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Evidence of post-Eneolithic human activities at the Hlinsko – Nad Zbružovým site

Důkaz post eneolitických lidských aktivit na lokalitě Hlinsko – Nad Zbružovým

– *Filip Ševčík*, Matěj Kmošek* –

KEYWORDS

Hlinsko – surface survey – Eneolithic – Bronze Age – necklace – XRF – tin bronze

ABSTRACT

The Hlinsko – Nad Zbružovým site is considered one of the most significant Moravian locations for the study of the Middle Eneolithic period. Earlier research provided valuable insights into the cultural and technological aspects of this period. During a re-examination of metal artefacts from the site, it was discovered that one of the artefacts (spiral) was made of tin bronze, thus not of an Eneolithic dating. The tin bronze material of the find corresponds to a later period, based on the material composition presumably from the long period between the Middle Bronze Age until the Early Iron Age. This new discovery raises a crucial question regarding the interpretation of the bronze artefact. Could this be the first evidence of later human activities at the site? To explore this possibility, the study compares the bronze artefact with contemporary analogies, evaluates other finds from the same contexts as the spiral, presents results from a surface archaeological survey at the site, analyses the elemental composition of discovered bronze artefacts and compares them with other prehistoric copper-based finds in order to determine their dating.

* Corresponding author – E-mail address: 460938@mail.muni.cz

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1. Introduction

The Hlinsko – Nad Zbružovým site is located in central Moravia on a trapezoidal promontory on the left bank of the Bečva River, approximately 1.5 km from its current course. It rises prominently above the valley with an elevation difference of 80 m. The longest axis of the trapezoidal plateau at the summit is oriented in a southwest-northeast direction. The plateau itself gently slopes towards the northeast, descending about 5 m from the highest part. The site is situated within the Kladnická Highland region but lies directly on its edge. Beneath the site is the Bečva floodplain, which merges into the floodplain of the Morava River (Fig. 1). Thanks to this geomorphological setting, the site offers extensive views of the surrounding areas to the southwest and northeast. The hillfort is one of the most significant Eneolithic sites in Central Europe. Archaeological excavations at the site have uncovered, for example, a fortification system that, in one phase, was supplemented with a stone wall, evidence of above-ground residential structures, a hoard of copper jewellery stored in a vessel, metallurgical activities, cult artefacts, etc. (Pavelčík 1979; Šebela 2007).

The site was first mentioned in academic literature in 1908 as the hillfort near Hlinsko (Šebela 2007, 13). The oldest archaeological find from the site is a stone mace discovered by J. Zbruž around 1970 (Pavelčík, Vencl 1970, 7; Šebela 2007, 13).

Significant interest in the site increased in connection with extraction activities at a nearby stone quarry. Due to the gradual expansion of the quarrying towards the hillfort, the Archaeological Institute of the Czechoslovak Academy of Sciences in Brno conducted an archaeological survey at the site in 1962 under the direction of J. Pavelčík. Subsequent research continued uninterrupted from 1968 until 1992. The site was explored through 107 excavation trenches and magnetometric surveys. Based on these investigations, it is known that the site's first occupation dates back to the Early Eneolithic period. However, the primary settlement activity belongs to the Middle Eneolithic, with additional occupation in the Late Eneolithic, which represents the latest documented settlement phase at the site (Šebela 2007, 13–16).

The site underwent its most recent archaeological investigation in 2006 during a rescue archaeological excavation on the eastern foreland of the hillfort, again linked to the quarry's expansion. This excavation uncovered material from the Eneolithic, the Late Paleolithic, and allegedly even the Iron Age (Šebela 2007, 16; Šebela et al. 2007; Škrdla 2007).

Due to Eneolithic metallurgical activities at the site, a re-evaluation of metal artefacts and finds associated with metallurgical activities was conducted by the authors of this study in late 2024. During a preliminary review using a handheld XRF device, an unexpected discovery was made. Among many other

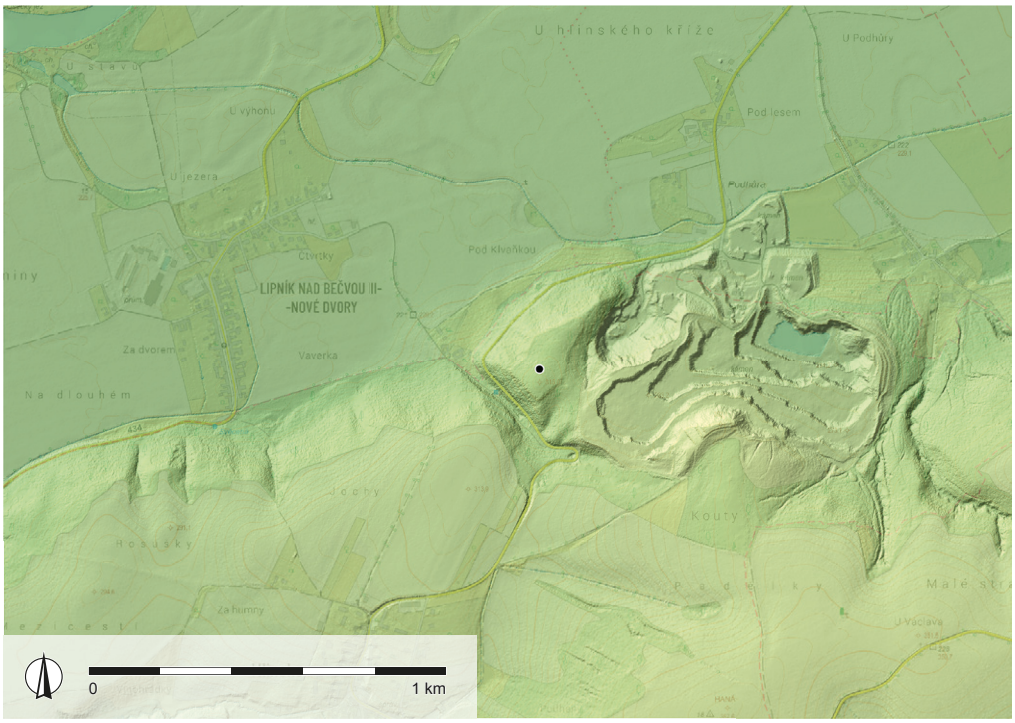


Fig. 1. Closeup of the site and its surrounding area. Base map: ČÚZK DMR5G; graphic by F. Ševčík.

Obr. 1. *Detail lokality a jejího okolí. Podkladová mapa: ČÚZK DMR5G; grafika F. Ševčík.*

Artefact	Cu	Sn	As	Sb	Ni	Bi	Pb	Zn	Fe	Cr
Spiral from feature 24/73	68.4	27.9	0.74	0.32	0.62		0.14	0.26	0.87	0.75
Spiral from feature 19/71	99.8					0.03	0.06	0.09		

Tab. 1. Results of surface XRF analysis on two spirals from necklace from feature 19/71 (wt. %).

Tab. 1. *Výsledky povrchové XRF analýzy dvou spirál z náhrdelníku z objektu 19/71 (hmotnostní %).*

finds, a unique necklace from feature 127 made of bone beads, animal teeth, and copper spirals was discovered at the site and is now displayed in the exhibition of the Comenius Museum in Přerov. This find is particularly exceptional, as no direct analogies have been found to date. Based on the context of the discovery, the necklace was dated to stage BK III of the Baden culture. During the aforementioned re-examination of metal finds from the site it was discovered that one of the spirals was made of copper, as initially assumed, but it is in fact made of tin bronze (Tab. 1). The author of the excavations (J. Pavelčík) mentions in the publication that the spiral on the reconstructed necklace does not come from the same context as the rest of the necklace but actually from feature 199, which is dated to stage BK Ib (Pavelčík 1989, 271). This discovery contradicts the original Eneolithic dating and points to previously unknown post-Eneolithic human activities.

