biotite flakes exhibit strong pleochroism.

Sample 8

Sample 8 exhibits a unique petrographic constitution characterised by a prevalence of graphitic metaquartzite fragments (*Fig. 15: G, H*). Metaquartzite appears commonly, while gneiss was observed only occasionally. In terms of the mineralogical composition, the sample is markedly dominated by graphite. Quartz is abundant. Other minerals, including alkali feldspars, plagioclases, biotite, and muscovite, are occasional. The accessory mineral amphibole was noted to occur occasionally.

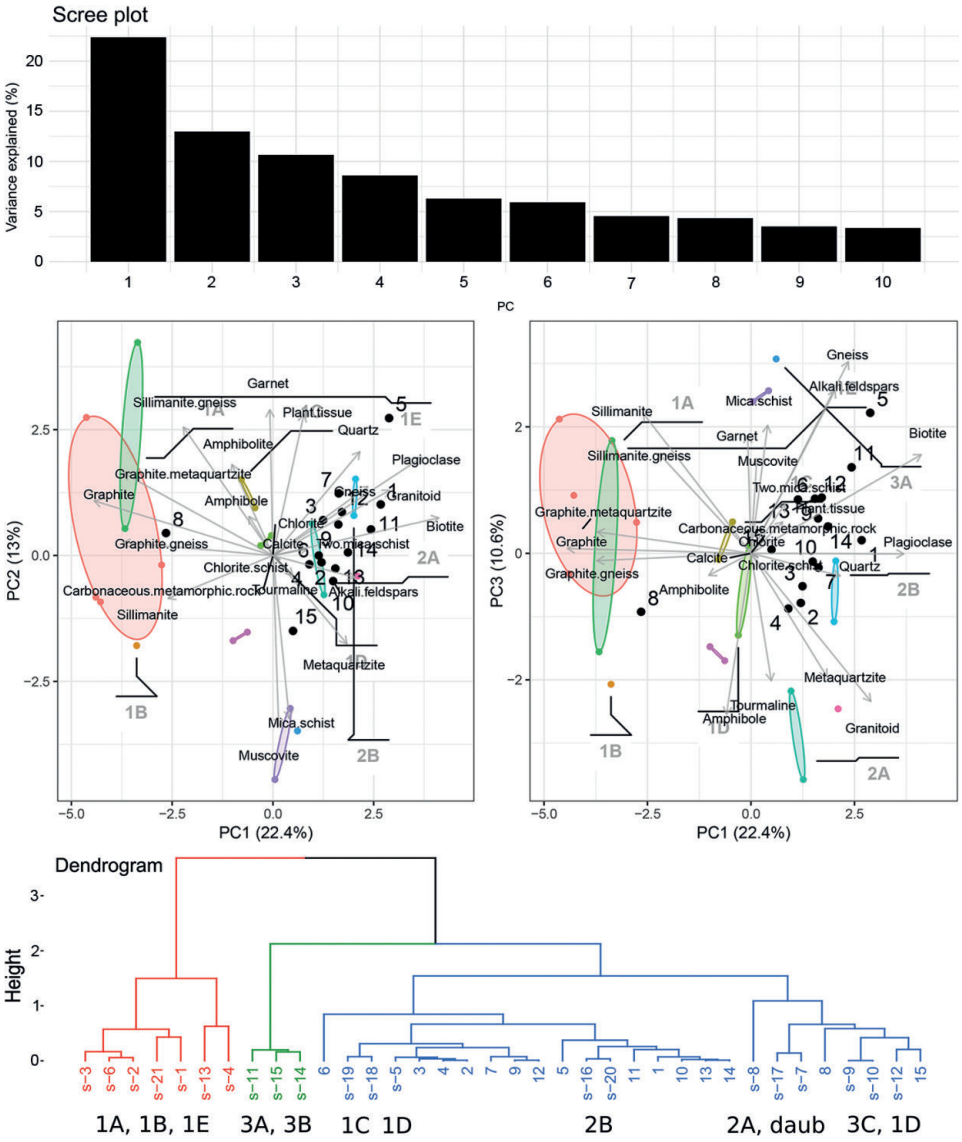

Fig. 13. Statistical analysis of the petrographic composition expressed in semi-quantities: top – scree plot followed by scatter plots contrasting the first PCA component with the second and third; bottom – hierarchical clustering dendrogram derived from the results of the principal component analysis.

Microstructure is weakly parallel. Aplastic inclusions are very poorly sorted with a strongly bimodal grain size distribution. The main ceramic body includes ~5% of naturally occurring silt-sized mineral grains and rock fragments. Sand-sized rock fragments and graphitic grains used as temper are elongated to equant and subangular. They make up ~20% of the whole ceramic mass. The layers close to the outer and inner surfaces were oxidised while the core of the sample section was reduced. Biotite pleochroism is weak.

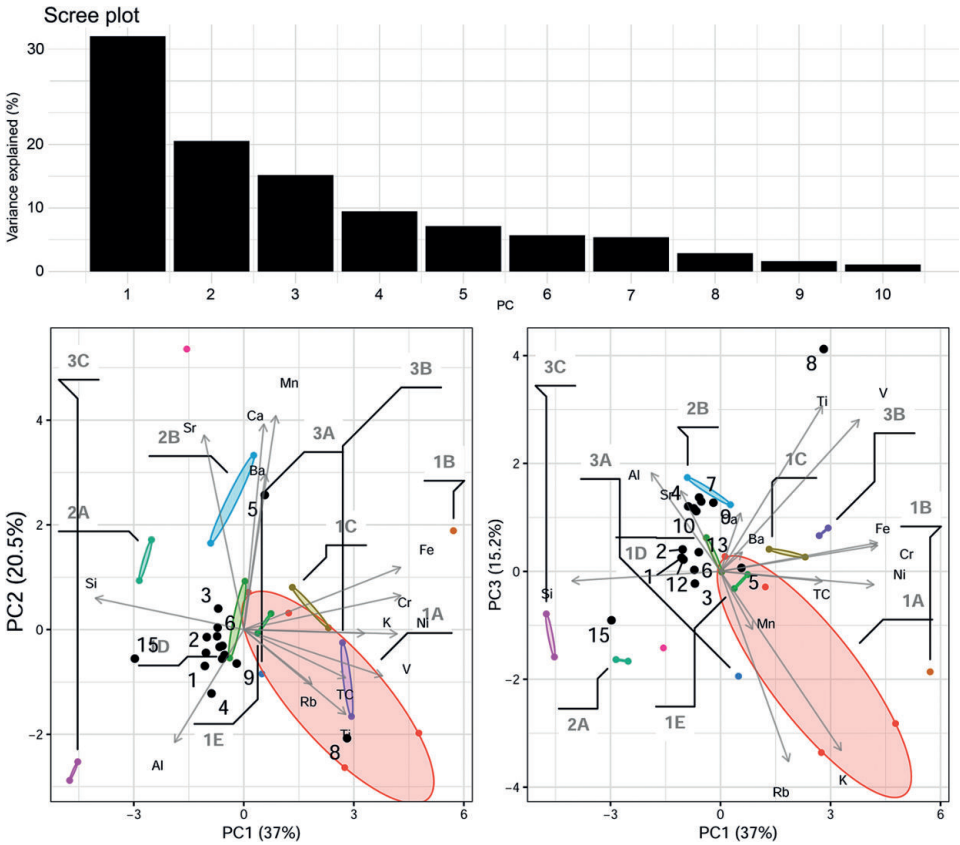

Fig. 14. Principal component analysis of the chemical composition. Top: scree plot followed by scatter plots contrasting the first PCA component with the second and third.

Sample 15 (brick)

Inclusions are composed of abundant metaquartzite and common granitoids or gneiss (*Fig. 15: I, J*). Among mineral grains, quartz is the most abundant, being observed as frequent. Alkali feldspars are common and prevalent over occasional plagioclase. Biotite is common and muscovite occasional. The sample includes common sillimanite.

The brick exhibits an unparalleled microstructure. The clay mass is coarse and includes 20% of inclusions and 10% of sand-sized temper. The overall grain size distribution is slightly bimodal. Sand is composed mostly of quartz, metaquartzite and granitoids fragments of an elongated shape varying between angular and subangular. The sample is completely oxidised. Biotite pleochroism is weak.

