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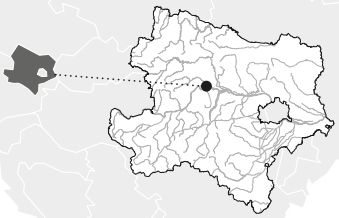
The adornments of the Gravettian site Krems-Wachtberg in chronological and techno-cultural context

Ozdoby z gravettienské lokality Krems-Wachtberg v chronologickém a technologicko-kulturním kontextu



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KEYWORDS

Upper Paleolithic – adornments – mammoth ivory – use-wear – chaîne opératoire

ABSTRACT

Adornments such as pendants, beads, and other perforated objects are an important finds category in Upper Paleolithic sites. Raw materials, production technology, and use-wear can tell us much about the objects and techno-cultural context of their carriers. Excavations from 2005–2015 at the Gravettian (Pavlovian) site of Krems-Wachtberg provided 110 objects which can be interpreted as adornments. They consist of mammoth ivory beads and pins, perforated canine teeth and molluscs, and fossil Serpulidae. More than half of these objects were found in the context of a double burial of infants. A recently conducted investigation describes all adornments and places them into a chronological and technological context.

Analyses of all objects in this study were carried out using a Keyence VHX 7000 stereomicroscope. Micro photos were produced for all objects and allowed a wide range of measurements which would otherwise not have been possible to make considering the objects' poor state of preservation. The produced micro photos will allow for additional non-destructive morphological analyses in the future. Information concerning the preservation of the raw material, use-wear, traces of production, method of perforation, fire exposure, and residues were collected in a database.

The 53 mammoth ivory beads found in the double burial in particular allowed not only for reconstructing a chaîne opératoire for the manufacture, but provided interesting information regarding the objects' lifecycle. Polishing on the bridges of some of the pendants' perforations, presumably caused by a thread, and the location of the polished areas in relation to their positions show that some beads had already been worn before being deposited in the burial. This suggests that they were not explicitly made for the infants' burial as previously suggested.

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1. Introduction

Unlike lithic tools, adornments do not have an obvious practical use in everyday life of the Paleolithic hunter-gatherer. To procure the raw material or manufacture the often-complex forms implies a certain amount of time invested which otherwise could have been used to ensure survival. There are many studies discussing the meaning of adornments; however, this article focuses more on the production and the lifecycle of the objects themselves, which can indicate their importance to the producers and wearers. The particular and personal feelings of the individual person towards adornments cannot be reconstructed solely from material findings, but there are signs that adornments played an important role in Paleolithic communities. This article presents the results of the analysis of the adornments of the site Krems-Wachtberg and places them in a chronological and techno-cultural context.

The site of Krems-Wachtberg lies in the centre of the modern city of Krems, in Lower Austria (Fig. 1). It is situated on a terrace-like hill called 'Wachtberg', which is part of the Bohemian Massif (Krammer 2008, 17; Händel 2021, 2) and the archaeological layers of the site were covered with up to 8 m of mostly aeolian transported loess (Zeeden et al. 2015, 189, 193). Originally, the River Krems entered the River Danube at the base of the Wachtberg (Händel et al. 2008, 92). In this area, the River Danube leaves the narrow valleys of the west and enters flatter terrain, in which it could spread and form branches. The site of Krems-Wachtberg is surrounded by further well-known sites which were assigned to the Aurignacian and Gravettian (Fladerer 2001, 432.), like Krems-Hundssteig, Krems-Wachtberg 1930 and Krems-Wachtberg Ost (Händel 2021, 2). The calibrated radiocarbon dates for the *in situ* horizon AH 4.4 showed an age of about 31 ka cal BP (Händel 2021, 6). Based on the significant archaeological structures, finds and radiocarbon dates (Simon et al. 2014), the site was assigned to the early Gravettian (Svoboda 2007, 3), more precisely the Pavlovian. However, this topic will be discussed in more detail below (4.3). A first excavation campaign in the immediate vicinity of the site was conducted in 1930 under the supervision of Josef Bayer (Einwögerer 2000, 25). Although core sampling was conducted in 2002 (Einwögerer, Simon 2008, 38), the site only gained public awareness with the extraordinary discovery of a double infant burial in 2005. Between 2005 and 2015, the site and subsequent examinations were conducted by the Austrian Archaeological Institute (ÖAI) of the Austrian Academy of Sciences (ÖAW) and financial support was given by the Austrian Science Fund and the state of Lower Austria (FWF P-17258, FWF P-19347, FWF P-21660, FWF P-23612, Project leader C. Neugebauer-Maresch; Einwögerer 2017, 82).

Fig. 1. Geographic position of the city of Krems, Lower Austria. Map source: D-maps; modified by V. Kaudela.

Obr. 1. *Geografická pozice města Krems, Dolní Rakousko. Mapový zdroj: D-maps; upravila V. Kaudela.*

The word 'adornment' already suggests that the named object's purpose is to beautify or decorate somebody (CALDT). This leads to the conclusion that adornments were worn on the body solely because of their aesthetic values. However, one should keep the possibility in mind that these objects could have had a far deeper meaning, and that one intended use does not exclude the other. Here, every object which can be threaded, sewn, or fastened in any way to a base material will be referred to as an adornment. The threads on or with which these adornments could have been fastened could have been made from leather, sinew, plant fibre (Scheer 1995, 58), or hair. The base material on which adornments could have been sewn on or pierced through could have been hide, leather, or knitted/braided plant fibres (Svoboda 2010, 52).

The find inventory of Krems-Wachtberg 2005 to 2015 contains a range of objects which can be defined as adornments: ivory beads, ivory pins, perforated canine teeth, perforated molluscs, and Serpulidae (Fig. 2). Based on their intentional perforation, the ivory beads, teeth, and molluscs possess the potential to be threaded or sewn on a base material. The Serpulidae have the same potential because of their natural tube-like form. The examined ivory pins and pin fragments represent a special case. They do not show any traces of perforation or notch, but do not show any traces of having been used as armatures either. The position of one specimen in Burial 2, where it appeared to have been used as a cloth pin (see below), suggests a significant decorative (co-) function. In this paper, ivory pins are therefore considered as adornments.

2. Methodological approach

The examination and evaluation of each object from each artefact category was done on three levels – the description, the technology, and additional information. The description was produced through the acquisition of all metric data and other specific information which was collected in a database. With the help of traces of production, it was aimed at reconstructing the technological production process. The identification and description of the traces of production on ivory, such as striae and polishing, or the process of perforation are based on experiments with ivory by Hein (2011) and the work of Hahn, Scheer and Waibel (Hahn et al. 1995), Bolus (2003), and Wolf (2015a). For the analysis of production traces, like the types of perforation (rotating, slot, picking), and use-wear traces in molluscs, the studies of D´Errico et al. (2005), Sauer (1995), and Bolus (2003) were consulted. The recognition, description, and interpretation of a worn hole/a polishing of the bridge of a perforation of an ivory bead or a canine tooth was based on Bolus (2003) and Tiley-Nel and Antonites (2015). The latter also shows examples of rounded ivory apices, resulting from repeated use. However, often the direct visual comparison to other, unused specimens from the same inventory, which, in the case of ivory beads, there were many, added weight to the assumptions. By consulting studies from Wolf (2015a), Wolf, Kind and Conard (Wolf et al. 2013), and Tiley-Nel and Antonites (2015), the polishing on adornments as a result of intense contact with a base material could be distinguished. The polishing of a thread, which was also identified in some specimens such as the serpulids, was recognised thanks the study by Vanhaeren and D´Errico (2003).

2.1 Defining regions

For the determination of the position of different kinds of traces of production and use-wear, as well as the designation of different regions, a system was developed to ensure consistency. It was applied to every examined find category (Fig. 3). In this system, axes divide most of artefacts into the upper part (superior), the lower part (inferior), the left part (sinister), the right

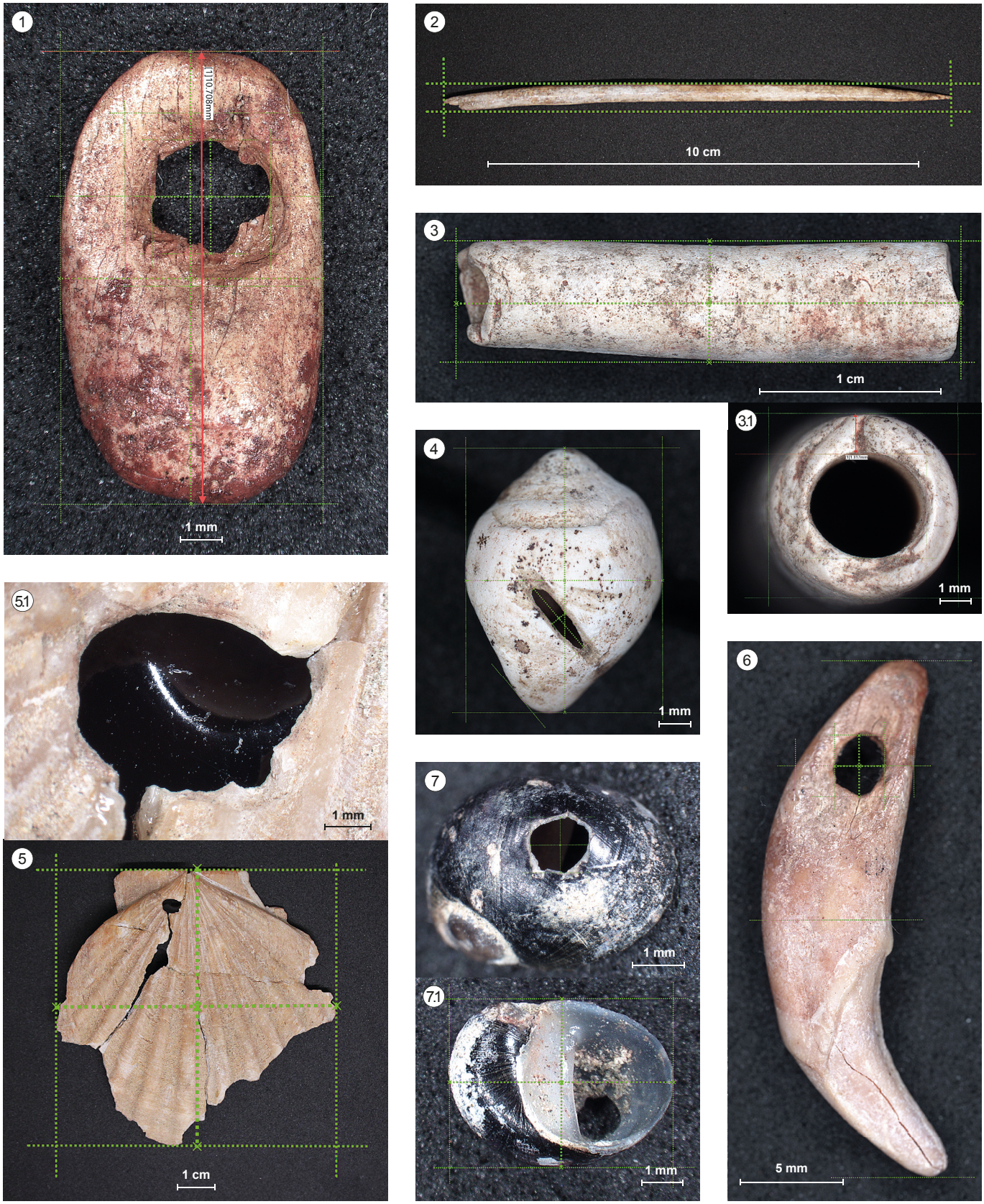


Fig. 2. Examples for reference lines used to obtain measurements in different artefact categories. 1 – Ivory bead (ID 18159); 2 – ivory pin (ID 177197); 3 – Serpulidae (ID 87753-108); 4 – tertiary snail (ID 179148); 5 – *Gigantopecten gigas planus* (ID 87792); 6 – canine tooth (ID 120209); 7 – *Theodoxus* sp. (ID 62793-19). Photo by V. Kaudela.

Obr. 2. *Příklady referenčních linií použitých k získání měření v různých kategoriích artefaktů. 1 – Slonovinový korálek (ID 18159); 2 – slonovinový špendlík (ID 177197); 3 – Serpulidae (ID 87753-108); 4 – třetihorní plž (ID 179148); 5 – Gigantopecten gigas planus (ID 87792); 6 – špičák (ID 120209); 7 – Theodoxus sp. (ID 62793-19). Foto V. Kaudela.*

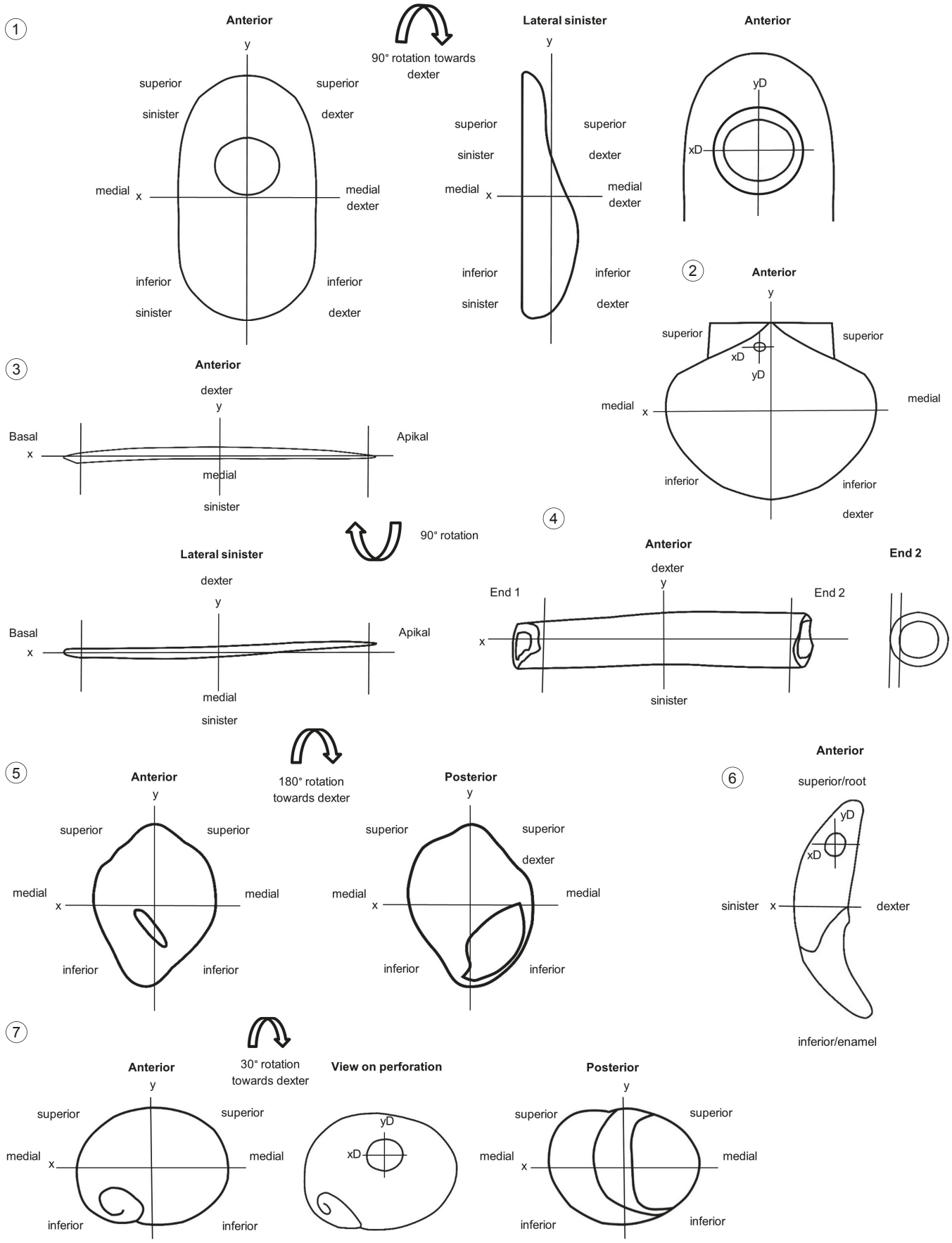


Fig. 3. Developed system for the designation of the different regions for different find categories. 1 – Ivory beads; 2 – bivalve; 3 – ivory pins; 4 – Serpulidae; 5 – gastropod; 6 – canine teeth; 7 – gastropod (*Theodoxus* sp.). Graphic by V. Kaudela.

Obr. 3. *Zavedený systém pro popis orientací pro různé kategorie nálezů. 1 – Mamutovinové korálky; 2 – škeble; 3 – mamutovinové jehly; 4 – Serpulidae; 5 – plže; 6 – špičáky; 7 – plže* (*Theodoxus sp.*). *Grafika V. Kaudela.*

part (dexter) and the middle part (medial), which can be viewed frontal (anterior), from the side (lateral), or from the backside (posterior). The superior part of the bead equals the 'proximal end' and the inferior equals the 'distal end', which was previously defined in the analysis of tear-drop-shaped beads by Vercoutère and Wolf (2018, 386, 391).

To keep in uniformity with the other artefact categories, the standard naming of tooth regions was changed a bit. Distal was changed to anterior, mesial to posterior (Cârciumaru et al. 2019, 83), labial/buccal to sinister and lingual to dexter (Schmid 1972, 76). The teeth were separated by a horizontal line at the point of the transition from the tooth root to the enamel. The part of the tooth root was named superior, and the part of the enamel anterior (Fig. 3: 6).

The broader end of the ivory pin or pin fragment was named basal, the slimmer end apical, and the middle part was medial. This terminology was adopted from sewing needles (Fig. 3: 3; Walter 2002, 9).

The different forms of molluscs needed to be handled independently in terms of terminology. The inner part (interior) of the bivalve *Gigantopecten gigas planus* was named posterior and the outer part (exterior) was named anterior (Fig. 3: 2; Mandic 2004, 139). The orientation of the gastropods and the terms of the designated regions were given based on the established system, depending on the position of the perforation (Fig. 3: 5, 7).

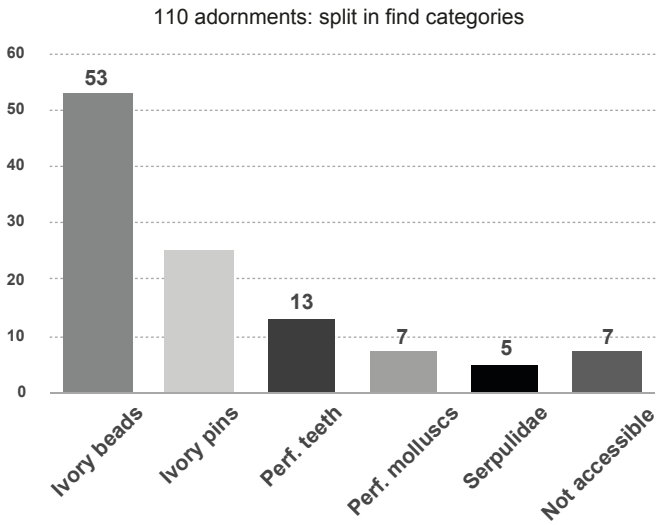
The two fractured ends of the Serpulidae were simply named 'end 1' and 'end 2', because the older part of the tube (proximal/posterior) and the younger part of the tube (distal/anterior) could not be determined during the examination (Fig. 3: 4; Jäger 2011, 682; Ippolitov et al. 2014, 145).

2.2. Database

At the outset, a database was generated where all 110 adornments were listed in a base table with their ID and sub-number. They were divided based on their material: ivory, tooth, mollusc, and fossil. For simplicity (concerning the measurements), the two fossil molluscs were grouped with the molluscs and not the fossil serpulids. Object specific information was gained from the excavation database (AQS). The close examination and measurements were undertaken with a Keyence VHX 7000 stereomicroscope to ensure exact numbers, repeatability, and prevent damage to the partially badly preserved objects. To facilitate the measuring process, an x- and y-axis were established, and further reference lines were defined from which parallel measurement was possible (Fig. 3). The exact weight of each object was determined with a very sensitive scale (Volcraft, PS-200HTP Taschenwaage, 0.01 g minimum weight). A photograph of each artefact was taken in full from different perspectives with a scale. Objects longer than 5 cm were photographed with a Canon EOS 700D (18,000 megapixel, 22.3 × 14.9 mm sensor). Photographs of smaller objects were taken with the already mentioned Keyence microscope. With this microscope, up to 100 detailed micro photos per artefact were made with 20× to 100× magnification. For every artefact, information regarding the preservation, additional information about the perforation (if existing), traces of production and use-wear, residues (like haematite), and signs of fire exposure were recorded in the database.

