

Reflections on the spatial organisation of a Gravettian occupation layer at Krems-Wachtberg

Úvahy o prostorové organizaci gravettské sídelní vrstvy na lokalitě Krems-Wachtberg

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KEYWORDS

Pavlovian – dwelling – activity areas – spatial organisation

ABSTRACT

Among the Upper Palaeolithic sites clustered around Krems in eastern Austria, the Gravettian site of Krems-Wachtberg 2005–2015 has gained particular prominence due to the discovery of two infant burials. Of equal importance is the exposure of an occupation layer that links these burials to other clearly identifiable settlement features, including hearths, pits, and postholes. Together with the archaeological and bioarchaeological finds, these features provide the material context for a wide range of both everyday and symbolic activities, which can be techno-culturally and chronologically attributed to the Early Pavlovian. The highest intensity and diversity of activities were documented in the area surrounding a large, multi-phased hearth.

Post-occupational sedimentary processes are responsible not only for the remarkable preservation of the site but also for the truncation of the occupation layer. This suggests that a considerable portion of the archaeological record is likely missing. Nevertheless, the preserved part allows for high-resolution intra-site analyses and provides valuable information on the spatial organisation of this particular occupation event. The absence of evidence for a dwelling must, however, be acknowledged. Any habitation structure may therefore have been located beyond the limits of the preserved occupation layer. It is thus highly probable that the full range of documented activities, both profane and symbolic, took place outdoors.

1. Introduction

Archaeological finds and findings represent only a part of the activities carried out in the course of an occupation at a site, and this share is usually inversely proportional to the occupants' mobility, even in the case of an optimal conservation of the record. For highly mobile hunter-gatherer societies of the Pleistocene, the overall record is sparse and the preservation of sites in most cases is incomplete. Often, we only encounter poorly organised find concentrations or layers which, in the best case, represent palimpsests of occupations that occurred in close chronological and/or cultural proximity, thus allowing only a general assessment of variables such as technology and subsistence. This applies both for explicit sediment traps such as caves with high success rates for finding Palaeolithic remains, as well as for open-air archives in extensive loess landscapes, where the density of anthropogenic traces is naturally much lower. While, in the case of multi-layered sites, caves often lack sedimentation rates high enough for separating individual occupations, identifying Palaeolithic open-air sites proved to be challenging partly due to the high sedimentation rates. On the other hand, open-air sites provide a higher potential for finding primary, i.e. *in situ*, contexts. However, this does not imply that palimpsests do not occur in loess landscapes. They are, in contrast, documented rather frequently given the apparent low probability of hunter-gatherer groups returning to the same place when considering the low population densities modelled for the Late Pleistocene (e.g. Tallavaara et al. 2015; Maier, Zimmermann 2017). Although palimpsests are the result of post-occupational sedimentary processes, a prerequisite is nevertheless repeated occupation at the same place. This can only be explained by preference, i.e. the strategic decisions of hunter-gatherer groups. It is highly likely that these decisions were made based on the groups' key requirements, and although we can today, at least in part, only speculate on the latter, it appears possible to deduce preferred topographic positions.

It is common practise in archaeology to obtain data on general mobility patterns of hunter-gatherer groups both on the basis of the campsites' distribution and information provided by the recovered finds. As such, state-of-the-art approaches include raw material provenance studies (e.g. lithics, colour pigments, fossils, marine shells, and other materials that have been introduced to a site) as well as using bioarchaeological material (e.g. faunal but also human remains) for obtaining data on habitats, environment, and migration. Together, these proxies provide information on off- and inter-site uses of space.

For the Gravettian in the Middle Danube Region, the most intensely and/or repeatedly occupied localities are often situated on mid to lower slopes of promontories or terraces at the

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confluence of a major river and a tributary (e.g. Škrdla 2005; Boemke et al. 2022). These slopes often face easterly directions. This is also the case for the Gravettian site cluster in the Wachtberg area of Krems, which includes the Krems-Wachtberg and Krems-Hundssteig sites.

2. The Gravettian site cluster at Krems

The city of Krems (Krems an der Donau, Lower Austria) is located on the Danube's north bank, where the river exits the narrow Wachau valley and enters a wide alluvial plain, the Tullnerfeld basin (Fig. 1a, b). After cutting the southeast fringes of the Bohemian Massif, the Danube runs east north of the Alp's easternmost extent, and eventually to the southeast into the Carpathian Basin after passing through the Vienna gate. Krems and the Wachau valley are located at the westernmost extent of the east Austrian loess belt. Most of the Upper Palaeolithic sites at Krems are concentrated above the medieval town centre on the Wachtberg hill (Fig. 1c). These comprise the Krems-Wachtberg and Krems-Hundssteig sites. The spur-shaped Wachtberg hill is a promontory of the Bohemian Massif's southeast fringes and overlooks the Tullnerfeld basin further east. It slopes gently to the south in the direction of the Danube and descends steeply to the valley of its tributary, the Kreams River, in the northeast. On the slopes to the valleys, the Bohemian Massif bedrock is covered by up to 20 m of loess sediments, which form the sedimentary matrix for the Upper Palaeolithic find layers (Händel et al. 2009a).

From a research historical perspective, the Krems sites (Fig. 1c) first became known for their Early Upper Palaeolithic collection. In the course of large-scale loess extraction at the turn of the 20th century, a large assemblage of mainly lithics, but also faunal remains and ornaments, were collected at Krems-Hundssteig (HU 1893–1904) and classified as Early Upper Palaeolithic (Strobl, Obermaier 1909). Later assessment showed, however, that the inventory cannot be considered technologically homogeneous, as it contains younger elements (Broglio, Laplace 1966). In fact, most Palaeolithic assemblages recovered from the Wachtberg area can be attributed to the Gravettian (Tab. 1). This includes a collection recovered in the course of a private excavation carried out by a local teacher, A. Kessendorfer, prior to the loess extraction. The excavation took place in the Krems-Hundssteig area, reportedly between 1890 and 1893; its exact location, however, remains unknown. The collection was transferred to the Natural History Museum Vienna in 1953 and later attributed to the Early Gravettian as represented by Willendorf II / layer 5 (Hahn 1972). In 1930, J. Bayer excavated a site further uphill on the Wachtberg promontory (Kießling 1934), which was later classified as Gravettian and named Krems-Wachtberg 1930 (WA 1930).

Modern research began to focus on the Wachtberg area in the 1990s with a reassessment of the old collections. This included documentation of loess profiles and core sampling, as well as processing of the material recovered by the J. Bayer excavation in 1930. The latter documented that Bayer had excavated part