Petrography of alluvial sediments

Sázava River

Both samples of river sand taken from the Sázava riverbed are petrographically identical. The most common rocks are biotite gneiss and metaquartzite. Traces of granulites

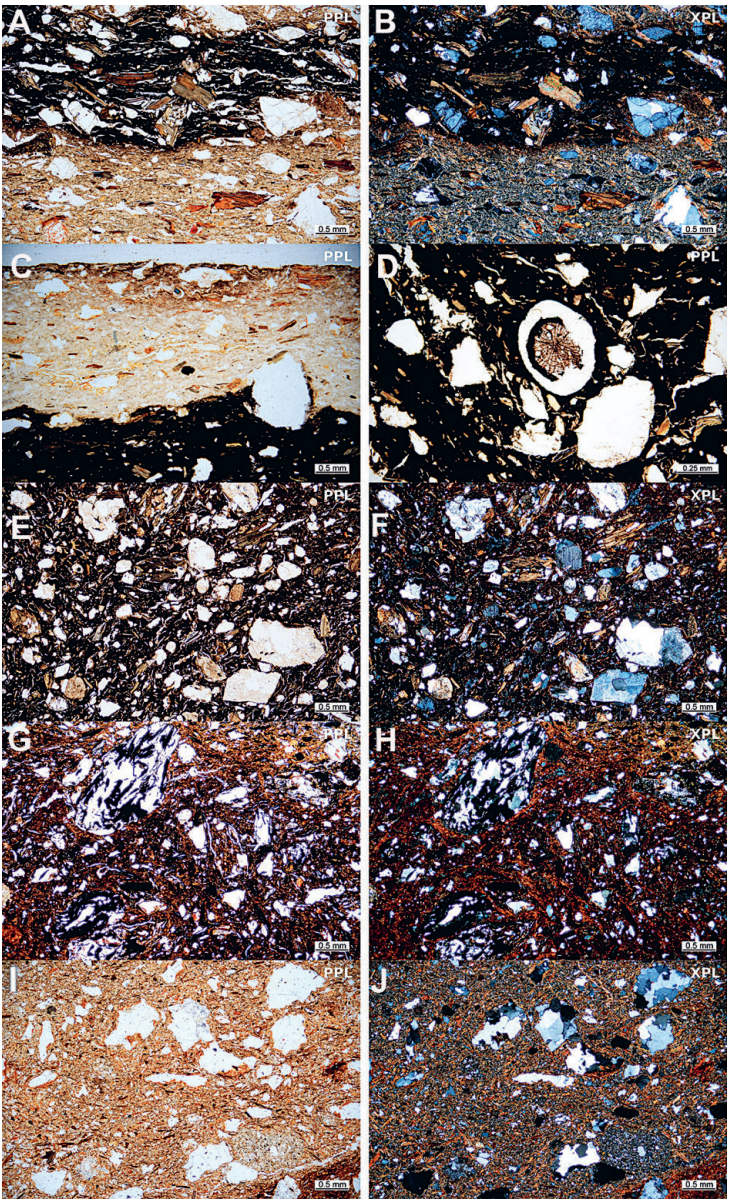

Fig. 15. Photomicrographs: A, B – sample 14 representing the main fabric group, an oxidation layer beneath the vessel surface with numerous biotite flakes and fragments of metaquartzite in the ceramic matrix; C – sample 11 showing a pronounced oxidised layer, ceramic matrix contains a lower amount of aplastics demonstrating variability within the main fabric group; D – unburned organic tissue in the reduced core of sample 11; E, F – sample 5 with unimodally distributed aplastics represented by biotite flakes, fragments of gneiss, granitoid rocks, quartz, and feldspars; G, H – graphite pottery (sample 8) displaying a significantly lower content of biotite compared to the main fabric, including isolated graphite grains and fragments of graphitic metaquartzite used as a temper; J – intrusive brick sample 15 showing a different microstructure compared to the pottery, the predominant rock fragments are metaquartzite with a lower amount of granitoids and gneiss, the entire sample was oxidised.

and granitoids are observed in the sample taken downstream. Among the minerals, quartz is most abundant. Plagioclases and alkali feldspars are common and present in similar proportions, as are muscovite and biotite. Traces of amphibole and chlorite were detected in the sample taken upstream.

Staviště Stream

The sand from the Staviště Stream bed was the most petrographically diverse. The most common rocks are gneiss, biotite gneiss, but also gneiss with sillimanite. Amphibolites are relatively abundant. Less frequent are chlorite schists, metamorphic rocks with carbonate, or standalone carbonates. Quartz grains are very abundant, and fragments of amphiboles and plagioclases are relatively common. Alkali feldspars are less common. Biotite predominates over trace amounts of muscovite. Traces of calcite and sillimanite are also present.

Unnamed stream between the Dívka and Mikšovec ponds

The collected deluvio-fluvial sediment from the unnamed stream west of the site is sandy-loamy, hence it contains fewer larger rock fragments in comparison to the other studied sediments. Rock fragments are represented only by metaquartzite and traces of granitoids. Among the minerals, quartz predominates, while other minerals are present in small and trace amounts. These include biotite, muscovite, plagioclase, alkali feldspars, amphibole, and tourmaline.

Discussion

Pottery kiln

The form and usage of the kiln can be reconstructed based on the preserved archaeological context, characteristics of the ceramics, ethnographic analogies, and experimental archaeology (*Fig. 16*). The preserved part, which was dug into the ground, has its closest analogy in Jihlava in the preliminarily published kiln from the U Skály site (*Kochan et al. 2021*).

Key features include the fired base, bottom walls, and rear heating channel, while other construction elements are missing. The side walls are inwardly narrow at the front, suggesting a back chimney and loading opening. The floor's slight slope from back to front indicates airflow in that direction. The absence of daub hints at a temporary or one-time covering, but the bulging back wall and heating channel suggest a permanent dome structure, likely made of clay plastered over a wicker frame, as seen in ethnography and experimental reconstructions (*Těsnohlídková 2021*; *Čapek et al. 2022*, 74–75). The missing plaster could be due to lower firing temperatures and short peak heat.

The heating channel, not fully excavated, appears to narrow towards its mouth, similar to the Jihlava – U Skály kiln (*Kochan et al. 2021*, 122). This design suggests the use of narrow, long fuel like branches or wood chips. Vessels may have been interleaved with fuel during loading, while the channel served primarily for air supply or occasional refuelling to extend combustion. The characteristics of pottery from the kiln (dark cores, mixed firing, and oxidising surface) indicate a dynamic firing method, potentially without constant refuelling. This involves igniting fuel around and possibly also between vessels and

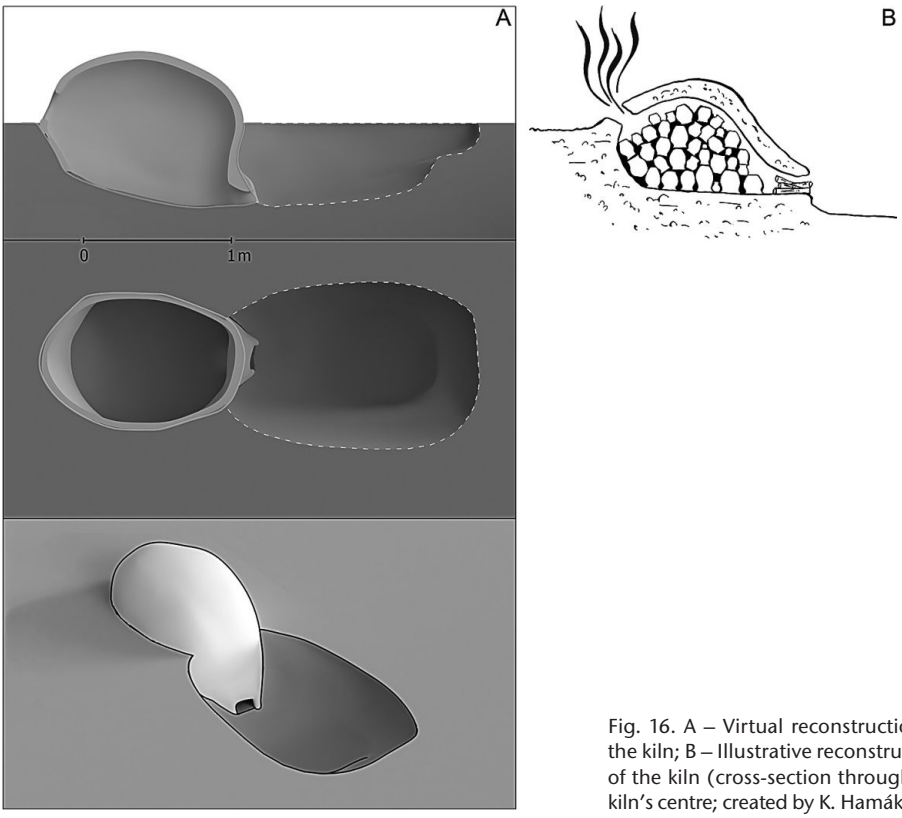

Fig. 16. A – Virtual reconstruction of the kiln; B – Illustrative reconstruction of the kiln (cross-section through the kiln's centre; created by K. Hamáková).

allowing it to fully burn out (e.g., *Roux 2019*; *Těsnohlídková 2021*, 165–167). The ceramic material, akin to brick clays with possible graphite admixtures, seems suited for this firing method characterised by short duration and generally lower temperatures (*Těsnohlídková 2021*, 172–174).

The size of the firing chamber, which determined the capacity of the kiln, remains unknown. In single-chamber kilns, space in the front must be allocated for fuel. The similar Jihlava – U Skály kiln held a full batch of 50–60 complete vessels (*Kochan et al. 2021*, 120). In contrast, the chronologically earlier kiln from Uherské Hradiště – Sady had an almost fully preserved dome. A vertical two-chambered kiln, it featured a furnace below the firing chamber with an elliptical base (100×120 cm), closely resembling the Žďár kiln. The dome height matched its base diameter. *Varadzin's* (*2010*, 31) general observations on kiln curvature provide a basis for estimating firing chamber heights. Considering that the Žďár kiln was sunk 50 cm below the ground, the above-ground part was likely 50–100 cm high.

Potter's workshop

The spatial definition of the potter's dwelling at the site is considerably challenged by the current state of research. Our discussions about its definition remain speculative. The

closest features are seemingly related to the kiln and the presence of a clay deposit can be also considered. A residential structure associated with the kiln was likely situated under a later building or in close proximity to the stonemason's workshop. The potter's workshop itself might have been an above-ground structure potentially spatially linked to the cluster of spherical pits. However, some of these structures might have been located on vacant land towards the southeast part of the settlement. This area either remained unexcavated or a mistake in field documentation is also possible.