2. Theoretical background

A unique necklace discovered at the site (Fig. 2) during the 1972 excavation season was composed of perforated animal teeth, bone beads, copper spirals, and mother-of-pearl beads, as well as parts of decorated shells (Pavelčík 1973; 1989). Not only is the necklace itself unique, so is the way it was deposited. The artefact was found in feature 19/71 (127). This feature was an irregular rectangular-shaped structure with dimensions of 215 × 137 × 25/30 cm, oriented at azimuth 35° (Fig. 3).

The feature was filled with dark brown soil in the upper part, which was heavily embedded with lumps of yellow, red, and black daub. The feature was outlined in the overlying yellow soil, and stones and fragments of a larger vessel lay on its surface. After their removal, it became clear that the walls of the feature were vaulted and that in the western part of the base was a cluster of large vessel fragments that descended towards the east and filled the entire area of the feature. Half of a ceramic vessel and an animal figurine were found (Fig. 3, 4) in the northwest part of the cluster. The vessel was lifted as a block, and upon disassembling its contents, a large quantity of charred grains and parts of the necklace made of animal teeth, their bone imitations, bone and mother-of-pearl beads, part of a decorated shell, part of a copper spiral, and small fragments of burnt bones were discovered. In the southeast corner of the feature stood the bottom part of a larger vessel. The pit created a recess towards the east, while the western side had a relatively shallow bottom sloping to the southeast. In the southwest part, the bottom even formed a triangular-shaped pedestal. The northern part of the western wall was also vaulted. In the central and eastern parts of the feature, a cluster of large, mostly worked stones appeared under the fragments, including a double polissoir, which extended into the recess. In the western part, only a larger smoothed stone and the bottom of a larger vessel were found. A 10 cm-thick grey ash layer covered the bottom of the pit (Pavelčík 1973).

Given the find situation described above, it is difficult to consider anything other than the intentional deposition of the necklace. The necklace was composed of fifteen perforated animal teeth from carnivorous mammals, three tubular bone beads, five bone imitations of animal teeth, one decorated shell pendant, twenty flat mother-of-pearl beads, and one copper spiral (Pavelčík 1973, 53–54; 1989, 256–271). Jiří Pavelčík made a hypothetical reconstruction of the necklace, taking care to preserve the principles of symmetry and weight distribution (Pavelčík 1989, 270–271). In the published illustrative reconstruction and also in the physical reconstruction is an additional metal spiral on the right side of the central decorated pendant (Fig. 2). However, this spiral was secondarily added to

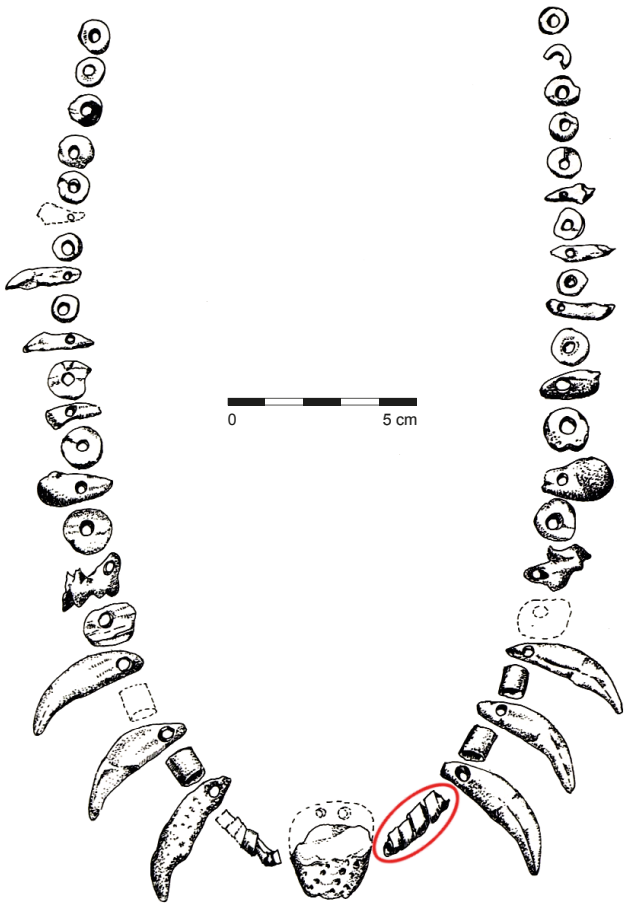


Fig. 2. Reconstruction of the necklace from feature 19/71 with bronze spiral from feature 24/73 highlighted in red. After Pavelčík 1989, 271, Fig. 6.

Obr. 2. *Rekonstrukce náhrdelníku z objektu 19/71 s bronzovou spirálou z objektu 24/73 zvýrazněnou červeně. Podle Pavelčík 1989, 271, obr. 6.*

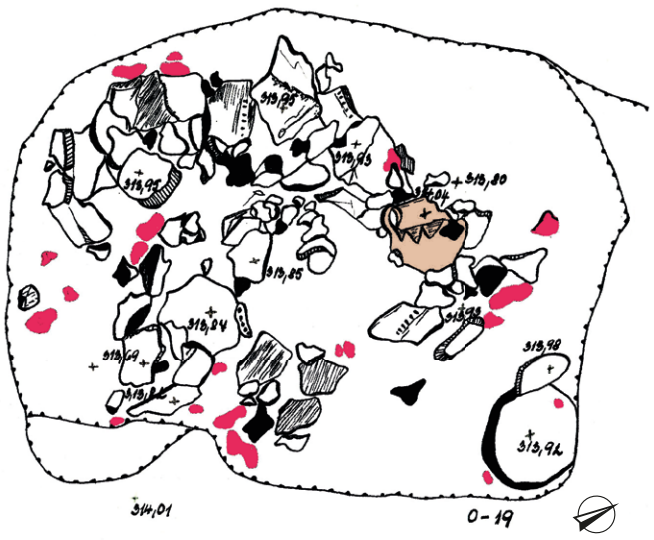


Fig. 3. Terrain documentation of feature 19/71 in the second phase of excavation with a vessel (highlighted in orange) under which the necklace was discovered. After Pavelčík 1973, 95.

Obr. 3. *Terénní dokumentace objektu 19/71 ve druhé fázi výzkumu s nádobou (zvýrazněnou oranžově), pod níž byl objeven náhrdelník. Podle Pavelčík 1973, 95.*

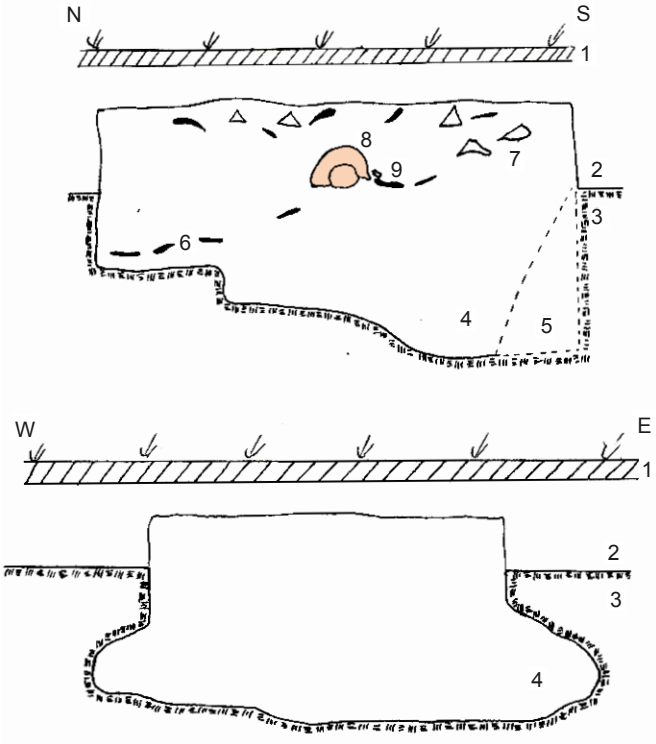


Fig. 4. Profiles of feature 19/71 with a vessel under which the necklace was discovered (highlighted in orange). 1 – Topsoil; 2 – light yellow layer; 3 – loess; 4 – brown layer with daub fragments; 5 – tree roots; 6 – pottery fragments; 7 – stones; 8 – vessel; 9 – bear idol. After Pavelčík 1973, 97.