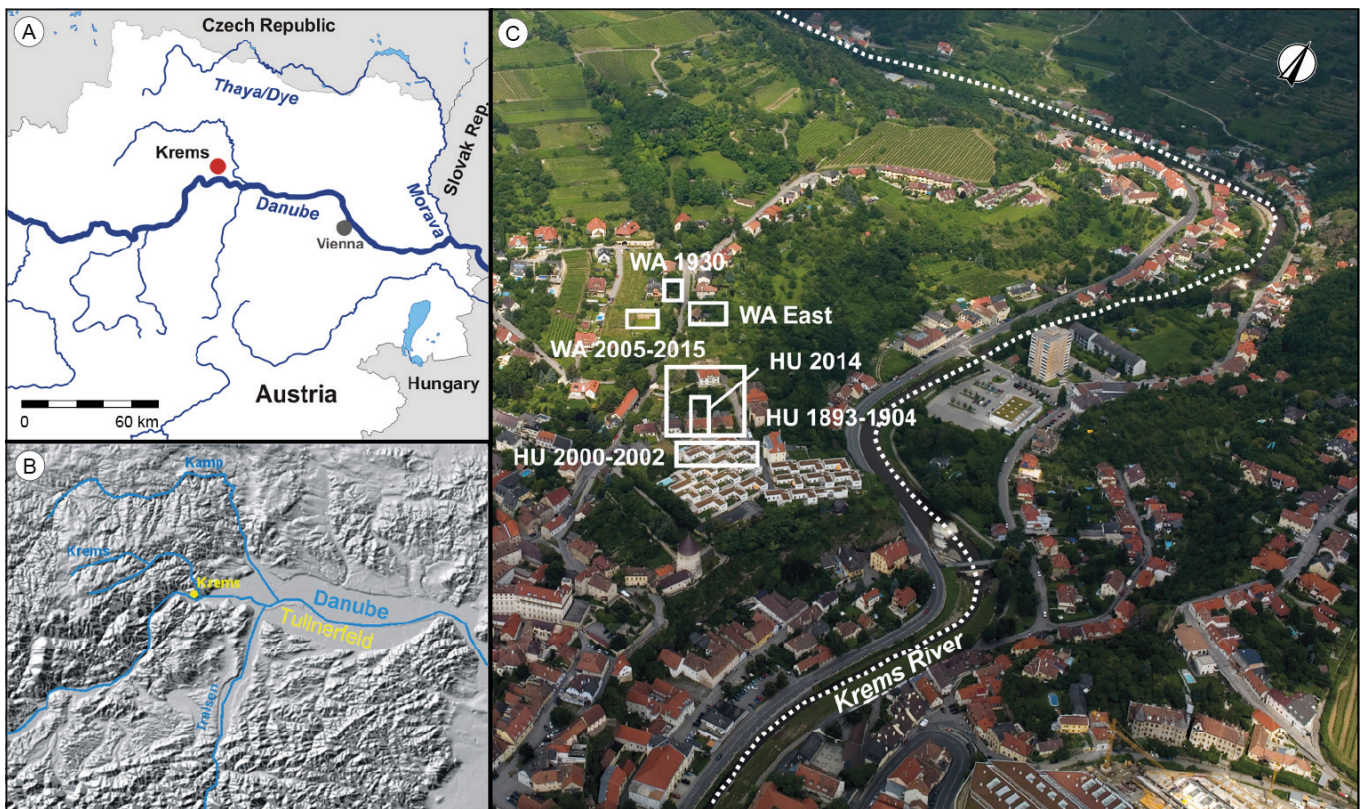


Fig. 1. Location of the city of Krems on the Danube, and the the Upper Palaeolithic site cluster in the Wachtberg area. A – map of northeast Austria (Map source: Dmaps; modified). B – topography of the area around Krems. Austrian Archaeological Institute of the ÖAW. C – aerial photograph of the Wachtberg area in Krems from the southeast. The Hundssteig sites (HU) are located on the lower part of the promontory, whereas the Wachtberg sites (WA) are situated further uphill (Institute of Prehistoric and Historical Archaeology, University of Vienna).

Obr. 1. Poloha města Kremže (Krems) na Dunaji a koncentrace mladopaleolitických lokalit v oblasti Wachtbergu. A – mapa severovýchodního Rakouska (Zdroj mapy: Dmaps; upraveno). B – topografie oblasti v okolí Kremže (Österreichisches Archäologisches Institut der ÖAW). C – letecká fotografie oblasti Wachtberg v Kremži od jihovýchodu. Lokality Hundssteig (HU) se nacházejí na nižší části ostrožny, zatímco lokality Wachtberg (WA) jsou situovány výše ve svahu (Institut für Urgeschichte und Historische Archäologie, Universität Wien).

of a campsite with preserved evident structures such as a hearth and pits and can be attributed to the Pavlovian, a regional subgroup of the earlier Gravettian (Einwögerer 2000; Fladerer 2001). From 2000 to 2002, the Austrian Academy of Sciences conducted salvage excavations at Krems-Hundssteig (HU 2000–2002). These documented an almost 1 m sequence of multiple Early Mid-Upper Palaeolithic find layers with a total of five at least partly preserved hearths (Neugebauer-Maresch 2008a). Subsequent investigations resulted in long-term research excavations at Krems-Wachtberg (WA 2005–2015), which became well-known for the discovery of two infant burials (Einwögerer et al. 2006; 2008a), one of which is a burial of monozygotic twins (Teschler-Nicola et al. 2020). Important contextual information for the site cluster's stratigraphy was provided by salvage excavations at Krems-Wachtberg East 2012–2013 (WA East; Einwögerer et al. 2015) and Krems-Hundssteig 2014 (HU 2014).

The Gravettian site cluster at Krems provides evidence for multiple occupations in a timeframe of approximately 33,500 to 31,000 years ago. All sites of the cluster are located on the loess-covered southeast slope of the Wachtberg promontory. *In situ* contexts have been documented for WA 1930 (lower part of the so-called 'main layer' with hearth and pits), for HU 2000–2002 with five hearths, find scatters, and horizons with tree remains in the form of calcified wood (Neugebauer-Maresch 2008b), and for WA 2005–2015 with two infant burials, two hearths, as well as numerous pits, all connected by an occupation surface (Händel et al. 2008). In terms of material culture and chronology, the most extensive *in situ* remains of the site cluster, located at WA 1930 and WA 2005–2015, can be placed in the Early Pavlovian (Einwögerer 2000; Simon et al. 2014) while the HU 2000–2002 *in situ* contexts belong to at least two stratigraphically separate phases of the earlier Gravettian (Neugebauer-Maresch 2008a). The earliest of these corresponds stratigraphically and chronologically to a layer evidenced at the WA sites, which provided Early Gravettian pre-Pavlovian radiocarbon ages (Händel 2017), but where, in contrast to HU 2000–2002, anthropogenic inclusions are almost exclusively charcoal. Omnipresent at all sites of the cluster are horizons with redeposited finds (Einwögerer et al. 2014). These were formed by periglacial and slope processes, and, in most cases, apparently represent palimpsests of different occupations (Händel et al. 2009a). Layers with redeposited finds are always found at the top of the local sequences (Händel 2017).

3. Stratigraphy and chronology

Of utmost importance for comparing the stratigraphies for the different Gravettian sites on the Wachtberg promontory is the occurrence of an omnipresent marker horizon within the loess sediment sequence, referred to as 'double ash layer' (Händel 2017; Händel et al. 2021). In the earliest Gravettian layers, faunal remains are rare and often poorly preserved, suggesting low sedimentation rates and/or unfavourable soil chemistry. Anthropogenic features, however, are generally well preserved, despite two examples of partly eroded hearths at HU 2000–2002 and WA East (Neugebauer-Maresch 2008a; Einwögerer et al. 2015). The lower Gravettian layers are covered by loess sediments, accumulated by both aeolian sedimentation and slope processes. As such, aeolian processes dominate the lower part of this sequence while the upper part is clearly banded, suggesting a prevalence of small-scale slope processes such as run-off after precipitation and/or snow melts and solifluction. *In situ* remains of the subsequent Gravettian occupations are intercalated between and situated on top of the aeolian unit, while several of the bands on top contain redeposited anthropogenic material (Händel 2017; Händel et al. 2021). The marker horizon referred to as 'double

ash layer' is always situated on top of the Gravettian sequences, and must therefore be regarded as not only post-occupational but also posterior to the redeposition of Gravettian material. It consists of two thin layers of organic ash spaced about 2 cm apart. The two layers' wavy morphologies presumably indicate ripples of the former surface. The layers consist almost exclusively of organic ash with some microscopic charcoal fragments and very few larger charcoal pieces several millimetres in size. This marker horizon is evidenced in comparable stratigraphic positions at all excavated sites, documented profiles, as well as in a number of core samples from the Wachtberg promontory (Neugebauer-Maresch 2008a; Händel et al. 2009a; Einwögerer et al. 2014).

Stratigraphic assessment of the anthropogenic features and archaeological layers was used as the basis for dividing the Gravettian occupation on the Wachtberg promontory in three phases (Händel 2017). Therefore, occupation phase I is the earliest Gravettian occupation preserved *in situ* at the Krems-Wachtberg and Krems-Hundssteig sites. Occupation phase II took place during aeolian loess accumulation. Although slope processes were active during phase II, aeolian processes clearly dominate. Phase II contexts are only preserved *in situ* at HU 2000–2002. *In situ* remains of occupation phase III are situated directly on top of the sediment unit showing dominating aeolian sedimentation processes, and are only preserved at the Krems-Wachtberg sites. Techno-culturally, they represent the earlier Pavlovian. The *in situ* contexts are superimposed by a sequence of banded sediment layers. The 2–5-cm-thick bands show alternating colours from beige to greyish and slightly brownish, suggesting fluctuating environmental conditions. In addition, several of these bands contain redeposited archaeological material pointing at the erosion of *in situ* contexts uphill.