To reconstruct the appearance of the potter's workshop, we can partially rely on other archaeological findings from our region and Eastern European ethnography (see *Holubowicz 1950*; *1965*; *Bobrinskij 1978*; *Zatloukal 1999b*; *Varadzin 2010*). More comprehensive archaeological records of pottery workshops are known primarily from later periods, when they predominantly took the form of roofed structures (*Richter – Krajíc 2001*; *Procházka 2015*; *Čapek – Preusz 2019*). Within a reasonable distance from the pottery kiln, one can anticipate storage for clay ageing (*Goš 1973*), which might have been a dug-out, wooden-lined pit or an above-ground wooden structure. Clay processing might also take place in pits or above ground (*Goš 1982*). Instruments used for pottery shaping are only rarely archaeologically documented. There might also have been a facility for drying pottery, possibly in the form of an oven (*Zatloukal 1998*). Pits containing pottery waste, sometimes repurposed clay pits, are also known (*Goš 1983*; *Měchurová 1991*; *Vyšohlíd 2015*). Although kilns are the most common evidence of pottery production, simpler devices for pottery firing that are harder to archaeologically detect can be also assumed in the 13th century (see *Procházka 2015*; *Čapek – Preusz 2019*; *Těsnohlídková 2021*).

Ethnographic data suggest that the production capacity of a single workshop could be sufficient for supplying surrounding villages, and in the case of the Staré Město potter's workshop, the Žďár monastery as well. *Holubowicz* (*1965*) estimates that a family of five in the Early Middle Ages would require 20 vessels annually. Assuming a batch of 50 vessels per firing, even with a 10% defect rate, only six to seven firings would be necessary each year for a settlement with 14 households. According to Holubowicz's data, a potter would need 9–13 days for the entire production process from clay extraction to firing. Thus, these six or seven firings would take approximately 78–91 days or about 2.5–3 months of work to supply just the settlement. If pottery was provided for the local market supplying other villages in the region and the monastery, it is necessary to consider a greater amount of time invested in the pottery-making process (*Holubowicz 1965*). It is questionable if the remaining time was spent by the potter in agricultural activities to provide himself and his family with food. The total volume of pottery produced on-site can be estimated by the duration of the settlement's existence. If the record in *Cronica Domus Sarensis* is accurate, the settlement's duration in the 3rd quarter of the 13th century could be in the range of 10–24 years, which means that the total consumption of the Staré Město settlement would have been 3,000–8,400 vessels (*Ludvikovský et al. 1964*; *Zatloukal 1999a*).

Interpretation of pottery from the kiln

Determining the significance of the pottery found in the kiln hinges on interpreting the type of the deposit itself. The complete and mended vessels share similar morphological and technological attributes. Only three types of pots are represented, each by multiple specimens. The limited variability of rims suggests rapid sequential manufacturing. Almost

all pots share the same type of neck offset from the belly and exhibit similar decorative motifs, while predominantly featuring undecorated rims. The majority of the ceramic material is sand-tempered without graphite, except for two specimens. Of the 14 analysed samples, 12 were made from the same raw material. Consistency in forming and firing technologies is evident. While it is uncertain if these vessels are from a single batch, their similarities indicate they were likely produced within a relatively short timeframe.

The limited number of vessels suggests they were not part of a complete kiln batch, as it is apparent from a comparison with similar contexts (*Kochan et al. 2021*, 120). Interpreting kiln batch finds is a complex issue; pots in their primary position are a crucial aspect of research (*Čapek – Preusz 2019*, 344–346). The vessels found may have been flawed or aesthetically unappealing, unlikely to be marketable, yet they were not complete failures. All exhibit signs of an oxidative final phase of firing with a dark core, and reductive firing. This pattern can also be recognised in material from other settlement features (*Těsnohlídková 2021*, 228–230; *Tab. 4*). Aesthetic displeasure is hinted at by manipulation marks on six vessels. In one case, a pronounced indentation led to a crack in the inner wall, possibly affecting functionality. However, in the other five instances, the indentations were minor and did not significantly alter the vessel shapes.

If the pots excavated in the kiln were vessels rejected by their maker, they might represent a secondary deposition following the kiln's active phase. This interpretation is supported by the fragmentary nature of part of the fill, including unsalvageable pieces totalling 629 fragments, some being small sherds. The rim shapes in this collection are more varied than those of the complete vessels, aligning more closely with the general rim pattern of the settlement than with the rim types of complete and torso-preserved vessels from the kiln (*Těsnohlídková 2022*, 241–243). While a few fragments might have unintentionally entered the kiln during operation, most of them, including bricks, were likely intentionally deposited after its termination.

Local production description

Morphology

The analysis of pottery from the kiln provides new insights into local production, especially the results obtained from complete pots. The kiln contents have significantly expanded the inventory of whole pots at the site, enhancing the ability to classify pot types based on dimensions and body profiling. This is a step forward from the previous classification method based on the position of the maximum belly diameter, which faces some limitations (*Zatloukal 2000*). It raises the question of whether these types represent a specific and short time period.

The occurrence of overlapping rim types across different pot shapes and varied rims within a single pot type indicates that rim shaping might not have been deliberate in terms of style, but rather showed tendencies toward reinforcing the neck or facilitating stable lid placement.

Of 16 analysed vessels, 15 were decorated with grooves. This proportion seems lower in the settlement assemblage, possibly because the decorations were limited to small areas of the belly. Complete motifs and combinations of decorative elements are more discernible on whole vessels. Although the dataset is limited, it suggests a chronological trend: the popularity of decorated rims and wavy lines on shoulders seems to decrease over time.

Tab. 6. Summarisation of the main fabric chemical composition.

	mean	sd	min	max
SiO_2	55.10	2.60	51.13	59.90
Al_2O_3	23.52	1.02	21.73	24,94
Fe_2O_3	4.98	0.16	4.60	5.18
K_2O	2.00	0.23	1.75	2.30
CaO	0.98	0.07	0.90	1.14
TiO_2	0.78	0.02	0.73	0.81
V	131	6	120	143
Cr	86	4	81	93
Mn	311	37	262	372
Ni	44	3	38	50
Cu	47	3	43	55
Ga	39	3	34	44
As	14	1	13	16
Rb	163	25	129	202
Sr	91	4	82	95
Ba	638	187	380	994
Pb	28	2	26	30

This finding offers a potential avenue for inferring typochronological trends in local pottery production.

Ceramic technology – tempering and provenance of raw materials

Only ceramic classes of local provenance were found in the kiln. The lower occurrence of graphite pottery (both among whole vessels and in the fragmentary assemblage) could suggest its decline assuming that the vessels from the kiln come from the last phase of the settlement's existence. Residues of plant tissues, exhibiting wood-like structures, were detected in low quantities in the ceramic body of sand-tempered pottery. These may represent charred remnants that were unintentionally incorporated into the clay, even though the technique of charcoal tempering was historically employed (*Gregerová – Procházka 2007*, 271; *Wallis et al. 2011*).

The base material for non-graphite pottery was likely loam or possibly clay loam. A significant diagnostic characteristic is the pronounced presence of stacks of biotite, which are quite short in length. It is important to consider whether this feature was already present in the original ceramic clay. Given the shape of the flakes and their frequency, this is highly probable. If the biotite was added to the clay as part of the temper, then the temper grains themselves would also have to contain biotite-rich rocks, which is not entirely the case. The temper consisted of sand containing quartz from feldspar rocks, often without biotite. The increased content of biotite in the brick, however, indicates a natural occurrence in the clay and at the same time a local origin of the raw material (see *Tab. 6* for the chemical composition of the main fabric).

The rocks used as a temper often exhibit a notable grain orientation, indicating they are metamorphosed rocks, i.e. gneiss. However, a substantial portion of rock fragments did not have grain orientation, and these rocks were identified as granitoids. This identification is apparently not accurate, as even gneiss bodies contain positions that do not demonstrate any orientation at such a scale as small fragments in ceramics. The site is situated directly

on bedrock formed by Moldanubian gneiss. The local origin of these rocks is confirmed by the accessory minerals found in the ceramics – amphibole and garnet, which are typical components of Moldanubian gneiss. As for granitoids, they form the bedrock only a few kilometres upstream of the Sázava River, on whose bank the site is located. The presence of granites in the Sázava sediment was also confirmed by an analysis of sand extracted directly from the riverbed. The partially rounded shape of the grains confirms that the grains used for tempering were carried over some distance by the river.

Morphologically, graphite pottery is not specific in terms of technology; it bears the same characteristics (apart from the addition of graphite). Similarly, a comparison of graphite and sandy ceramics from the site does not reveal significant differences. The presence of graphite pottery among the complete vessels in the kiln does not necessarily imply that these were vessels from a different batch. The technological features of the ceramic vessels from the kiln, pertaining to both shaping and firing, match the features observed in sandy and graphite pottery from the settlement. It can be assumed that throughout the duration of the settlement, there was no substantial transformation in the pottery technology.

The only representative of graphite ceramics analysed from the fill differs from the rest solely in material aspects. The biotite content is significantly lower compared to the rest. Therefore, the clay must have been acquired from a different location or a biotite-poorer stratum, which could be, however, still described as loam or clay loam. The temper used was isolated graphitic grains and flakes and graphitic rocks, specifically graphitic metaquartzite. Lenses of graphitic rocks are common for the variegated series of the Moldanubian zone, but their presence has not yet been proven in the immediate vicinity of Žďár. The closest proven outcrops are Cikháj, Herálec, Netín, Vídeň, and Zvole, which are located 8–20 km away (*Burkart 1953*). There are two possible explanations: graphite was either imported to the site or graphite was extracted from unknown outcrops located in the developed area of today's city. Other components of the temper are non-graphitic rocks, specifically gneiss, which are found in both the eluvial sediment at the site as well as in Sázava alluvial sediment.