Obr. 4. *Profily objektu 19/71 s nádobou, pod níž byl objeven náhrdelník (zvýrazněnou oranžově). 1 – Ornice; 2 – světle žlutá vrstva; 3 – spraš; 4 – hnědá vrstva s úlomky mazanice; 5 – kořeny stromů; 6 – keramické střepy; 7 – kameny; 8 – nádoba; 9 – medvědí idol. Podle Pavelčík 1973, 97.*

the necklace by J. Pavelčík and comes from a different feature (Pavelčík 1989, 271). Jiří Pavelčík mentions this secondary addition only briefly in the caption of the reconstruction drawing (Pavelčík 1989, 271).

The added spiral was discovered in feature 24/73 (199) two years later during the 1973 excavation season. This feature, with dimensions of 162 × 110 × 45/90 cm, was oriented at an azimuth of 300° and had an oval opening, straight walls and a flat bottom. The northwestern wall sloped in a step-like manner. Stones were found along the southeastern and northern walls. The entire feature was filled with dark brown soil along with many pottery shards, chipped stones and bones (Fig. 5; Pavelčík 1974, 68–71).

3. Discussion

3.1 The spirals

The spiral from feature 24/73 has a similar character to that from feature 19/71. It is coiled from a flat sheet of metal and has a diameter of ca 0.5 cm. Both spirals exhibit characteristics of the Eneolithic period and closely resemble other published Eneolithic copper spirals (cf. Goš 1982, 483; Podborský a kol. 1993, 210; Novotná et al. 2022). However, it is important to note that similar spirals also occur in contexts from the Early Bronze Age (e.g. Podborský a kol. 1993, 233).

A significant difference exists between material of the aforementioned spirals. Both of them were analysed on their surface by XRF (X-Ray Fluorescence) spectrometer (Niton Xl3t 980, mode General Metals, duration 60 seconds) and the results are shown in Table 1. Given the fact that it is only a surface measurement with heavy corrosion alterations, it is not possible to draw far-reaching conclusions, but general alloy composition can be

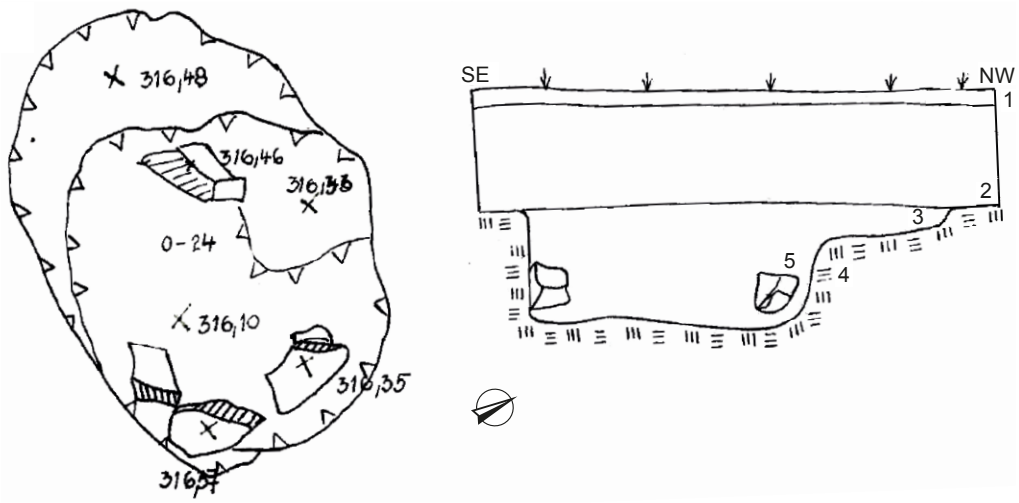


Fig. 5. Plan and profile of feature 24/73. 1 – Topsoil; 2 – light yellow layer; 3 – brown layer; 4 – loess; 5 – stone. After Pavelčík 1974, 122, 136.

Obr. 5. *Půdorys a profil objektu 24/73. 1 – Ornice; 2 – světle žlutá vrstva; 3 – hnědá vrstva; 4 – spraš; 5 – kámen. Podle Pavelčík 1974, 122, 136.*

distinguished. The spiral from feature 19/71 is made of pure copper, whereas the spiral from feature 24/73 is made of tin bronze. This find raises several questions, because the bronze spiral was found in a feature which dated to the Middle Eneolithic period. Could this represent one of the earliest experiments with tin bronze in Central Europe? Or is feature 24/73 misdated? The simplest explanation would be that over the years, the spiral artefact was mistakenly replaced in the depository. However, upon comparing the spiral with the original drawn and photographic documentation from the excavation report, it is undeniable that this is the same artefact (Fig. 6).

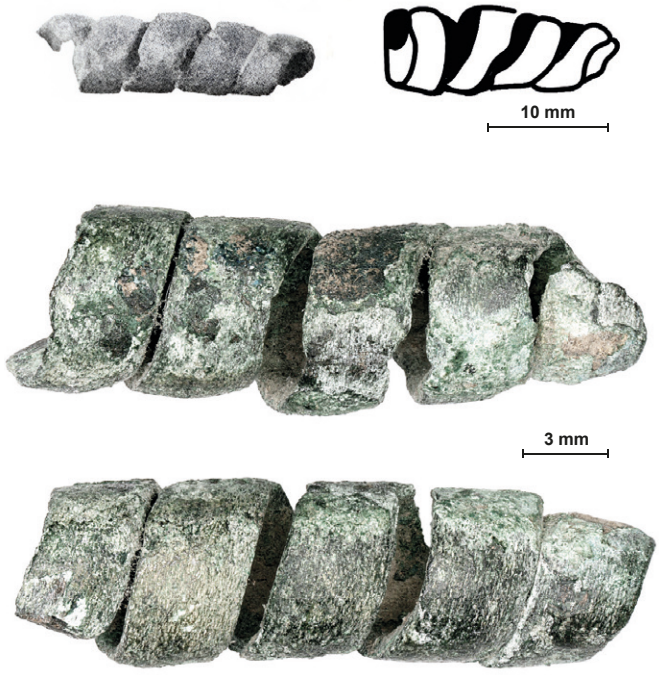


Fig. 6. Comparison of spiral from feature 24/73 with photographic (above left; after Pavelčík 1975, 640, Fig. 673) and drawn documentation (above right; after Pavelčík 1974, 255, Fig. 673) from excavation reports. Photo by F. Ševčík.

Obr. 6. *Srovnání spirály z objektu 24/73 s fotografickou (vlevo nahoře; podle Pavelčík 1975, 640, obr. 673) a kreslenou dokumentací (vpravo nahoře; podle Pavelčík 1974, 255, obr. 673) z nálezových zpráv. Foto F. Ševčík.*

3.2 Dating of feature 24/73

Based on the findings mentioned above, it was necessary to reexamine and reevaluate the material from feature 24/73. The feature contained a relatively large number of pottery fragments, most of which were atypical and could not be precisely dated. A smaller portion of the pottery fragments in the feature filling exhibited characteristics allowing for their dating to the Middle Eneolithic period. The most reliable artefact for dating was a vessel with inventory number 689/73 (Fig. 7: 1), decorated with 'wolf tooth' motifs below a double line of stamped ornamentation. The assemblage also included several pottery fragments decorated with fluting, which could similarly be attributed to the Middle Eneolithic period. Overall, the pottery displayed a Eneolithic character (Fig. 7: 7–13).

The fill of the feature also contained several pieces of chipped stone industry, which could likewise be dated to the Eneolithic period. These included blades (Fig. 7: 3), scrapers, retouched flakes, and one heart-shaped arrowhead (Fig. 7: 2). Polished stone industry was present in several pieces, including a preform, a hematite miniature axe (Fig. 7: 4), a fragment of an axe (Fig. 7: 5), an 'anvil', and an artefact interpreted as a reamer (Fig. 7: 6). Most of the ground stone tools could be dated to the Eneolithic period. The 'reamer' likely represents a modern stopper, ruling out its attribution to the Eneolithic period.