When the radiocarbon data are grouped according to these phases (Tab. 2), they show a chronological sequence in agreement with the stratigraphic placement (Fig. 2). The radiocarbon chronology places the Gravettian sequence at the Krems-Wachtberg and Krems-Hundssteig sites in the timeframe between c. 33,500 and 31,000 cal BP, and thus into the earlier part of the regional Gravettian (Jöris et al. 2010). According to the chronostratigraphic model, occupation phase I falls into stadial conditions between GI-6 and GI-5.2, while phase II appears to have been connected to GI-5.2. Occupation phase III with layer AH 4.4/4.3 falls into stadial conditions, and the 'double ash layer' seems to be connected to GI-5.1. This agrees with the sedimentary record showing that the entire AH 4 complex at WA 2005–2015, including both the occupation connected to AH 4.4/4.3 and the redeposition events marked by AH 4.11/4.01–4.22, which buried and truncated occupation layer AH 4.4/4.3 by a mix of sedimentary processes including solifluction, slope wash and aeolian deposition, occurred between two stable phases marked by tundra gleyic soils (Händel et al. 2021). Ages from layers with redeposited material reflect the entire occupation span.

Applying these data to the topography of the Wachtberg area suggests that there was no preference with regard to topographic position for phase I occupation, whereas phase II occupation was concentrated on lower mid-slope positions (HU 2000–2002), and phase III occupation preferred upper mid-slope positions (WA 1930 and WA 2005–2015). Judging from the calcified tree roots observed at HU 2000–2002 (Neugebauer-Maresch 2008b) but not at the WA sites, it seems that, during occupation phase I, a local 'tree line' could have run in between the lower (HU) and upper (WA) part of the site cluster. This could imply that a preference for camp location did not depend on vegetation. We should, however, not assume strict contemporaneity for

Context/Layer	Assessment	Pedogenesis	Evident anthropogenic structures	14C data	Lithics
HU 1890-1893	Collection biased by selection; lithics show high integrity	No data	Unclear (possibly a hearth - 30% lithics show fire influence; 1 charcoal Pinus)	No	Yes
WA 1930	<i>In situ</i> structures; stratigraphically mixed material; selection probably biased; stratigraphy like WA 2005-2015 and WA East	No data, but probably not	Hearth, pits, ditch?	Yes	Yes
HU 2000-2002					
HU-AH 3.1/3.23/3.24	Find layers with re-deposited material	No	No	Yes	Yes
HU-AH 3.21	Partly <i>in situ</i> ; hearth B with surrounding find scatter (surrounding finds presumably re-deposited)	No	Hearth	Yes	Yes
HU-AH 3.22	Partly <i>in situ</i> ; hearth D with surrounding find scatter	No	Hearth	Yes	Yes
HU-AH 3.34	Find layer with re-deposited material	No	No	Yes	Yes
HU-AH 3.43	<i>In situ</i> ; burnt log with surrounding find scatter	No	No	Yes	Yes
HU-AH 3.44	Find layer with re-deposited material	No	No	Yes	Yes
HU-AH 3.51	<i>In situ</i> ; hearth A with surrounding find scatter	(yes)	Hearth	Yes	Yes
HU-AH 3.54	<i>In situ</i> ; hearth C with surrounding find scatter	(yes)	Hearth	Yes	Yes
HU-AH 3.64	Unsure: <i>in situ</i> but heavily eroded; hearth E	Yes	Hearth	Yes	Yes
HU-AH 3.7	Unsure: palaeosol with significant amounts of calcified wood remains; many roots	Yes	No	Yes	No
WA 2005-2015					
WA-AH 4.11/4.01-4.22	Find layers with re-deposited material; palimpsest of different occupations (WA-AH 4.4 and earlier)	No	No	Yes	Yes
WA-AH 4.4/4.3	<i>In situ</i> ; occupation surface (living floor)	No	Hearths, pits, burials, postholes	Yes	Yes
WA-AH 5	<i>In situ</i> ; concentric charcoal scatter (= latent anthropogenic structure); calcified traces	Yes	No	Yes	Yes
WA East					
WA East-AH 101	Find layer with re-deposited material	No	No	Yes	Yes
WA East-AH 102	Unclear; layer looks disturbed but stratigraphic position corresponds to WA-AH 4.4	No	No	Yes	Yes
WA East-AH 103/104	Palaeosol with few calcified wood remains, ashy patches, heavily disturbed combustion feature	Yes	(yes)	Yes	Yes

Tab. 1. Gravettian contexts and/or layers documented at the Krems-Wachtberg (WA) and Krems-Hundssteig (HU) sites.

Tab. 1. Gravettské kontexty a/nebo vrstvy dokumentované na lokalitách Krems-Wachtberg (WA) a Krems-Hundssteig (HU).

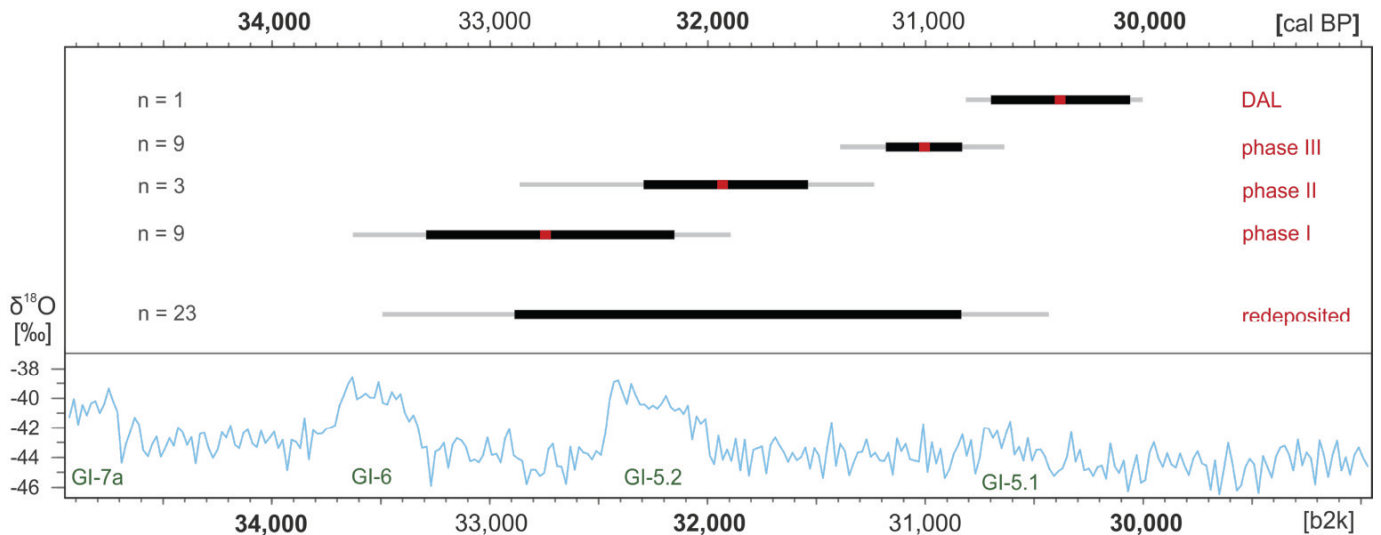


Fig. 2. Chronostratigraphic placement of the occupation floor WA-AH 4.4/4.3 within the Gravettian sequence at Krems. See the next page.

Obr. 2. Chronostratigrafické zařazení sídelního horizontu WA-AH 4.4/4.3 v rámci gravettské sekvence v Kremži. Viz další strana.