Ceramic technology – vessel forming

The analysis of complete vessels significantly enhances the understanding of vessel forming technology at the Staré Město site. It reveals a link between papillary ridge and groove impressions on vessel necks and coil traces in the lower parts of vessels along with signs of dusting and base attachment or removal. Coil traces are found mostly at the less accessible lower inner walls and below the neck. It suggests that these areas were smoothed only after the vessel's completion or before finalising the rim.

Technological traces, which are observable also in fragmentary materials, are complemented by vessel dimensions and discrepancies in measurements. Variations up to 1 cm in the diameters of rims, necks, and maximum bellies diameter, as well as variations up to 1.5 cm in the vertical position of these elements, indicate underutilisation of rapid rotation and profile turning in shaping.

The parallel orientation of inclusions, indicative of the use of rotational energy at some shaping stage, is less pronounced in material from Staré Město than in fully wheel-thrown vessels. This suggests that rotational energy from the wheel or turntable was applied only during final shaping, as supported by 3D analysis. The upper body of the pot shows less wall thickness variability, while the lower part varies more due to coil remnants. Further-

more, complete symmetry along the rotational axis, typical for fast wheel usage, is absent; the pots exhibit significant asymmetry. This points to a technique in which the process began with coiling, followed by a wheel or turntable used for final shaping. It means that the potter integrated both traditional hand-building and wheel techniques.

Ceramic technology – firing

The analysed ceramics was fired heterogeneous technique characterised by a smaller share of reduction, dark cores and an oxidised layer by the surface. The oxidised layer appears irregularly. This indicates that the firing temperatures and duration were insufficient for full burnout of the graphite or organic temper, particularly in the core of the sherd. Experimental archaeology suggests such patterns emerge during a rapid, single-time firing without additional stoking, which could take place in open hearths or partially enclosed spaces. This method involves significant temperature spikes and brief peak temperatures. Therefore, it demands ceramic materials resistant to thermal shock, like the brick clays akin to Žďár pottery combined with a suitable temper (*Těsnohlídková 2021*, 299–300).

The position of some vessels within the kiln could be tentatively determined, yet a detailed reconstruction of the kiln loading method cannot be inferred from the archaeological context. Reduced-fired parts were either covered by other vessels, leaned against the kiln wall, or covered with charred fuel. If the pottery was from a single batch, its arrangement within the kiln appeared irregular and lacked regular patterns.

Rapid firing processes and short maximum temperature durations were typical for pottery production in the 13th century. It applies both to the Staré Město site and the larger area surrounding it called the Bohemian-Moravian Highlands region. This contrasts with late-medieval advancements marked by improved ceramic properties (increased plasticity, finer grain, possible mica admixture) aligning with the demands of fast wheel throwing. The new material required more controlled firing with gradual temperature rises because of its lower thermal shock resistance. Partial sintering at high temperatures reduced permeability, but it requires kilns capable of these conditions. They highlight the dominance of professional pottery emerging with the colonisation of peripheral regions of Bohemia in the 13th century. These advanced kilns started to appear already in traditional production period, but their full potential in enhancing pottery quality was not yet fully realised by pottery producers.

Pottery from the kiln in the context of the settlement

Morphology

The shapes of vessels found in the kiln morphologically correspond to the finds from the settlement, as pointed out by *Těsnohlídková* (*2022*). Pots are predominant forms accompanied by bell-shaped and flat lids, miniature vessels, a spouted pitcher, a jug, and a bottle. The pots had everted and roof-shaped rims, which were represented in a similar proportion. A simple-edged rim appears only sporadically. If we assume the kiln termination coincided with the end of the settlement, there might have been a gradual increase in the number of roof-shaped rims. This hypothesis could be supported by a higher occurrence of roof-shaped rims in sandy and mica pottery compared to graphite pottery, as mentioned earlier. In terms of the recess of the neck from the belly, the smooth recess (type A) predominates in the kiln as well as in the pottery from the rest of the Staré Město settlement.

The sharp recess (type B) is rare in the kiln compared to overall production. The decoration observed in the kiln is consistent with local production but notable differences appeared in the proportion of decorated rims.

Ceramic technology – tempering

From a technological standpoint, the vessels found in the kiln closely align with the sandy and graphite components of local ceramic production. The graphite component is minimally represented (only two pots). Morphologically, graphite pottery cannot be distinguished from non-graphite pottery, and it also shows similar technological characteristics, except for the graphite additive. The traces of formation align with those of the settlement material. Firing traces reconstructed for the material in the kiln with no significant signs of over-firing and with a dominance of oxidation firing also match the majority of the local production. These traces might indicate no significant technological transformation during the short lifespan of the settlement.

Petrographic examination categorised settlement ceramics into three main petrofabric groups: graphite-based (1), non-graphite sandy (2), and 'exotic' mica-rich and glazed (3). Each petrofabric is further classified according to specific inclusions or technological firing traces. Most petrofabrics were identified as locally sourced. However, the origin of graphite-based ceramics (petrofabric 1) is uncertain due to the unknown local graphite sources. The closest known graphite-bearing rock outcrops are 8–20 km away. And yet, the presence of graphite lenses in the Moldanubian variegated series suggests local sources might have been available in the past. Petrofabric 1B, with a high muscovite content, likely did not use exclusively local materials. Suitable rock outcrops are at least 10 km away, in the Kutná Hora – Svratka crystalline complex. For sandy petrofabric 2, local origin was confirmed by petrographic analysis of nearby river sands. The 'exotic' petrofabric 3, rich in muscovite and mica schist, is the only clearly non-local type having origin in production or just the material in the Kutná Hora – Svratka geological complex. This suggests either local production with imported materials or production in the region where these rocks are common.

The non-graphite pottery found in the kiln petrographically corresponds to petrofabric 2B (see *Fig. 13*, *14*; *Tab. 1*). The chemical composition is not entirely identical, which was manifested in the PCA component 2. The settlement's petrofabric 2B has a comparatively higher content of Ca and Sr. However, when disregarding these two elements, as indicated by the scatter plot of the first and third components, the composition of the kiln's non-graphite pottery and petrofabric 2B is congruent. The first PCA component is mainly shaped by the negative correlation between Si and metals, predominantly Fe, Cr, and Ni, while the third PCA component is shaped by Ti and Al vs. Rb, Mn, and K. The other non-graphite petrofabric 2A is petrographically somewhat similar to the kiln pottery but is distinguished by a lower content of gneiss fragments and biotite. A difference in the manufacturing technology is also evident. The 2B petrofabric was fired at a higher temperature, as indicated by its vitrified matrix. The difference in chemical composition is apparent and is mainly reflected in the higher Si content in petrofabric 2A.

The graphite pottery from the kiln is petrographically most similar to petrofabric 1A. However, it markedly deviates by chemical composition due to its high Ti content, which was prominently exhibited in the second PCA component. The scatter plot of the first and second components affirmed its affinity to 1A in chemical composition.

An intriguing observation is that the chemical composition of the non-graphite pottery from the kiln has brought petrofabric 2B closer to certain graphitic petrofabrics, specifically 1D and 1E. The 1D pottery contains a relatively small amount of graphite, and most importantly, the matrix character aligns with the non-graphite pottery from the kiln. The clay for this pottery most probably originated from the same source, suggesting that it was produced on-site and graphite was brought into the local workshop. Pottery belonging to petrofabric 1E has a distinct base matter; its biotite content is no longer increased. The chemical composition of the non-graphite pottery from the kiln also aligns with sample 13 from the settlement (petrofabric 1A), which differs slightly in its petrography. However, it fits perfectly in the geological context of the settlement and its surroundings.

The analysis of the kiln fill has shown that the local workshop produced pottery goods made from at least two distinctly different types of clays – one with a naturally high biotite content and one without biotite. The biotite content is not contingent upon whether graphite was added to the ceramics or not. Non-graphite petrofabric 2A has a lower biotite content, whereas graphite 1D has a biotite content consistent with non-graphite pottery 2B and most of the kiln fill. The chemical composition analysis demonstrates the variability in the chemical composition of local production. Only mica petrofabrics 3A and 3B with muscovite and mica schist as well as graphite 1B (which was identified just from sample 1) are apparently different and not directly local. Whether these were produced on-site with raw materials (especially the temper) being brought in, or they represent pottery imports, remains inconclusive at this point. The mica or mica pottery might have originated from the vicinity of Škrdlovice (*Čapek – Slavíček 2022*). Similarly, the interpretation regarding the origin of glazed pottery 3C remains open; it is too fine-grained for petrographic determination and its chemical makeup significantly differs from the rest of the collection.

Conclusion

The medieval pottery workshop in Staré Město, while speculative in its exact layout due to research limitations, was likely a hub for ceramic production serving both the settlement and the nearby Žďár monastery. Drawing from archaeological and ethnographic references, it is assumed that the workshop had roofed structures with storage and processing areas. While pottery found in the kiln exhibit similarities, variations in their quality hint at the inclusion of both market-worthy and flawed pieces. This dichotomy possibly indicates a secondary deposition of unsatisfactory vessels after the kiln had completed its primary function. Overall, the pottery workshop played an essential role in the 13th-century settlement, emphasising its cultural and economic significance.