2.3 Basis of Data

Originally, 110 artefacts which have been interpreted as adornments were recovered. A hands-on examination was possible on 103 objects. This number includes 53 ivory beads, 25 ivory pins, 13 perforated teeth, seven molluscs, and five Serpulidae. Seven artefacts, which are composed of one ivory bead, three teeth, and three Serpulidae, are currently not available (Graph 1). Most of the adornments derive from the Gravettian horizons AH 4.11, 4.4/4.3 (Fig. 4). AH 4.11 includes moved archaeological material which was transported downhill through periglacial processes and solifluction (Händel et al. 2009, 47; 2014, 45; 2021b, 1411). Find inventories and reconstruction of the



Graph 1. Categories of adornments at Krems-Wachtberg.
Graf 1. *Kategorie ozdob z lokality Krems-Wachtberg.*

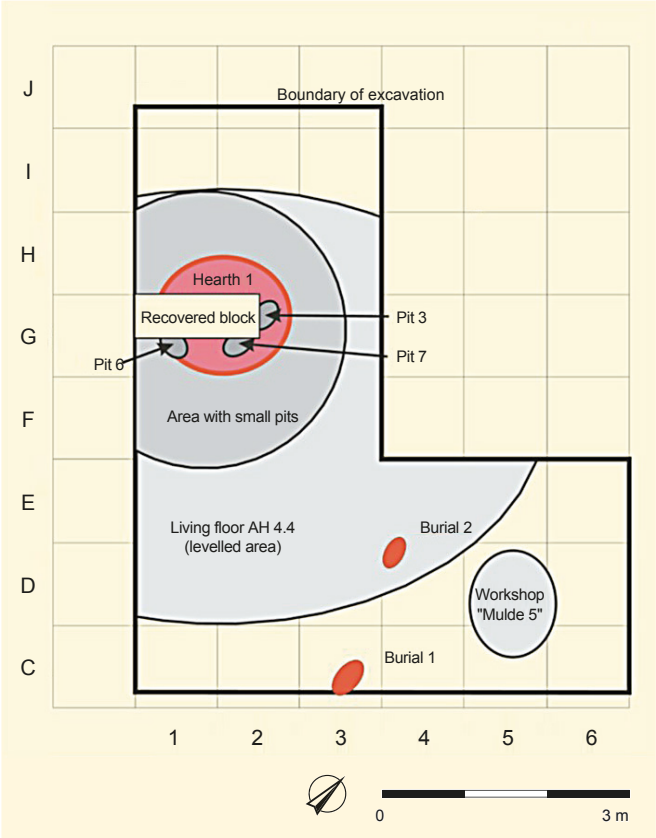


Fig. 4. Schematic display of the occupation area of Krems-Wachtberg, excavated from 2005 to 2007, including Burials 1 and 2. After Händel et al. 2008, 105.
Obr. 4. *Schematické znázornění sídelní plochy na lokalitě Krems-Wachtberg, zkoumané mezi lety 2005 až 2007, zahrnující pohřeb 1 a 2. Podle Händel et al. 2008, 105.*

Fig. 5. Ivory beads. 1 – Burial 1, Individual 1 (ID 150002); 2 – from the moved horizon AH 4.11 (ID 87913-43). Photo by V. Kaudela.

Obr. 5. *Mamutovinové korálky. 1 – Pohřeb 1, jedinec 1 (ID 150002); 2 – z přesunutého horizontu AH 4.11 (ID 87913-43). Foto V. Kaudela.*

formation of AH 4.11 show that the layer includes material from AH 4.4/4.3 as well as material from other sources (Händel et al. 2014, 45; 2021b, 1411). Next to fauna and lithic artefacts, this layer provided a rib of an approximately 12-year-old individual (Einwögerer, Simon 2008, 39; Einwögerer 2017, 87) and 30 of the examined adornments: one ivory bead, 15 ivory pins, five perforated teeth, three molluscs, and six serpulids. AH 4.3 was defined as the eroded peripheral area of the *in situ* horizon AH 4.4 (Händel 2021, 4). Both will therefore be considered together as AH 4.4/4.3. This horizon includes Burial 1 and within it 57 adornments, which included 53 ivory beads, 3 molluscs, and a tooth. The living floor provided several structures next to Burials 1 and 2 such as two hearths, and different pits (Händel 2021, 11), which were interpreted as cooking pits or postholes (Einwögerer 2017, 83). Here, ten ivory pins, nine perforated teeth, one mollusc, and two serpulids were excavated. One perforated tooth was documented coming from a disturbed context.

3. Results and discussion

3.1 Ivory beads

Originally, 53 ivory beads were recovered from Burial 1 – one of them is presently not accessible for examination. One additional ivory bead originates from the moved horizon AH 4.11 and has no direct connection to Burial 1, but it shows such a close resemblance to the ones from the burial that it was included in the examination and compared to them (Fig. 5). Due to the likeness of the archaeological material of the layers AH 4.11 and 4.4/4.3, comparisons were already made in previous research (Simon et al. 2013, 78; Thomas, Ziehaus 2014, 135). Consequently, the sum of the examined ivory beads is 53 pieces, consisting of 52 pieces from Burial 1 and one piece from AH 4.11.

3.1.1 Description

The ivory beads can be roughly described as oval to oblong, perforated objects, with a flat (posterior) and a partly rounded or bulgy (anterior) side. 23 of the 53 beads are complete with no other damage than the weathering of the ivory. The rest shows small damage or is fragmented. All the beads show residues of red pigment, which was identified as red ochre (haematite) (Neugebauer-Maresch et al. 2013, 139).

3.1.2 Position in Burial 1 and usage

During excavation in 2005, a shallow depression with a flat bone on its base was discovered. It was the scapula of an adult mammoth, which was modified in a way that a part of it, the *spina scapulae,* was removed (Einwögerer 2017, 86), and which showed signs of contact with fire (Händel et al. 2008, 102). The scapula

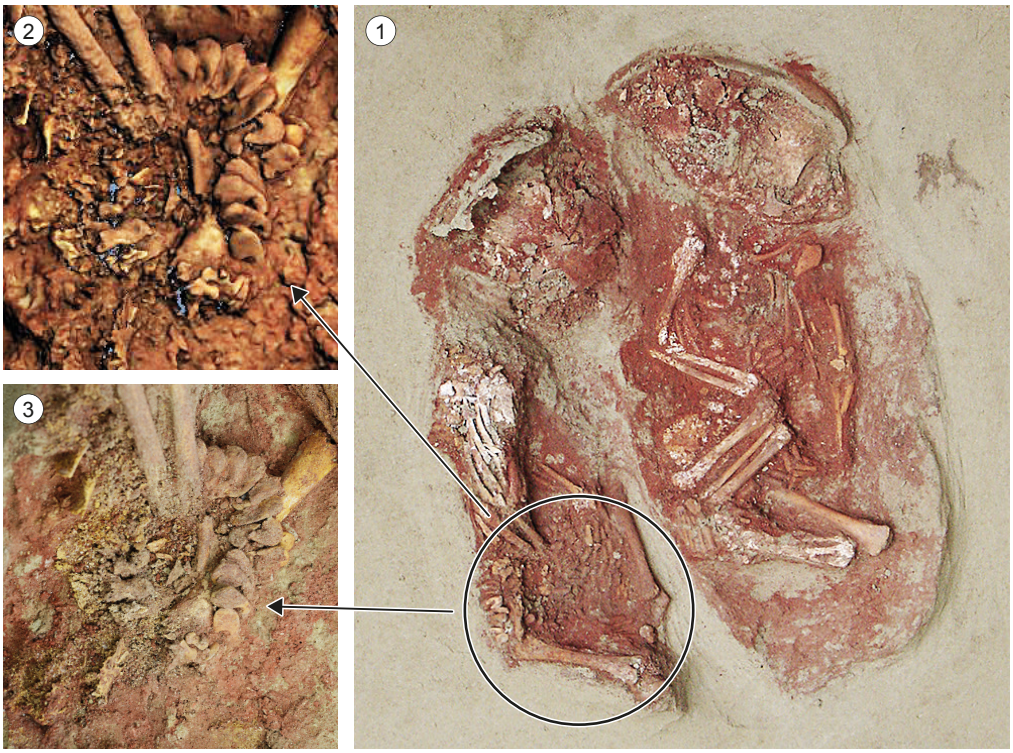


Fig. 6. Burial 1, Krems-Wachtberg, 2005. 1 – Left Individual 1, right Individual 2 (after Einwögerer, Simon 2008, 38); 2 – 3D-detail of the overlapping position of the ivory beads; 3 – detailed picture of the *in situ* position of the beads. Photo by Austrian Archaeological Institute (ÖAI), Austrian Academy of Sciences (ÖAW); modified by V. Kaudela.

Obr. 6. *Pohřeb 1, Krems-Wachtberg, 2005. 1 – Vlevo jedinec 1, vpravo jedinec 2 (podle Einwögerer, Simon 2008, 38); 2 – 3D detail překrývajícího se uložení mamutovinových korálků; 3 – detailní obrázek in situ pozice korálků. Foto Österreichische Archäologische Institut (ÖAI), Österreichische Akademie der Wissenschaften (ÖAW); upravila V. Kaudela.*

Fig. 7. Examples of different ivory beads with abrasion of the bridge sinister and/or dexter. From left: ID 18165, ID 151129, ID 18167. Photo by V. Kaudela.

Obr. 7. *Příklad různých mamutovinových korálků s abrazí můstku na levé a/nebo pravé straně. Zleva: ID 18165, ID 151129, ID 18167. Foto V. Kaudela.*

was supported by a piece of mammoth ivory and covered a pit that was 36 × 28 cm in diameter and 20 cm deep (Einwögerer et al. 2006, 285; Einwögerer, Simon 2008, 38; Händel 2021, 10). In this pit, the remains of two infants, surrounded by powdered haematite, were found (Burial 1, Fig. 6: 1) (Einwögerer et al. 2006, 285; Einwögerer, Simon 2008, 38; Neugebauer-Maresch et al. 2013, 139). Years after the discovery, aDNA-sampling established that these two infants were monozygotic, male twins (Teschler-Nicola et al. 2020, 1–3). The skeletons of the two individuals were found in a flexed position with their heads pointing north and their faces east (Einwögerer, Simon 2008, 39; Einwögerer 2017, 86). It seems that the individual on the right side (Individual 2) had a more central position in the pit than the one on the left side (Individual 1). During the excavation process, this observation already led to the assumption that they were not buried simultaneously. It appeared that the burial pit was initially made for Individual 2 and that Individual 1 was laid down some time later (Teschler-Nicola et al. 2020, 2–3). Large-scale analysis of the remains, including the Barium (Ba) intake as a biomarker of breastfeeding in their teeth, showed that Individual 2 died before, during, or shortly after being born, whereas Individual 1 lived for 6 to 7 weeks (Teschler-Nicola et al. 2020, 2, 8).

The ivory beads were discovered in the left individual's pelvis area (1) (Fig. 6: 1; Simon 2018, 52). In 2005, when the burial was found, 30 beads were documented (Einwögerer et al. 2006, 285) and 18 of them were taken out of the pit, before it was decided to take out the whole burial as a block and examine it under more controlled conditions. After several unsuccessful attempts of scanning the whole block via CT, it was cautiously excavated and documented in the Natural History Museum of Vienna (NHM) in 2015 (Einwögerer 2017, 87). Thanks to repeated scanning and photographing of the excavated surface and the documentation of each bone and adornment, the position of every ivory bead, the perforated tooth, and the molluscs can be reconstructed (Neugebauer-Maresch et al. 2023, 113). The ivory beads were lying in a slightly overlapping succession, in roughly the form of an 'N' (Fig. 6: 1, 6: 2). Their position in the burial suggests that the beads were strung on some kind of thread before they were positioned with Individual 1. The succession of this thread with beads began in the loin area and ran under the right hand and forearm and over the left femur (Händel 2016, 35).

Regarding the life cycle of the beads, two questions arose: Were the ivory beads made initially for the burial of the infant, or had they been worn before? And if so, how had they been worn? The answers to these questions can be found with the help of use-wear analysis. Artefacts without traces of use-wear could have been made initially for the burial, artefacts with traces of use-wear would already have been worn before they were positioned with the buried. Further, the position of the use-wear can give additional information about the way in which the artefact was attached to the body or base material. On 24 of 53 ivory beads a more or less significant abrasion of the bridge, sinister, and/or dexter of the perforation was identified (Fig. 7, 9: 2) (for the system for defining regions of use-wear on the bridge of the perforation, see Fig. 8). The position of the thinning suggests that in these areas of the bridge, a thread has abraded the material, seemingly while they were sewn onto some material with two stitches, left and right of the perforation of each bead. If artefacts had been worn threaded for some time, they would be hanging due to gravity and the abrasion would appear superior on the bridge. This would also be the case if the bead was sewn on with just one stitch in the superior part of the bridge (Kölbl, Conard 2003, ivory beads from the catalogue). The attachment with two stitches, compared to just one, shows at least two advantages; the bridge is the thinnest and most fragile part due to the position of the perforation in the superior part of the bead and shows the most potential for fracture. If the pressure of the thread is not concentrated on one point of the bridge but on two points, the risk of breaking is reduced. The second advantage is

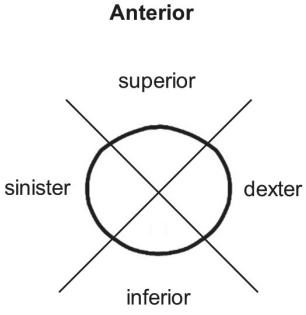


Fig. 8. Developed system for the designation of the different regions of the polishing of the bridge. Graphic by V. Kaudela.

Obr. 8. *Zavedený systém pro popis umístění ohlazení na můstku. Grafika V. Kaudela.*

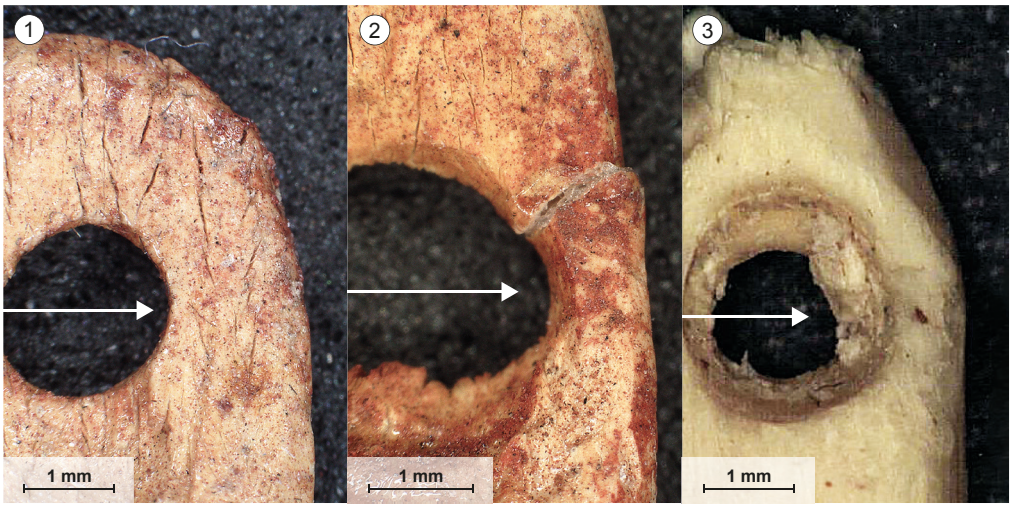


Fig. 9. Comparison between three ivory beads. 1 – Ivory bead (ID 18156) with rounded bridge, Krems-Wachtberg (photo by V. Kaudela); 2 – ivory bead (ID 18167) with polishing of the bridge dexter, Krems-Wachtberg (photo by V. Kaudela); 3 – experimentally produced ivory bead without any use-wear (after Wolf 2015a, 72). Modified by V. Kaudela.

Obr. 9. *Porovnání tří mamutovinových korálků. 1 – Korálek se zaobleným můstkem (ID 18156), Krems-Wachtberg (Foto V. Kaudela); 2 – korálek s ohlazením můstku na pravé straně, Krems-Wachtberg (Foto V. Kaudela); 3 – experimentálně vyrobený korálek bez jakýchkoli známek opotřebení (podle Wolf 2015a, 72). Upravila V. Kaudela.*

that if the bead is attached with two stitches, it is quite steadily connected to the base material with its flat side (posterior) to the base material. If the bead is attached with just one stitch, it is more likely to move with every movement of the material, which puts even more pressure on the spot where it is sewn. If the bead was sewn onto some kind of clothing worn on the body, there would have also been the risk of ripping it off e.g., when carrying something. However, if the bead was attached with two stitches, and therefore more tightly to the material, the risk of losing it would have been reduced. On 26 of the remaining 29 of 53 ivory beads, no abrasion of the bridge could be detected. In some cases, the edges of the perforation looked somewhat rounded (Fig. 9: 1). A rounded perforation does not necessarily imply usage but could also have been established by a thorough rework of the hole. In other cases, no use-wear was discovered because either the bridge is too fragmented, or the perforation is filled with hardened sediment. In 12 cases, the sediment was not cleaned away during the examination due to the fragility of the ivory beads. To figure out if there would be an abrasion at the bridges in these cases as well, some other method like µ-CT scanning would be a possibility and is also planned for the future. On three of the remaining 29 of the total of 53 ivory beads the perforation was not rounded at all; on the contrary it looked freshly broken and rough (Fig. 10: 2, 9: 3). On 22 of 53 ivory beads, it was possible to get the full measurements of the length and width of the perforation. The length ranges between 1.4 and 3 mm and the width between 1.4 and 3.8 mm. There is a tendency to a wide rather than long perforation, which could be the result of an abrasion sinister and dexter of the bridge. Taking all examined ivory beads into consideration, some of them look like they were either made by an inexperienced hand or in a great hurry (Fig. 10). The shape seems nonuniform to the others. Even when a scraped mould and sometimes a perforation cone are visible, the perforation seems to have been vaguely finished by breaking the remaining thin wall of ivory through with the tip of the lithic tool. The perforations of some of these look similar to an experimentally produced ivory bead, where residues of material are still visible in the hole (Wolf 2015a, 72) (Fig. 9:3). The producer either did not take the time or trouble to properly round the edges of the perforation. On the other hand, there is proof of the importance of the uniformity and aesthetics of the ivory beads. One object (ID 18156) shows the remains of an unfinished perforation (Fig. 11). It seems that the perforation of the bead was started, then stopped halfway through because it was too centric, restarted again and finished in the superior

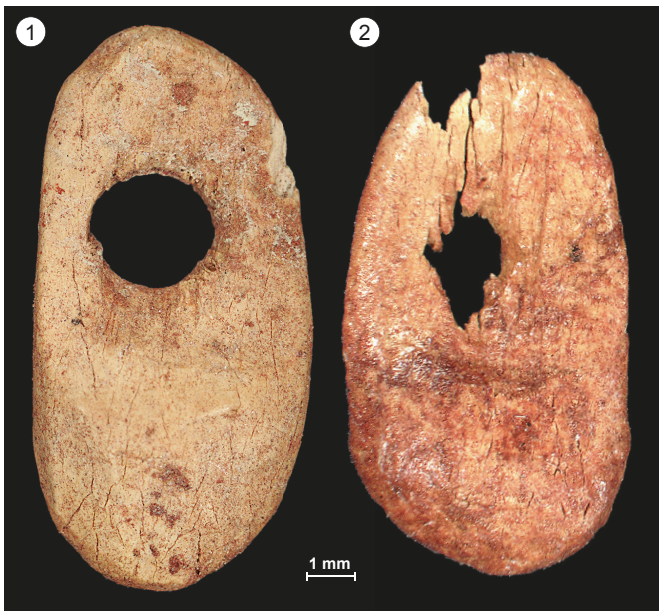


Fig. 10. Comparison between two ivory beads. 1 - carefully processed ivory bead (ID151177); 2 - imprecisely processed ivory bead (ID150004). Photo by V. Kaudela.

Obr. 10. *Porovnání dvou mamutovinových korálků. 1 – Pečlivě vyrobený korálek (ID151177); 2 – nedbale vyrobený korálek (ID150004). Foto V. Kaudela.*

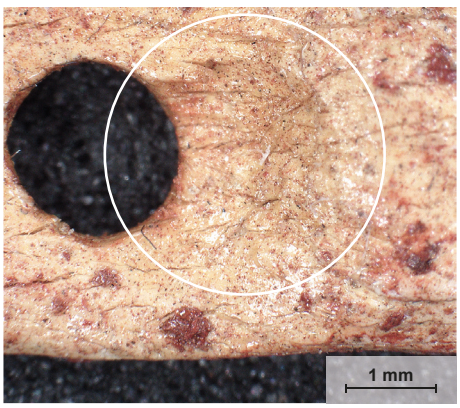


Fig. 11. Ivory bead with unfinished perforation (ID 18156). Photo by V. Kaudela.

Obr. 11. *Mamutovinový korálek s nedokončenou perforací (ID 18156). Foto V. Kaudela.*

part of the bead. Considering the signs of use-wear on the ivory beads, the position in Burial 1 suggests another way of use. The already mentioned, slightly overlapping position next to each other strongly suggests that they were threaded when they were positioned with Individual 1. In view of these considerations, the following theory was formed: the 53 ivory beads were threaded on a thread when they were positioned with Individual 1, but for most of them this was not their primary use, but the secondary. Originally, at least 24 of them had been worn before, sewn with two stitches onto a base material. Three of 53 (Fig. 10: 2) were either explicitly made for the burial or had not been used before. In the case of the leftover 26 objects, it was impossible to determine. The adornments of Individual 2 are treated in the chapter '3.4 Perforated molluscs'.

3.1.3 Production sequence

While observing the shape of all 53 ivory beads, the importance of uniformity and aesthetics for the producer/producers, as well as the skill of producing symmetrical forms is clearly visible (Bednarik 2015, 61–62). The serial production of ivory beads and pendants is already known from Aurignacian onwards (Hahn et al. 1995, 29), but even if the 53 ivory beads look like a standardised product, signs of the individual producer/producers are visible. These traces can be found in the smallest details of manufacturing, such as the shape of the bead and the process of the perforation. Whether all 52 beads of Burial 1 and the single bead from AH 4.11 were manufactured by one individual, or if more people were involved, cannot be said for sure. When 345 ivory beads and pendants from the site Vogelherdhöhle (D) were examined, it was stated that it was possible to group them into different categories, but that every object had individual features which could be the result of many different people producing these ivory adornments (Wolf 2015a, 246).