Fauna	Colour materials	Adornments	Art	Human remains	Main synoptic references
Yes (very few)	No	No	No	No (6 long bones are not Palaeolithic)	Hahn 1972
Yes	Yes	17 serpulides	2 ceramic zoomorphic figurines, 1 ceramic object	No	Einwögerer 2000; Fladerer 2001
					Neugebauer-Maresch 2008a
Yes	Yes	No	No	No	
Yes	Yes	No	No	No	
Yes	Yes	No	No	No	
Yes	No	No	No	No	
Yes	No	No	No	No	
Yes	No	No	No	No	
Yes	Yes	No	No	No	
Yes	Yes	No	No	No	
No	No	No	No	No	
Yes	No	No	No	No	
					Händel et al. 2009a; Simon et al. 2014; 2020
Yes	Yes	6 serpulides, 14 ivory pins, 6 pierced animal teeth, 1 pierced mollusk, 1 ivory bead	39 formed ceramic objects, 3 painted bone/ivory objects	Yes (1 rib, adolescent)	
Yes	Yes	2 serpulides, 10 ivory pins, 10 pierced animal teeth, 4 pierced mollusks, 53 ivory beads	1 ceramic zoomorphic figurine, 9 formed ceramic objects, 1 ivory fragment with incised herringbone pattern; 1 bone fragment with parallel incisions	Yes (3 infants)	
Yes	No	No	No	No	
					Einwögerer et al. 2015
Yes	Yes	No	No	No	
Yes	Yes	No	No	No	
Yes	Yes	No	No	No	

Fig. 2. Chronostratigraphic placement of the occupation floor WA-AH 4.4/4.3 within the Gravettian sequence at Krems. Graph of calibrated 14C dates (cal BP) from Gravettian contexts in the Wachtberg area. Groups were determined by stratigraphic and archaeological criteria, resulting in the identification of three Gravettian occupation phases I–III (Händel 2017). The date of the double ash layer (DAL; sample from layer WA-GH 25) represents the terminus ante quem for both the Gravettian occupation and the redeposition of Gravettian material. WA-AH 4.4/4.3 belongs to occupation phase III. Calibration was carried out using IntCal20 (Reimer et al. 2020). Calibrated ages are plotted in stratigraphic groups with average values (red), and 1- and 2-sigma error bars. The lower curve shows the GICC05 timescale (20 yr d¹⁸O) (Andersen et al. 2006); Greenland Interstadials (GI) follow the INTIMATE event stratigraphy (Rasmussen et al. 2014). See the previous page.

Obř. 2. Chronostratigrafické zařazení sídelního horizontu WA-AH 4.4/4.3 v rámci gravettské sekvence v Kremži. Graf kalibrovaných radiokarbonových dat (cal BP) z gravettských kontextů v oblasti Wachtbergu. Skupiny byly určeny na základě stratigrafických a archeologických kritérií, což vedlo k identifikaci tří fází gravettského osídlení I–III (Händel 2017). Stáří dvojité popelavé vrstvy (DAL; vzorek z vrstvy WA-GH 25) představuje terminus ante quem jak pro gravettské osídlení, tak pro redepozici gravettského materiálu. WA-AH 4.4/4.3 patří do fáze osídlení III. Kalibrace byla provedena pomocí křivky IntCal20 (Reimer et al. 2020). Kalibrovaná stáří jsou vynesena ve stratigrafických skupinách s průměrnými hodnotami (červeně) a s chybovými úsečkami 1 a 2 sigma. Spodní křivka ukazuje časovou škálu GICC05 (20ti leté rozlišení d¹⁸O) (Andersen et al. 2006); grónské interstadiály (GI) sledují eventovou stratigrafii INTIMATE (Rasmussen et al. 2014). Viz předchozí strana.

Phase	Context	Lab number	Field ID	Material	14C age [yr BP]	±
Gravettian – Phase I	HU-AH 3.51	VERA-2292	ID 60001	Charcoal	28780	270
Gravettian – Phase I	HU-AH 3.51	VERA-2293	ID 63012	Charcoal	28550	250
Gravettian – Phase I	HU-AH 3.54	VERA-3282	ID 121027	Charcoal	28250	280
Gravettian – Phase I	HU-AH 3.64	VERA-3283	ID 188007	Charcoal	28360	280
Gravettian – Phase I	HU-AH 3.64	VERA-3912	ID 188007	Charcoal	28110	270
Gravettian – Phase I	WA-AH 5	VERA-3939	ID 22156	Charcoal	28750	270
Gravettian – Phase I	WA-AH 5	VERA-3940	ID 22191	Charcoal	28470	280
Gravettian – Phase I	WA-AH 5	VERA-4535	ID 64186	Charcoal	28700	290
Gravettian – Phase I	WA East-AH 104	POZ-51492	ID 1687	Charcoal	28780	260
Gravettian – Phase II	HU-AH 3.21	VERA-3281	ID 225018	Charcoal	27970	270
Gravettian – Phase II	HU-AH 3.22	VERA-3279	ID 446001	Charcoal	27800	250
Gravettian – Phase II	HU-AH 3.43	VERA-3513	ID 413005	Charcoal	27860	270
Gravettian – Phase III	WA East-AH 102	POZ-51491	ID 1315	Charcoal	26660	210
Gravettian – Phase III	WA-AH 4.4	VERA-3935	ID 19771	Charcoal	27220	230
Gravettian – Phase III	WA-AH 4.4	VERA-3938	ID 22056	Charcoal	27000	220
Gravettian – Phase III	WA-AH 4.4	VERA-4536	ID 71968	Charcoal	26980	210
Gravettian – Phase III	WA-AH 4.4	VERA-3941	ID 23775	Charcoal	26870	220
Gravettian – Phase III	WA-AH 4.4	VERA-4532	ID 33435	Charcoal	26840	220
Gravettian – Phase III	WA-AH 4.4	POZ-12920	ID 9105	Charcoal	26580	160
Gravettian – Phase III	WA-AH 4.3	VERA-3819	ID 18075	Charcoal	26520	210
Gravettian – Phase III	WA-AH 4.3	OxA-18529	ID 15940.99	Bone; mammoth scapula	26980	210
Post-occupational	WA-GH25	VERA-4538	ID 100362	Charcoal	26050	200
Gravettian	HU 1893-1904	VERA-670	Old collection	Charcoal	27000	150
Gravettian	WA 1930	GrN-3011	Old collection	Charcoal	27400	300
Gravettian	WA 1930	Groningen	Old collection	Charcoal	27910	510
Gravettian	WA 1930	VERA-669	Old collection	Charcoal	27700	200
Gravettian	WA 1930	VERA-671	Old collection	Charcoal	27100	170
Gravettian	HU-AH 3.21	VERA-2291	ID 46008	Charcoal	27200	240
Gravettian	HU-AH 3.21	VERA-3280	ID 27005	Charcoal	27640	260
Gravettian	HU-AH 3.24	VERA-1615	ID 14017	Charcoal	27940	210
Gravettian	HU-AH 3.24	OxA-18525	ID 177020	Bone; mammoth vertebra	26600	150
Gravettian	HU-AH 3.44	VERA-3514	ID 235002	Charcoal	28070	240
Gravettian	HU-AH 3.44	VERA-3515	ID 261001	Charcoal	27630	230
Gravettian	HU-AH 3.44	VERA-3910	ID 239003	Charcoal	27820	270
Gravettian	HU-AH 3.73	VERA-3944	ID 436001	Charcoal	27900	230
Gravettian	HU-AH 3.74	VERA-3943	ID 369003	Charcoal	27790	250
Gravettian	WA-AH 4.11	VERA-3932	ID 8886	Charcoal	28300	270
Gravettian	WA-AH 4.11	VERA-3933	ID 17176	Charcoal	27420	240
Gravettian	WA-AH 4.11	VERA-3934	ID 17775	Charcoal	27190	230
Gravettian	WA-AH 4.11	VERA-4533	ID 39440	Charcoal	27230	230
Gravettian	WA-AH 4.11	VERA-4534	ID 40983	Charcoal	28000	250
Gravettian	WA-AH 4.11	VERA-5196	ID 10913	Bone; brown bear phalanx	26800	220
Gravettian	WA-AH 4	VERA-1767	RKS-B7/1a (re-named RKS-M7)	Charcoal	27470	200
Gravettian	WA-AH 4.4	VERA-3937	ID 21423	Charcoal	28240	270
Gravettian	WA East-AH 101	POZ-51490	ID 1073	Charcoal	27780	240

occupations grouped in one phase. In addition, due to their limited size, there is too little information on site function aspects of the documented findspots. More significant for the potential extent of phase I occupation in the Wachtberg area is the fact that radiocarbon data provided according ages for redeposited charcoals from the banded sequence superimposing phase III *in situ* deposits at WA 2005–2015 (see below). This implies that phase I occupation must have extended farther upslope. However, coring conducted upslope did not provide evidence of preserved Early Gravettian find layers (Einwögerer et al. 2014), suggesting these may be entirely eroded.