Finally, the aforementioned bronze spiral was found in the fill of feature 24/73. It is possible that the spiral was excavated from the upper layer of the fill and could be a later intrusion (possible surface loss) compared to other finds from the feature. Due to the nature of the excavation, which unfortunately did not record the depths of individual finds, this remains a hypothesis. Considering the modern intrusion classified alongside Eneolithic artefacts (modern stopper, Fig. 7: 6), this possibility is quite realistic.

To determine whether any later components, visually indistinguishable, were present among the atypical pottery fragments, an analysis of the elemental composition of all pottery fragments was conducted. The analysis was performed using a desktop XRF ElvaX Pro. Pottery fragments were measured at fractures and areas free of soil were selected. Each fragment was measured for 60 seconds (mode Soils, dual spectrum 8 and 35 kV, collimator 7 mm) without helium purge. The results were subsequently processed and plotted on a t-SNE (t-distributed stochastic neighbour embedding) chart, which is mainly used to visually represent multidimensional data in a reduced number of dimensions while preserving the structure of the data

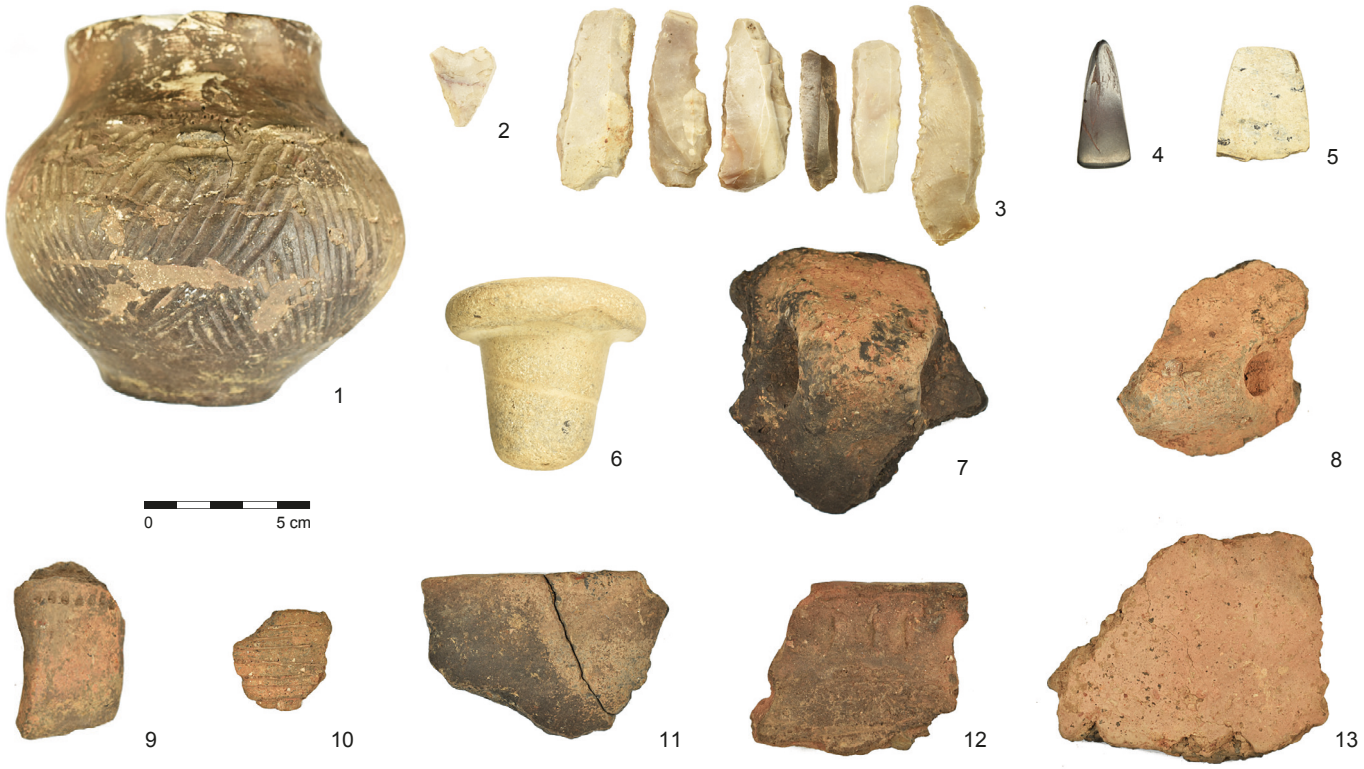


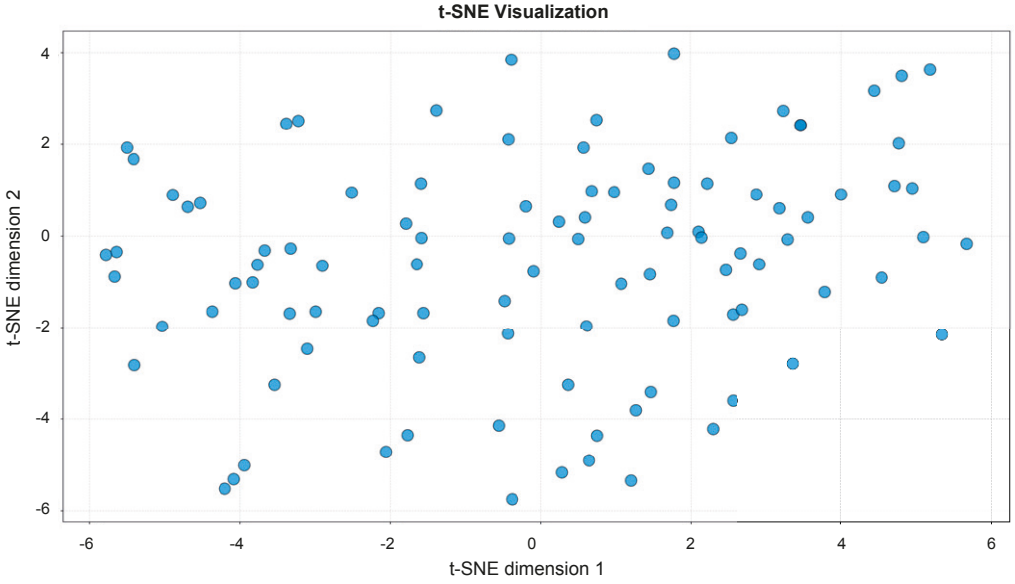
Fig. 7. Selection of finds from feature 24/73. Photo by F. Ševčík.
Obr. 7. *Výběr nálezů z objektu 24/73. Foto F. Ševčík.*

by maintaining pairwise distances when constructing a 2D visualisation. Therefore, the closer the points are in the T-SNE plot, the closer they were in the original n-dimensional space before dimensionality reduction (Balamurali et al. 2019, 79). This method revealed that there are no distinct clusters present (Graph 1). These results indicate no material differences in elemental composition among the pottery fragments, complementing traditional visual assessments to some extent, and it does not prove the presence of intrusions later than Eneolithic pottery in the material.

3.3 Eneolithic bronze?

If we were to consider the hypothesis that the archaeological feature is dated to the Middle Eneolithic period and the bronze spiral was discovered within the feature alongside Middle Eneolithic material, making it contemporaneous, it would undoubtedly represent the oldest tin bronze object in Central Europe. But is this even possible?