The 53 ivory beads from Krems-Wachtberg seem identical at first glance but show major differences when examined in detail. Examples are their shape – some of them are oval and some more oblong; the position of the perforation – sometimes superior and sometimes more centred; or the elaborateness of the manufacturing. The last point could be strongly influenced by either the fact that the production of all beads was a learning experience for one individual, or that different people with different levels of precision contributed to the assemblage, which is reflected in the ivory beads.

With the information gained from the detailed examination of the artefacts, the inclusion of a potential rod and the *chaîne opératoire* for ivory, bone, and antler and from Bolus 2003 (Bolus 2003, 51), an attempt was made at reconstructing the production sequence of the ivory beads from Krems-Wachtberg (Fig. 12): the selection and acquisition of the raw material, the segmentation and production of blanks/rods, the preparation of the perforation, the production of the preforms, and the finishing of the product. The first step in producing ivory adornments is the selection and acquisition of the raw material – mammoth ivory. The faunal remains of the AH 4.11 and 4.4/4.3 from 2005–2015 yielded at least 4 individuals (2 per AH) of *Mammuthus primigenius* (Händel et al. 2015, 284). The ivory presumably was brought into the site by the slaughter of mammoths, but it is also possible that tusk fragments were collected, as it is assumed for the sites of the Swabian Jura (Wolf 2015a, 49). Altered ivory is still hard but is easier to take apart than green ivory (Hahn et al. 1995, 33). Different kinds of tusk fragments were described to be found in the AH 4.11 and 4.4, such as big chunks, rods (Einwögerer 2017, 89) and shavings, which implies that the ivory was worked directly on the site (Simon et al. 2013, 79).

Fig. 12. Production process theory for the ivory beads of Krems-Wachtberg. Top to bottom: mammoth tusk fragment (ID 166157), ivory rod (ID 97580), ivory rod with lateral notches and perforation (on the basis of ID 166157 – perforations and lateral notches made with a photo editing program, not from the find inventory), ivory beads (left to right: ID 18167, ID 18169, ID 150002, ID 18165). Photo and modified by V. Kaudela.

Obr. 12. *Teoretický proces výroby mamutovinových korálků z lokality Krems-Wachtberg. Shora dolů: fragment mamutího klu (ID 166157), mamutovinová tyčinka (ID 97580), mamutovinová tyčinka s postranními výřezy a perforacemi (na základě nálezu ID 166157 – perforace a výřezy udělány pomocí foto-editoru, ne podle vzoru konkrétního nálezu), mamutovinové korálky (zleva: ID 18167, ID 18169, ID 150002, ID 18165). Foto a úprava V. Kaudela.*

Once mammoth tusk is provided, the next step would be segmenting or breaking-down the ivory into smaller pieces by segmentation, extraction, or fracture (Bolus 2003, 54; Heckel, Wolf 2014, 2). After that, rods would have been extracted by presumably producing grooves and breaking elongated pieces out of the ivory debitage or longitudinal flakes (Hahn et al. 1995, 29; Bolus 2003, 56; Wolf 2015a, 50). This process is demonstrated through multiple finds of half products, basic forms, and process waste from the sites Vogelherdhöhle (D) and Geißenklösterle (D) (Wolf et al. 2013, 298). But it should be noted that it is of course possible that individual beads also could have been made from smaller ivory flakes (Vercoutère, Wolf 2018, 396). Due to the observation that the axis of all ivory beads from the site Krems-Wachtberg runs with the longitudinal axis of the ivory, the rods were presumably also cut in this direction. Working on green ivory, not towards but against its structure, is very hard and was most likely avoided (Hein 2022, 37).

The extracted rod, as described by S. Wolf, is an oblong, slender object with parallel edges (Wolf 2015a, 54). These rods are a basic form for producing ivory beads and were likely formed by chopping, scraping, and grinding until they reached the desired thickness and width (Bolus 2003, 56; Wolf, Conard 2015, 333). All in all, two rods, which could have been basic forms, were discovered at Krems-Wachtberg, one of them possibly for an ivory pin and one of them for bead production. One rod (Fig. 13), which is 87.7 mm long, max. 10.6 mm wide, is very straight, has a regular appearance with parallel edges, an even surface, and is rectangular in its cross-section. The thickness of the rod varies between 1.94 mm and 4.5 mm, whereas the maximum thickness of the ivory beads, which is the rounded part anterior inferior, is between 1.26 and 2.97 mm, which lies in the range of the rod.

Fig. 13. Ivory rod (ID 97580), potential basic for ivory bead production. Photo by V. Kaudela.

Obr. 13. *Mamutovinová tyčinka (ID 97580), potenciální základ pro výrobu korálků. Foto V. Kaudela.*

One surface of the rod shows broad grooves, which are characteristic of the transition between cementum and detin (Wolf 2015a, 35). Most ivory beads of Geißenklösterle (D) were made from the outer layers of the tusk, which is also likely for those of Krems-Wachtberg (Hahn et al. 1995, 30). When the required dimensions were reached with the rod, it was probably regularly grooved laterally to section it into segments (Fig. 14: 1). The notches determined the future shape of the bead and made the segmentation easier. Notched rods such as these were observed to be a production stage of other kinds of beads on other sites (Bolus 2003, 56). In this stage it is also possible that further notches on the anterior inferior end of the bead were placed to ease future shaping (Fig. 14: 2). The dimensions of the rod were crucial to the final dimensions of the beads. At this point, another working step is proposed for the already notched rods: a thinning of the anterior superior part of the prospective bead. This is visible in 52 of 53 of the ivory beads and would certainly

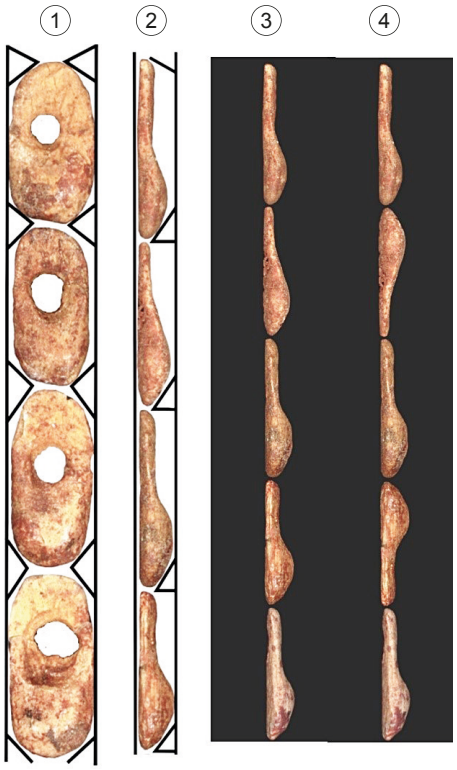


Fig. 14. Positioning of the lateral notches in the rod and arrangement of the beads. 1 – Notches anterior superior / inferior sinister and dexter; 2 – notches superior/inferior; 3 – bead arrangement superior to inferior; 4 – bead arrangement inferior to inferior / superior to superior. Photo by V. Kaudela.

Obr. 14. *Pozice postranních vrubů na tyčince a uspořádaní korálků. 1 – Vruby anterior superior / inferior sinister a dexter; 2 – vruby superior/inferior; 3 – uspořádaní korálků superior – inferior; 4 – uspořádaní korálků inferior – inferior/superior – superior. Foto V. Kaudela.*

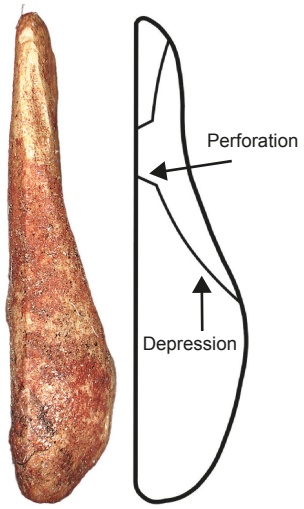


Fig. 15. Ivory bead lateral view. Schematic view of the depression and the actual perforation cone. Photo and graphic by V. Kaudela.

Obr. 15. *Mamutovinový korálek, boční pohled. Schematické zobrazení prohlubně a samotné perforace. Foto a grafika V. Kaudela.*

have eased the process of perforation. The thinner superior part of the bead often shows half the thickness or less than the bulgy part. Another visible step to ease the perforation process is the scraping of a flat, slightly cone-shaped depression in the already thinned superior part of the future bead (Fig. 15) (Vercoutère, Wolf 2018, 396). This depression is bordered by the edges of the bead and therefore often not visible from a lateral view. The perforation was placed on the deepest part of it (Fig. 16). After these stages, most of the material removal would have taken place. There are some small ivory flakes from the excavations which can be interpreted as shavings. They show the characteristic shape of wood shavings: the oblong, thin, slightly bent form with a sharp end and a thinning end. The occurrence of these pieces confirms the assumption that at least some of the beads were produced on-site or at least that ivory manufacturing has taken place.

Fig. 16. Exemplification of the scraped depression which was made before the perforation (ID 18169). 1 – Anterior; 2 – anterior, edges of depression highlighted. Photo by V. Kaudela.

Obr. 16. *Příklad škrábané prohlubně, která byla vytvořena před perforací (ID 18169). 1 – Přední pohled; 2 – přední pohled, okraje prohlubně zvýrazněny. Foto V. Kaudela.*

The next step in the *chaîne opératoire* of Bolus would be the segmentation and production of raw forms. However, it should be mentioned that the perforation process would also be a reasonable next step for the notched ivory rods. This approach is confirmed by perforated, notched rods for producing beads with a double perforation in the Aurignacian layers of the Hole Fels (D) (Wolf 2015b, 98). One can imagine that it would be easier to hold a rod with a few centimetres of length with one hand while drilling a hole with the other hand, rather than holding a small raw form of a bead with a maximum width of 6 mm and an average length of 1 cm. The perforation was most likely executed with a retouched lithic drill or an unretouched flake (Bolus 2003, 58) in a rotating motion. It appears in some beads the perforation was not performed fully, and the actual hole does not appear as a perfect circle (Fig. 17: 2). The tool which was used left a thin wall of material which pierced to break through. This was observed in some of the perforations, which show a hemispherical depression with an irregularly shaped hole (Fig. 17:2). The print of the tool is preserved in a bead, which was already mentioned previously (Fig. 11). This bead shows a hemispherical depression medial, which is an unfinished perforation. It seems that while drilling, the manufacturer decided to place the perforation further superior, stopped the process and began and finished the hole next to the first. It appears that the position of the perforation was roughly predetermined, as it was noticed that the perforation in 30 of 53 beads is situated in the superior part and only in 16 cases medial. It is likely that the perforation process was primarily started from the anterior side of the bead, as big cones were observed.

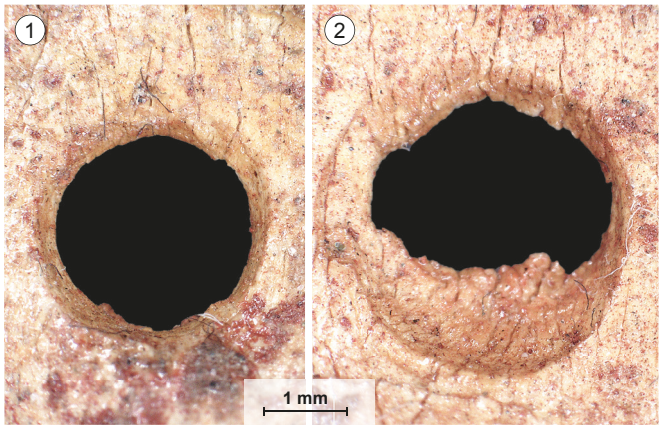


Fig. 17. Different states of the perforation. 1 – Perforation with smoothed edges (ID 18155); 2 – perforation with remnants of the ridge (ID 18158). Photo by V. Kaudela.

Obr. 17. *Různá stádia perforace. 1 – Perforace s hladkým okrajem (ID 18155); 2 – perforace se zbytky hrany okraje (ID 18158). Foto V. Kaudela.*

After the perforation, the next step is segmenting the rod and therefore producing raw forms. This was presumably done by the controlled breaking or sawing of the weak points which were created by the lateral notches. In 29 of 53 beads, it was possible to take full measurements of length and width, which vary between 8.1 mm to 11.5 mm in length and 4.3 mm to 6.2 mm in width. Raw forms are already quite similar in shape to the finished product (Bolus 2003, 57), but some rough forming is still required. After the segmentation, remains of the breaking point had to be removed and the edges had to be rounded. This step left noticeable fine and rough striae from the carving process which are still visible today (Fig. 18).

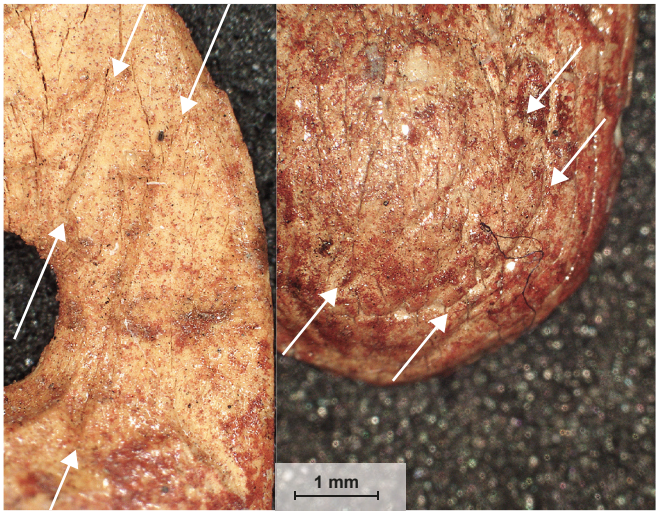


Fig. 18. Striae – traces of scraping and grinding on the surface of ivory beads. 1 – ID 18165; 2 – ID 18162. Photo by V. Kaudela.

Obr. 18. *Striace – stopy škrabání a broušení na povrchu mamutovinových korálků. 1 – ID 18165; 2 – ID 18162. Foto V. Kaudela.*

The last step is the surface finishing and finalising of the bead, where smaller corrections of the shape such as grinding, smoothing, and polishing are done. Due to the weathering of the ivory, it was not possible to recognise any traces of these subtler activities or even a polishing caused by usage. However, fact is that the edges are quite smooth and rounded. This could have been achieved by grinding the ivory with fine-grained quartzite, sand and water, powdered ochre, or wet limestone, as experiments show (Bolus 2003, 60; Hein 2008, 58; Wolf 2015a, 51).

3.2 Ivory pins

In total, 25 pins and pin fragments of mammoth ivory were recovered. 15 originate from AH 4.11 and 10 from AH 4.4. The fragments can be grouped into nine medial fragments, 13 medial to apical fragments and three apical fragments. None of the 25 pins are 100% complete, since every nearly complete pin shows some kind of damage. Nine pins are nearly complete, and they show no signs of any notch, so it is safe to call them pins instead of needles. The other 16 pieces are just fragments, where it is not certain whether they possessed a notch or not.

3.2.1 Description

Not every pin has the typical shape of a broader base and a pointy apex. A few have a thin apex on both ends and a broader medial area. The cross-section of the pins and pin fragments is different as well. Fifteen show a relatively round cross-section, five are oval, four rectangular, and one triangular. The nearly complete pins range in length between 7.4 cm and 20 cm. The nearly complete pins are partly fragmented into up to ten pieces, and some of them were glued back together after recovery. The breakage could have been due to usage and, the process of excavation, but also due to the high pressure of the sediment. Eleven of 25 pins show signs of manufacture, such as fine and rough striae which run with, against, or at an approximate 30–45° angle to the longitudinal axis of the ivory (Fig. 19). Rounded edges and apices point to a abrasion caused by usage (Fig. 19: 2) – or more precisely the repeated penetration of a base material, for example, hide or leather. In eight cases of all 25 pins and pin fragments, the apex is still available and preserved, seven of which showed a significant rounding of the apex, and one shows a still pointy apex which did not appear to have been used. Four of the

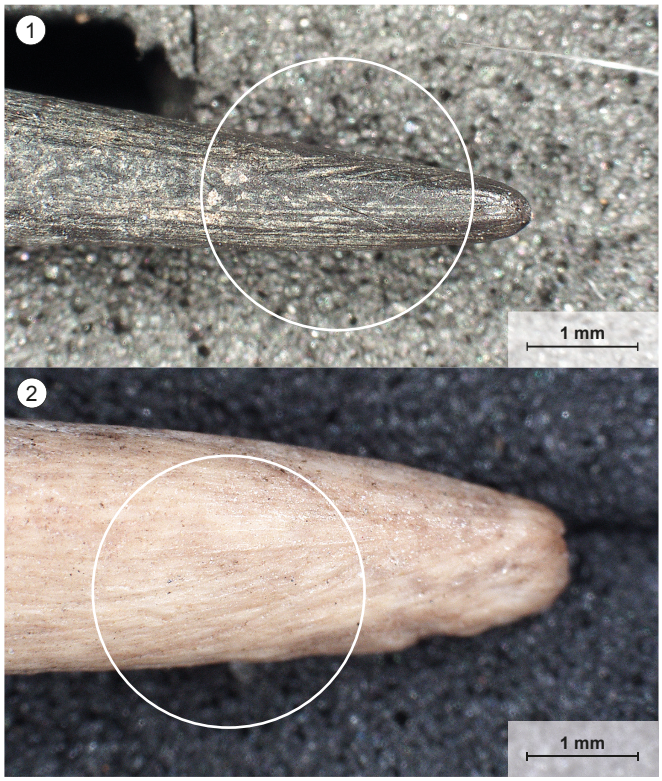


Fig. 19. Examples of striae on the apices of ivory pins. 1 – ID 74295-114; 2 – ID 210034-5. Photo by V. Kaudela.

Obr. 19. *Příklady striací na hrotech mamutovinových jehel. 1 – ID 74295-114; 2 – ID 210034-5. Foto V. Kaudela.*

seven rounded apices belong to nearly complete pins (Fig. 19: 2), which can be interpreted as adornments. Some of the pins show signs of haematite, impact of fire, and two pin fragments are completely charred (Fig. 19: 1).

3.2.2. Position in Burial 2 and usage

In 2006, the burial of an additional infant (Individual 3; Fig. 20: 1), which was situated about 1 m north of the double burial, was found and recovered in a block (Einwögerer et al. 2006, 285; Einwögerer, Simon 2008, 38). The skeleton of the infant was found in a flexed position with the head pointed south, the face directed to the east and surrounded by powdered haematite. Genetic analysis showed that the individual was male (Fu et al. 2016, 213, Tab. 4), and the age of death was determined to be at about 3 months. As the genetic material of all three infants was compared, a relationship of the third degree was detected between the twins and the single burial (Teschler-Nicola et al. 2020, 1).

About 2 cm above the skull of the infant (Simon et al. 2013, 82), a 7.4 cm long ivory pin was located (Fig. 20: 2; Einwögerer, Simon 2008, 39). The pin is nearly complete, with a round cross-section, a broader base, and an apex. It was most likely broken during recovery and glued back together afterwards. The pin shows fine and rough striae which are linked to the production process. The apex is not completely present anymore, but a rounding of the apical part is clearly visible, which is evidence of repeated use of the object. In general, pins can be practically used to fasten clothing or cloths. Despite the steadiness of ivory, the pins look quite fragile considering a max. length of 20 cm and a max. cross-section of 6 mm. The pin from the burial could have been part of clothing or garb, or it was used to fasten a base material which was draped around the body. The already mentioned haematite concentration showed sharp boundaries around the body, which led to the theory that the body of the infant was wrapped in a base material, which was filled with the pigment and fastened with the ivory pin (Einwögerer, Simon 2008, 39; Simon et al. 2013, 82).

3.2.3 Production sequence

The first steps of the production sequence were presumably the same as with the ivory beads. As a basic form, long ivory rods can be assumed which were presumably formed by carving with a lithic tool or grinding on a coarse stone. As already mentioned, one of the ivory rods which was found on the site could have been a basic form of a pin. The rod has a length of 111.1 mm, a maximum width of 8.2 mm and is slightly bent. The surface is very rough and covered with root and tool marks.