In contrast, the (15–25 m) lower elevations for phase II compared to phase III occupation could indeed represent preference, particularly because the WA sites exhibit the complete absence of anthropogenic traces in the stratigraphic position, where phase II occupation is evidenced at HU 2000–2002.

4. Site formation at WA 2005–2015

These general thoughts on Gravettian occupation in the Wachtberg area are based upon multidisciplinary investigations at HU 2000–2002, WA 2005–2015, and WA East, together with an extrapolation of the detailed site formation model developed for the main Gravettian horizon AH 4 at WA 2005–2015 (Händel et al. 2014). AH 4 consists of a lower part, AH 4.4/4.3, representing an *in situ* occupation surface with evident anthropogenic features, and a banded sequence of layers with redeposited finds, AH 4.11/4.01–4.22, placed immediately on top of it, i.e. without an intercalated layer of archaeologically sterile sediment. While the layer with *in situ* deposits is a direct result of human activities, the sequence with redeposited finds provides insights into post-occupational sedimentary processes. Most of occupation layer AH 4.4/4.3 was documented as AH 4.4, while the denomination ‘AH 4.3’ was initially used for areas in its

cal BP – CalAge P(68%)	Reference	Comment
33040 ± 550	Neugebauer-Maresch 2008a	<i>In situ</i> (hearth A)
32730 ± 460	Neugebauer-Maresch 2008a	<i>In situ</i> (hearth A)
32420 ± 460	Neugebauer-Maresch 2008a	<i>In situ</i> (hearth C)
32530 ± 460	Neugebauer-Maresch 2008a	<i>In situ</i> (hearth E)
32280 ± 460	Neugebauer-Maresch 2008a	<i>In situ</i> (hearth E)
33000 ± 550	Einwögerer et al. 2009	<i>In situ</i>
32650 ± 470	Einwögerer et al. 2009	<i>In situ</i>
32940 ± 560	Einwögerer et al. 2009	<i>In situ</i>
33040 ± 540	Einwögerer et al. 2014	<i>In situ</i>
32120 ± 470	Neugebauer-Maresch 2008a	<i>In situ</i> (hearth B)
31730 ± 290	Neugebauer-Maresch 2008a	<i>In situ</i> (hearth D)
31860 ± 360	Neugebauer-Maresch 2008a	<i>In situ</i> (burnt log)
30800 ± 250	Einwögerer et al. 2014	(<i>in situ</i>)
31320 ± 180	Einwögerer et al. 2009	<i>In situ</i>
31120 ± 130	Einwögerer et al. 2009	<i>In situ</i>
31100 ± 110	Einwögerer et al. 2009	<i>In situ</i>
31010 ± 140	Einwögerer et al. 2009	<i>In situ</i>
30980 ± 150	Einwögerer et al. 2009	<i>In situ</i>
30770 ± 230	Einwögerer et al. 2006	<i>In situ</i>
30710 ± 250	Einwögerer et al. 2009	<i>In situ</i> (burial 1)
31100 ± 110	Händel 2017	<i>In situ</i> (cover of burial 1)
30390 ± 260	Einwögerer et al. 2009	Double ash layer; steppe fire
31120 ± 70	Neugebauer-Maresch 2008a	Unknown
31440 ± 220	Vogel, Zagwijn 1967	Unsure
32160 ± 670	Heinrich 1973	Unsure
31590 ± 210	Einwögerer 2000	Unsure
31200 ± 110	Einwögerer 2000	Unsure
31310 ± 190	Neugebauer-Maresch 2008a	Re-deposited
31570 ± 240	Neugebauer-Maresch 2008a	Re-deposited
31930 ± 280	Neugebauer-Maresch 2003	Re-deposited
30790 ± 220	Händel 2017	Re-deposited
32230 ± 440	Neugebauer-Maresch 2008a	Re-deposited
31550 ± 220	Neugebauer-Maresch 2008a	Re-deposited
31790 ± 330	Neugebauer-Maresch 2008a	Re-deposited
31880 ± 290	Neugebauer-Maresch 2008a	Disturbance?
31720 ± 290	Neugebauer-Maresch 2008a	Disturbance?
32460 ± 450	Einwögerer et al. 2009	Re-deposited
31430 ± 190	Einwögerer et al. 2009	Re-deposited
31310 ± 180	Einwögerer et al. 2009	Re-deposited
31330 ± 180	Einwögerer et al. 2009	Re-deposited
32150 ± 450	Einwögerer et al. 2009	Re-deposited
30940 ± 170	Simon et al. 2014	Re-deposited
31440 ± 180	Ziehaus 2007	Core sampling
32410 ± 450	Einwögerer et al. 2009	Presumably intrusion from WA-AH 5
31700 ± 270	Einwögerer et al. 2014	Re-deposited

Tab. 2. Radiocarbon data of Gravettian occupations at the Krems-Wachtberg (WA) and Krems-Hundssteig (HU) sites sorted by occupation phases and archaeological context. The ages are given with 1-sigma deviations. Calibration was carried out using the IntCal20 calibration curve (Reimer et al. 2020) by application of the OxCal 4.4 tool (ORAU).

Tab. 2. Radiokarbonová data gravettského osídlení na lokalitách Krems-Wachtberg (WA) a Krems-Hundssteig (HU) seřazená podle fází osídlení a archeologického kontextu. Stáří jsou uvedena s odchylkami 1 sigma. Kalibrace byla prováděna pomocí kalibrační křivky IntCal20 (Reimer et al. 2020) za použití programu OxCal 4.4 (ORAU).

periphery where the occupational layer was not as well expressed. Within the redeposited sequence, only AH 4.11 extends over the entire area of excavation, while layers AH 4.01 to 4.22 represent only small-scale events of erosion and redeposition. These are separated from AH 4.11 by intercalated layers of archaeologically sterile sediment, indicating that these represent separate events. Nevertheless, although a subdivision of AH 4.01 to 4.22 is possible, this obviously does not imply that AH 4.11 represents only a single event. On the contrary, it is shown below that the layer allows for detailed discrimination of sequences of natural processes. Regarding the number of anthropogenic inclusions, layers AH 4.01–4.22 account for less than 3% of the redeposited assemblage. Therefore, for reasons of improved clarity, these layers are not considered in the site formation model (Fig. 3). The model shows that occupation layer AH 4.4/4.3 is preserved in an area with lower slope gradient, while AH 4.11 was documented

above and around it. Towards its edges, AH 4.4/4.3 decreases in thickness until it is eventually truncated by AH 4.11. It cannot be established how much of the original occupation deposits are missing, but it is likely that a considerable part of material was embedded in AH 4.11. This is suggested by a high degree of similarity of the assemblages, both of which can be classified as earlier Pavlovian (Simon et al. 2014) when applying the criteria discussed by Svoboda (1996, 2007), and is supported by refittings of lithics (Thomas, Ziehaus 2014; Thomas 2023). However, the find assemblages of AH 4.11 and AH 4.4/4.3 also show differences. Microlithic elements are more pronounced in the *in situ* layer (Thomas et al. 2016), and faunal remains show a higher degree of fragmentation because the bones were intentionally fractured to access marrow and bone fats (Fladerer et al. 2014). On the other hand, the faunal spectrum is broader in AH 4.11 and *Capra ibex* is more frequent (Händel et al. 2015).