The oldest bronze artefacts in Europe appear during the 5th millennium BC in the context of the Vinča culture in the Balkans. From this region, we currently know of 15 artefacts



Graph 1. t-SNE plot of chemical composition of pottery fragments.
Graf 1. *t-SNE graf chemického složení keramických fragmentů.*

made of tin bronze, though only the bronze foil from the Pločnik site is reliably dated (Radivojević et al. 2013, 1035). However, the occurrence of these artefacts disappears by the end of the 5th millennium BC (Radivojević et al. 2013, 1042). This raises the question of whether the spiral might represent an import that arrived at the site much later, originating from this early phase of bronze production. The main problem with this hypothesis is that there is no evidence to this date of these early bronzes occurring outside the Balkan region. Tin bronze occurs sporadically in the second half of the 4th millennium BC in Afghanistan (Pare ed. 2000, 6), which chronologically aligns with the dating of the Hlinsko site. The alloy of copper and tin was first used on a widespread basis in Anatolia around 3000 BC. In Central Europe, artefacts made of tin bronze begin to appear only from 1800/1700 BC (Pare ed. 2000, 26). While the Bronze Age in Central Europe begins earlier, its onset is associated with arsenical and fahlore type copper rather than tin bronze (Kienlin 2013, 420).

For all the reasons mentioned above, dating the spiral from feature 24/73 to the Middle Eneolithic period is highly improbable.

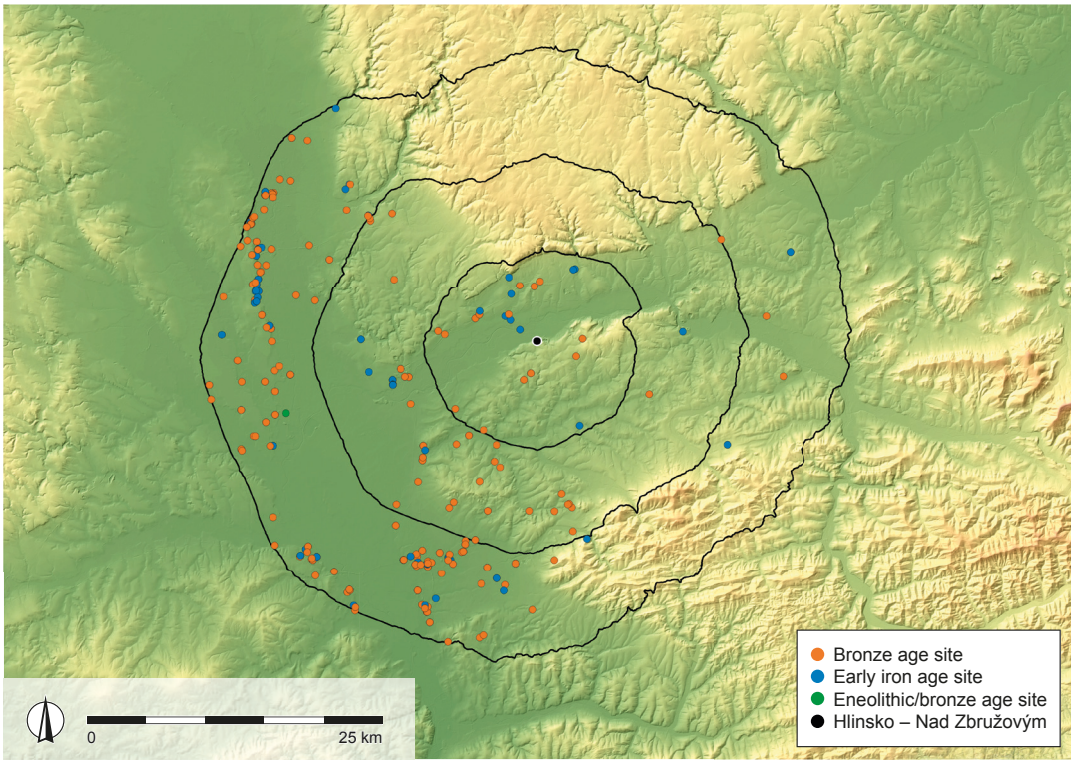


Fig. 8. Map of later sites in the vicinity of Hlinsko – Nad Zbružovým. Base map: ČÚZK DMR5G; graphic by F. Ševčík.

Obr. 8. *Mapa mladších lokalit v okolí Hlinska – Nad Zbružovým. Podkladová mapa: ČÚZK DMR5G; grafika F. Ševčík.*

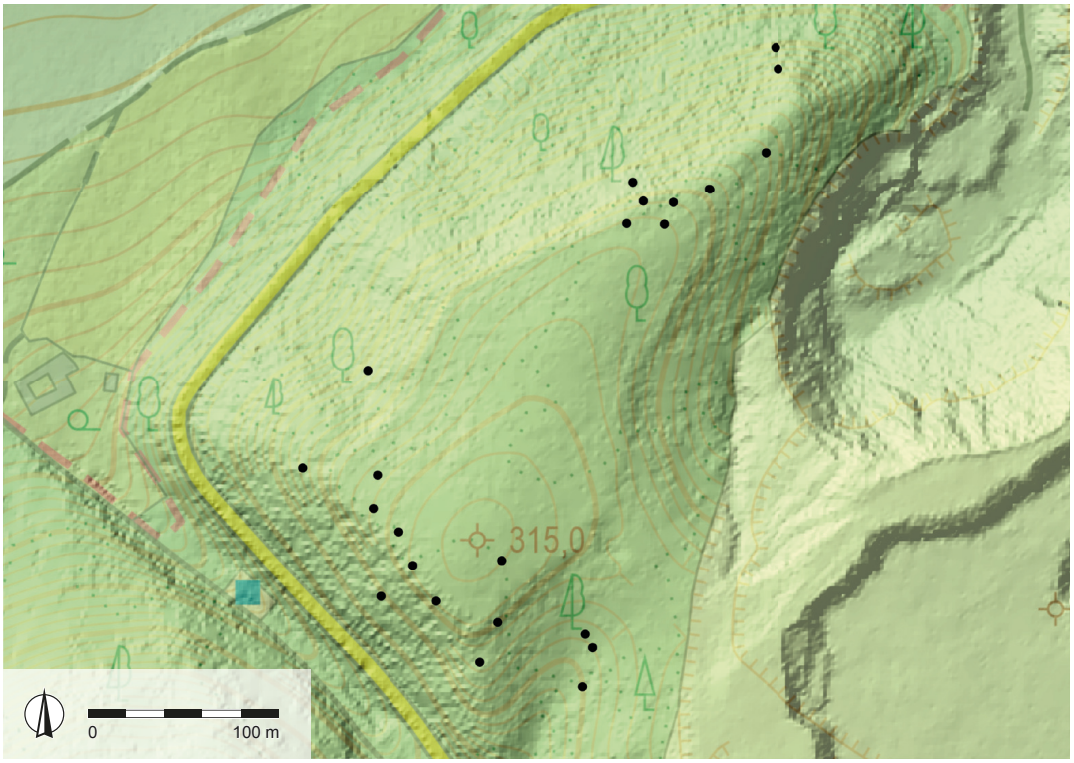


Fig. 9. Spatial distribution of artefact discovered during surface survey. Base map: ČÚZK DMR5G; graphic by F. Ševčík.

Obr. 9. *Prostorové rozložení artefaktů objevených během povrchové prospekce. Podkladová mapa: ČÚZK DMR5G; grafika F. Ševčík.*

3.4 Proximity of later sites

If we rule out the Eneolithic dating of the spiral, its origin must be assumed to belong to a later period. Since no later archaeological components have been recorded at the site to date, it is necessary to examine the occurrence of younger archaeological components in the surrounding area (Fig. 8). For this purpose, three buffer zones were created in QGIS, symbolising the distances that can be covered by foot in two, four, and six hours from the site, depending on the difficulty of the terrain. Archaeological site data for the Czech Republic (Demján et al. 2021) were then plotted within this area. Subsequently, only settlements from the Bronze Age and Early Iron Age were selected.

The first zone has a relatively large number of later archaeological components. The nearest Bronze Age component is located approximately 3,3 km away, while the closest Early Iron Age component is about 1,7 km away. Most nearby components are situated in the floodplain of the Bečva River. However, Bronze Age components also appear in the terrain of the Podbeskydská Upland, on whose edge the Hlinsko – Nad Zbružovým site is located.