3.3 Perforated animal teeth

Sixteen animal teeth, which possessed a perforation, were recovered at Krems-Wachtberg. All teeth derive from carnivores. Unfortunately, three of them are presently not available and were not analysed in person. However, due to the official database and pictures of the research group 'Quaternary Archaeology', some data could be acquired. The identification of the available 13 teeth was kindly provided by Florian Fladerer (University of Vienna, Austrian Archaeological Institute), Tina Salcher-Jedrasiak (University of Vienna, Austrian Archaeological Institute), Kerstin Pasda (Friedrich-Alexander-University Erlangen-Nürnberg, Institute for Pre- and Protohistory) and

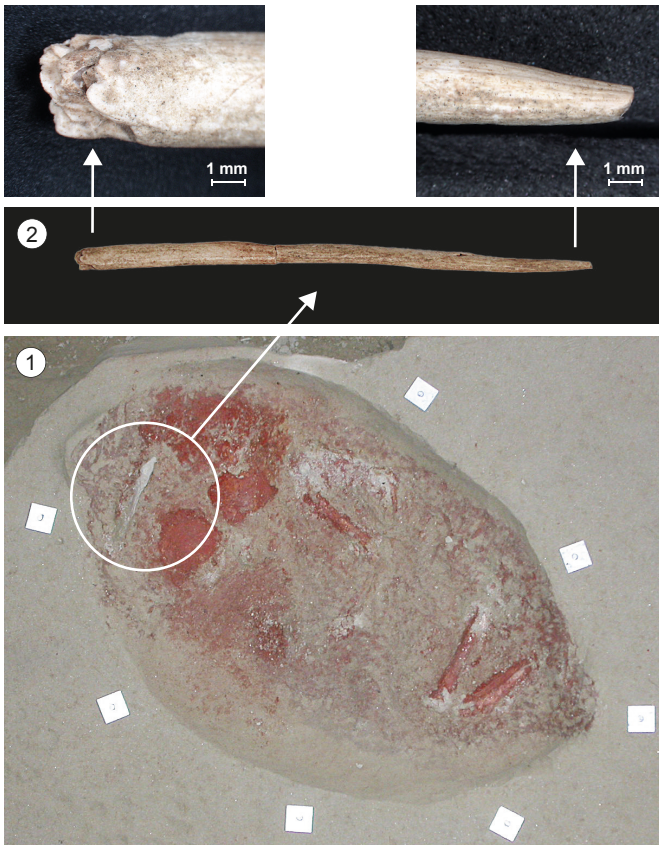


Fig. 20. Burial 2 with ivory pin. 1 - Individual 3, position of the ivory pin highlighted. Photo by ÖAI, ÖAW; modified by V. Kaudela; 2 - Ivory pin with detail of base and apex (ID 37552). Photo by V. Kaudela.

Obr. 20. *Pohřeb 2 s mamutovinovou jehlou. 1 – Jedinec 3, místo nálezu jehly zvýrazněno. Foto ÖAI, ÖAW; upravila V. Kaudela; 2 – detail báze a hrotu mamutovinové jehly (ID 37552). Foto V. Kaudela.*

Fig. 21. Display of teeth from fox and wolf. 1 - Incisor, *Vulpes* (ID 24043); 2 – incisor, *Canis* (ID 24551-1); 3 – canine, *Vulpes* (ID 120209); 4 – canine, *Canis* (ID 107244). Photo by V. Kaudela.

Obr. 21. *Ukázka zubů lišky a vlka. 1 – Řezák, Vulpes (ID 24043); 2 – řezák, Canis (ID 24551-1); 3 – špičák, Vulpes (ID 120209); 4 – špičák, Canis (ID 107244). Foto V. Kaudela.*

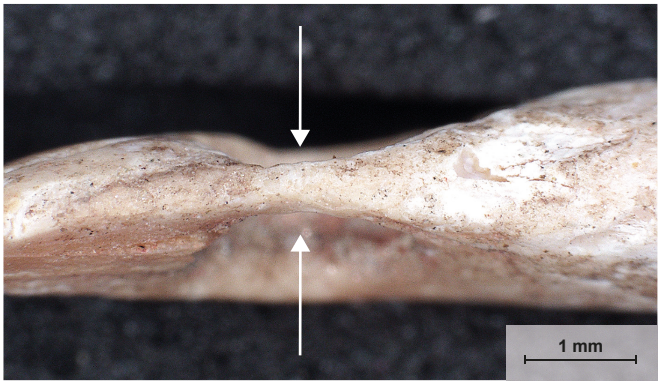


Fig. 22. Example of a heavily thinned bridge of a fox tooth, lateral (ID 161580-20). Photo by V. Kaudela.

Obr. 22. *Příklad výrazně ztenčeného můstku u perforovaného liščího zubu, boční pohled (ID 161580-20). Foto V. Kaudela.*

Laëtitia Demay (Muséum National d'Histoire Naturelle, Département de Préhistoire). Important details of the identification were the genus, element, mandible or maxilla, the side, and the approximate age of the animal.

3.3.1 Description

Of the 13 perforated teeth which were examined in person, four were identified as deriving from *Canis* and nine from *Vulpes*. Two of the four *Canis* were determined to be of *Canis lupus*. Five of the nine *Vulpes* teeth were determined to be of *Vulpes lagopus* and one of *Vulpes vulpes* (Fig. 21). Five of the 16 perforated teeth were identified as canine teeth and eleven as incisors (2 × I, 2 × I2, 7 × I3). Twelve of 16 teeth could be determined to be from adult individuals. However, it was hard to detect if the rounding of the enamel was due to the age of the animal or the polishing from usage. Eight of 13 perforated teeth show a significant rounding of their edges, meaning the root area and the enamel. It seems like they had been rubbing for quite some time against some base material to achieve this grade of roundness. Nine of 13 show a relatively clear rounding of the bridge of the perforation (Fig. 22). In eight of nine cases the rounding showed itself sinister and/or dexter, and in one case (Fig. 21: 2) superior of the perforation. As it is assumed with the ivory beads, the teeth with the lateral traces of use-wear were presumably sewn onto a base material with two stitches, whereas the one with the superior rounding was either sewn on just with one stitch or worn as a pendant.

3.3.2 Position in Burial 1 and usage

During the controlled excavation of the double burial, additional adornments were found in the subcranial area of Individual 2 (Fig. 23; Einwögerer 2017, 87). The adornments include the perforated I3 of a *Vulpes* sp. and three (four) perforated molluscs which are treated below (3.4). The perforated tooth was in good condition when recovered, but unfortunately due to aDNA sampling, the object's surface was damaged. However, thanks to pictures which were taken directly after recovery, a rounding of the bridge of the perforation could be detected; more precisely a thinning sinister, dexter, and slightly superior. This indicates that the fox tooth was not primarily perforated for the newborn or for the process of the burial, but that it had already been worn before. The thinning leads to the conclusion that it was sewn onto a base material with two stitches sinister and dexter of the

Fig. 23. Burial 1, Individual 2. 1 – Position of perforated fox tooth in throat area of Individual 2; 2 – *in situ* position of artefacts; 3 – reconstruction of the original position of the adornments. Photo by ÖAI, ÖAW; modified by V. Kaudela.

Obr. 23. *Pohřeb 1, jedinec 2. 1 – Umístění perforovaného liščího zubu v krční oblasti jedince 2; 2 – in situ poloha artefaktů; 3 – rekonstrukce originální polohy ozdob. Foto ÖAI, ÖAW; upravila V. Kaudela.*

Fig. 24. Detail of fox tooth with an unfinished perforation (ID 87752-67). Photo by V. Kaudela.

Obr. 24. *Detail liščího zubu s nedokončenou perforací (ID 87752-67). Foto V. Kaudela.*

perforation for some time. However, the position in which the tooth was found does not fit completely with the traces of use wear. The combination of the molluscs and the tooth, their position next to each other, and the fact that they were found in the subcranial area of the infant hint that they were threaded onto some kind of string and placed as a necklace. It is also possible that the tooth was worn for some time, double-stitched onto some base material, and later threaded on a string.

3.3.3 Production sequence

The faunal remains of the AH 4.11 and 4.4 revealed a minimum of nine individuals of *Vulpes vulpes* and *Vulpes lagopus*, and six individuals of *Canis* (Händel et al. 2015, 284). The teeth could have been taken from hunted animals or gathered from otherwise deceased ones. To produce adornments, incisors were seemingly preferred compared to canine teeth.

The perforation of the root of the tooth was mostly done in two steps: first, the root was thinned on both sides by scraping, which is visible in eleven of 13 teeth. This step prevents splintering on the opposite side of the perforation (Winiarska-Kabacinska 2017, 74). The second step, the perforation itself, was made on both sides of the root. In some teeth, it does not seem necessary to perform a bilateral perforation because they possess a compact root. However, the root of one incisor of a *Vulpes* and the two canine teeth of *Canis* are hollow and the best way to perforate them is from both sides. A special artefact is an incisor of a *Vulpes* (Fig. 24) from the AH 4.11 with an unfinished perforation. With this semifinished product, the scraping and thinning of the root till the point of break-through was done, but the finishing drilling which would have made the perforation rounder and smoother had not been accomplished any more. After the perforation, the teeth are ready to be sewn on or threaded and worn as adornments.

3.4 Perforated molluscs

In archaeological contexts, molluscs, like gastropods and bivalves, appear in a recent or fossil state. The first evidence of the collection of fossils is from the Acheulean over 100,000 years ago (Oakley 1971, 581). Subsequently, molluscs which had a living occurrence in the area and at the time they were collected are called 'recent' molluscs. The ones which were already in a fossilised state when collected are called 'fossil' molluscs. In further consequence, recent and fossil, gastropods and bivalves, are displayed together, but with consideration of their state and age. The seven molluscs of the site Krems-Wachtberg consist of five recent gastropods, one fossil gastropod and a fossil bivalve. The recent gastropods were identified as *Theodoxus* sp., the fossil bivalve as *Gigantopecten gigas planus*. The fossil gastropod was determined as a Tertiary snail (Determination by Andreas Kroh of the NHM Vienna, Austria).

3.4.1. Description and production sequence

Theodoxus sp. are freshwater molluscs which nowadays occur in Europe, West Asia, and North Africa (Sands et al. 2020, 25). They are smaller than 1 cm, hemispherical snails, with a lateral apex and a dominating last coil. There was a genus of *Theodoxus* which was already spread in the Danube area during the Pleistocene (Fehér et al. 2009, 99), which could suggest that the perforated snails were collected in the nearby rivers Danube or Krems.

Three of the five gastropods (Fig. 25: 2, 28: 3) were found in Burial 1 with Individual 2 in connection with the already described fox tooth (Fig. 23: 3). The other two derive from the moved horizon AH 4.11 (Fig. 25: 1) and the AH 4.4. The snails range between 4.9 mm and 5.9 mm in length and 3.7 mm and 4.1 mm in width. Three of five are complete and the others show damage, like a fracture around the perforation on the last coil. This fractured specimen was found in Burial 1 with Individual 2 and another, smaller *Theodoxus* is stuck in its aperture (Fig. 25: 3.1). Considering this additional snail, all in all, there are six *Theodoxus* that were found on the site, but for the sake of convenience the number will be referred to as 5. For the position of the perforation, the last and therefore biggest coil of the gastropod was chosen. Pressure was presumably exerted repeatedly on the outer wall from inside of the aperture, positioned against another object for counterpressure. Hence, the thin material was perforated, and the hole could also be enlarged and formed in a controlled manner. There is evidence in some of the snails of splintering on the edges of the perforation on the outer part of the coil, which supports this theory of the process. If pressure was put on the fragile snails from outside on

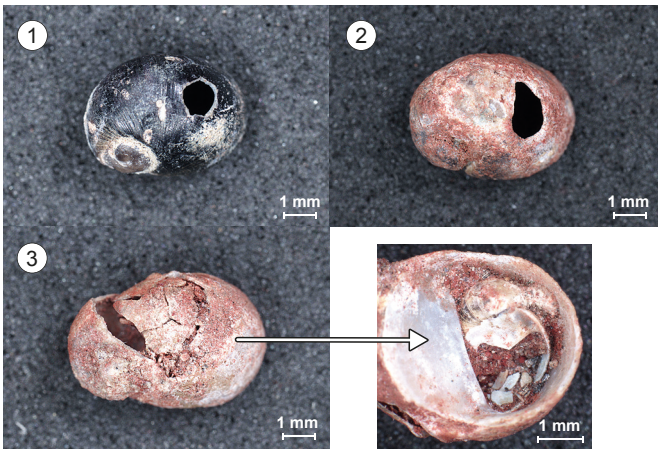


Fig. 25. Display of some specimens of *Theodoxus* sp. 1 – Specimen from AH 4.11 (ID 62793-19); 2, 3 – specimens from Burial 1, Individual 2 (ID 151561, ID 151564); 3.1 – detail of the additional, smaller snail in the aperture of the bigger one. Photo by V. Kaudela.

Obr. 25. *Ukázka vybraných nálezů Theodoxus sp. 1 – Nález z AH4.11 (ID 62793-19); 2, 3 – nálezy z pohřbu 1, jedinec 2 (ID 151561, ID 151564); 3.1 – detail menší schránky umístěné v otvoru větší schránky. Foto V. Kaudela.*

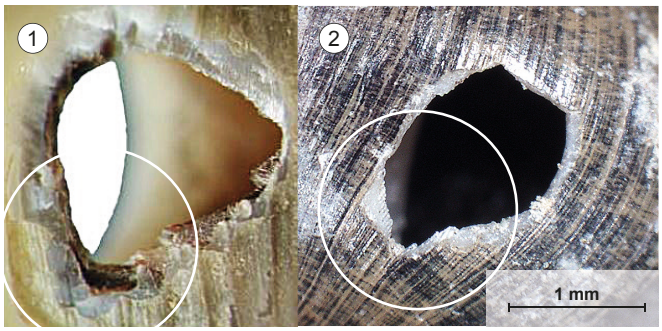


Fig. 26. Comparison of splintering on the outer surface of gastropods as a result of a perforation from the inside of the aperture. 1 – Recent experiment with *Nassarius kraussianus*; after D´Errico et al. 2005, 17; modified by V. Kaudela. 2 – *Theodoxus* sp. from the site Krems-Wachtberg (ID 63627-1). Photo by V. Kaudela.

Obr. 26. *Porovnání tříštění na vnějším povrchu schránek plžů jako výsledek perforace z vnitřní strany schránky. 1 – Experimentální perforace Nassarius kraussianus; podle D´Errico et al. 2005, 17; upravila V. Kaudela. 2 – Theodoxus sp. z lokality Krems-Wachtberg (ID 63627-1). Foto V. Kaudela.*

the last coil, not supporting it with counterpressure, they would have been crushed. Experiments on gastropods have backed this theory by showing characteristic splintering which appears when the perforation is executed from inside of the aperture (Fig. 26). Further, it was noticed that lithic tools are not the best to perform the perforation, but rather softer tools like bone awls (D´Errico et al. 2005, 13). In four of the five specimens, a slight polishing of the edges of the perforation was noticed (Fig. 25: 2). One piece shows slight scratches on its surface, which could be due to frequent rubbing against a base material and a sign of use wear.

The fossil bivalve was assigned to be one half of a *Gigantopecten gigas planus* (Fig. 27), which was found in horizon AH 4.11. It is possible that it was collected from outcrops of the Eggenburgium, which is known for its giant scallops such as *Gigantopecten holgeri* (Piller et al. 2007, 154), or in an outcrop of the Langhium in the Leithagebirge, which also carries specimen of the genus *Gigantopecten* (Wiedl et al. 2013, 234). The artefact is fragmented and possesses a 4.9 mm × 3.7 mm perforation under its left auricle (Fig. 27: 2; Mandic 2004, 139). The hole was presumably made by picking and/or drilling the material from both sides, but mostly from the posterior. The cone of the perforation is more pronounced on this side of the bivalve, additionally to the typical splintering on the edges of the perforation anterior, which was already described with the *Theodoxus* sp. While observing this artefact, the question arises as to why this nearly perfect symmetrical bivalve was not perforated superior medial but superior sinister, especially considering the uniformity, symmetry, and perfection of the 53 ivory beads. An explanation could be that there already was a weak point or even a natural hole under the left auricle, which was expanded. The bivalve has an incomplete length of 7.2 cm, a width of 7.1 cm, and weighs 11.8 grams. There are no traces of intentional forming or polishing, but there are signs of some polishing posterior inferior, which could have developed while rubbing against some base material for some time. Another trace of use-wear shows itself in the form of the polishing of the bridge of the perforation anterior superior. This leads to the conclusion that the mollusc was strung on thread and worn as a pendant or sewn onto a material with one stitch.

The second fossil mollusc is a tertiary gastropod (Fig. 28), which was recovered from the AH 4.11, and has a length of 8.4 mm and width of 6.3 mm. Although it is still complete, it is badly abraded and weathered, with traces of red ochre. Unlike the other molluscs, this snail was perforated by sawing a slot (Fig. 28: 1) with a lithic tool, which is 2.4 mm long and 0.6 mm wide. It was positioned on the last coil of the snail, parallel to the aperture. At about a 45° angle next to the slot, a few scratches were noticed, which could be a first attempt at a perforation. The producer could have changed their mind and placed the slot parallel to the edge of the aperture. Otherwise, no traces of manufacturing or use wear are visible due to the bad preservation of the snail's surface.

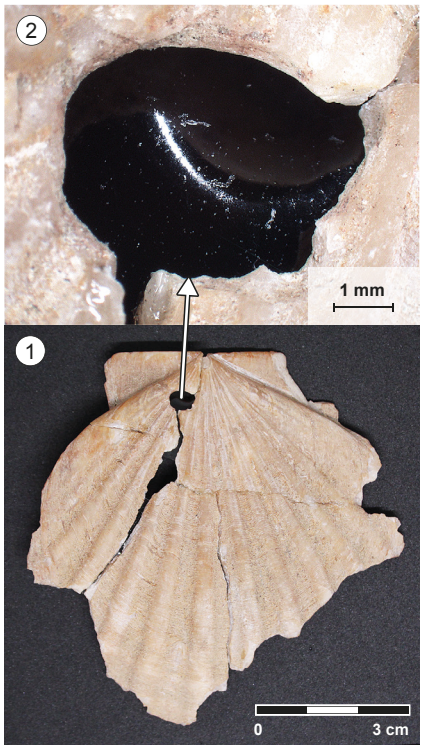


Fig. 27. *Gigantopecten gigas planus* (ID 87792). 1 – Detail of the perforation; 2 – anterior view. Photo by V. Kaudela.

Obr. 27. *Gigantopecten gigas planus (ID 87792). 1 – Detail perforace; 2 – přední pohled. Foto V. Kaudela.*

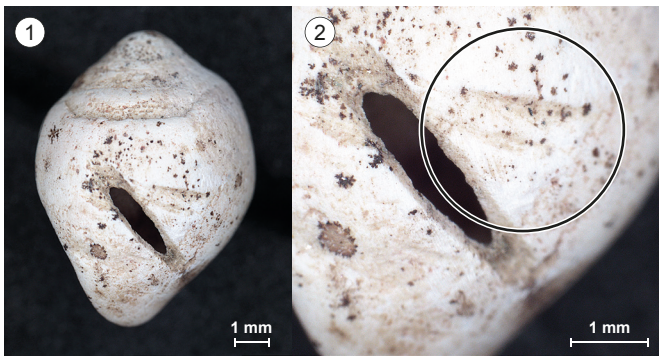


Fig. 28. Fossil tertiary gastropod (ID 179148). 1 – Anterior; 2 – detail of the slot perforation and scratches. Photo by V. Kaudela.

Obr. 28. *Fosilní terciérní plž (ID 179148). 1 – Přední pohled; 2 – detail štěrbinové perforace a škrábanců. Foto V. Kaudela.*

3.4.2 Position in Burial 1 and usage

Taking a step back to the three *Theodoxus* sp. which were found in Burial 1, with Individual 2: as already mentioned, there was one specimen with an additional, smaller snail stuck in its aperture. Unfortunately, it could not be spotted if the smaller gastropod was perforated or not, due to its position and a crust of sediment around it. It would be reasonable to assume that the smaller *Theodoxus* was perforated as well and slipped into

the larger one while they were threaded onto a thread, because it blocks the complete aperture of the larger one, making it impossible to thread it. Furthermore, for the sake of symmetry and perfectionism, the combination of the fox tooth flanked by two snails on each side in contrast to one on one side and two on the other, looks more aesthetically pleasing. As already described, the fox tooth showed signs of use-wear, as do two of the snails; they show a polishing of the bridge of the perforation, and one shows slight surface polishing. This leads to the conclusion that these objects were not produced for Individual 2 or for this burial, but that they had already been worn before they were positioned, presumably draped as a necklace.

3.5 Serpulidae

It was possible to study five of the eight Neogene serpulids in person, and fortunately, due to photos and the official database, some information could be gathered about the three presently unavailable ones as well (Simon et al. 2014, 11). All three specimens have a whitish to fresh ivory colour. Their ends seem rounded and all of them appear to even have a semi-circular recess, which presumably happens when polished by a thread frequently. One of them shows cut marks, according to the database. In further consequence, the five personally examined serpulids are described.

3.5.1 Description

The cross-section of the five serpulids from Wachtberg (Fig. 29) is round, whereas there are serpulids with oval and almost triangular cross-sections. The serpulids show a whitish to fresh ivory colour (Fig. 29: 1), except two, which have a dark grey colour caused by contact with fire (Fig. 29: 2). They range in length between 15.8 mm and 29.4 mm and a maximum width between 5.9 mm and 7.1 mm. The ends of these specimens show old fractures, but if these were intentionally done or if they were already collected in this state cannot be reconstructed. However, what can be stated is that four of five serpulids show a distinctive rounding of at least one of their ends, which looks like a semi-circled recess which was presumably caused by the abrasion of a thread (Vanhaeren, D´Errico 2003, 502) (Fig. 29: 1.1, 29: 2.1). Any intentional forming, smoothing, or polishing was not noticed, but two of five show traces of polishing from a base material, which is probably a sign of use wear (Fig. 29: 2.1). Three of the five show traces of haematite and one shows strong calcification in addition to the pigment.

4. Comparison to other sites

The adornments of the site Krems-Wachtberg (2005–2015) were compared to adornments from other Paleolithic sites to incorporate them into the already-known inventory of Central Europe. The selection of the sites is based on the presence of comparable adornments in their find inventory, which lie in manageable distance to the main site (Central Europe), and which were assigned from the Aurignacian to the Magdalenian (Upper Paleolithic). These sites were divided into categories based on the answers to the following questions (Fig. 30): the chronological and regional context – which sites predate and succeed Krems-Wachtberg and which of them also lie in the vicinity of the site? And the burial context – which sites show comparable human burials?