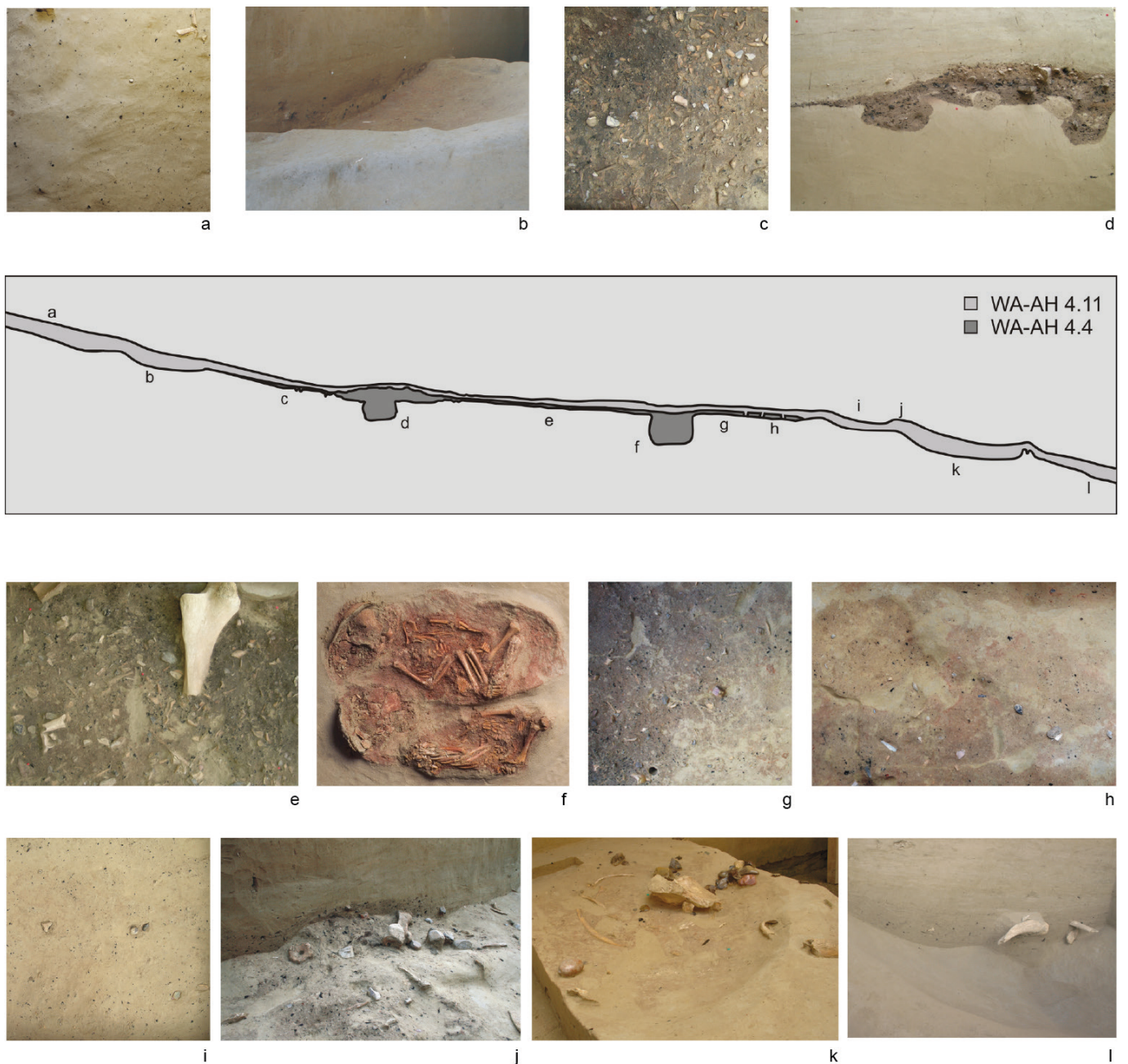


Fig. 3. Formation model of the main Gravettian layers AH 4.11 and AH 4.4/4.3. The model shows an idealised transect and corresponds to a distance of c. 12 m. The slope angles are realistic. Selected positions along the slope are illustrated by photographs: a – AH 4.11 contains redeposited archaeological material from an unknown position uphill; b – periglacial slope processes with alternating erosional and depositional events form shallow circular depressions; c–f – base of the occupation layer remained preserved in areas with reduced slope angle. AH 4.4/4.3 includes evident anthropogenic structures such as hearth 1 (d) and the infant burials (f); g, h – with increasing slope angle, AH 4.4 decreases in thickness, breaks up, and is eventually truncated by (i) WA-AH 4.11 which also includes redeposited material from the occupation layer. Increase in slope angle is connected to periglacial features like (j) stacks of sediment clods pushed together and (k) the shallow circular depressions which eventually break open into (l) erosional gullies. Photo a–e g–l: Austrian Archaeological Institute of the ÖAW; f: Natural History Museum Vienna.

Obr. 3. Model formování hlavních gravettských vrstev AH 4.11 a AH 4.4/4.3. Model ukazuje idealizovaný profil a odpovídá vzdálenosti cca 12 m. Úhly sklonu svahu jsou realistické. Vybrané pozice podél svahu jsou ilustrovány fotografiemi: a – AH 4.11 obsahuje redeponovaný archeologický materiál z neznámé pozice výše na svahu; b – periglaciální svahové procesy se střídáním erozních a akumulčních událostí vytvářejí mělké kruhové deprese; c–f – báze sídelní vrstvy zůstala zachována v místech s menším sklonem svahu. AH 4.4/4.3 zahrnuje zřetelné antropogenní objekty, jako je ohniště 1 (d) a pohřby kojenců (f); g, h – s rostoucím sklonem svahu se mocnost AH 4.4 zmenšuje, vrstva se rozpadá a nakonec je seříznuta (i) vrstvou WA-AH 4.11, která rovněž obsahuje redeponovaný materiál ze sídelní vrstvy. Zvýšení sklonu svahu je spojeno s periglaciálními jevy, jako jsou (j) nakupené hroudy sedimentu stlačené k sobě a (k) mělké kruhové deprese, které se nakonec otevírají do (l) erozních rýh. Foto a–e, g–l: Österreichisches Archäologisches Institut der ÖAW; f: Naturhistorisches Museum in Wien.

Looking at the colour pigments, red ochre is more dominant in the occupation layer, while graphite and yellow ochre are more frequent in AH 4.11 (Cappa et al. 2019). In addition, the radiocarbon ages in AH 4.11 have a wider range and include ages for local Gravettian occupation phase I, i.e. they significantly pre-date the *in situ* occupation layer (Einwögerer et al. 2009; Händel 2017). The redeposited sequence thus represents a palimpsest of materials derived from different archaeological layers

representing different occupations, some of which are earlier than AH 4.4/4.3. A range of natural periglacial features were documented in AH 4.11, which provide information about its formation. Short-range solifluction events are shown by stacks of sediment clods, in some cases pushed into each other. Shallow and more or less circular depressions with diameters between 0.7 and 1.5 m occur around the preserved occupation surface and correlate with an increase in slope angle. The features appear to