In the subsequent zones, a significant number of later archaeological components can also be found. There is an appreciable increase in their density towards the southwest, while their absence is notable in the Nízký Jeseník area. From an overall perspective, the distribution of later archaeological components around the Hlinsko site indicates that the region was relatively intensively inhabited in later periods. A total of 413 archaeological components from the Bronze Age and Early Iron Age are present within a six-hour walking distance of the site, thus suggesting that the spiral may have reached the Hlinsko site as part of later human activities in the region.

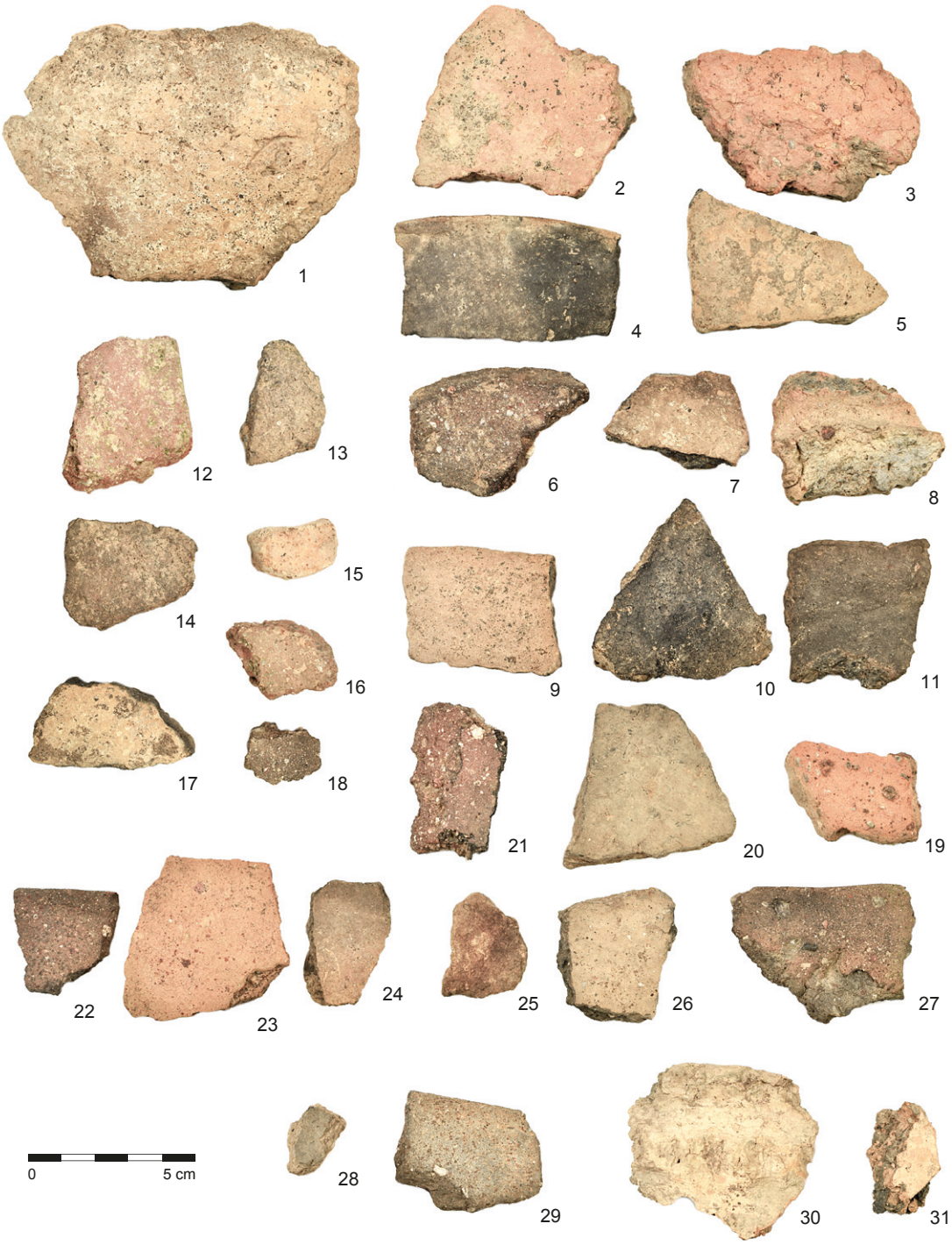


Fig. 10. Pottery fragments discovered during surface survey. Photo by F. Ševčík.

Obr. 10. *Keramické fragmenty objevené během povrchové prospekce. Foto F. Ševčík.*

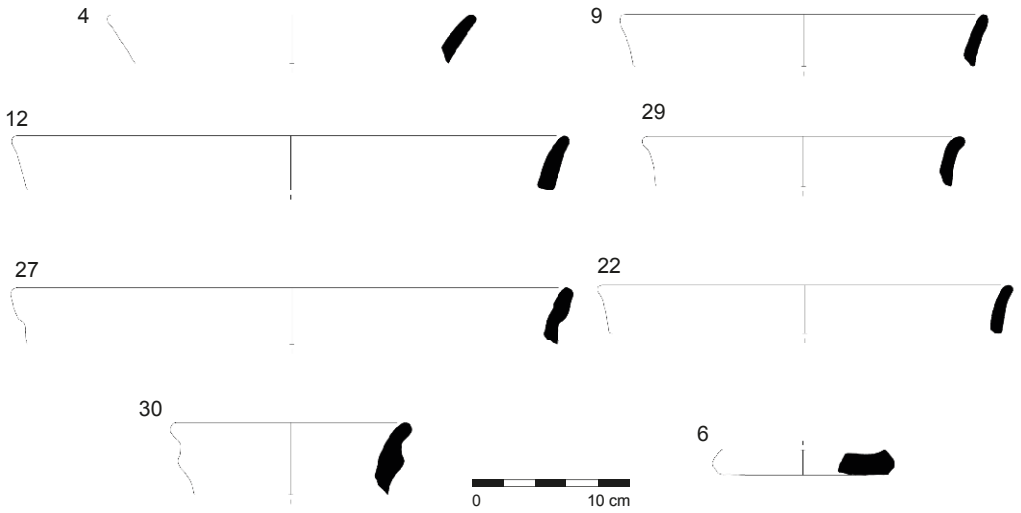


Fig. 11. Reconstruction of vessel profiles from characteristic pottery fragments (numbers correspond to those in Fig. 10). Drawing by F. Ševčík with Laiser Aided Profiler (LAP).

Obr. 11. *Rekonstrukce profilů nádob z charakteristických keramických fragmentů (čísla odpovídají číslům z obr. 10). Kresba F. Ševčík pomocí Laiser Aided Profiler (LAP).*

3.5 Archaeological survey

Based on the finding that the spiral may have originated from the upper layers of the feature, the fact that the earliest bronze objects appeared in Central Europe much later and given the proximity of later archaeological components in the vicinity of the site, it was concluded that the spiral was likely introduced to the site as part of later human activity. To verify whether additional artefacts later than the Eneolithic period might be present at the site, a metal detector survey was conducted across the area.

The archaeological survey (AMČRa) was conducted using the method of surface prospecting with metal detectors. Only artefacts from the topsoil were collected to avoid disturbing archaeological features. The coordinates of all finds were recorded using mobile GPS devices. Non-metallic artefacts from the surface were also collected and documented. Due to the current condition of the site, with the main part covered by dense, impenetrable vegetation, a systematic surface survey along predetermined lines was not feasible. Hillforts densely overgrown with vegetation thus represent another type of methodological challenge, as do, for example, hill-top sites that were partially quarried or flooded in the past (Čižmář 2004; Bartík et al. 2022).

4. Results of the survey

A total of 58 artefacts were recovered. These include 31 pottery fragments, 7 fragments of daub, 2 stone artefacts, 5 artefacts made of copper alloys, 2 artefacts made of silver alloys, 3 objects made of lead alloys, 2 artefacts made of zinc alloys, and 6 artefacts made of iron alloys (Fig. 9). All of these finds are described below, despite their mostly younger age, to provide complex data about the site. Two copper alloy artefacts relevant for this study are examined in more detail.