In the comparison, value was placed on similarities but also on significant differences between the adornments, their material, and other aspects. This should lead to a better understanding of the tradition of the manufacturing of the specific categories of adornments. The focus on the description of the sites lies in their comparable attributes and their adornment inventory, emphasising the ones which show similarities with the inventory of Krems-Wachtberg. Adornments from other categories were mainly disregarded. If there is no striking optical similarity between artefacts, no pictures are included.

All ages calibrated with the OxCal online tool (accessed 18.04.2024) applying the IntCal20 calibration curve.

4.1 Chronological and regional context

The sites which were chosen for the chronological and regional comparison range from the Aurignacian to the Magdalenian and some of them lie in the proximity, in a range between 250 m and 17 km, from the Krems-Wachtberg site. Below, the succession of the sites is based on their chronology.

Already in the Aurignacian, the well-known sites of the Swabian Jura (D), such as Geißenklösterle or Hohle Fels, show intense use of mammoth ivory in the production of adornments and other artefacts. The huge number of ivory artefacts such as finished beads and pendants, raw forms and half products helped in getting a basic idea of the production sequence of Paleolithic

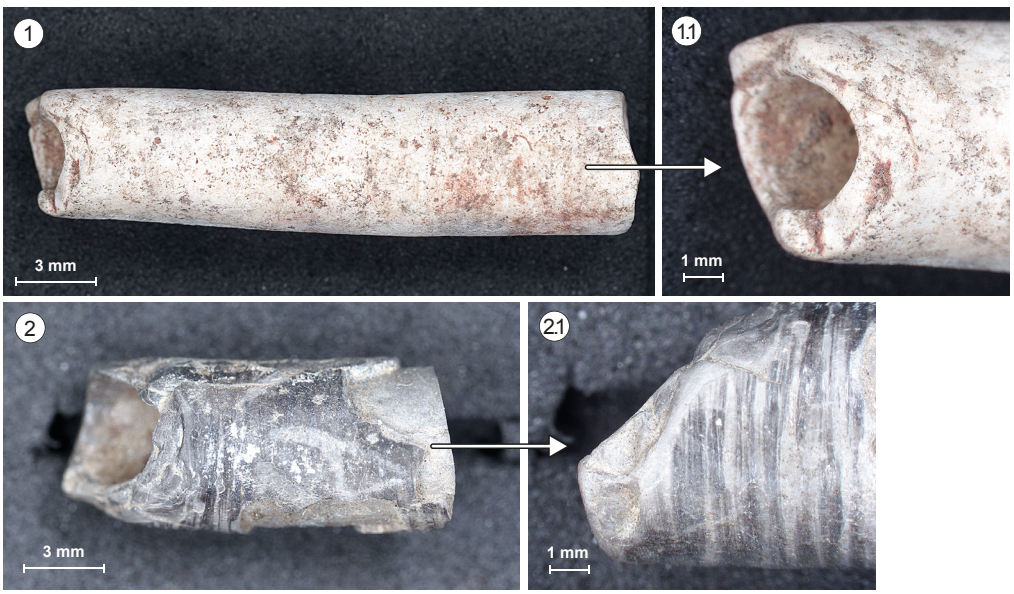


Fig. 29. Display of some Serpulidae from Krems-Wachtberg. 1 – ID 87753-108; 1.1 – detailed view of polishing of a thread; 2 – ID 110022; 2.1 – detail of the polishing of the thread. Photo by V. Kaudela.

Obr. 29. *Ukázka nálezů Serpulidae z lokality Krems-Wachtberg. 1 – ID 87753-108; 1.1 – detailní pohled na oleštění závitu; 2 – ID 110022; 2.1 – detailní pohled na oleštění závitu. Foto V. Kaudela.*

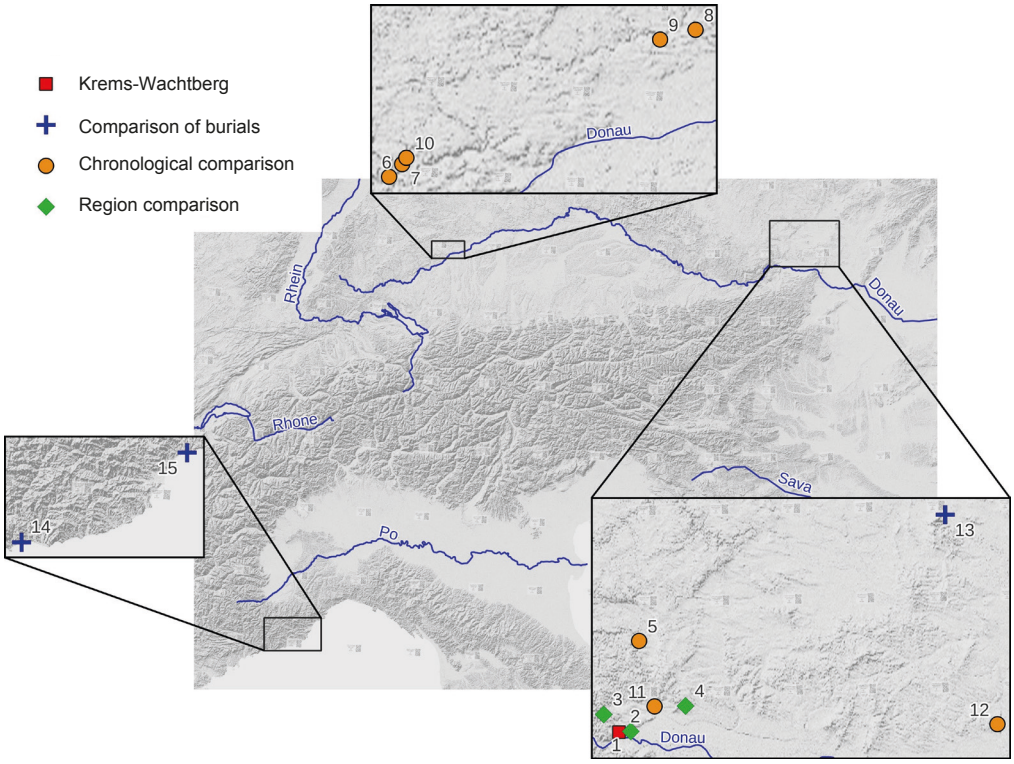


Fig. 30. Sites chosen for comparison with Krems-Wachtberg. 1 – Krems-Wachtberg (AUT); 2 – Krems-Hundssteig (AUT); 3 – Senftenberg (AUT); 4 – Gösing-Setzergraben (AUT); 5 – Kamegg-Ziegelei (AUT); 6 – Hohle Fels (D); 7 – Geißenklösterle (D); 8 – Vogelherdhöhle (D); 9 – Hohlenstein Stadel (D); 10 – Brillenhöhle (D); 11 – Kammern-Grubgraben (AUT); 12 – Grub/Kranawetberg; 13 – Dolní Věstonice and Pavlov (CZ); 14 – Balzi Rossi / Grimaldi caves (I); 15 – Arene Candide (I). Graphic by S. Frauenschuh; data sources: © OpenStreetMap contributors – CC BY-SA 2.0; European Environment Agency. EEA CC BY 2.5 DK; BY 2.5 DK.

Obr. 30. *Lokality vybrané pro srovnání s lokalitou Krems-Wachtberg. 1 – Krems-Wachtberg (AT); 2 – Krems-Hundssteig (AT); 3 – Senftenberg (AT); 4 – Gösing-Setzergraben (AT); 5 – Kamegg-Ziegelei (AT); 6 – Hohle Fels (DE); 7 – Geißenklösterle (DE); 8 – Vogelherdhöhle (DE); 9 – Hohlenstein Stadel (DE); 10 – Brillenhöhle (DE); 11 – Kammern-Grubgraben (AT); 12 – Grub/Kranawetberg (AT); 13 – Dolní Věstonice a Pavlov (CZ); 14 – jeskyně Balzi Rossi / Grimaldi (IT); 15 – Arene Candide (IT). Grafika S. Frauenschuh; zdroj dat: © OpenStreetMap contributors – CC BY-SA 2.0; European Environment Agency. EEA CC BY 2.5 DK; BY 2.5 DK.*

ivory beads and pendants. For the Gravettian, drop-shaped ivory beads/pendants, as well as perforated carnivore teeth, are deemed to be the most common forms of adornment (Conard 2003, 23–24; Einwögerer et al. 2008, 174). The ivory beads of the site Krems-Wachtberg, which were previously published as 'drop shaped ivory pendants', most resemble this bead/pendant category. Even if ivory production decreases in LGM to post LGM sites, the custom of perforating canine teeth and molluscs continues.

4.1.1 Aurignacian sites

The provision of ivory objects of the Aurignacian layers (II, III) from Geißenklösterle (D), which were dated between 47,400 and 31,900 cal BP (Conard, Bolus 2008, 890), seems meagre with 18 pieces, compared to the other sites of the Swabian Jura or even Krems-Wachtberg (Conard 2003, 36). The AH III provided two perforated pendants from ivory, which possess a similar shape to the 53 beads from Burial 1. They were described as a 'symmetric, oval pendant' (Fig. 31: 2.1) and as a pendant which possesses '...a cylindrical, slightly bulgy form' (Fig. 31: 2.2). It seems that both pendants have a thicker inferior and a thinner superior part, where the perforation was placed. Their length of about 1.1 cm also fits with the ivory beads from Krems-Wachtberg. Furthermore, two perforated fox teeth with a broken perforation (Wolf 2015a, 227) and one with an intact perforation were mentioned (Conard 2003, 34; Wolf 2019, 127).

During past excavations at the site Hohlenstein-Stadel (D), two ivory beads/pendants and six perforated fox canines were recovered (Conard 2003, 19; Wolf 2015a, 253). Unfortunately, the ivory objects cannot be compared with the beads from the Wachtberg regarding their shape. In later campaigns further perforated animal teeth, including one wolf and seven fox teeth, have been found in the heap of the previous excavation. As another perforated fox tooth was recovered from an intact Aurignacian horizon (Wolf 2015b, 98; 2019, 125), which lies between 42,200 and 35,300 cal BP (Conard, Bolus 2008, 892), it was assumed that the others derive from there as well (Wolf 2015b, 98; 2019, 125). Of the 15 perforated teeth, which are possibly from the Aurignacian layer except for the wolf tooth, two were described as premolars, two as canines and three as incisors, so there is no real visible pattern. All perforated fox teeth (except one canine) show the same process of perforation (Wolf 2019, 126–127). This was described as preparing the tooth's root with a notch which thinned it anterior and posterior, before the actual perforation (Kind 2019, 30). The holes themselves show different dimensions but the average diameter is 1 mm (Wolf 2019, 127). This procedure of thinning the root before the actual perforation is also known from the teeth of the site Krems-Wachtberg. The dimensions of the perforations, however, range between 0.8 and 2.9 mm. Nevertheless, the strong polishing and thinning of the bridges due to usage must be taken into consideration when comparing these numbers.

When a test trench was conducted at the next site, Senftenberg (AUT), which is a village 5-km distance from Krems as the crow flies, a tertiary snail was found. Due to its position in the grubbed humus horizon, it was not possible to assign it to the Aurignacian layer (Hinterwallner 2006, 138), which was dated between 42,200 and 37,600 cal BP (Einwögerer 2013, 84), but it likely derives from it. The turritella has a perforation in the form of a slot (Hinterwallner 2006, 137; Einwögerer 2013, 84), positioned seemingly parallel to the aperture on the unfortunately fractured last coil. Even though no specimen of turritella was found on the Wachtberg, the similarity is the tertiary gastropod with a slot as a perforation.

Like the site Krems-Wachtberg, the site of Hohle Fels (D) provides big chunks of mammoth tusk as small residues, such as fine shavings, as a sign of on-site production. The Aurignacian levels, which date between 41,400 and 40,000 cal BP (Conard, Bolus 2008, 890), provide a mass of over 200 finished and nearly completed beads (Conard 2003, 20; Wolf 2015a, 111; 2015b, 95). One ivory pendant, which was found in an Aurignacian layer (AH IIIa), shows quite a resemblance to the ones from Austria. This concerns a 'cone shaped pendant' (Fig. 31: 1) which is described as an unusual, special type for the Swabian Jura.

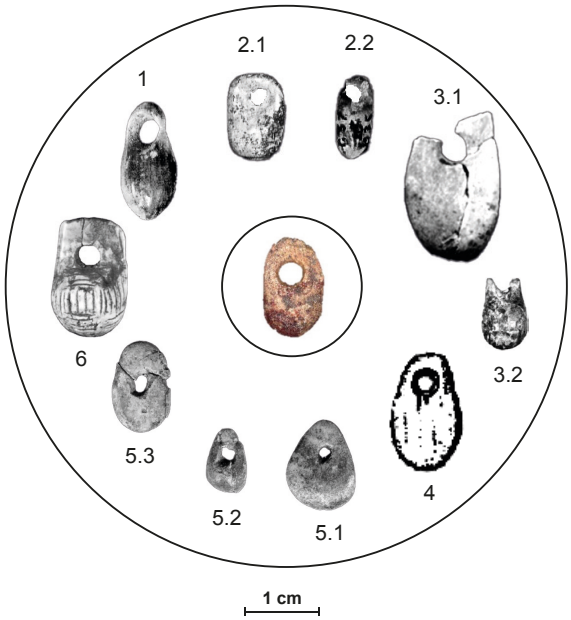


Fig. 31. Ivory beads from chosen sites in comparison with an ivory bead of the Burial 1 of Krems-Wachtberg, positioned in the centre. 1 – Cone shaped pendant from the site Hohle Fels (D); after Wolf 2015a, 137. 2.1 – Oval ivory bead from Geißenklösterle (D); after Wolf 2015a, 181. 2.2 – Cylindric ivory bead from Geißenklösterle (D); after Wolf 2015a, 18. 3.1 – Red deer canine pendant from Grub/Kranawetberg (D); after Antl, Bosch 2015, 238. 3.2 – Drop-shaped bead from Grub/Kranawetberg (D); after Antl, Bosch 2015, 240. 4 – Drop-shaped ivory bead from Hohle Fels (D); after Conard 2003, 41. 5.1–5.3 – Three of four ivory beads from the triple burial of Dolní Věstonice II (CZ); after Lázničková-Galetová 2021, 8. 6 – One of nine ivory beads of the site Barma Grande (I); after Malerba, Giacobini 2014, 313. Modified by V. Kaudela.

Obr. 31. *Mamutovinové korálky z vybraných lokalit ve srovnání s korálky z pohřbu 1, Krems-Wachtberg, umístěné ve středu. 1 – Kuželovitý přívěsek z lokality Hohle Fels (DE), podle Wolf 2015a, 137. 2.1 – Oválný mamutovinový korálek z lokality Geißenklösterle (DE); podle Wolf 2015a, 181. 2.2 – Cylindrický mamutovinový korálek z lokality Geißenklösterle (DE); podle Wolf 2015a, 18. 3.1 –Přívěsek z jeleního špičáku z lokality Grub/Kranawetberg (DE); podle Antl, Bosch 2015, 238. 3.2 – kapičkovitý korálek z lokality Grub/Kranawetberg (DE); podle Antl, Bosch 2015, 240. 4 – Kapičkovitý mamutovinový korálek z lokality Hohle Fels (DE); podle Conard 2003, 41. 5.1–5.3 – Tři ze čtyř mamutovinových korálků z trojhrobu z lokality Dolní Věstonice II (CZ); podle Lázničková-Galetová 2021, 8. 6 – Jeden z devíti mamutovinových korálků z lokality Barma Grande (IT); podle Malerba, Giacobini 2014, 313. Upravila V. Kaudela.*

The pendant has a broader inferior part, which is lightly tapered and resembles the form of a pinecone. The perforation sits in the thinned superior part of the pendant and shows a strong thinning or polishing of the bridge dexter. It is assumed that it was sewn onto a base material in this area (Wolf 2015a, 89). Two perforated teeth of the arctic fox are an additional similarity to the Wachtberg site (Conard 2003, 39).

The Krems-Hundssteig site (AUT), lies just 250 m from Krems-Wachtberg. During the quarrying, around 1900, several perforated molluscs were collected by J. Strobel, which unfortunately cannot be related to a specific archaeological horizon today (Neugebauer-Maresch 2008a, 13). The molluscs were identified as belonging to the genera *Cyclope neritea, Cyclonassa neritea, Vivipara, Melanopsis Vindobonensis, Nassa,* and *Lithoglyphus naticoides* (Neugebauer-Maresch 2008b, 41). The material of the old collection was dated between 44,600 and 36,300 cal BP and assigned to the Aurignacian (Neugebauer-Maresch 2008a, 13; Neugebauer-Maresch 2008c, 168). However, during the more recent excavations, Gravettian horizons dating between 33,900 and 31,100 cal BP were documented (Neugebauer-Maresch 2008c, 168).

4.1.2 Gravettian sites

The Gravettian layers of Geißenklösterle, which date between 39,300 and 27,700 cal BP (Conard, Bolus 2008, 889), provided about 66 drop-shaped ivory pendants with traces of use-wear and several half products (Conard 2003, 32, 34). The pendants present a similar look with their perforation superior medial and the rounding inferior. However, the shape overall seems more oval, the hole of the perforation narrower, and the bulge appears often on both sides (Conard 2003, 40). In the category of molluscs, a bivalve of the genus *Glycimeris* with an off-centre perforation was found, which resembles the peculiar off-centre perforation of the *Gigantopecten gigas planus*. On closer examination, it was detected that the perforation of the *Glycimeris* was presumably not made by humans. However, it was possibly used by humans to thread or sew the mollusc to a base material and wear it. Further, five perforated canines and one incisor of either the red or the polar fox, two polar fox canines, and the canine of a wolf in addition to the half product of a perforated fox canine were recovered (Conard 2003, 34).

From the Gravettian layers of Hohle Fels, several perforated canine teeth were recovered (Conard 2003, 24). Furthermore, 42 ivory pendants from the AH IIb, c, and cf were found, some of them described as 'drop-shaped' beads. One of these (Fig. 31: 4) shows a surprising similarity in shape with the 53 ivory beads. Unfortunately, there is no detailed description available, however, in an illustration, one can see a seemingly thinner anterior superior part and a slight bulge on the inferior part which is not as pronounced as in the Wachtberg beads. Additionally, two bivalve halves of the genus *Glycimeris* with rounded perforations were found (Conard 2003, 24). The molluscs derive from two layers which were dated between 35,300 and 30,800 cal BP (Conard, Bolus 2008, 890).

The next Gravettian site lies also in the proximity of Krems-Wachtberg and is the about 17 km from the Gösing-Setzergraben site (AUT). It showed four Upper Paleolithic horizons, where the most pronounced one, AH 1, was dated between 31,200 and 30,700 cal BP and assigned to the Pavlovian. Due to the circumstances of a rescue excavation, the adornments cannot be assigned to a distinctive horizon anymore, but it is likely that they originate from AH 1. It concerns three serpulids which were collected from the excavation heap (Buchinger 2020, 120). One of them shows residues of haematite and the other traces of contact with fire. Neither shows any recent fractures, they have a distinctive rounding on both of their ends, and were described as having a thinned section on one of their ends which can be interpreted as the abrasion of a thread (Verdianu, Kasemann 2019, 24–25). Gainfarn near Baden is assumed to be an outcrop for the collection of the fossils (Einwögerer 2000, 139).

The Gravettian layers of the site Grub/Kranawetberg (AUT), which lies about 90 km from Krems-Wachtberg, were dated between 29,900 and 28,200 cal BP (Antl 2013, 124). A respectable number of ivory beads and pendants, 265 pieces, were found in previous excavations (Antl, Bosch 2015, 238). Concerning the shape of some of them, a resemblance between them and the ones from Krems-Wachtberg can be observed. Especially two specimens with a broken perforation, which were described as a 'pendant shaped like a red deer canine' (Fig. 31: 3.1) and 'drop-shaped bead' (Fig.31: 3.2) (Antl-Weiser 1999, 26, 32; Antl-Weiser et al. 2010, 239; Antl, Bosch 2015, 238). The former shows a rounded frontside and a flat back, and it is nearly double

in length and width when compared to the ones from Burial 1. It was noticed that its backside was heavily smoothed, and that the perforation was done from both sides (Antl, Bosch 2015, 239). The drop-shaped bead is more similar in dimension, even if it is fragmented. It was previously compared to adornments from Geißenklösterle (D), Hohle Fels (D), Dolní Věstonice and Pavlov I – Northwest (CZ) (Antl-Weiser 1999, 32; Antl, Bosch 2015, 242). Another connection to the site Krems-Wachtberg are around 100 potential needle fragments from ivory. Thirty pieces show a pointed apex but none of the 100 fragments possesses a perforation (Antl, Bosch 2015, 237). Furthermore, this site offered perforated fossil molluscs (Antl-Weiser 1999, 25), where the perforation seems to be made by grinding the material until a hole forms. A snail shows the perforation in the form of a slot (Antl-Weiser et al. 2010, 240), which is known from the tertiary gastropod of Krems-Wachtberg, but the slot from the one from Grub/Kranawetberg does not seem to be positioned parallel to the aperture.