Comprehensive analysis of whole vessels from the kiln has provided a clearer understanding of the local pottery morphology, revealing a variety of pot shapes and decoration trends. Despite the limited representation of graphite pottery, both graphite and sandy pottery exhibit consistent technological features. It suggests minimal transformation in production techniques over time. The pottery seems to be formed by a method combining coiling with rotational energy, perhaps from a turntable or rudimentary wheel. Firing practices from this period were notably rapid, with a focus on short durations at peak temperatures.

Examination of the kiln pottery in the context of the settlement finds provided an in-depth understanding of the technological and morphological nuances of ceramic production.

Morphologically, the pottery in the kiln and settlement contexts was consistent. Technologically, it is evident that there were subtle shifts in production methods, especially concerning the use of graphite clay. The petrographic analyses of settlement ceramics reveal a multi-faceted material base emphasising both local and potentially external influences. The presence of non-local petrofabrics, especially those rich in muscovite, contributes to the long-standing research question of Czech medieval archaeology concerning material sourcing and technological exchange in pottery production.

The archaeological excavations of the Staré Město site offer a profound glimpse into the nuanced layers of the past. The work showcases a brief yet significant period of habitation on the northern periphery of present-day Žďár nad Sázavou. The archaeometric analysis of pottery enabled a close look into many details of local pottery production. This paper aims not only to serve as a thorough base for the future research of socio-economic relationships within the Žďár region colonised in the 13th century, but also as a cornerstone for regional ceramic research covering the entire Middle Ages.

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KAREL SLAVÍČEK, Institute of Archaeology of the Czech Academy of Sciences, Brno, Čechyňská 363/19, CZ-602 00 BRNO, Czech Republic; Masaryk University, Faculty of Science, Department of Geological Sciences, Kotlářská 267/2, CZ-602 00 Brno, Czech Republic; slav.karel@sci.muni.cz
KATEŘINA TĚSNOHLÍDKOVÁ, Institute of Archaeology of the Czech Academy of Sciences, Brno; Čechyňská 363/19, CZ-602 00 Brno, Czech Republic; tesnohlidkova@arub.cz
MARTIN KOŠŤÁL, Masaryk University, Faculty of Arts, Department of Archaeology and Museology, Arna Nováka 1/1, CZ-602 00 Brno, Czech Republic; 462845@mail.muni.cz
DOMINIKA VÁCLAVÍKOVÁ, Charles University, Faculty of Arts, Department of Archaeology, nám. Jana Palacha 1/2, CZ-116 38 Praha 1, Czech Republic; vaclavikova.dominika@gmail.com
KRISTÝNA TRNOVÁ, Masaryk University, Faculty of Science, Department of Geological Sciences, Kotlářská 267/2, CZ-602 00 Brno, Czech Republic; kristynatrna@gmail.com

NEWS – ZPRÁVY

Artifacts – Images – Texts. Archaeology and the Historiography of Sound (ISGMA, Würzburg, 25.–29. 9. 2023)

Muzikologické oddělení würzburské univerzity patří k významným centrům hudebně archeologického výzkumu. Není proto divu, že v pořadí již dvanáctý ročník setkání Mezinárodní skupiny pro výzkum hudby v archeologii (International Study Group on Music Archaeology, www.musicarchaeology.org), které proběhlo v posledním zářijovém týdnu, hostila jedna z nejvýznamnějších barokních památek UNESCO na území Evropy – palác knížecího biskupství (tzv. Würzburger Residenz). Konference se koná pravidelně jednou za dva roky (předchozí ročník viz *Chroustovský 2022*), proto trvá týden a je intenzivně vyplněna příspěvky, ale i workshopy a koncerty. Již podruhé byla pořádána hybridní formou, přičemž většina z účastníků byla přítomna osobně, což je pochopitelné vzhledem ke specifické náplni zahrnující reprodukované i živé hudební ukázky, koncerty či sdílení zkušeností s replikami. Konference, jejíž chronologický a geografický rozsah zůstává neomezen, sestávala z 15 sekcí čítajících celkem 45 příspěvků, z toho 9 posterů.

ISGMA slouží již od svých počátků jako platforma pro diskuse v interdisciplinárním rámci. Letošní téma posunulo těžiště zájmu zejména k historické muzikologii, filologii a ikonologii. Specifičnost využití historických písemných pramenů demonstrovala úvodní keynote S. Hagela (např. *2009*) o pojetí harmonie ve starověkém Řecku. Hypotézy se pohybovaly od čistě hudebně teoretického konceptu po specifický druh hudebního nástroje či tělesa. Následovala sekce o multikulturních a mezikulturních perspektivách věnovaná vývoji hudby v mladém paleolitu (M. Praxmarer), srovnání nástrojů starověkého Egypta a Řecka (J. Lloyd) a instrumentáři Mayské civilizace (M. Howell), dále sekce o recentních nálezech a jejich historických kontextech s příspěvky o strunných nástrojích středoasijských stepí (G. Kolltveit, A. Tazhekeyev a G. Curie) a místním středověkém dechovém nástroji z historického centra Würzburgu (B. Spies). Následovala veřejně přístupná přednáška o symbolice osla hrajícího na harfu (potažmo příbuzné strunné nástroje) v historických a ikonografických pramenech (N. Thym), jež byla součástí zahájení (O. Wiener) výstavy Musical instruments and animals prezentující zajímavé aspekty vzájemné provázanosti nástrojů a zvířecí říše na materiální a technické, ale i symbolické a rituální rovině. Výstava probíhala pouze během konferenčního týdne, byla umístěna v malé galerii sousedící s hlavním toskánským sálem a navazovala na rozsáhlejší archeomuzikologicky zaměřenou expozici Mus-ic-on! Klang der Antike (*Leitmer et al. 2019*).

Druhý konferenční den tvořily čtyři paralelní programy, dva praktické workshopy, teoretický seminář a komentovaná prohlídka sbírky antického umění Antikensammlung des Martin von Wagner Museums (www.phil.uni-wuerzburg.de/archaeologie/antikensammlung), která je umístěna přímo v prostorách Würzburské rezidence. Workshopy se zaměřily na možnosti rekonstrukce pravěkých harf, v tomto případě fragmentu z halštatské lokality Fritzens-Pirchboden v Rakouských Alpách (G. Heel, M. Schick, G. Tomedi, U. Töchterle, N. Thym),[1] a praktickou výrobu pravěkých keramických chřestítek (K. Tatoň) vycházející ze zkušeností získaných v rámci nedávného polského projektu (*Gruszczyńska-Ziółkowska et al. 2021*). Teoretický seminář (F. Leitmeir, D. Shehata) se věnoval přípravě příručky hudební archeologie, jež započala před deseti lety a jejíž dosavadní editoři (*Howell et al. v přípravě*) otevřeli charakter i náplň knihy k diskusi mezi zainteresovanými účastníky, kteří tvořili naprostou většinu z přítomných. Hlavní otázky směřovaly k cílové skupině, obsahu

[1] Viz https://www.uibk.ac.at/archaeologien/forschung/arbeitsgemeinschaften/musikarchaeologie/harfe/harfe_fritzens.html.

https://doi.org/10.35686/AR.2023.29

a formě. Obecná příručka je pro specialisty hudební archeologie zbytečná, zatímco pro specialisty či studenty jiných disciplín by mohla být velmi užitečná, stejně jako pro odbornou či laickou veřejnost. Z hlediska obsahu je otázkou, zda představit všechny obory, které se podílí na interdisciplinárním charakteru hudební archeologie, určitě je však třeba zahrnout základní teoretické a metodologické rámce a specifika výzkumu dle jednotlivých civilizačních okruhů. Původní představa tištěné knihy zdá se již překonaná, neboť v případě tak dynamicky se rozvíjející výzkumu, je dnes preferována snadno aktualizovatelná e-kniha, i když byla diskutována i možnost otevřeného webového portálu, či autorského kolektivu (je žádoucí, aby příslušné kapitoly tvořili zkušení specialisté, ale otázky výrazně odlišných přístupů v rámci dané specializace a vůbec jejich ne/zařazení do obecné příručky zůstávají i nadále otevřené.

Důraz na historické prameny a jejich konfrontaci s těmi archeologickými přetrvával i v dalších dnech. Přednášky byly tematicky zaměřené na určitou kategorii nástrojů (staroegyptská flétna Nai – M. Maged, M. Mamdouh; anglosaské plátkové nástroje z Ipswich – L.-A. Taylor; keramické bubny středověké Andalusie – A. M. S. Bento; kolektivní hra na Panovy flétny v původních jihoamerických kulturách – J. Pérez de Arce; rohy z mořských ulit v novověkých Čechách – M. Ondříčková, L. Chroustovský), specifickou oblast využití (starořecká mystéria – S. Perrot; zvuky čínského válečnictví – K. Xu), metodiku (tzv. nesmyslné nápisy v hudebních kontextech – A. Gandossi-Boshnakova), ale i další témata (statické prvky starověkých řeckých tanců – L. Gianvittorio-Ungar; konzervativní a inovativní aspekty staré čínské hudby – J. Bonan; filologický rozbor středověké čínské novely – B. Congcong).

Významnou součástí konference byly příspěvky založené na studiu ikonografických pramenů, z nichž významnou oblastí je řecké vázové malířství (vizualizace zvuků – G. Gerleignery, M.-L. Herzfeld-Schild, role sirén – F. V. Cerqueira, loutna pandura – J. P. Charest), neméně významné jsou však četné prameny z území dnešní Číny (metodika výzkumu – J. Fang; difuze kulturních prvků – X. Wang; plastiky na bronzových bubnech či gonzích – R. Huang; sestavy kamenných či bronzových gongů starověké Číny – X. Fang). K dalším zastoupeným oblastem patřil starověký Egypt (hudebníci a tanečníci – N. K. El Malt), Přední východ (bubeníci jako ikony či indexy – A. Aioanei, R. Hunziker-Rodewald), starověká Indie (trojice bubnů – D. Gupta), Střední Amerika (palácové umění klasického Mayského období – M. Cuira), či jihovýchodní Asie (středověké gongy na Jávě a v Kambodži – N. Arsenio).