4.1 Pottery

The pottery assemblage is dominated by small fragments from vessel bodies. There are 21 pieces, ranging in size from a few centimetres to the largest fragment measuring 10 cm (Fig. 10: 1). The assemblage also includes seven rim fragments, one base fragment, and one fragment of a tube-shaped handle (Fig. 10, 11).

The pottery material is generally coarse, with prominent inclusions of crushed stone fragments. Decoration is present on only one fragment—a rim piece featuring ornament in the form of a raised, incised band (Fig. 10: 30).

Given the overall characteristics of the pottery fragments and the lack of diagnostic features, the assemblage can be reliably dated only broadly to the prehistoric period. However, based on the nature of the ceramic material, the presence of a tube-shaped handle, and the decorated fragment, which is consistent with all settlement horizons at the site, the assemblage can be cautiously assigned to the Middle Eneolithic period.

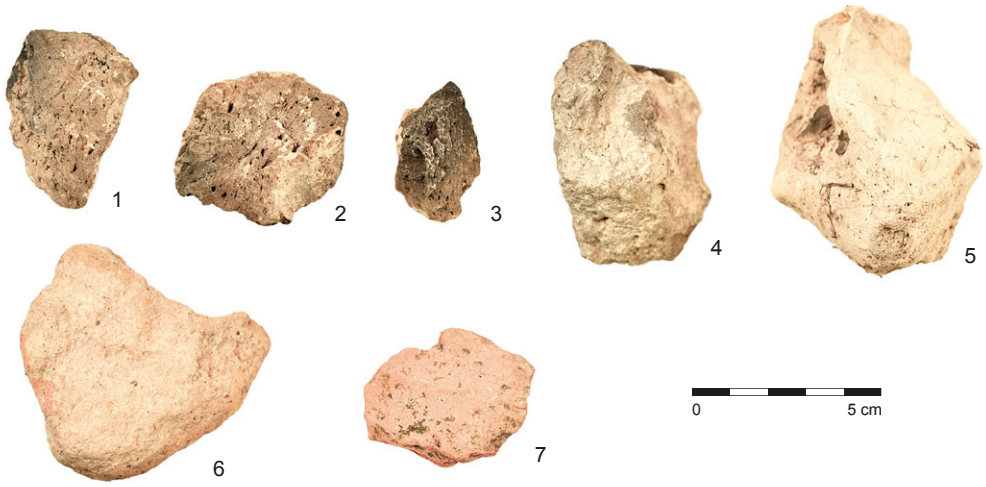


Fig. 12. Daub fragments discovered during surface survey. Photo by F. Ševčík.

Obr. 12. *Fragmenty mazanice objevené během povrchové prospekce. Foto F. Ševčík.*

4.2 Daub

Seven small fragments of daub were recovered in the survey (Fig. 12). The fragments rarely exceed 5 cm in size. With the exception of one piece, the daub fragments show no impressions of structural elements. One of the fragments (Fig. 12: 7) has impressions of wooden rods on one side. The daub fragments are most likely related to the settlement of the site during the Middle Eneolithic period.

4.3 Stone

During the survey, two stone fragments were recovered (Fig. 13). One is a fragment of a grinding stone with a clearly worn working surface (Fig. 13: 1). The other fragment is an elongated object with a rectangular cross-section and rounded corners (Fig. 13: 2). This object resembles a flint striker. The dating is problematic in this case due to the lack of an exact context. However, given the location of the find on a slope disturbed by illegal digging and where a number of pottery fragments belonging to the Middle Eneolithic period were found, it is reasonable to assume that both of these stone fragments could have the same dating.

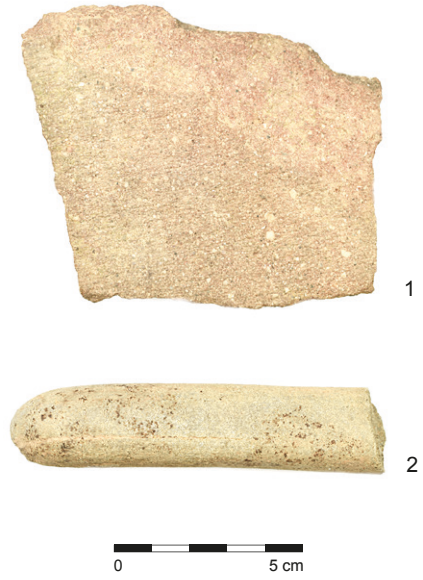


Fig. 13. Fragments of stone artefacts discovered during prospection. Photo by F. Ševčík.

Obr. 13. *Fragmenty kamenných artefaktů objevené během prospekce. Foto F. Ševčík.*

4.4 Non-ferrous metals

A total of 12 objects made of non-ferrous metals were discovered. In terms of material, the finds can be divided as follows:

a) Finds from copper alloys (Fig. 14: 1–5, 7) – In this case, we can distinguish two categories of artefacts based on preliminary surface analysis using a handheld XRF spectrometer (Niton Xl3t 980).
- Brass finds (Fig. 14: 2, 4, 5, 7) – These artefacts are relatively recent, and their dating, according to typological classification, ranges from the Modern period to the present.
- Tin bronze finds (Fig. 14: 1, 3) – Tin bronze finds include two fragments closely relevant to this study and their elemental composition analysis will be examined in greater detail below. Unfortunately, their size is very small, so it is difficult to determine the artefact from which they originated. The larger of the fragments (Fig. 14: 1; AMČRb) has a visible casting seam. The smaller one (Fig. 14: 3; AMČRc) has a slight curvature in its shape and could come from a socket (e.g. socketed axe). Given the high tin content in both fragments (intentional alloying with tin), their dating to the Eneolithic is ruled out and they can be dated to the Bronze Age or possibly to later periods (see below for more details). Both of the finds come from the northeastern tip of the site from the upper edge of the slope.

b) Finds from silver alloys (Fig. 14: 8, 9) – This category includes two coin finds. The first is a kreuzer of Leopold I (Fig. 14: 8) minted between 1694 and 1704 (Numista 2025b). The second is a kreuzer of Ferdinand II from the mint in Olomouc (Fig. 14: 9), struck between 1625 and 1635 (Numista 2025a).

c) Finds from lead alloys (Fig. 14: 6, 11, 12) – Three artefacts made of lead alloys were discovered during the survey. These include a modern fishing weight (Fig. 14: 6), a modern projectile for a firearm (Fig. 14: 12), and an undatable ingot (Fig. 14: 11).

d) Find from zinc alloy (Fig. 14: 10) – This category includes one find: a Reichspfennig minted between 1938 and 1945 (Numista 2025c).

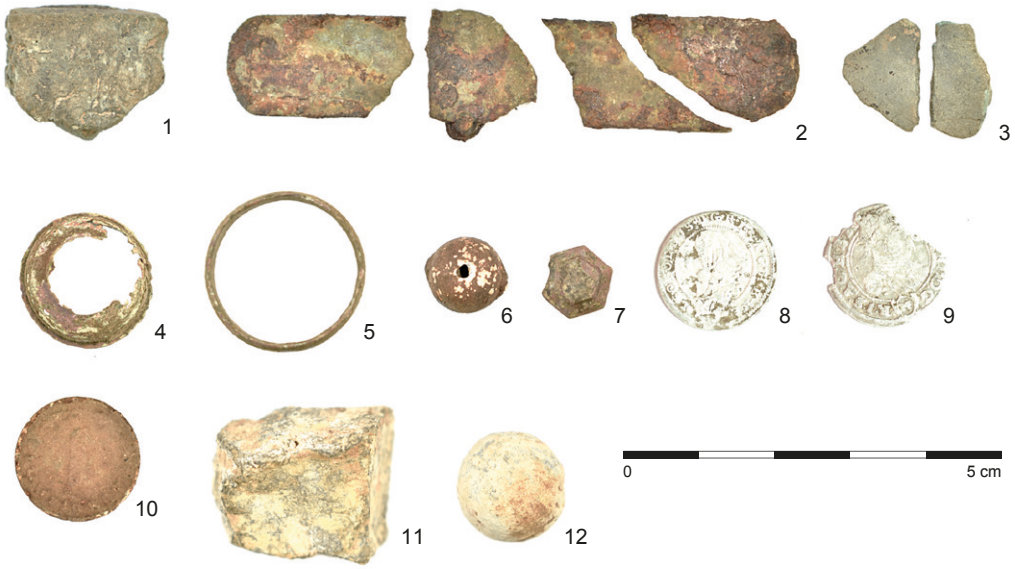


Fig. 14. Non-ferrous metal artefacts discovered during surface survey. Photo by F. Ševčík.