4.1.3 Last Glacial Maximum (LGM) to post-LGM

At the Kammern-Grubgraben site (AUT), which is situated just 10 km from Krems-Wachtberg, several adornments have been recovered from its Epigravettian horizon (Brandtner 1996, 128). The archaeological horizons date between 23,400 and 22,000 cal BP (Händel et al. 2021a, 151). This site stands out due to its richness in fossil artefacts. Already 700 pieces of dentalia, gastropods, bivalves, serpulids, belemnites, and shark teeth have been recovered, with the numbers rising with every year of excavation (Kunze 2020, 25–27). The majority of the fossils are dentalia, with over 550 specimens, but there is also a respectable number of at least 22 serpulids (Kunze 2020, 39; Händel et al. 2021a, 140). Further, over 70 pieces of perforated, predominantly tertiary molluscs of different genera were found (Händel et al. 2021a, 145). In 11 cases of the fossil molluscs, the perforation shows itself in the form of a slot (Kunze 2020, 40), which is also known from the one tertiary snail of the site Krems-Wachtberg. Additionally, the Kammern-Grubgraben site provides over 20 pieces of perforated and some unperforated carnivore teeth; canines of foxes and wolves occur, whereas the former predominate (Neugebauer-Maresch et al. 2016, 231). The rarity of mammoth remains on this site explains the lack of usage of the raw material of mammoth ivory to produce adornments.

The Kamegg Ziegelei site (AUT) provided radiocarbon ages of 17,500 and 16,400 cal BP (Händel et al. 2021a, 151) and lies in just 22 km from Krems-Wachtberg. Since campaigns in the 1930s, 252 gastropods of the genus *Theodoxus danubialis danubialis Pfeiffer* and some other recent and fossil molluscs, which do not show similarities to the ones from Wachtberg, have been recovered (Brandtner 1955, 4, 54). In 15 of 252 specimens, a round to oval, intact perforation was detected near the aperture (Simetsberger 1993, 101). In 76 further cases, the perforation and the aperture were broken, and 81 snails were also fractured in the area of the aperture (Simetsberger 1993, 102).

4.2 Burial context

The subsequent section aims to compare Burials 1 and 2 of the Krems-Wachtberg site to other Gravettian burials from Central Europe and assess similarities and differences. The focus lay on connecting elements such as adornments (which were prioritised), followed by the position of the buried (flexed position), coverage of the buried, and the use of pigment. As it had already been done in the regional and chronological comparisons, the adornment categories of ivory beads/pendants, pins (if available), perforated canine teeth, perforated molluscs, and serpulids were the main focus. As the importance lies in the kind of adornment and its position within the burial context, situations with isolated, scattered, or deposited skeletal elements were not included in the comparison. The two big clusters for comparison are the South Moravian (CZ) sites and the Balzi Rossi / Grimaldi caves (I). The first obvious and outstanding difference between these clusters concerns the kind of sites they are: the Balzi Rossi are cave sites, whereas the Moravian sites are open-air sites like Krems-Wachtberg. This observation shall just be mentioned but not given much attention, because this difference may only be relevant due to the actual state of research and the general preservation of Paleolithic sites in Central Europe.

As already mentioned above (2), the Krems-Wachtberg site was assigned to the Pavlovian. The archaeological material of the site shows a striking resemblance to the Pavlovian site cluster in South Moravia (Klíma 1991, 7; Einwögerer, Simon 2008, 40; Svoboda 2010, 8; Fewlass et al. 2019, 5). What is the most interesting for this study is the similarity in the adornment inventory of the site Krems-Wachtberg, Dolní Věstonice and Pavlov (Simon 2018, 52). A further, connecting link between the Dolní Věstonice and Krems-Wachtberg sites was shown by aDNA analysis of the human remains of both sites, which will be discussed in more detail in the next chapter (Fu et al. 2016, 202; Teschler-Nicola et al. 2020, 3).

4.2.1 Dolní Věstonice and Pavlov

The site cluster of Dolní Věstonice and Pavlov lies in the foothills of the Pavlov mountains in the south of the Czech Republic. The area lies about 100 km from the Krems-Wachtberg site. The occupation floors of the sites of Pavlov I–VI and Dolní Věstonice I-III provided a large number of ivory objects, such as beads and pins, perforated teeth, and molluscs (Tab. 1). The burials from these sites date between 31,500 and 29,500 cal BP (Pettitt 2011, 188, Tab. 6.2; Fewlass et al. 2019, 6) and were assigned to the Gravettian, to be more precise the Pavlovian (Klíma 1991, 7; Svoboda 2010, 8).

Burial DV III was found at the site of Dolní Věstonice I in 1949. The remains, which were identified as a female individual, were found in a flexed position, oriented north-west, in a shallow pit. Two mammoth scapulas were covering the burial and there was an intense use of red pigment, especially in the area of the head and torso. In the pelvis region, where the right hand was positioned as well, ten fox canines and some additional incisors were discovered (Svoboda 2006, 15–18). The significant resemblance to the burials from Krems-Wachtberg lies in the use of the pigment, the flexed position of the bodies, the scapula, and adornments in the form of teeth.

In 1986, the burial of three individuals, DV XIII–XV, of Dolní Věstonice II was discovered (Alt et al. 1996, 115; Svoboda 2006, 19). A shallow pit held the remains of two young adults and one adult (Alt et al. 1996, 116), lying stretched with the heads towards south (Klíma 1995, 97; Alt et al. 1996, 115). There was a strong concentration of red pigment in the cranial areas of the buried, which was interpreted as remains of a coating of the heads in a thick paste containing the pigment (Klíma 1995, 99).

In the area of the forehead of Individual DV XIII, 20 perforated fox teeth and two ivory beads were discovered in their original position, encrusted in the thick layer of red pigment. They were discovered situated in three slightly overlapping rows containing four, five and eleven teeth, which lay next to each other and were sorted by size (Svoboda 2006, 20). The perforations lay cranial, and the crowns of the teeth pointed towards the face, which indicates that they were either threaded onto

a thread or sewn onto a base material – for example, a piece of clothing such as a headband, hat, or hood. The three rows of teeth were flanked by one ivory bead each (Klíma 1995, 99). Two further ivory beads were discovered in combination with three perforated wolf canines in Individual DV XIV's forehead area. The four ivory objects were described as drop-shaped beads, which seem very similar; however, there are small differences (Fig. 31: 5.1–5.3). Three of the four show a kind of triangular or drop-shape (Fig. 31: 5.1, 5.2) and one seems to be rather oval (Fig. 31: 5.3). The triangular ones have the perforation situated in the upper part of the bead, whereas the oval one is quite central. Unfortunately, in three pieces the bridges are fragmented. One can see a resemblance between the four beads of this burial and the infant burial of the Krems-Wachtberg site, concerning their shape, the position of the perforation, and the hint of a slight bulge in the inferior part of the bead (Lázničková-Galetová 2021, 8). The third individual, DV XV, was found with four perforated fox teeth the area of the head (Svoboda 2006, 21). Further finds connected to the burial were lithics, formed loam and not perforated but partly burned tertiary snails of the genus *Melanopsis* (Klíma 1995, 100). There is a theory hypothesising that the bodies were covered with wood, which was lit and afterwards smothered by sediment (Klíma 1995, 104).

Another, interesting find was the burial of Individual DV XVI, of Dolní Věstonice I, which was situated near a small fire pit. The individual was determined to have been a 45–55-year-old male, who was laid in a shallow pit in a flexed position on his right side, orientation east-west. In the area of his left elbow, two perforated fox canines were discovered, in addition to another two in the pelvis area. A very intense use of red pigment in the region of the pelvis and the cranium was noticed (Svoboda 1988, 829; Klíma 1995, 104; Svoboda 2006, 24). The analysis of the aDNA from this individual and the comparison to the aDNA of the three Wachtberg infants showed an interesting result. A high coverage of alleles indicates a close relatedness between Individuals 1, 2, and 3 of Krems-Wachtberg and Individual DV XVI of Dolní Věstonice I (Fu et al. 2016, 202; Teschler-Nicola et al. 2020, 3).

This means that there is not only a connection in the burial rites but also a strong genetic connection between the sites.

In 1957, a burial was found at the site of Pavlov I. Individual P I was found in a flexed position and a badly preserved state. The upper part of the skeleton was covered by a mammoth scapula. Like with Burial 1, the scapula protected the skeleton partly from post-sedimentary processes (Klíma 1997, 36). According to the excavator, the usage of red pigment or adornments cannot be connected to the burial context (Svoboda 2006, 24).

4.2.2 Balzi Rossi / Grimaldi caves and Arene Candide (I)

The Balzi Rossi or the Grimaldi caves (I) consist of 15 abris and caves (Fedele 2017, 366) containing well-known Paleolithic sites and some burials. The site Arene Candide (I) lies about 100 km from the cave complex, on the shore of the Mediterranean Sea, which is why it was included in this chapter. Some attributes of the Gravettian burials from these sites are similar to the burials of Krems-Wachtberg. The sites/burials were dated between 32,100 and 26,000 cal BP (Pettitt 2011, 16, Tab. 6.2; Pinilla et al. 2016, 957; Riel-Salvatore et al. 2018, 339, 344; Onoratini et al. 2012, 149, 154).

The first to mention is Grotta del Caviglione, where the remains of a male individual in a flexed position were discovered (Pettitt 2011, 176). An intense use of haematite, especially in the area of the head, was documented in the burial context (Otte 2016, 55), as well as a wide range of adornments. Over 200 perforated molluscs of the genus *Nassa neritea* and 22 perforated red deer canines were found in a position which indicates that they were either sewn onto a type of head coverage or threaded into the hair of the individual. Furthermore, 41 perforated molluscs of the same kind were situated near the tibia (May 1962, 50). Other than the perforated molluscs, there are no other adornments which can be compared to the site Krems-Wachtberg. Similarities, however, were found in the flexed position, the use of red pigment, and the deposition of adornments in the burial itself.

The next site which was attended to is Barma Grande, where a triple burial with several adornments was discovered in 1892. The two subadults and the adult were found in a stretched position (Pettitt 2011, 180), covered in red pigment (Onoratini et al. 2012, 146, 154). In the area of the throat and head of the assumingly male adult (right side), perforated molluscs, fish vertebra, and perforated red deer canines were found (Pettitt 2011, 182; Onoratini et al. 2012, 148) in addition to nine ivory beads (Fig. 31: 6) (Malerba, Giacobini 2014, 311). They possess a flat part anterior superior, where the perforation is situated, and a bulgy part anterior inferior. The bulge however seems to be more prominent, the superior part is not as rounded, and they are a little bit larger than the beads from Krems-Wachtberg (Malerba, Giacobini 2014, 314). Further, they show intentional ornamentation in the form of longitudinal and transversal grooves (Malerba, Giacobini 2014, 315), which the ones from Austria lack. In previous publications, they have been described as an imitation of red deer canines (Onoratini et al. 2012, 148, 155). Antl-Weiser (1999) recognised that such imitations from bone or stone were widespread during the Upper Paleolithic (Antl-Weiser 1999, 33). White (1997) stated that the shape of the ivory beads was an intentional, deliberate imitation of those red deer canines (White 1997, 96). In sites where both find categories, red deer canines and ivory beads, appear, the interpretation of the bead imitating the canine sounds like a plausible possibility. Due to the fixation of the loamy sediment, the excavators were able to document the *in situ* position of the adornments, which were probably assembled as a kind of collar (Onoratini et al. 2012, 146, 154).

The Grotta dei Fanciulli provided a double burial of a flexed male and a female individual. It is assumed that the male was buried first, and the grave reopened later to place the female individual as well. This process of reopening the grave is also known for the double burial of Krems-Wachtberg. Several perforated molluscs were positioned with the buried, which are also a find category at Krems-Wachtberg (Pettitt 2011, 176).

On the next site, Baousso da Torre, the remains of three individuals were found (Villotte, Henry-Gambier 2010, 3). Two of them were found with several perforated molluscs from the Mediterranean Sea, which were positioned on various parts of the body (May 1962, 65, 67; Villotte, Henry-Gambier 2010, 4; Pettitt 2011, 176). Some of the gastropods show a perforation in the form of a slot which is also found on the tertiary gastropod of the Krems-Wachtberg site.

The last comparable site is situated, as already mentioned, in some distance from the Balzi Rossi cave complex. Caverna delle Arene Candide (I) is another cave site which was investigated intensely in the 1940s. Next to the remains of several individuals who were assigned to Epigravettian horizons, the skeleton of a young male in a stretched position was found, which is known as 'El Principe' (Pettitt 2011, 182; Riel-Salvatore et al. 2018, 337). In the head area, hundreds of perforated molluscs and red deer canines were discovered. Furthermore, pendants of mammoth ivory were mentioned, in addition to the intense use of red ochre (May 1962, 42; Pettitt 2011, 182; Pettitt et al. 2015, 15).

Site		Assigned to	Ivory beads	Ivory pins	Perf. teeth	Perf. molluscs	Serpulidae	Other similarities	Reference
Krems-Hundssteig (AUT)		Aurignacian				Sev.			Neugebauer-Maresch 2008a
Senftenberg (AUT)		Aurignacian				1			Hinterwallner 2006 Einwögerer 2013
Gösing-Setzergraben (AUT)		Aurignacian					2		Verdianu, Kasemann 2019
Hohle Fels (D)		Aurignacian	1		2				Conard 2003 Wolf 2015a
		Gravettian	1		10	2			Conard 2003
		Magdalenian				2			Kölbl, Conard 2003 Conard 2003
Geißenklösterle (D)		Aurignacian	2		4				Conard 2003 Wolf 2015a, 2019
		Gravettian	2		10	1			Conard 2003
Vogelherdhöhle (D)		Aurignacian	2						Wolf 2015a
Hohlenstein-Stadel (D)		Aurignacian			16				Conard 2003 Wolf 2015a, b, 2019
Grub/Kranawetberg (AUT)		Gravettian	2	Sev.		Sev.			Antl-Weiser et al. 2010 Antl 2013 Antl, Bosch 2015
Kamegg-Ziegelei (AUT)		Magdalenian				252			Simetsberger 1993 Brandtner 1955
Kammern-Grubgraben (AUT)		Epigravettian			> 20	> 70	22		Neugebauer-Maresch et al. 2016 Kunze 2020 Händel et al. 2021a
Brillenhöhle (D)		Magdalenian						Notched rod	Conard 2003
Dolní Věstonice I (CZ)	DV III	Gravettian			10			Scapula	Svoboda 2006
Dolní Věstonice II (CZ)	DV XIII, XIV, XV	Gravettian	4		27				Klíma 1995 Svoboda 2006 Lázničková-Galetová 2021
	DV XVI	Gravettian			4				Svoboda 2006 Klíma 1995
Pavlov I (CZ)		Gravettian		Sev.	185	385	104		Klíma 1994 Hladilová 2005 Nývltová Fišáková 2005
	P I	Gravettian						Scapula	Klíma 1997
Pavlov VI (CZ)		Gravettian		1	32				Hladilová 2011 Lázničková-Galetová 2011
Grotta del Caviglione (I)	Burial	Gravettian				> 240			May 1962
Barma Grande (I)	Burial II	Gravettian	9			Sev.			May 1962 Pettitt 2011 Onoratini et al. 2012 Malerba, Giacobini 2014
Grotta dei Fanciulli (I)	Burial	Gravettian				Sev.			May 1962 Pettitt 2011
Baousso da Torre (I)	Burial I	Gravettian				Sev.			Villotte, Henry-Gambier 2010 Pettitt 2011
	Burial II	Gravettian				Sev.			Villotte, Henry-Gambier 2010 Pettitt 2011

Tab. 1. Overview of all considered sites for the comparison with Krems-Wachtberg. Not all sites are mentioned in the text. Comparable adornments (only includes comparable ivory beads and canine teeth) and other comparable attributes are listed. 'Sev.' means several pieces, the exact number was not available.

Tab. 1. *Přehled všech zvažovaných lokalit pro porovnání s lokalitou Krems-Wachtberg. Ne všechny lokality jsou uvedeny v textu. Uvedeny jsou porovnatelné ozdoby (zahrnují pouze mamutovinové korálky a špičáky) a další porovnatelné atributy. „Sev." značí několik kusů, přesný počet nebyl dostupný.*

Unfortunately, no closer description or illustration of the ivory pendants could be found, but there is a connection between the use of perforated molluscs as adornments and the red pigment in the burial context.

5. Conclusion

The systematic examination of the 103 adornments of the site of Krems-Wachtberg (2005-2015) led to new insights into the production sequence, life cycle and importance of the pieces. These insights regard the production process, the use, and partly the importance of these objects. The inclusion of possible basic preforms like ivory rods, residues of production such as ivory shavings, and half products (animal teeth) helped to reconstruct the steps of the *chaîne opératoire*.

Due to the high number of ivory beads from the double infant burial, the most interesting observations were made in this find category. The analysis showed that the 53 beads are very similar but not identical, which is either due to different manufacturers or a different time of manufacture. There is evidence that several beads were already worn before they were positioned with Individual 1. Just a few beads look like they were either newly made, maybe in a hurry, or just not used before. Furthermore, the traces of use-wear indicate that the beads were probably sewn with two stitches onto a base material. On the other hand, the position of the beads in the burial, next to each other and slightly overlapping, suggests that they were threaded onto

a type of string when they were placed with Individual 1. Some of the ivory pins from the site show rounded apices, the result of repeated penetration of a base material, including the one from Burial 2. This pin was probably used to close a type of wrapping in which the body of Individual 3 was draped. However, the pin was not explicitly made for this purpose, but was already used before. In the find category of perforated teeth, a preference of fox over wolf, and incisors over other teeth can be noticed. The perforated fox tooth of Burial 1 was presumably threaded with three (four) perforated molluscs, assembled into a necklace for Individual 2. However, the tooth shows strong rounding of its natural edges and shows traces of use-wear sinister, dexter, and superior on the bridge of the perforation. This indicates that the tooth was sewn onto base material sinister and dexter of the perforation, and maybe also worn strung as a pendant. To conclude, the tooth and some of the threaded molluscs were not initially made for the purpose of depositing them with the infant, but they already had a life before that. As well as some of the *Theodoxus* sp., the bivalve of the genus *Gigantopecten gigas planus*, shows the polishing of a thread on the edges of the perforation, which likely derived from threading it and wearing the bivalve as a pendant. The tertiary gastropod showed no significant signs of use-wear, partly because of its poor preservation. The serpulids, which did not require a perforation due to their natural shape, show signs of rounding of their ends as a result of threading, or rather sewing them onto a base material.

Due to traces of the production process on the finished objects, like the unfinished perforation on a bead or the scratches next to the actual slot perforation on the tertiary mollusc, the behaviour patterns of the people who manufactured these adornments can be recognised. This gives us an intimate insight into the thought processes and lives of Paleolithic people.

The comparison of the adornments of the site of Krems-Wachtberg to other sites in a regional, chronological, and burial context, show that these find categories were also produced at other sites in other times. The material culture of Paleolithic sites shows us, that the people collected small objects such as molluscs, fossils, and animal teeth to use them, not for practical purposes, but seemingly for aesthetical ones. In general, the raw material which was available on or near the camp site was used to produce adornments. Ivory and carnivore teeth were either taken from hunted animals or collected alongside molluscs and fossils. Teeth or molluscs were chosen either based on aesthetic value, or on some other basis we are unable to comprehend today, and simply perforated. This can be observed at many of the compared sites (Tab. 1). More interesting results were provided by the comparison of the ivory beads. The production of their specific form and shape was deliberately chosen by the manufacturers. Similar beads, with an oval to oblong shape, their perforation superior, a slight bulge anterior inferior and a flat posterior side, also appear at other sites such as Hohle Fels (D), Geißenklösterle (D), Grub/Kranawetberg (AUT), Barma Grande (I), and Dolní Věstonice (CZ).

The detailed analysis aimed to collect as much data as possible, to provide the possibility to answer future research questions based on the collected data and micro photos, in order to minimize handling of the original objects. However, further non-destructive methods like µ-CT scanning, would provide an even better picture and more information about every single object, especially the partly sediment-incrusted ivory beads. This would lead into the right direction to gain even more knowledge about the production and the producers, as well as the use and the users of the adornments from the Gravettian site of Krems-Wachtberg.

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References

Alt, K. W., Pichler, S., Vach, W. 1996: Die Dreifachbestattung von Dolní Věstonice, Mähren/CR – Kollaterale versus affinale Verwandte. *Anthropologie* XXXIV(1–2), 115–122. Available also from: http://puvodni.mzm.cz/Anthropologie/downloads/articles/1996/Alt_1996_p115-122.pdf.

Antl, W. 2013: The inventories of archaeological horizons 4 and 3 and the loess section of Grub/Kranawetberg, a Gravettian site in Lower Austria. *E&G Quaternary Science Journal* 62(2), 120–126. DOI: 10.3285/eg.62.2.03. Available also from: https://egqsj.copernicus.org/articles/62/120/2013/egqsj-62-120-2013.pdf.

Antl, W., Bosch, M. 2015: The use of ivory at the Gravettian site Grub/Kranawetberg, Lower Austria. *Anthropologie* LIII(1–2), 233–244. Available also from: http://puvodni.mzm.cz/Anthropologie/article.php?ID=1837.

Antl-Weiser, W. 1999: Paläolithischer Schmuck von der Gravettienfundstelle Grub/Kranawetberg bei Stillfried, Niederösterreich. *Annalen des Naturhistorischen Museums in Wien, Serie A* 101, 23–41. Available also from: https://www.jstor.org/stable/41702136.