Ani v rámci letošní ISGMA nechyběly příspěvky zaměřené výrazně experimentálně, zejména na rekonstrukce a replikace (instrumentář starověkého Egypta – H. Köpp-Junk; výroba usňové blány mezopotámských kotlových bubnů na základě historických pramenů – D. Sánchez Muñoz; aulos z Pompejí – K. Wyslucha, S. Hagel; aulos z Azaila ve Španělsku – R. Jimenez Pasalodos, S. de Luis Mariño; repliky a vzdělávání – E. Fock), ale též akustický výzkum (starověké čínské zvonkohry – Q. Wang, T. Ng; keramická a kovová chřestidla na území Polska – K. Tatoń, I. Czajka; středověké poutnické rolničky a zvonky – A. Gruszczyńska-Ziółkowska), psychoakustika (eneolitické keramické rohy v jeskyních a pod převisy – A. Schlauch, J. Schween), využití virtuální reality (R. Till) či obecnější reflexe (experiment v čínské archeomuzikologii – Z. Wang).

Výsadou archeohudebních setkání jsou, kromě striktně vědeckého obsahu, také rekonstrukce hudebních nástrojů prezentované v rámci příspěvků, posterů. Mnohdy jsou dokonce nástroje na určitém místě k dispozici ke studijním účelům, samozřejmě za stálého dohledu jejich zhotovitelů či držitelů. Další neodmyslitelnou složku tvoří dva večerní koncerty přístupné zdarma také široké veřejnosti. Středeční večer patřil tradičním loutnám z prostředí Předního východu a Magrebu představeným na základě repertoáru tradičních hudebních forem, ale i moderních kompozic. Čtvrteční večer byl pojat spíše jako popularizační přednášky s hudebními ukázkami. Letos bylo na programu srovnání tradiční tamburíny dof a staroegyptských nálezů (M. Maged, Z. Ahmed), dále srovnání akustických možností římského cornu a barokních trubek (T. Rute) a netradičně, ale zajímavě pojaté vyprávění o rituální roli dvojice rohů (organických, bronzových i z drahých kovů) v pravěku Irska (S. O'Dwyer, J. Schween).

Z mého pohledu je pro budoucnost ISGMA nejvýznamnější její interdisciplinární charakter. Vzhledem k tematické šíři studia minulých hudebních kultur, nástrojů, areálů i akustiky si perspektivu tohoto odborného fóra ani jinak představit nelze. Četnost účastníků neklesá, těžiště konference sice patří jádru specialistů, kteří se hudební archeologii věnují intenzivně a delší dobu, nicméně mezi účastníky je celá řada mladých badatelů či badatelů z příbuzných disciplín. V odborných debatách zaznívají nejen potřebné kritické názory, ale je v nich cítit společná chuť zabývat se hudbou v minulosti, studovat nové nálezy, klást si nové otázky či vyvájet nové metody, ale také kriticky reflektovat vlastní výsledky a zkušenosti. Tradiční forma publikování příspěvků v rámci řady Orient-Archäologie (naposledy *Eichmann et al. 2019*) byla již od minulého ročníku nahrazena novým mezinárodním recenzovaným časopisem Journal of Music Archaeology (*Shehata et al. 2023*; https://jma.vlg.oeaw.ac.at) vydávaným Rakouskou akademií věd.

Luboš Chroustovský

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BOOK REVIEW – RECENZE

Lorenzo Zamboni – Manuel Fernández-Götz – Carola Metzner Nebelsick (eds.): Crossing the Alps. Early Urbanism Between Northern Italy and Central Europe (900–400 BC). Sidestone Press, *Leiden 2020*. ISBN 978-90-8890-961-0. 434 pgs.

The book represents the output of the *Crossing the Alps*: *Early Urbanism Between Northern Italy and Central Europe (900–400 BC)* conference organised by the University Milano-Bicocca, the University of Pavia, the University of Edinburgh, and the Ludwig-Maximilians-Universität Munich in Milan, Italy, in 2019. The opening quote: '*The great arc of the Alps to the north, as much as one would expect to the contrary, seems to have been a negligible barrier to communication and trade*' (*Barfield 1971*, 9) essentially captures the focus of the entire monograph. While it would seem that much has already been written about urbanism, trade and communication in the Iron Age (see, e.g., *Lang – Salač 2002*; *Biel – Krausse 2005*; *Krausse – Beilharz 2010*; *Sievers – Schönfelder 2012*; *Schumann – van der Vaart-Verschoof 2017*; *Fernández-Götz 2018*; *Cowley et al. 2019*), it is precisely the complex interconnection between the Italian environment and Central Europe or the Balkans without the traditional 'art historical' or 'centre-periphery' view (civilised Mediterranean vs. 'barbaric Central Europe') that has been absent in the literature to date, with a few exceptions.

The book, thanks to new theoretical approaches and the enormous number of new finds that can no longer be considered as exceptions and ignored, tries to reinterpret earlier approaches and study the mutual interactions between cisalpine and transalpine regions. Proto-urbanism and urbanism is a key theme of the book. In the introduction, the authors note not only the differences between Italy and Central Europe, but also the different approaches to studying urbanisation within Italy itself, especially between the heavily urbanised Central and Southern Italy and the 'peripheral' Northern Italy. From the perspective of classical archaeology, the emphasis has naturally been on the study of Greek colonies and Etruscan agglomerations, or the rise of Rome. The aim of the work, according to the editors, is nothing less than to transcend these existing boundaries and to stir debate across regions.

The book contains 26 articles divided into four thematic areas: *1. Urban Origins and Trajectories Across the Alps*; *2. Early Urbanisation Processes in Northern Italy*; *3. Early Urbanisation Processes in Central Europe*; and *4. Concluding Thoughts and Comparative Perspectives*.

The first part is more of a theoretical and methodological outline of the issue and touches on topics such as *interaction*, *definitions of cities*, *urbanism*, *urban cycles – urbanisation* and *de-urbanisation*, *hierarchisation*, *trade*, and *long-distance routes*. It includes a carefully crafted introduction to the subject by the editors of the monograph, L. Zamboni, M. Fernández-Götz, and C. Metzner-Nebelsick. The second chapter by M. Pearce masterfully describes the visibility and invisibility of cities in the archaeological sources and discusses the inappropriateness of using Greek, Etruscan and Roman cities as comparative units for Iron Age cities in Europe as specific cases. Interestingly, the author suggests the use of medieval cities to define urban environments, since they better capture urban processes in the Iron Age. He then uses as examples the site of Fratessina from the Final Bronze Age – Early Iron Age and another settlement of the Terramare culture in the Po Valley, Northern Italy. The use of one of the many definitions of medieval towns may seem very surprising, as at least in the Czech environment towns are defined on the basis of a legal framework and so for prehistory the use of a definition seems quite inappropriate. The author uses the definition of *Heighway* (*1972*), which instead of the founding charters of cities (cf. *Kejř 1998*; critically for the territory of Bohemia and Moravia, e.g. *Hoffmann 2008*) requires only their "legal recognition" and moreover does not always require the presence of all 12 criteria. Thus, the author believes that these criteria may better reflect the urban setting even for prehistoric proto- and urban centres. This is a very important and sophisticated idea and will certainly need to be addressed in the future. It is key to add, however, that

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except for the criteria of coinage and the existence of a market (the most important criterion), a large number of prehistoric sites (i.e. not only hillforts but also lowland settlements) would meet this definition (if we consider the current findings of geophysical measurements or surface collections).

The third chapter by M. Fernández-Götz starts the discussion on the definition of cities and its criteria, thus fully building on the previous paper. It deals with both urban cycles and the well-known phenomenon of princely seats in Central Europe. In particular, he takes a critical approach to the standard '*classical cities*' of the Greek and Roman style, considering them as only one of many forms of urban manifestations. He argues, for example, for Sumerian cities, medieval cities of Northern Europe, Islamic, Aztec or Chinese cities, etc. He also describes the fluidity of cities as phenomena and their cyclical transformations. He also carefully examines the critique of civilised versus barbaric environments. This part is very stimulating and we realise that especially in the Central European environment we frequently encounter the classical-archaeological approach. The author gives an exhaustive argumentation of urban cycles and their transformations in the Iron Age with a special focus on the 'Fürstensitz'. This novel and comprehensive approach will hopefully become the cornerstone of research on prehistoric urban structures and, as the author himself states, the '*fear of the town*' will finally be overcome.

The fourth and final chapter of the first section is the work by L. Nebelsick and C. Metzner-Nebelsick dealing with transalpine routes, trade, and interactions with special emphasis on elite settlements and their role in controlling long-distance communications. The leitmotif of the article is then the contacts between the Western Hallstatt culture and the Gollaseca culture in the NW part of Northern Italy. The authors also emphasise the key role of women in the formation of Hallstatt identities north of the Alps. Such a comprehensively oriented approach is significant, and it is perhaps a pity that the authors do not at least partially mention the issue of the Eastern Hallstatt culture, which also has great interpretive potential in terms of the issues mentioned. Indeed, the methodological chapter would have been very valuable.