Obr. 14. *Neželezné kovové artefakty objevené během povrchové prospekce. Foto F. Ševčík.*

Fig. 15. Iron artefacts discovered during surface survey. Photo by F. Ševčík.

Obr. 15. *Železné artefakty objevené během povrchové prospekce. Foto F. Ševčík.*

4.5 Iron finds

During the metal detector survey, six artefacts made of iron alloys were discovered (Fig. 15). With the exception of the blade of a folding knife (Fig. 15: 3), which is undoubtedly of recent origin, and an undatable artefact (Fig. 15: 6), these objects can be dated with some degree of uncertainty to the Modern period. An artefact that could be older is an ox horseshoe (Fig. 15: 5), which occurs since the Middle Ages. Finds with a safe medieval dating include an iron knife with a rivet on the handle and a cutler/blacksmith mark on the blade (Fig. 15: 1), as well as a buckle frame (Fig. 15: 2).

5. Analysis of chemical composition

The two aforementioned bronze fragments from surface survey (Fig. 14: 1, 3) and the spiral from feature 24/73 were subjected to more precise analysis of the elemental composition of metal core samples. The results are used for a comparison with other analysed artefacts for an attempt to classify them in prehistoric time periods. Artefacts were sampled using an HSS-TiN drill with a diameter of 1 mm to avoid contamination from surface layers of corrosion. Samples were analysed by desktop ED-XRF spectrometer ElvaX Pro under the following conditions: duration 600 seconds, mode Cu, acceleration voltage 45 kV, collimator 5 mm. The results are given in Table 2.

All three artefacts are made of bronze alloyed with various amounts of tin (2.2–7.4%). The spiral has an elevated content of arsenic and nickel. One of the fragments (Fig. 14: 3) together with a higher arsenic and nickel content also have an elevated lead, antimony and cobalt content. The second fragment (Fig. 14: 1) generally has a low level of admixtures (total of 0.3 %). Given the high tin content, the dating of all the artefacts to the Eneolithic is ruled out/highly improbable (as stated above). Based on the absence/low amount of silver in the alloy, dating to the Early Bronze Age is also unlikely due to a predominantly high silver content during this period. The composition corresponds closely to artefacts from a long time period from the Middle Bronze Age to the Early Iron Age. This time period is characterised by material with a typically elevated content of nickel, and sometimes also lead, arsenic, antimony, cobalt and, on the other hand, the absence of silver. Later prehistoric periods are distinguished by alloying with lead beginning in the Late Iron Age or zinc starting in the Roman period (Frána et al. 1995, 1997; Kmošek 2019).

6. Conclusion

Based on the findings from the revision of artefacts associated with Eneolithic metallurgical activities at the Hlinsko – Nad Zbružovým site, a comprehensive analysis of selected artefacts was conducted along with field survey activities. Through a combination of these methods, it was discovered that this site also contains, in addition to numerous Eneolithic finds, previously undocumented human activities from a later period. Although the site has been extensively and systematically researched, traces of later human activities had not been detected until now. Expectedly, numerous finds from the Middle Ages and especially the Modern and recent periods were found during the surface survey. Artefacts presumably from the long time period from the Middle Bronze Age to the Early Iron Age were also found, thus suggesting human activities at the site during this time frame as well. This finding should serve as an impulse for more detailed exploration of the site, which is under immediate threat of destruction by stone extraction in the neighbouring quarry and apparently still has much to reveal to us.

CrediT authorship contribution statement

Filip Ševčík: Conceptualization, Supervision, Writing – review & editing, Writing – original draft, Investigation, Formal analysis, Visualization.

Matěj Kmošek: Conceptualization, Writing – review & editing, Investigation, Formal analysis.

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ID	Figure	Context	Cu	Sn	As	Sb	Ag	Ni	Pb	Co	Bi	Au	Fe
1/99 (257-673/73)	7	Feature 24/73	91.7	7.4	0.15	0.04		0.33		0.02			0.25
M-202405386-N00020	15: 3	Surface survey	95.9	2.2	0.72	0.14		0.34	0.54	0.07	0.01	0.04	
M-202405386-N00025	15: 1	Surface survey	95.7	4.0	0.04	0.05	0.01	0.01	0.10	0.02	0.02	0.05	

Tab. 2. Results of ED-XRF analysis of metal core samples from three bronze artefacts from Hlinsko – Nad Zbružovým (wt. %).

Tab. 2. *Výsledky ED-XRF analýzy kovového jádra tří bronzových artefaktů z Hlinska – Nad Zbružovým (hmotnostní %).*

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Resumé

Lokalita Hlinsko – Nad Zbružovým patří mezi nejvýznamnější eneolitická sídliště na Moravě, přičemž dosavadní archeologické výzkumy přinesly cenné poznatky o kulturních a technologických aspektech tohoto období. Dosavadní výzkumy na lokalitě odhalily například opevňovací systém s kamennou hradbou, relikty nadzemní obytné struktury, depot měděných šperků, náhrdelník z provrtaných zvířecích zubů a kostěných korálků,

doklady metalurgie a artefakty s možným kultovním významem. Nový výzkum zaměřený na revizi kovových artefaktů přinesl překvapivý objev – jedna ze spirál z výše zmíněného náhrdelníku, původně považovaná za měděnou, byla ve skutečnosti vyrobena z cínového bronzu. Tento fakt významně zpochybňuje její dřívější dataci do eneolitu, jelikož slitina mědi s cínem se v širším měřítku v Evropě začíná používat až ve starší době bronzové. Cílem studie bylo ověřit, zda nález této bronzové spirály představuje důkaz pozdějších lidských aktivit na lokalitě. Za tímto účelem byl detailně také zhodnocen kontext jejího objevu a zkoumány možné intruze jiných než eneolitických artefaktů v objektech odkud části náhrdelníku pocházejí. Dále byla provedena přesnější analýza prvkového složení kovového jádra a výsledky byly porovnány s jinými analyzovanými pravěkými předměty ze slitin mědi. Případná přítomnost mladších komponent na lokalitě byla ověřována a prokázána pomocí povrchového archeologického průzkumu včetně použití detektorů kovů. Při průzkumu bylo nalezeno celkem 58 artefaktů, z nichž většinu lze datovat jako středověké, ale především novověké a recentní. Nejvýznamnějšími nálezy jsou však dva drobné bronzové úlomky nalezené na severovýchodním okraji lokality. Spolu s bronzovou spirálkou odpovídají předměty materiálově předmětům z období od střední doby bronzové do mladší doby železné. Na základě kombinace revize kovových artefaktů, chemické analýzy a povrchového archeologického průzkumu studie prokázala, že na lokalitě Hlinsko – Nad Zbružovým je doložena lidská aktivita i v pozdějších obdobích, než se dosud předpokládalo. Toto zjištění by mělo posloužit jako impuls k podrobnějšímu prozkoumání lokality, která nám má zjevně stále co odhalit a která je navíc bezprostředně ohrožena těžbou kamene v přiléhajícím lomu.

Contacts

Filip Ševčík
Department of Archaeology and Museology
Faculty of Arts, Masaryk University
Joštova 13
CZ-602 00, Brno
460938@mail.muni.cz
ORCID: 0000-0003-4022-006X

Matěj Kmošek
Institute of Classical Archaeology
Faculty of Arts, Charles University
Celetná 20
CZ-110 00 Prague
kmosekm@ff.cuni.cz
ORCID: 0000-0002-5471-2201