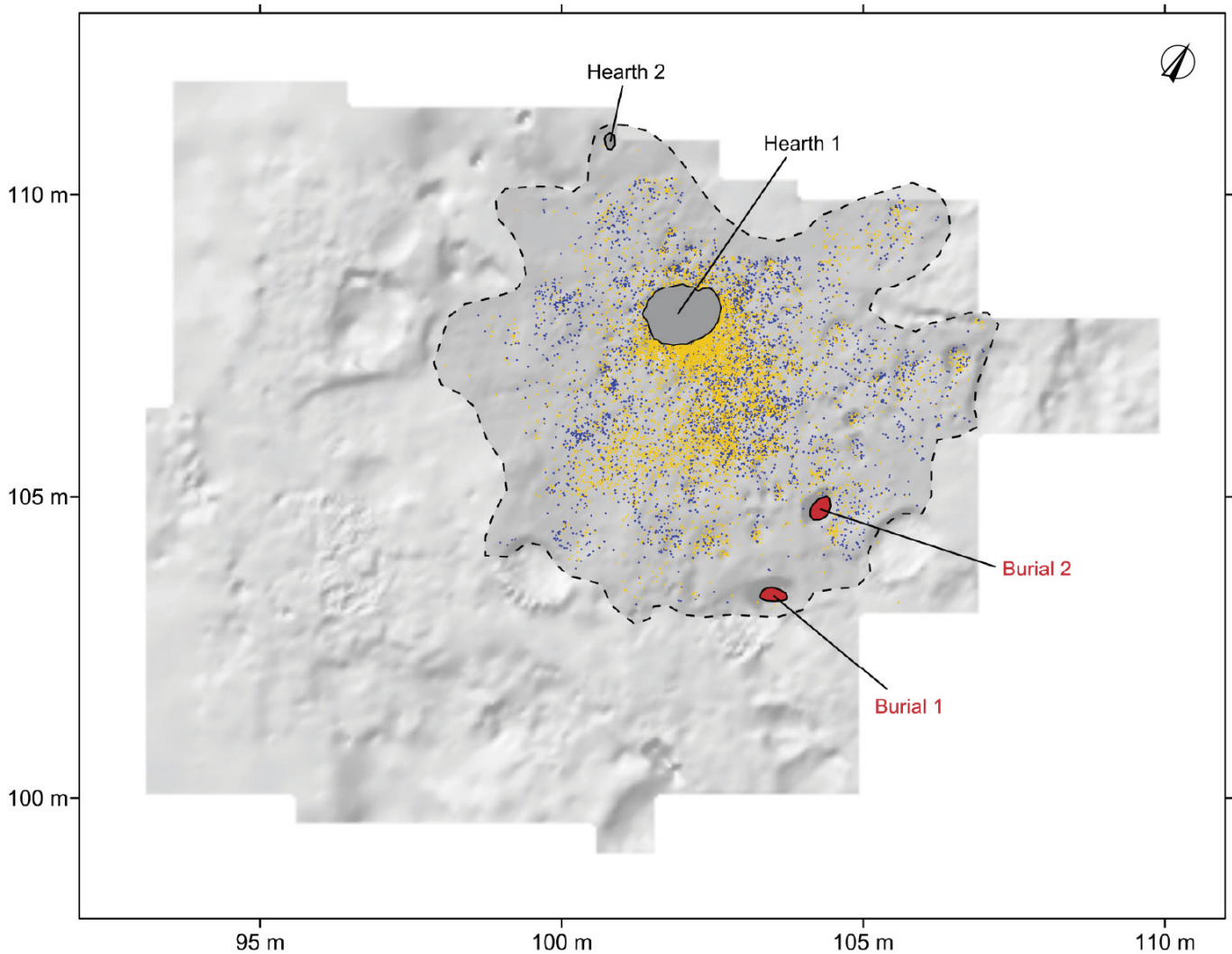


Fig. 4. Surface model of the excavated area at Krems-Wachtberg 2005–2015. Extent of AH 4.4/4.3 with main anthropogenic structures with the distribution of lithics and faunal remains. Author M. Händel.

Obr. 4. Povrchový model zkoumané plochy v lokalitě Krems-Wachtberg 2005–2015. Rozsah vrstvy AH 4.4/4.3 s hlavními antropogenními objekty a distribucí štípané industrie a zbytků fauny. Autor M. Händel.

represent a periglacial pattern of solifluction at the transition from sheet to rill erosion (Bertran et al. 2010). Downhill, as the slope angle increases further, these depressions open into small erosional gullies.

Not included in this model is Early Gravettian horizon AH 5, which is situated about 0.3 m beneath AH 4 and appears as concentric charcoal scatter with very few other finds.

The total sediment sequence with the Gravettian remains in the Wachtberg area increases downslope from about 0.7 m at WA 2005–2015 to around 1.2 m at HU 2000–2002, suggesting that redeposition of aeolian sediment by slope processes played a crucial role not only at WA 2005–2015 but for the entire site cluster in the Wachtberg area. It is, in fact, important to acknowledge that the combination of aeolian sedimentation and periglacial slope processes is not only responsible for the disintegration of Gravettian layers and features in some cases but also for the conservation and excellent preservation in others (Händel et al. 2009a).

5. Occupation layer AH 4.4/4.3

Any intra-site assessment of the specific occupation event connected to layer AH 4.4/4.3 should consider the implications of the formation model, in particular the conclusion that an

unknown part of the occupation surface is missing. A first glance at the extent of the occupation surface with its main features, the hearths and burials, together with the distribution of lithic artefacts and faunal remains suggests that activities took place around a large centrally positioned hearth (Fig. 4). At the same time, the two hearths seem grouped in the west, while the burials are placed in the east. It appears that the distribution of lithics and faunal remains is neither homogeneous nor congruent, both important indicators that the context is *in situ*. However, as shown above, it should be kept in mind that the occupation surface's area of c. 45 m² represents only the preserved extent, and that the limits are decisively influenced by natural, post-occupational formation processes. This particularly applies to the distribution of the finds in the preserved occupation surface's peripheral zones, where AH 4.4/4.3 is reduced to a very thin band with a reddish-brownish matrix and very few inclusions. Here, it is to be expected that most finds were eroded.

How much may be missing is illustrated by the large combustion feature, hearth 1 (Fig. 3d), which preserved a considerable depth of fill sediments. These are characterised by an ashy, reddish to dark brown matrix and include high amounts of charcoal and burnt faunal remains. The numerous sediments have been attributed to three main phases of use (Simon et al. 2014;