The second part presents selected case studies from Northern Italy. It is by far the most comprehensive part, representing mostly key Northern Italian sites. The great strength of this part is that all the sites are published together in a comprehensive, coherent manner and in English (which is certainly not standard in the Italian environment). The first chapter in this section, Chapter 5, focuses on one of the most remarkable Italian sites, Verucchio, a settlement with an abnormal amount of amber and a great number of amber workshops located, as it were, on long-distance routes. The site is also renowned for the impeccable preservation of wooden and organic materials in graves, making it a key source of knowledge for us. The authors P. Rondini and L. Zamboni reflect on the complex development of the site and reject the view of Verucchio as an 'Etruscan colony'. Chapter 6 by J. Ortalli discusses the city of Felsina, today's Bologna, which Pliny himself describes as the first city of the Etruscan world. The paper discusses graves and social structures, the relationship to the site of Verucchio, urban infrastructure such as canals, fortifications and public buildings, the urban layout of the site and even the presence of shrines and a city treasury. Chapter 7 by C. Iaia is devoted to bronze metalwork and especially axes and their typological and chronological dispersion across regions. It focuses not only on production circuits but also on their storage, ritual treatment and circulation, describing two crucial transregional routes. A crucial insight of the paper is that their consumption and circulation coexist in the same part and do not necessarily intersect, which depends on the social and cultural treatment of the artefacts. With Chapter 8 by the authors E. Gori, Ch. Pizzirani, and A. Gaucci, we come to the Etruscan city of Kainua – today's Marzabotto. It is one of the finest examples of urbanisation, combining aspects of urban plan or craftsmanship as well as sacred and religious layout, social identities and structures. Moreover, Marzabotto, thanks to its unique location, is one of the best-preserved Etruscan cities. Its extensive research allows us to form a comprehensive image of the Etruscan city with all its components, including the burial. The paper represents fascinating virtual reconstructions serving as a tool for studying and modelling key historical and social issues.

Chapter 9 by G. Gambacurta attempts to connect the relationship between cities and necropolises in Northern Italy, particularly using the example of Venetian cities – to name but a few of the sites of Este and Padua. The analysis focuses not only on topography but also on the much needed and often neglected monumentality and ritual sites. Of particular importance in this chapter is the connection between sacred and burial locations and urban places. It is important to remember that even cities are not devoid of sacredness, but when studying such complex structures (as cities undoubtedly are), it is important to keep in mind other key components that may or may not be apparent at first glance – such as sanctuaries or burial sites. The author herself divides urban structures into cities – cities of the dead and sanctuaries. It should be noted here that she could have stayed with its own terminology and called the sanctuaries, for example, 'cities of deities'. In Chapter 10 by M. Saracino and A. Guidi, we are introduced to the population dynamics of the Oppeano site, today's Verona. This was a large proto-urban agglomeration exceeding 80 hectares. The authors present its evolution from the Neolithic to the Iron Age and note urban features, such as workshops, ramparts, division and material culture. Based on a detailed study, they then divide the settlement into pre-urban, proto-urban and urban phases. Chapter 11 by A. Vanzetti, M. Bertoldo, F. Di Maria, D. Monti, L. Salzani, and F. Saccocio presents one of the lesser-known (despite having been studied now for 150 years) sites – Coazze near Gazzo Veronese, located on the border of Veneto and Etruria Padana. It is an example of a minor (yet independent) town that can enrich our view of urbanisation as such. The authors consider the site as evidence of a dendritic market system located on one of the long-distance roads.

Chapter 12 by S. Bonomi, M. Ch. Vallicelli and C. Balista outlines the issue of the Etruscan city of Adria and presents, in particular, new preliminary data obtained during 2015–2016 excavations. The site is key not only because of its location in a humid paleochannel, allowing the preservation of organic materials, but also because of the presence of workshops together with the first real coinage, the *aes rude*. The continuity of the site into the Roman Period is remarkable. The site benefited in particular from its strategic position on both land and long-distance maritime routes. The article outlines the different phases of the city and points out that even an Etruscan city may have been primarily composed of wood-earth architecture and thus stone architecture depends on the availability of materials in the local conditions rather than the stage of development. Either way, the presence of the two waterways shows the extraordinary design and planning of the then inhabitants of Adria. The following Chapter 13 deals with another essentially neighbouring and no less important site, Spina. The paper is presented by A. Mistireki and L. Zamboni and refers to the site as an *emporium*. They focus on trade, connectivity and building and settlement layouts. They present the background as well as the fortification and settlement of the Spina site, imports from Greece, the foundation of the town and its development. They also emphasise the site's key location on long-distance roads and consider it one of the most important trading locations in the whole of Italy. Subsequent Chapter 14 smoothly leads to the site of Forcello di Bagnolo San Vito by R. Komp, T. Quirino and M. Rapi. This is another of the key ports in the Po River area, this time introduced through excavations and non-invasive methods. The paper introduces the different developmental phases of the site and considers the classification of the site as a proto- or urban settlement based on the appearance of territorial organisation and social organisation.

Chapter 15 by R. F. de Marinis and S. Casini focuses on proto-urbanisation around Lake Como and the Ticino River of the Golasecca culture. It presents both the urban structure and the nearby burial sites and their development. This is followed by Chapter 16, again on Como, by F. Welc, L. Nebelsick, C. Metzner Nebelsick, I. Balzer, A. Vanzetti, and B. Grassi. The paper is an extension of the previous chapter and deals with preliminary results of geophysical prospecting at the same site. The last chapter of the second section, Chapter 17, deals with the Bergamo and Parre sites and is written by R. Poggiani Keller and P. Rondini. The sites are presented as important points on long-distance routes that formed boundary points and benefited from their location. The continuity of the sites from the 10th to the 4th century BC is remarkable. The urban phase is then, as at other sites, attributed

to the 6th–5th century BC and the demise of the site is placed at the beginning of the Celtic invasion of Italy. These are key but by no means widely known sites, where their contribution to the debate may be quite pivotal and bring fresh wind to the debate compared to traditional sites.

The third part presents the most important urban cases from Central Europe. Chapter 18 by D. Krausse, L. Hansen, and R. Tarpini is devoted to the most studied and debated site of the Early Iron Age north of the Alps – the site of Heuneburg and its surroundings. It describes the latest excavations, the construction phases and the surrounding rich graves such as Bettelbühl, and especially other surrounding sites such as Alte Burg, Grosse Heuneburg and Bussen, which are gradually entering the literature and scholarly awareness. It also addresses the position of the site of Heuneburg as the first city north of the Alps (described by Herodotus of Halicarnassus in the 5th century BC). Chapter 19 by R. Krause deals with the site of Ipf bei Bopfingen in Bavaria and its hinterland, placing it among similar sites across the Hallstatt and Italian areas and their interrelationships. Chapter 20 by M. Chytráček reflects on current research on early urbanism and the relationships between Northern Italy and Bohemia using several highland and homestead sites as examples, namely Štítary nad Radbuzou, Lhota-Závist, Svržno and Záhořice-Vladař. The elaborate argumentation points to the sites' relations with Northern Italy and their urban processes, not avoiding the theory of chieftaincy and social systems (corporate versus individual mode). It is commendable that this is one of the few works from Central Eastern Europe to appear in the monograph and is by no means less significant than other works in terms of the scope of research and content of the publication.

Chapters 21 and 22 deal with two of the most famous French sites – Vix and Bourges-Avaricum. The chapter on Vix by B. Chaume presents new investigations, new results of geophysical prospecting and new central houses, as well as new concepts of Hallstatt princely seats. The chapter on Bourges by I. Ralston deals with the presentation of excavations of the site and its context between other central places of the Early Iron Age, its surroundings, chronology, and interregional contacts. In Chapter 23, S. Tecco Hvala presents the central site of Most na Soči in the territory of present-day Slovenia. She deals not only with the distribution of the site's structures, but also with complementary activities such as agriculture and breeding, production activities, residences and burials of the lower elite, public places and social diversity, and, last but not least, sacred practices. She concludes that the site, although much smaller in size, is nevertheless comparable to central sites such as Heuneburg or Manching in terms of architecture and material culture, including imports. The third section concludes with Chapter 24 written by H. Wendling, which deals with Dürrnberg bei Hallein. The author sees the importance of this site not only in its natural wealth (salt and copper deposits) but also in its strategic position on the supra-regional roads. He describes the settlement complexity of the site and also discusses imports from distant places. It also provides social models and reflects comprehensively on social and political interactions, structures, infrastructure or individual burial districts in necropolises. Overall, it is a holistic approach that deserves careful study.

In the fourth and final part, we encounter a synthesising approach combining comparison and theoretical modelling. In Chapter 25, C. Riva focuses on the Mediterranean and urban origins. She relativises the Mediterranean-centric perspective and takes into account previously introduced points of views. She emphasises a combined approach in terms of both historical and archaeological sources. She considers it crucial to develop urban categories so that the study of other sites can contribute to the debate on urban structures, especially in the first millennium BC. S. Stoddart concludes the papers with the final chapter – Chapter 26. He summarises the richness of Alpine urbanism and offers their use as examples for further study. He does not shy away from examples from rural environments and considers urbanism as a manifestation of political power.

The team of authors, whose joint work emerged from fruitful exchanges at the Milan conference, deserves recognition and wide acceptance of the monograph for discussion. All the authors, mostly well-known and respected specialists in the field of Iron Age archaeology, argue concisely and factually – and although the book is quite substantial, the whole work comes across as very organic and readable. The ability of the team of authors to present the information clearly and systematically adds

greatly to the value of the book. All contributions are accompanied by relevant diagrams, tables, figures and maps (in colour).