Antl-Weiser, W., Fladerer, F. A., Nigst, P. R., Verpoorte, A. 2010: Grub/Kranawetberg (Lower Austria) – Insights into a Gravettian Micro-Region in Eastern Austria. In: Chr. Neugebauer-Maresch, L. R. Owen (eds.): *New Aspects of the Central and Eastern European Upper Palaeolithic. Methods, Chronology, Technology and Subsistence. Symposium by the Prehistoric Commission of the Austrian Academy of Sciences Vienna, November 9–11, 2005*. Mitteilungen der Prähistorischen Kommission der Österreichischen Akademie der Wissenschaften 72. Wien: Verlag der Österreichischen Akademie der Wissenschaften, 231–243.

AQS: *Austrian Quaternary sites – AQS: Quaternary Archaeology Database project* [online]. Austrian Academy of Sciences, Austrian Archaeology Institute, ©2010 [Accessed 2024-04-28]. Available from: https://www.oeaw.ac.at/en/oeai/research/prehistory-wana-archaeology/quaternary-archaeology/austrian-quaternary-sites.

Bednarik, R. 2015: The Significance of the earliest Beads. *Advances in Anthropology* 5(2), 51–66. DOI: 10.4236/aa.2015.52006. Available also from: https://www.scirp.org/journal/paperinformation?paperid=54515.

Bolus, M. 2003: Zur Herstellung von Eiszeitschmuck. In: S. Kölbl, N. J. Conard (Hrsg.): *Eiszeitschmuck. Status und Schönheit.*

Urgeschichtliches Museum Blaubeuren, Museumsheft 6. Blaubeuren: Urgeschichtliches Museum Blaubeuren, 51–62.

Brandtner, F. 1955: *Kamegg, eine Freilandstation des späteren Paläolithikums in Niederösterreich*. Mitteilungen der Prähistorischen Kommission der Österreichischen Akademie der Wissenschaften 7. Wien: Rohrer.

Brandtner, F. 1996: Zur geostratigraphischen und kulturellen Zuordnung der Paläolithstation Grubgraben bei Kammern, NÖ. In: J. A. Svoboda (ed.): *Paleolithic in the Middle Danube Region*. Spisy Archeologického ústavu AV ČR Brno 5. Brno: Archeologický ústav AV ČR, Brno, 121–145. Available also from: https://www.arub.cz/wp-content/uploads/Paleolithic_in_the_Middle_Danube_Region_m-1.pdf.

Buchinger, N. 2020: *Das Silexinventar der gravettienzeitlichen Fundstelle Gösing-Setzergraben* [online]. Manuscript of the thesis. Universität Wien. Historisch-Kulturwissenschaftliche Fakultät. Stored in: Hochschulschriften-Repositorium der Universität Wien. [Accessed 2024-04-25]. Available from: https://utheses.univie.ac.at/detail/56918.

CALDT: Adornment. In: *Cambridge Advanced Learner's Dictionary Thesaurus* [online]. [Accessed 2023-12-28]. Available from: https://dictionary.cambridge.org/dictionary/english/adornment.

Cârciumaru, M., Nițu, E.-C., Obadă, T., Cîrstina, O., Covalenco, S., Lupu, F. L., Leu, M., Nocolae, A. 2019: Personal Ornaments in the Mid Upper Palaeolithic east of the Carpathians. *Paleo* 30(1), 80–97. DOI: 10.4000/paleo.4446. Available also from: https://journals.openedition.org/paleo/4446.

Conard, N. 2003: Eiszeitlicher Schmuck auf der Schwäbischen Alb. In: S. Kölbl, N. J. Conard (eds.): *Eiszeitschmuck. Status und Schönheit*. Urgeschichtliches Museum Blaubeuren, Museumsheft 6. Blaubeuren: Urgeschichtliches Museum Blaubeuren, 15–49.

Conard, N. J., Bolus, M. 2008: Radiocarbon dating the late Middle Paleolithic and the Aurignacian of the Swabian Jura. *Journal of Human Evolution* 55(5), 886–897. DOI: 10.1016/j.jhevol.2008.08.006. Available also from: https://www.sciencedirect.com/science/article/pii/S0047248408001644.

D´Errico, F., Henshilwood, C., Vanhaeren, M., van Niekerk, K. 2005: Nassarius kraussianus shell beads from Blombos Cave. Evidence for symbolic behaviour in the Middle Stone Age. *Journal of Human Evolution* 48(1), 3–24. DOI: 10.1016/j.jhevol.2004.09.002. Available also from: https://www.sciencedirect.com/science/article/pii/S0047248404001307.

D-maps: *D-maps.com. Free maps* [online]. ©2007–2024. [Accessed 2024-06-10]. Available from: https://www.d-maps.com/carte.php?num_car=33844&lang=en.

Einwögerer, T. 2000: *Die jungpaläolithische Station auf dem Wachtberg in Krems, NÖ. Eine Rekonstruktion und wissenschaftliche Darlegung der Grabung von J. Bayer aus dem Jahre 1930*. Mitteilungen der Prähistorischen Kommission der Österreichischen Akademie der Wissenschaften 34. Wien: Verlag der Österreichischen Akademie der Wissenschaften.

Einwögerer, T. 2013: Altsteinzeit. In: F. Pieler (Hrsg.): *Geschichte aus dem Boden. Archäologie im Waldviertel*. Schriftenreihe des Waldviertler Heimatbundes 54. Horn: Waldviertler Heimatbund, 73–118.

Einwögerer, T. 2017: Krems-Wachtberg. Ein Fundplatz des mittleren Jungpaläolithikums (Pavlovien) in Niederösterreich. In: F. Pieler, P. Trebsche (Hrsg.): *Beiträge zum Tag der Niederösterreichischen Landesarchäologie 2017. Festschrift für Ernst Lauermann*. Katalog des Niederösterreichischen Landesuseums, Neue Folge 541. Asparn/Zaya: Bösmüller Print Management GesmbH & Co. KG, 81–93.

Einwögerer, T., Friesinger, H., Händel, M., Neugebauer-Maresch, C., Simon, U., Teschler-Nicola, M. 2006: Upper Palaeolithic infant burials. *Nature* 444, 285. DOI: 10.1038/444285a. Available also from: https://www.nature.com/articles/444285a.

Einwögerer, T., Simon, U. 2008: Die Gravettienfundstelle Krems-Wachtberg. *Archäologie Österreichs* 19(1), 38–42.

Einwögerer, T., Simon, U., Händel, M. 2008: Neue Gravettienfunde vom Wachtberg in Krems an der Donau. *Das Waldviertel* 57(2), 171–175.

Fedele, F. G. 2017: Grimaldi Caves. In: A. S. Gilbert et al. (eds.): *Encyclopedia of Geoarchaeology*. Encyclopedia of Earth Sciences series. Dordrecht: Springer, 366–367. DOI: 10.1007/978-1-4020-4409-0_190.

Fehér, Z., Zettler, M. L., Bozsó, M., Szabó, K. 2009: An attempt to reveal the systematic relationship between Theodoxus prevostianus (C. Pfeiffer, 1828) and Theodoxus danubialis (C. Pfeiffer, 1828) (Mollusca, Gastropoda, Neritidae). *Mollusca* 27(2), 95–107.

Fewlass, H., Talamo, S., Kromer, B., Bard, E., Tuna, T., Fagault, Y., Sponheimer, M., Ryder, C., Hublin, J., Perri, A., Sázelová, S., Svoboda, J. A. 2019: Direct radiocarbon dates of mid Upper Palaeolithic human remains from Dolní Věstonice II and Pavlov I, Czech Republic. *Journal of Archaeological Science: Reports* 27, 1–8. DOI: 10.1016/j.jasrep.2019.102000. Available also from: https://www.sciencedirect.com/science/article/pii/S2352409X19303979.

Fladerer, F. 2001: The Krems-Wachtberg-campsite. Mammoth carcass utilization along the Danube 27,000 years ago. In: G. Cavarretta et al. (eds.): *The World of Elephants. Proceedings of the 1st International Congress, Rome, 16–20 Ottobre 2001*. Roma: Consiglio Nazionale delle Ricerche, 432–438. Available also from: https://1url.cz/t1ty2.

Fu, Q., Posth, C., Hajdinjak, M., Petr, M., Mallick, S., Fernandes, D., Furtwangler, A., Haak, W., Meyer, M., Mittnik, A., Nickel, B., Peltzer, A., Rohland, N., Slon, V., Talamo, S., Lazaridis, I., Lipson, M., Mathieson, I., Schiffels, S., Skoglund, P., Derevianko, A. P., Drozdov, N., Slavinsky, V., Tsybankov, A., Cremonesi, R. G., Mallegni, F., Gely, B., Vacca, E., Gonzalez Morales, M. R., Straus, L. G., Neugebauer-Maresch, C., Teschler-Nicola, M., Constantin, S., Teodora Moldovan, O., Benazzi, S., Peresani, M., Coppola, D., Lari, M., Ricci, S., Ronchitelli, A., Valentin, F., Thevenet, C., Wehrberger, K., Grigorescu, D., Rougier, H., Crevecoeur, I., Flas, D., Semal, P., Mannino, M. A., Cupillard, C., Bocherens, H., Conard, N. J., Harvati, K., Moiseyev, V., Drucker, D. G., Svoboda, J. A., Richards, M. P., Caramelli, D., Pinhasi, R., Kelso, J., Patterson, N., Krause, J., Paabo, S., Reich, D. 2016: The genetic history of Ice Age Europe. *Nature* 534, 200–215. DOI: 10.1038/nature17993. Available also from: https://www.nature.com/articles/nature17993.

Hahn, J., Scheer, A., Waibel, O. 1995: Gold der Eiszeit. Experimente zur Elfenbeinbearbeitung. In: A. Scheer (Hrsg.): *Eiszeitwerkstatt. Experimentelle Archäologie*. Museumsheft 2 Urgeschichtliches Museum Blaubeuren. Blaubeuren: Urgeschichtliches Museum, 29–37.

Händel, M. 2016: Excavation and 3D documentation of a Palaeolithic grave. Developing a methodology for the Krems-Wachtberg double burial. In: *Hugo Obermaier Society for Quaternary Research and Archaeology of the Stone Age. 58th Annual Meeting in Budapest, March 29th – April 2nd 2016*.Hugo Obermaier Society. Erlangen: Hugo Obermaier-Gesellschaft, 35–37. Available also from: https://obermaier-gesellschaft.de/2016_budapest/Tagungsband_2016.pdf.

Händel, M. 2021: Assessing the Gravettian occupation floor at Krems-Wachtberg. *L´anthropologie* 125(4), 1–17. DOI: 10.1016/j.anthro.2021.102921. Available also from: https://www.sciencedirect.com/science/article/pii/S0003552121001199.

Händel, M., Einwögerer, T., Simon, U. 2008: Krems-Wachtberg – A Gravettian settlement site in the Middle Danube Region. *Wissenschaftliche Mitteilungen Niederösterreichisches Landesmuseum* 19, 91–108. Available also from: https://www.zobodat.at/pdf/WM_19_0091-0108.pdf.

Händel, M., Einwögerer, T., Simon, U., Neugebauer-Maresch, C. 2014: Krems-Wachtberg excavations 2005-12: Main profiles, sampling, stratigraphy, and site formation. *Quaternary International* 351, 38–49. DOI: 10.1016/j.quaint.2013.02.024. Available also from: https://www.sciencedirect.com/science/article/pii/S104061821300102X.

Händel, M., Salcher-Jedrasiak, T. A., Fladerer, F. A. 2015: Putting Gravettian hunters´ behaviour under the microscope: The case of hearth 1 at Krems-Wachtberg. *Quaternary International* 359–360, 280–291. DOI: 10.1016/j.quaint.2014.06.015. Available also from: https://www.sciencedirect.com/science/article/pii/S1040618214003814.

Händel, M., Simon, U., Einwögerer, T., Neugebauer-Maresch, C. 2009: Loess deposits and the conservation of the archaeological record – The Krems-Wachtberg example. *Quaternary International* 198(1–2), 46–50. DOI: 10.1016/j.quaint.2008.07.005. Available also from: https://www.sciencedirect.com/science/article/pii/S1040618208002206.

Händel, M., Simon, U., Maier, A., Brandl, M., Groza-Săcaciu, S. M., Timar-Gabor, A., Einwögerer, T. 2021a: Kammern-Grubgraben revisited. First results from renewed investigations at a well-known LGM site in east Austria. *Quaternary International* 587–588, 137–157. DOI: 10.1016/j.anthro.2021.102921. Available also from: https://www.sciencedirect.com/science/article/pii/S1040618220303244.

Händel, M., Thomas, R., Sprafke, T., Schulte, P., Brandl, M., Simon, U., Einwögerer, T. 2021b: Using archaeological data and sediment parameters to review the formation of the Gravettian layers at Krems-Wachtberg. *Journal of Quaternary Science* 36(8), 1397–1413. DOI: 10.1002/jqs.3293. Available also from: https://onlinelibrary.wiley.com/doi/abs/10.1002/jqs.3293.

Heckel, C. E., Wolf, S. 2014: Ivory debitage by fracture in the Aurignacian. Experimental and archaeological examples. *Journal of Archaeological Science* 42, 1–14. DOI: 10.1016/j.jas.2013.10.021. Available also from: https://www.sciencedirect.com/science/article/pii/S0305440313003683.

Hein, W. 2008: Elfenbein und Feuerstein - Zur Herstellung einer Replik des Pferdchens vom Vogelherd mit authentischen Werkzeugen. In: L. Steguweit (Hrsg.): *Menschen der Eiszeit. Jäger, Handwerker, Künstler. Begleitband zur Ausstellung des Instituts für Ur- und Frühgeschichte der Friedrich-Alexander Universität Erlangen-Nürnberg und des Stadtmuseums Erlangen, 17. Februar - 20. April 2008*. Erlangen: Praehistorika-Verlag, 55–59.

Hein, W. 2011: With flintstone and ivory – Manufacturing the Horse Figurine from the Vogelherd Cave with Authentic Tools. In: A. Banerjee, C. Eckmann (Hrsg): *Elfenbien und Archäologie. INCENTIVS-Tagungensbeträge 2004–2007 = Ivory and Archaeology. Proceedings of INCENTIVS-meetings 2004–2007*. Mainz: Verlag des Römisch-Germanischen Zentralmuseums Mainz, 43–46.

Hein, W. 2022: Recreating the palaeolithic lion man statuette from the Swabian Alb. Experimenting with mammoth ivory. In: M. Mărgărit, A. Boroneant (eds.): *Recreating Artefacts and ancient skills. From experiment to interpretation*. Târgoviște: Cetatea de Scaun, 33–41.

Hinterwallner, M. A. 2006: *Die Aurignacien-Fundstelle Senftenberg, NÖ Auswertung des Fundmaterials der Grabungen 1949 und 1952*. Universität Wien. Stored in: Hochschulschriften-Repositorium der Universität Wien.

Hladilová, Š. 2005: Tertiary fossils, especially molluscs. In: J. A. Svoboda (ed.): *Pavlov I – Southeast. A Window into the Gravettian Lifestyles*. The Dolní Věstonice Studies 14. Brno: Academy of Sciences of the Czech Republic, Institute of Archaeology at Brno, 374–390.

Hladilová, Š. 2011: Tertiary and Quaternary molluscs from Pavlov VI. In: J. A. Svoboda (ed.): *Pavlov Excavations 2007–2011*. The Dolní Věstonice Studies 18. Brno: Academy of Sciences of the Czech Republic, Institute of Archaeology at Brno, 61–75.

Ippolitov, A. P., Vinn, O., Kupriyanova, E. K., Jäger, M. 2014: Written in stone. History of serpulid polychaetes through time. *Memoris of Museum Victoria* 71, 123–159. DOI: 10.24199/j.mmv.2014.71.12. Available also from: https://1url.cz/N1zah.

Jäger, M. 2011: Sabellidae, Serpulidae and Spirorbinae (Polychaeta sedentaria) from the Barremian (Lower Cretaceous) of the Serre de Bleyton (Drôme, SE France). *Annalen des Naturhistorischen Museums Wien, Serie A* 113, 675–733. Available also from: https://www.zobodat.at/pdf/ANNA_113A_0675-0733.pdf.

Kind, C. J. 2019: Die Ausgrabungen 1935 bis 1939 und 1956 bis 1961 durch Robert Wetzel. In: C. J. Kind (Hrsg.): *Löwenmensch und Mehr. Die Ausgrabungen 2008–2013 in den altsteinzeitlichen Schichten der Stadel-Höhlen im Hohlenstein (Lonetal), Gemeinde Asselfingen, Alb-Donau-Kreis*. Forschungen und Berichte zur Archäologie in Baden-Württemberg 15. Wiesbaden: Dr. Ludwig Reichert Verlag, 30. DOI: 10.29091/9783954907045.

Klíma, B. 1991: *Die jungpaläolithischen Mammutjäger-Siedlungen Dolní Věstonice und Pavlov in Südmähren. Zur Ausstellung "Mensch und Mammut" im Museum im alten Zeughaus*. Archäologie und Museum 23. Liestal: Amt für Museen und Archäologie des Kantons Beselland.

Klíma, B. 1994: The bone industry, decorative objects and art – Die Knochenindustrie, Zier- und Kunstgegenstände. In: J. A. Svoboda (ed.): *Pavlov I. Excavations 1952-1953*. ERAUL 66, The Dolní Věstonice Studies 2. Liège: Université de Liège, 95–160.

Klíma, B. 1995: *Dolní Věstonice II. Ein Mammutjägerplatz und seine Bestattungen*. ERAUL 73, The Dolní Věstonice Studies 3. Liège: Université de Liège.

Klíma, B. 1997: Excavation History, Stratigraphy and Context – Grabungsgeschichte, Stratigraphie und Fundumstände, In: J. A. Svoboda (ed.): *Pavlov I – Northwest. The Upper Palaeolithic burial and its settlement context*. The Dolní Věstonice Studies 4. Brno: Academy of Sciences of the Czech Republic, Institute of Archaeology in Brno, 13–52.

Krammer, M. 2008: Naturräumliche Rahmenbedienungen. In: C. Neugebauer-Maresch (Hrsg.): *Krems-Hundssteig – Mammutjägerlager der Eiszeit. Ein Nutzungsareal paläolitischer Jäger- und Sammler(innen) vor 41.000–27.000 Jahren*. Mitteilungen der Prähistorischen Kommission 67. Wien: Verlag der Österreichischen Akademie der Wissenschaften, 17–27.

Kölbl, S., Conard, N. J. 2003: *Eiszeitschmuck. Status und Schönheit*. Urgeschichtliches Museum Blaubeuren, Museumsheft 6. Blaubeuren: Urgeschichtliches Museum.

Kunze, M. 2020: *Eine erste Auswertung des fossilen Schmuckmaterials der Fundstelle Kammern-Grubgraben der Grabungen 1985 – 1994*. Manuscript of the thesis. Universität Wien. Stored in: Hochschulschriften-Repositorium der Universität Wien.

Lázničková-Galetová, M. 2011: Analysis of personal ornaments. In: J. A. Svoboda (ed.): *Pavlov Excavations 2007–2011*. The Dolní Věstonice Studies 18. Brno: Academy of Sciences of the Czech Republic, Institute of Archaeology at Brno, 245–249.

Lázničková-Galetová, M. 2021: Gravettian ivory ornaments in Central Europe, Moravia (Czech Republic). *L´anthropologie* 125(2), 1–15. DOI: 10.1016/j.anthro.2021.102870. Available also from. https://www.sciencedirect.com/science/article/pii/S0003552121000388.

Malerba, G., Giacobini, G. 2014: Les objets en ivoire des sépultures gravettiennes de la Barma Grande de Grimaldi (Ligurie, Italie). *Étude descriptive et technologique. L´anthropologie* 118(3), 309–327. DOI: 10.1016/j.anthro.2013.10.005. Available also from: https://www.sciencedirect.com/science/article/pii/S0003552114000533.

Mandic, A. 2004: Pectinid bivalves from the Grund formation (Lower Badenian, Middle Miocene, Alpine-Carpathian Foredeep) – Taxonomic revision and stratigraphic significance. *Geologica Carpathica* 55(2), 129–146.

May, A. F. 1962: *Der Schmuck aus jungpaläolithischen Bestattungen in Frankreich und Ligurien*. Bern: Fritz Marti.

Neugebauer-Maresch, C. 2008a: Einleitung. In: C. Neugebauer-Maresch (Hrsg.): *Krems-Hundssteig – Mammutjägerlager der Eiszeit. Ein Nutzungsareal paläolitischer Jäger- und Sammler(innen) vor 41.000–27.000 Jahren*. Mitteilungen der Prähistorischen Kommission 67. Wien: Verlag der Österreichischen Akademie der Wissenschaften, 13–15.

Neugebauer-Maresch, C. 2008b: Der Wachtberg in Krems an der Donau. In: C. Neugebauer-Maresch (Hrsg.): *Krems-Hundssteig – Mammutjägerlager der Eiszeit. Ein Nutzungsareal paläolitischer Jäger- und Sammler(innen) vor 41.000–27.000 Jahren*. Mitteilungen der Prähistorischen Kommission 67. Wien: Verlag der Österreichischen Akademie der Wissenschaften, 28–54.

Neugebauer-Maresch, C. 2008c: Absolute Datierung. In: C. Neugebauer-Maresch (Hrsg.): *Krems-Hundssteig – Mammutjägerlager der Eiszeit. Ein Nutzungsareal paläolitischer Jäger- und Sammler(innen) vor 41.000–27.000 Jahren*. Mitteilungen der Prähistorischen Kommission 67. Wien: Verlag der Österreichischen Akademie der Wissenschaften, 168–176.

Neugebauer-Maresch, C., Einwögerer, T., Richter, J., Maier, A., Hussain, S. T. 2016: Kammern-Grubgraben. Neue Erkenntnisse zu den Grabungen 1985-1994. *Archaeologia Austriaca* 100, 225–254. DOI: 10.1553/archaeologia100s225. Available also from: https://www.austriaca.at/?arp=0x00349823.

Neugebauer-Maresch, C., Hammer, V. M. F., Einwögerer, T., Händel, M., Simon, U. 2013: Die gravettienzeitlichen Rötelgräber und die Farbstoffe des Fundplatzes Krems-Wachtberg/Niederösterreich. In: H. Meller et al. (Hrsg.): *Rot – Die Archäologie bekennt Farbe. 5. Mitteldeutscher Archäologentag vom 4. bis 6. Oktober 2012 in Halle (Saale)*. Tagungen des Landesmuseums für Vorgeschichte Halle 10. Halle (Saale): Landesamt für Denkmalpflege und Archäologie Sachsen-Anhalt, 135–141.

Neugebauer-Maresch, C., Teschler-Nicola, M., Einwögerer, T., Händel, M., Simon, U. 2023: Verwandtschaft im östlichen Gravettien am Beispiel von Krems-Wachtberg. In: H. Meller et al. (Hrsg.): *Kinship, Sex, and Biological Relatedness. The contribution of archaeogenetics to the unterstanding of social and biological relations. 15. Mitteldeutscher Archäologentag vom 6. bis 8. Oktober 2022 in Halle (Saale)*. Tagungen des Landesmuseums für Vorgeschichte Halle 28. Halle (Saale): Landesamt für Denkmalpflege und Archäologie Sachsen-Anhalt, 113–123. DOI: 10.11588/propylaeum.1280.c18001. Available also from: https://books.ub.uni-heidelberg.de/propylaeum/catalog/book/1280/chapter/18001.

Nývltová Fišáková, M. 2005: Animal bones selected for tools and decorations. In: J. A. Svoboda (ed.): *Pavlov I – Southeast. A Window into the Gravettian Lifestyles*. The Dolní Věstonice Studies 14. Brno: Academy of Sciences of the Czech Republic, Institute of Archaeology at Brno, 247–251.

Oakley, K. P. 1971: Fossils collected by the earlier palaeolithic men. In: A. Varagnac (ed.): *Mélanges de Préhistoire, d'archéo civilisation et d'ethnologie*. Paris: Sevpen, 581–584.

Onoratini, G., Arellano, A., del Lucchese, A., Elie Moullé, Serre, P. F. 2012: The Barma Brande cave (Grimaldi, Vintimiglia, Italy). From Neandertal, hunter of "Elephas antiquus", to Sapiens with ornaments of mammoth ivory. *Quaternary International* 225, 141–157. DOI: 10.1016/j.quaint.2011.05.015. Available also from: https://www.sciencedirect.com/science/article/pii/S1040618211002886.

Otte, M. 2016: The Caviglione (Ventimiglia, Imperia). The matrix in the cave. *Incontri Annuali di Preistoria e Protostoria* 1, 55–56.

Pettitt, P. 2011: *The Palaeolithic Origins of Human Burial*. London, New York: Routledge. DOI: 10.4324/9780203813300.

Pettitt, P., Richards, M., Maggi, R., Formicola, V. 2015: The Gravettien burial known as the prince ("Il Principe"). New evidence for his age and diet. *Antiquity* 77(295), 15–19. DOI: 10.1017/s0003598x00061305. Available also from: https://1url.cz/X1KYq.

Piller, W. E. Harzhauser, M., Mandic, O. 2007: Miocene Central Paratethys stratigraphy. Current status and future directions. *Stratigraphy* 4(2–3), 151–168. DOI: 10.29041/strat.04.2.09.

Pinilla, B., Dennison, J., Perez-Perez, A., Puech, B., Puech, P.-F., Garrigue, N. 2016: Usure dentarie et mode masticatoire de „la Dame du Cavillon". Variabilité de la nourriture des hommes modernes du dernier maximum glaciaire. In: H. Lumley (ed.): *La grotte du Cavillon sous la falaise des Baousse Rousse Grimaldi, Vintimille, Italie*. Paris: CNRS Éditions, 949–967.

Riel-Salvatore, J., Gravel-Miguel, C., Maggi, R., Martino, G., Rossi, S., Sparacello, V. S. 2018: New Insights into the Paleolithic Chronology and Funerary Ritual of Caverna delle Arene Candide. In: V. Borgia, E., Cristiani (eds.): *Palaeolithic Italy. Advanced Studies on Early Human Adaptations in the Apennine Peninsula*. Leiden: Sidestone Press, 335–356.

Sands, A. F., Glöer, P., Gürlek, M. F., Albrecht, C., Neubauer, T. A. 2020: *A revision of the extant species of Theodoxus (Gastropoda, Neritidae) in Asia, with the description of three new species*. Zoosystematics and Evolution. 96(1), 25–66. DOI: 10.3897/zse.96.48312. Available also from: https://zse.pensoft.net/article/48312/.

Sauer, G. 1995: Schmuck der Jungpaläolithischen JägerInnen. In: A. Scheer (Hrsg.): *Eiszeitwerkstatt. Experimentelle Archäologie*. Urgeschichtliches Museum Blaubeuren, Museumsheft 2. Blaubeuren: Urgeschichtliches Museum Blabeuren, 40–46.

Scheer, A. 1995: Von der Rohaut bis zur Kleidung In: A. Scheer (Hrsg.): *Eiszeitwerkstatt. Experimentelle Archäologie*. Urgeschichtliches Museum Blaubeuren, Museumsheft 2. Blaubeuren: Urgeschichtliches Museum Blabeuren, 47–67.

Schmid, E. 1972: *Atlas of Animal Bones. For Prehistorians, Archaeologists and Quaternary Geologists*. New York: Elsevier Publishing Company. DOI: 10.1126/science.178.4058.297-a.

Simetsberger, B. 1993: *Die fossilen Mollusken Reste aus jungpaläolithischen und neolithischen Fundstellen in Niederösterreich und Burgenland, Österreich*. Manuscript of the thesis. Universität Wien. Stored in: Hochschulschriften-Repositorium der Universität Wien.

Simon, U. 2018: Gravettian ivory beads at Krems-Wachtberg (Austria). In: A. Maier (Hrsg.): *Neanderthal behaviour and ecology in the Mediterranean area. April 3 – April 7, 2018 in Tarragona. 60th Annual Meeting in Tarragona, Hugo Obermaier Society*. Erlangen: Hugo Obermaier-Gesellschaft, 52–53. Available also from: https://www.obermaier-gesellschaft.de/2018_tarragona/conference_booklet_2018.pdf.

Simon, U., Einwögerer, T., Händel, M., Neugebauer-Maresch, C. 2013: Die neuen Ausgrabungen an der Gravettienstation Krems-Wachtberg in Niederösterreich. In: L. Steguweit (Hrsg.): *Tagungsbeiträge der 55. Jahrestagung der Hugo Obermaier-Gesellschaft in Wien, 02.-06. April 2013*. Erlangen: Hugo Obermaier-Gesellschaft, 75–85.

Simon, U., Händel, M., Einwögerer, T., Neugebauer-Maresch, C. 2014: The archaeological record of the Gravettian open air site Krems-Wachtberg. *Quaternary International* 351, 5–13. DOI: 10.1016/j.quaint.2013.08.009. Available also from: https://www.sciencedirect.com/science/article/pii/S1040618213006137.

Svoboda, J. A. 1988: A new male burial from Dolní Věstonice. *Journal of Human Evolution* 16(7–8), 827–830. DOI: 10.1016/0047-2484(87)90026-1. Available also from: https://www.sciencedirect.com/science/article/pii/0047248487900261.

Svoboda, J. A. 2006: The Burials. Ritual and Taphonomy. In: E. Trinkaus, J. A. Svoboda (eds.): *Early Modern Human Evolution in Central Europe. The People of Dolní Věstonice and Pavlov*. The Dolní Věstonice Studies 12. Oxford: Oxford University Press, 15–26.

Svoboda, J. A. 2007: The Gravettian on the Middle Danube. *Paleo*, 2007, 1–18. DOI: 10.4000/paleo.607. Available also from: https://journals.openedition.org/paleo/607.

Svoboda, J. A. 2010: *Dolní Věstonice – Pavlov. Místo: jižní Morava, čas: 30 000 let*. Mikulov: Regionální muzeum Mikulov.

Teschler-Nicola, M., Fernandes, D., Händel, M., Einwögerer, T., Simon, U., Neugebauer-Maresch, C., Tangl, S., Heimel, P., Dobsak, T., Retzmann, A., Prohaska, T., Irrgeher, J., Kennett, D. J., Olalde, I., Reich, D., Pinhasi, R. 2020: Ancient DNA reveals monozygotic newborn twins from the Upper Palaeolithic. *Communications Biology* 3, 1–11. DOI: 10.1038/s42003-020-01372-8. Available also from: https://www.nature.com/articles/s42003-020-01372-8.

Thomas, R., Ziehaus, J. 2014: Spatial and chronological patterns of the lithics of hearth 1 at the Gravettian site Krems-Wachtberg. *Quaternary International* 351, 134–145. DOI: 10.1016/j.quaint.2011.10.031. Available also from: https://www.sciencedirect.com/science/article/pii/S1040618211006045.

Tiley-Nel, S. L., Antonites, A. R. 2015: *Archaeological worked bone and ivory. A guide to best practice in preservation, research and curation*. Pretoria: University of Pretoria.

Vanhaeren, M., D´Errico, F. 2003: Childhood in the Epi-Palaeolithic. What do personal ornaments associated with burials tell us? In: L. Larsson et al. (eds.): *Mesolithic on the Move. Papers presented at the Sixth International Conference on the Mesolithic in Europe, Stockholm 2000.* Oxford: Oxbow, 494–505.

Verdianu, D., Kasemann, S. 2019: *Ausgewähltes Fundinventar der jungpaläolithischen Fundstelle Gösing-Setzergraben aus der Bergung 2014*. Manuscript of the thesis. Universität Wien. Stored in: Hochschulschriften-Repositorium der Universität Wien.

Vercoutère, C., Wolf, S. 2018: Gravettian tear-drop-shaped beads. *L´anthropologie* 122(3), 385–401. DOI: 10.1016/j.anthro.2017.10.002. Available also from: https://www.sciencedirect.com/science/article/pii/S0003552117300559.

Villotte, S., Henry-Gambier, D. 2010: The Rediscovery of Two Upper Palaeolithic Skeletons From Baousso da Torre Cave (Liguria-Italy). *American Journal of physical Anthropology* 141(1), 3–6. DOI: 10.1002/ajpa.21164. Available also from: https://onlinelibrary.wiley.com/doi/10.1002/ajpa.21164.

Walter, R. 2002: Magdalénienzeitliche Knochennadeln aus Baden-Württemberg. Archäologischer Befund, Experiment und Museumspräsentation. In: M. Fansa (Hrsg.): *Experimentelle Archäologie. Bilanz 2001.* Archäologische Mitteilungen aus Nordwestdeutschland. Beiheft 38. Oldenburg: Isensee Verlag, 7–20.

White, R. 1997: Substantial Acts. From Materials to Meaning in Upper Paleolithic Representation. In: M. Conkey et al. (eds.): *Beyond Art. Pleistocene Image and Symbol*. San Francisco, California: California Academy of Sciences, 93–107.

Wiedl, T., Harzhauser, M., Kroh, A., Ćorić, S., Piller, W. E. 2013: Ecospace variability along a carbonate platform at the northern boundary of the Miocene reef belt (Upper Langhian, Austria). *Palaeogeography, Palaeoclimatology, Palaeoecology* 370, 232–246. DOI: 10.1016/j.palaeo.2012.12.015. Available also from: https://www.sciencedirect.com/science/article/pii/S0031018212006979.

Winiarska-Kabacinska, M. 2017: Animal perforated teeth deposit from Magdalenian site at wilczyce (southeastern Poland). What they were used for? A use-wear case study. *Cuadernos de Prehistoria y Arqueología de la Universidad de Granada* 27, 73–82.

Wolf, S. 2015a: *Schmuckstücke. Die Elfenbeinbearbeitung im Schwäbischen Aurignacien*. Tübinger Monographien zur Urgeschichte. Tübingen: Kerns Verlag Tübingen.

Wolf, S. 2015b: Personal ornaments as signatures of identity in the Aurignacian – the case of the Swabian Jura and western Germany. In: N. Sanz (ed.): *Human Origin Sites and the World Heritage Convention in Euroasia. Heads 4, volume I*. World Heritage Papers 41, Paris: UNESCO, 92–102. Available also from: https://whc.unesco.org/en/series/41/.

Wolf, S. 2019: Schmuck aus den neuen Ausgrabungen. In: C. J. Kind (ed.): *Löwenmensch und Mehr. Die Ausgrabungen 2008–2013 in den alt-steinzeitlichen Schichten der Stadel-Höhlen im Hohlenstein (Lonetal), Gemeinde Asselfingen, Alb-Donau-Kreis*. Forschungen und Berichte zur Archäologie in Baden-Württemberg 15. Wiesbaden: Dr. Ludwig Reichert Verlag Wiesbaden, 125–128. DOI: 10.11588/propylaeum.887.c13866. Available also from: https://books.ub.uni-heidelberg.de/propylaeum/catalog/book/887/chapter/13866.

Wolf, S., Conard, N. J. 2015: Personal ornaments of the swabian Aurignacian. In: R. White et al. (eds.): *Aurignacian Genius. Art, Technology and Society of the First Modern Humans in Europe. Proceedings of the International Symposium, April 08-10 2013*. New York: New York University, P@lethnology, 7, 330–345. DOI: 10.4000/palethnologie.897. Available also from: https://journals.openedition.org/palethnologie/897.

Wolf, S., Kind, J. C., Conard, N. J. 2013: Schmuck aus dem Aurignacien von der Schwäbischen Alb im Vergleich mit Inventaren aus dem Lahntal und dem Rheinland. *Archäologisches Korrespondenzblatt* 43(3), 295–313. DOI: 10.11588/ak.2013.3.90147. Available also from: https://journals.ub.uni-heidelberg.de/index.php/ak/article/view/90147.

Zeeden, C., Hambach, U., Händel, M. 2015: Loess magnetic fabric of the Krems-Wachtberg archaeological site. *Quaternary International* 372, 188–194. DOI: 10.1016/j.quaint.2014.11.001. Available also from: https://www.sciencedirect.com/science/article/pii/S1040618214008337.

Resumé

Při archeologických výzkumech pavlovienské lokality Krems-Wachtberg (Dolní Rakousko) v letech 2005–2015 bylo objeveno 110 předmětů, které lze charakterizovat jako ozdoby – korálky a jehly z mamutoviny, perforované zuby psovitých šelem a schránky měkkýšů a zkameněliny rournatců. Téměř všechny korálky z mamutoviny se nacházely v kontextu dvojhrobu malých dětí, jednovaječných dvojčat mužského pohlaví (pohřeb 1). Korálky byly umístěny poblíž levého z obou dětí (jedinec 1), zatímco u pravého (jedinec 2) byl nalezen perforovaný liščí zub spolu se třemi perforovanými schránkami měkkýšů. Jedna jehla z mamutoviny se nacházela v kontextu pohřbu dalšího malého dítěte (pohřeb 2, jedinec 3), který byl objeven v blízkosti prvního pohřbu. Zbytek ozdob pochází ze dvou gravetienských horizontů; jeden z nich je interpretován jako přesunutý horizont a druhý jako obytná vrstva. Z celkového počtu 110 ozdob bylo 103 možno přímo prozkoumat. Každý z předmětů byl vyhodnocen na třech úrovních – popis, technologie a doplňující informace. Veškeré metrické údaje byly získány pomocí stereomikroskopu Keyence VHX 7000 a vah (minimální váha 0,01 g). Pomocí zmíněného stereomikroskopu byly pořízeny mikrofotografie, a dále též fotografie pomocí fotoaparátu Canon EOS 700D. Pro dosažení konzistence byl vyvinut systém značení jednotlivých částí předmětů umožňující též popis pozic, na nichž se nacházely různé druhy stop výroby či opotřebení předmětů. Tento systém byl aplikován na jednotlivé kategorie nálezů. K rozpoznání stop výroby a opotřebení byly využity citované publikace. Cílem podrobné analýzy bylo shromáždit co nejvíce dat, která by v budoucnu mohla pomoci zodpovědět výzkumné otázky vyplývající ze shromážděných údajů a mikrofotografií, a to při co nejmenší nutnosti manipulace s původními objekty.

Systematický průzkum 103 ozdob z lokality Krems-Wachtberg poskytl nové poznatky týkající se výrobního postupu, životního cyklu, využití a významu jednotlivých artefaktů. Zahrnutí základních polotovarů (např. tyčinky z mamutoviny), výrobních pozůstatků (mamutovinové hobliny) a částečně dokončených výrobků (zvířecí zuby) napomohlo při rekonstrukci operačního řetězce (*chaîne opératoire*).

Vzhledem k vysokém počtu mamutovinových korálků z dvojitého dětského pohřbu byla nejzajímavější pozorování učiněna právě v této kategorii nálezů. Analýza ukázala, že 53 korálků je velmi podobných, avšak nikoli identických; důvodem jsou buď různí výrobci nebo různá doba výroby. Je doloženo, že několik korálků bylo v době, kdy byly uloženy k jedinci 1, již opotřebováno. Několik korálků naopak vypadá, že bylo buď nově vyrobeno, možná v chvatu, nebo nikdy nepoužito. Stopy použití/opotřebení navíc ukazují, že korálky byly na základový materiál pravděpodobně přišity dvěma stehy. Pozice korálků v rámci pohřbu – vedle sebe s mírným překryvem – naopak naznačuje, že byly před tím, než došlo k jejich umístění do hrobu s jedincem 1, navlečeny na nějaký druh šňůrky. Některé mamutovinové jehly z lokality mají zakulacené špičky, což je důsledek opakovaného propichování základového materiálu; to se týká i jehly z pohřbu 2. Ta byla pravděpodobně použita na sepnutí materiálu, do nějž bylo tělo jedince 3 zabaleno. Jehla však nebyla pro tento účel vyrobena; je patrné její dřívější používání. V kategorii perforovaných zubů si můžeme povšimnout preference liščích zubů nad vlčími a řezáků nad ostatními druhy zubů. Perforovaný liščí zub v pohřbu 1 byl podle všeho navlečen na šňůrku se třemi (čtyřmi) perforovanými schránkami měkkýšů a tvořil s nimi náhrdelník jedince 2. Zub však má silně zakulacené přirozené hrany a vykazuje znaky použití/opotřebení na levé, pravé a horní straně můstku perforace. To naznačuje, že zub byl vpravo a vlevo od perforace našit na základový materiál a je možné, že byl nošen na závěsu coby přívěsek. Můžeme tedy učinit závěr, že zuby a některé ze schránek měkkýšů navlečených na šňůrky nebyly vyrobeny pro účely pohřbu malého dítěte, ale byly používány již předtím. Některé ze schránek měkkýšů *Theodoxus* sp. a *Gigantopecten gigas planus* vykazují známky vyleštění šňůrkou na okrajích perforace, které jsou pravděpodobně důsledkem toho, že byly navlečeny na šňůrku a nošeny jako přívěsek. Čtvrtohorní plž nevykazoval žádné významné známky použití/opotřebení, což mohlo být částečně způsobeno špatným stavem dochování. Rournatci, které díky jejich přírodnímu tvaru nebylo třeba perforovat, pak vykazují známky zakulacení konců následkem navlečení na šňůrku, nebo spíše přišití na základový materiál.

Ze stop výrobního procesu na dokončených předmětech, jako je nedokončená perforace korálku či škrábance poblíž místa skutečné perforace čtvrtohorního měkkýše, lze rozpoznat vzorce chování lidí, kteří tyto ozdoby vyrobili. To nám poskytuje důvěrný vhled do myšlení a životů lidí starší doby kamenné.

Srovnání ozdob z lokality Krems-Wachtberg s dalšími lokalitami v regionálním, chronologickém a pohřebním kontextu ukazuje, že tyto kategorie nálezů byly vyráběny i na jiných lokalitách a v jiných obdobích. Hmotná kultura paleolitických lokalit dokládá, že lidé sbírali malé předměty jako jsou schránky měkkýšů, zkameněliny a zvířecí zuby a používali je podle všeho nikoli pro praktické, ale pro estetické účely. Obecně můžeme říci, že k výrobě ozdob sloužily suroviny, které byly k dispozici na sídlišti nebo v jeho blízkosti. Mamutovina a zuby masožravých zvířat pocházely z lovené zvěře nebo byly sbírány spolu s měkkýši a zkamenělinami. Výběr zubů a schránek měkkýšů závisel buď na jejich estetické hodnotě nebo na jiném základě, kterému dnes nejsme schopni porozumět. Následně je lidé jednoduše perforováli. Toto chování můžeme pozorovat na mnoha z porovnávaných lokalit (tab. 1). Zajímavé výsledky poskytlo srovnání mamutovinových korálků, jejichž konkrétní podoba a tvar byly úmyslně voleny výrobci. Podobné korálky oválného či podlouhlého tvaru s perforací v horní části, mírným vyboulením vpředu dole a plochou zadní stranou se vyskytují i na dalších lokalitách, např. Hohle Fels (D), Geißenklösterle (D), Grub/Kranawetberg (AUT), Barma Grande (I) či Dolní Věstonice (CZ).

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