Overall, the collective of authors not only provides a comprehensive and much sought-after summary of information across the Alps, but also brings new perspectives, methodological approaches and innovative ideas. Particularly key are the introductory chapters dealing with theoretical approaches to the study of cities, urban structures and agglomerations and their careful and thoughtful methodological definitions based on different types of sources. The authors are not afraid to break away from traditional approaches and explore Iron Age cities from new angles, which is refreshing and brings new perspectives to the research. I particularly appreciate the discussion of the fluidity of urban forms and cycles of urbanisation. It is a pity that the list of Central European case studies does not include more representation of the sites of the Eastern Hallstatt culture (which can perhaps be attributed to the lack of interest of domestic scholars in this issue and their inability to introduce the issue to a wider audience rather than to the state of research), but otherwise the book has a very diverse and organic feel. Personally, I believe that this monograph is essential for any scholar of the (Early) Iron Age, and it may also be useful to scholars dealing not only with the urban environment in the Middle Ages or other periods, but also with the general study of central places. The monograph brings fresh wind to the debate on Early Iron Age centres, and I personally hope that it will inspire, for example, the treatment of urban planning at selected Bronze Age or Late Iron Age sites, as it brings a wealth of insights and stimuli for further, rich debate. Overall, the book makes a significant contribution to the field of Iron Age urbanism in Europe, especially through its new theoretical approaches and its linking of Italian and Central European settings. Although some of the ideas are innovative, there is still room for deeper reflection and discussion, opening up further directions for future research. I can only add that I hope that a similar debate will not escape the Czech environment in the coming years.

Zuzana Golec Mírová

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BOOK REVIEW – RECENZE

Karel Sklenář a kol.: Život v lesích. Kritický katalog k výstavě Život v lesích. Mendelova univerzita v Brně, *Brno 2022*. ISBN 978-80-7509-868-9. 98 str.

Výstava „Život v lesích“, následující katalog a publikace dvou certifikovaných metodik (*Sklenář a kol. 2022*; *Kadavý a kol. 2022*) významně přispěly k poznání minulosti i současnosti lesa na Drahanské vrchovině. Po metodické stránce, zaměřené na památkovou ochranu, však tato publikace daleko přesahuje stanovené území.

Na Drahanské vrchovině byly stanoveny tři pracovní zájmové oblasti, a to Jih, Střed a Západ, každá o rozloze 5 km^2. Jednotlivé oblasti byly popsány z hlediska archeologických poznatků, které pro pravěk známe jen v oblasti Jih. Mnohem více je toho známo o středověku, ať již se jedná o zříceninu hradu Vildenberka, nejistého Hradišťka u Jezer, hrádku u Klepačova a zaniklých středověkých vsí Klepačov, Polom a Bohdalůvka. Podrobně je popsán proces zalesňování v raném novověku a moderní lesní hospodaření. Průzkum a výzkum jednotlivých oblastí byl proveden různými metodami (nedestruktivně s využitím lidarových dat, vizuálně, geoarcheologicky a pedologicky).

Vlastní sondážní archeologický výzkum se zaměřil na šest uhlířských plošin. Dendrochronologie z jednoho milířiště přinesla data pokácení stromů v letech 1753–1758 a radiouhlíkové datování 1640 až 1955, což souvisí s výrobou dřevěného uhlí pro nedaleké železárny. Součástí tohoto katalogu jsou i tabulky s daty dendrochronologického i radiouhlíkového datování a ilustrační obrázky. Náplní páté kapitoly je charakteristika pozůstatků lidské činnosti v lesích. Jedná se o povrchovou těžbu hlíny pro výrobu cihel nebo dolování železných rud v 18. až 19. století. Zvláštní pozornost byla věnována milířištím, kterých bylo potvrzeno 116. Jednalo se o plošiny kruhového nebo oválného půdorysu o průměru 3 až 15 m. Bohužel nebyl získán žádný archeologicky datovaný materiál, takže s ohledem na známý zájem nedalekých hutí o dřevěné uhlí jsou datovány do období od druhé poloviny 17. do druhé poloviny 19. století. K dalším pozůstatkům lidské činnosti patří pece na pálení cihel a vápna, ne zcela průkazný mlýn u hradu Vildenberka, nádrže na vodu, zaniklé rybníky, vodní příkop, cisterny, zaniklé plužiny a kamenohlinité valy nejasného významu i stáří. Vizuálnímu průzkumu a dokumentaci středověkých plužin se v sedmdesátých a osmdesátých letech minulého století intenzivně věnoval Ervín Černý a k dispozici měl tehdy ne běžně přístupné mapy. Výsledky jeho práce byly publikovány (*Černý 1979*) a ve své době i náležitě oceněny. Dnes, za použití lidarových snímků, je možná korekce rozsahu klepačovské a polomské plužiny. Z toho je zřejmé, že by byla potřebná nová dokumentace plužin celého území Drahanské vrchoviny metodou dálkového průzkumu země, která by jistě přinesla nové poznatky.

Z hlediska památkové ochrany a archeologických výzkumů v lesích je důležitá šestá kapitola, která se kriticky zabývá současnou legislativou založenou na zákonu z roku 1987 a také na Maltské konvenci, která v České republice vstoupila v platnost roku 2000. Praktické uplatnění těchto zákonů však bylo využito jen částečně. Vzhledem k tomu, že „*proces prohlášení věci za kulturní památku je poměrně komplikovaný*“ (str. 56), většina zaniklých středověkých vsí s viditelnými terénními pozůstatky v lesích za kulturní památku prohlášena nebyla a návrhy zůstávají často bez odezvy. Tyto kulturní památky v lesích (zaniklé vsi, mohylníky, hradiska, hrádky, popraviště, rýžoviště, milířiště a jiné) by mohly být dokonce i finančně zajímavé pro vlastníky, protože by jim to umožňovalo čerpat příspěvek na obnovu kulturní památky, a především osvobození od daně z nemovitostí. Na druhé straně ani legislativní ochrana, která, jak je napsáno, „*ustrnula v minulém tisíciletí*“ (str. 59), bez skutečného zájmu organizací k tomu vytvořených a pochopení vlastníků, je málo účinná. Obsáhlou částí publikace jsou přílohy, v kterých najdeme soupis stručně popsaných datovaných objektů lokalizovaných souřadnicemi. Skutečností je, že vedle míst těžby a zpracování surovin, rybníků, plužin a početných milířišť se většinou jedná o novověké pařeziny.

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S recenzovaným katalogem výstavy úzce souvisí také certifikovaná metodika ochrany antropogenních objektů v lesích, zpracovaná autorským kolektivem pod vedením Karla Sklenáře. Představuje podrobný návod, jak dosáhnout účinné ochrany těchto objektů. Podstatný je proces přenosu informací od archeologů a památkářů k vlastníkům lesa a zapojení do jejich lesního hospodářského plánu. Výsledkem by pak bylo použití optimálních technologií hospodářské činnosti. Na území s jednoznačným výskytem archeologických nálezů (UAN I) by pak byla povolena jen přirozená obnova lesa, což snad neznamená nechat území zarůst nepřístupnou vegetací. Samozřejmě by bylo třeba upřesnit, že například u zdiva zřícenin hradů, šibenic a zaniklých vsí, ohroženého především náletovou zelení, by bylo možné tuto „přirozenou obnovu lesa“ odstraňovat.

Navržené postupy jsou zpracovány z hlediska archeologického a památkářského, ale z hlediska lesního hospodářství znamenají určité omezení. Především by bylo třeba si ujasnit, zda na této ochraně mají skutečně zájem odpovědné organizace, a to Archeologické ústavy AV ČR a Národní památkový ústav, pro které by vymezení konkrétních území znamenalo vyvinutí nemalého úsilí. Dále je třeba si ujasnit, zda stát má na tom skutečný zájem nejen legislativně, ale počítá i s finančním zajištěním. Vzhledem k tomu, že někteří ekonomičtí poradci vlády se dnes dívají i na povinnost provést archeologický výzkum před stavebním zásahem do země jako na brzdu hospodářského pokroku, je to otázkou. Dalším činitelem celého procesu jsou vlastníci lesa a lesní hospodáři, od kterých by se vyžadovala spolupráce nejen při vymezení zájmových území, ale i konkrétním způsobu hospodaření. Ať ochrana těchto antropogenních objektů historické činnosti člověka dopadne jakkoliv, tyto památky budou postupně degradovat a mizet. Z toho důvodu by bylo třeba zajistit dokumentaci jejich současného stavu dostupnými metodami, což je v silách za památkovou ochranu zodpovědných institucí. Je otázkou, do jaké míry bylo využito odlesnění velkých ploch v souvislosti s kůrovcovou kalamitou, která umožnila použití metod dálkového průzkumu zemského povrchu. Na prvním místě nejsou v tomto případě peníze, ale zájem.

Druhá certifikovaná metodika, zpracovaná Janem Kadavým a kolektivem, se zabývá také památkovou ochranou a doplňuje předchozí publikaci. Podrobně jsou zde popsány základní pojmy, legislativní prostředí, typy objektů, procesy narušující lesní prostředí a metody identifikace objektů. Praktické využití je předvedeno na modelovém území Střed, kde bylo navrženo nové území zasluhující si nejvyšší ochranu v rámci území s archeologickými nálezy I.

Tyto tři publikace, vycházející ze spolupráce odborníků různých profesí, ukazují na veliké možnosti účinné ochrany památek v lesním prostředí a podrobným popsáním metod i legislativy umožňují dobrou orientaci v této problematice. Konkrétní využití však zůstává na zájmu a možnostech zodpovědných institucí.

Josef Unger

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