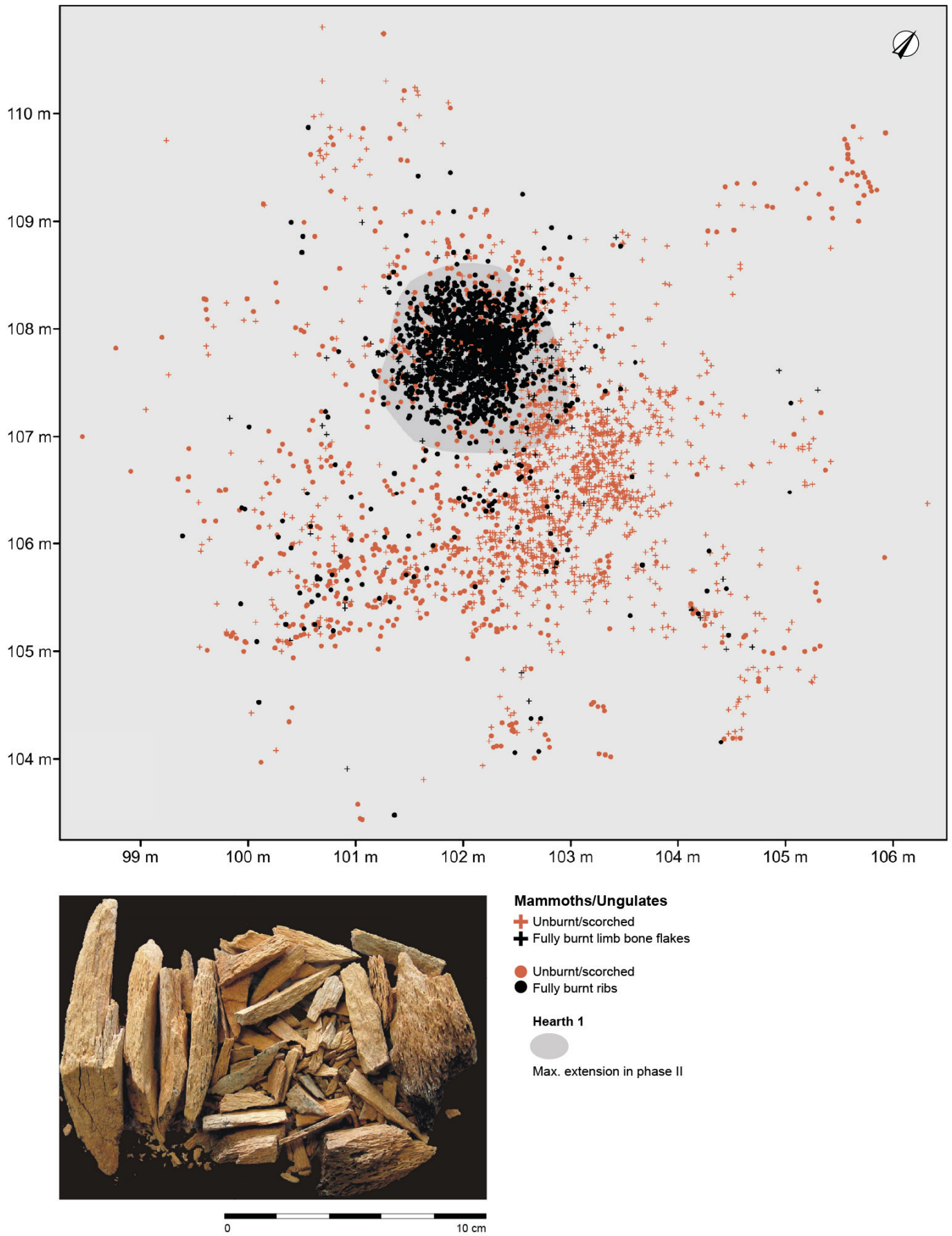


Fig. 5. Distribution of mammoth/ungulate limb bone flakes versus rib fragments in AH 4.4/4.3. Ribs of large herbivores were discarded in hearth 1, whereas unburnt limb bone fragments (photo) cluster to the east. Photo by Austrian Archaeological Institute of the ÖAW; graphic by M. Händel.

Obr. 5. Distribuce úštěpů z kostí končetin mamutů/kopytníků a fragmenty žeber ve vrstvě AH 4.4/4.3. Žebra velkých býložravců byla odhazována do ohniště 1, zatímco nespálené fragmenty kostí končetin (foto) se shlukují na východě. Foto Österreichisches Archäologisches Institut der ÖAW, grafika M. Händel.

Context	Total	Total	<i>Mammuthus primigenius</i>	<i>Cf. Coelodonta antiquitatis</i>	<i>Equus sp.</i>	<i>Cervus elaphus</i>	<i>Rangifer tarandus</i>	<i>Oribos moschatus</i>	<i>Capra ibex</i>	<i>Ursus arctos</i>	<i>Canis lupus</i>	<i>Vulpes vulpes/V. lagopus</i>	<i>Gulo gulo</i>	<i>Cf. Mustela sp.</i>	<i>Lepus timidus</i>	<i>Spermophilus sp.</i>	<i>Cricetus cricetus</i>	<i>Arvicola sp.</i>	<i>Microtus sp.</i>	<i>Aves spec. div.</i>	<i>Tetrao urogallus</i>	<i>Lagopus cf. Lagopus</i>	Reference
WA-AH 4.4/4.3	n	13301	3478	2	929	0	465	0	43	11	65	56	4	4	51	1	1	1	3	36	1	0	Fladerer et al. 2014
	MNI		22	2	1	2	0	2	0	1	1	3	1	1	2	1	1	1	1	1	0	0	Händel et al. 2015
WA-AH 4.11	n	21055	6296	6	585	4	335	0	307	124	378	375	32	14	130	34	5	1	12	47	0	2	Fladerer et al. 2014
	MNI		43	2	1	2	1	2	0	10	2	5	6	1	1	3	3	1	1	1	0	1	Händel et al. 2015
WA 1930	n	292	111	0	0	2	7	2	5	0	49	22	21	0	0	0	0	0	0	0	0	0	Fladerer 2001
	MNI		28	8	0	0	1	2	1	2	0	6	5	3	0	0	0	0	0	0	0	0	Fladerer 2001

Tab. 3. Faunal remains (NISP and MNI) of occupation layer AH 4.4/4.3 and other Pavlovian contexts at Krems-Wachtberg (Fladerer 2001; Fladerer et al. 2014; Händel et al. 2015).

Tab. 3. Ostatky fauny (NISP a MNI) ze sídelní vrstvy AH 4.4/4.3 a dalších kontextů z období pavlovienu v lokalitě Krems-Wachtberg (Fladerer 2001; Fladerer et al. 2014; Händel et al. 2015).

Händel et al. 2015). The utilisation phases (not to be confused with the occupation phases) are defined by major alterations in the hearth's structure and allow for an approximate reconstruction of events: after the initial construction of a shallow pit, a fire was lit at least three times and put out at least twice. Three different (cooking?) pits were dug and used at different times, and the hearth was lined with flat stones at least twice. In addition, size and location of the hearth shifted between its phases of use. When the fire was put out or went out the first time, it was partly covered by archaeologically more or less sterile loess. This must have occurred after the embers cooled, because only the top of this sediment cover is baked, obviously from the later fire lit during the second phase of use. The second time the fire went out is not marked by sterile sediment but matrices and find compositions in the fill layers of the second and third phases are strikingly different. While the fill of the second phase is characterised by a brown ashy matrix, the third phase shows the reddish and much more compact structure of baked loess. It can therefore be concluded that it in fact represents not only a fill but at the same time the base of yet another phase of use, the actual fill of which was eroded (Händel et al. 2015). The degree of calcination is generally high among the faunal remains in the fills, suggesting high temperatures and prolonged exposure. This is particularly the case for the third utilisation phase. However, unburnt material is a component of all fills. This supports the observation that the fire must have cooled in between the burning events. This reconstruction suggests a duration of the occupation connected to AH 4.4/4.3 of not less than at least several days.

Another useful indicator for forming an image of the time depth of an occupation is seasonality. While Gravettian occupation of the Wachtberg promontory in general was not season-specific (Nývtova Fišáková 2013), the event represented by layer AH 4.4/4.3 provided evidence for one season only. This evidence, however, is very sparse, as it derives from a single specimen only, particularly when considering the size of the assemblage (Tab. 3). The carbonised ulna of a late foetal or newborn reindeer from the second utilisation phase of hearth 1 points to late spring or early summer (Fladerer et al. 2014). The sparse seasonality data is presumably connected to the nature of the faunal assemblage, as the great majority of the faunal remains are highly fragmented because the bones have been deliberately fractured, in particular the bones of large and medium-sized herbivores, apparently to access marrow and bone fats. While the vast majority of the fully burnt rib fragments, representing refuse presumably at least in

part resulting from rib meat consumption next to the fire, are concentrated inside hearth 1, waste from marrow extraction, i.e. unburnt and scorched limb bone flakes, are concentrated east of the hearth (Fig. 5).

In addition to hearth 1 and activities connected to the processing of hunted game, the chaînes opératoires of spatially defined activities can also be established for the infant burials. The burial of monozygotic twins (Fig. 3f) in particular is the result of a complex sequence of activities: the digging of the grave pit, the deposition of the first body, the application of red ochre, the sealing of the grave (probably already using the mammoth scapula), the re-opening of the grave, the deposition of the second body, the placement of the stringed ivory pendants, and finally the sealing of the grave with a mammoth scapula (Teschler-Nicola et al. 2020). Although the grave was not covered but instead backfilled, the single burial must have also demanded a complex sequence of activities (Einwögerer et al. 2006; 2008a).

Spatially delimited activities within occupation layer AH 4.4/4.3 are also evidenced by refittings of lithic artefacts (Thomas, Ziehaus 2014; Thomas et al. 2016, Thomas 2023). A compilation of all refit lines within AH 4.4/4.3 shows the highest concentration of short-distance refits immediately to the east of hearth 1 (Fig. 6). The concentration can be subdivided in two well-connected centres, located northeast and southeast of the main hearth. The area in which the refittings are concentrated is in accordance with the area of the highest sums of single lithic finds and débitage per square metre, and corresponds to the spatial distribution of recorded lithic single finds (Fig. 4). It does not, however, agree with the high density of lithics inside the hearth, where a comparatively low number of refittings are documented.

6. Connections between features and activity areas

Connections between activity areas and features in occupation layer AH 4.4/4.3 provide important information for an assessment of integrity, contemporaneity, and spatial organisation. A range of different types of connections can be attested between hearth 1 and the occupation floor, between the two hearths, and between hearth 1 and the burials.

We have already seen above that lithics and faunal remains show connections between different areas of the occupation surface, as well as between the occupation floor and hearth 1. In contrast to refittings of lithics, bone refitting has not yet been carried out systematically, as this is very time consuming

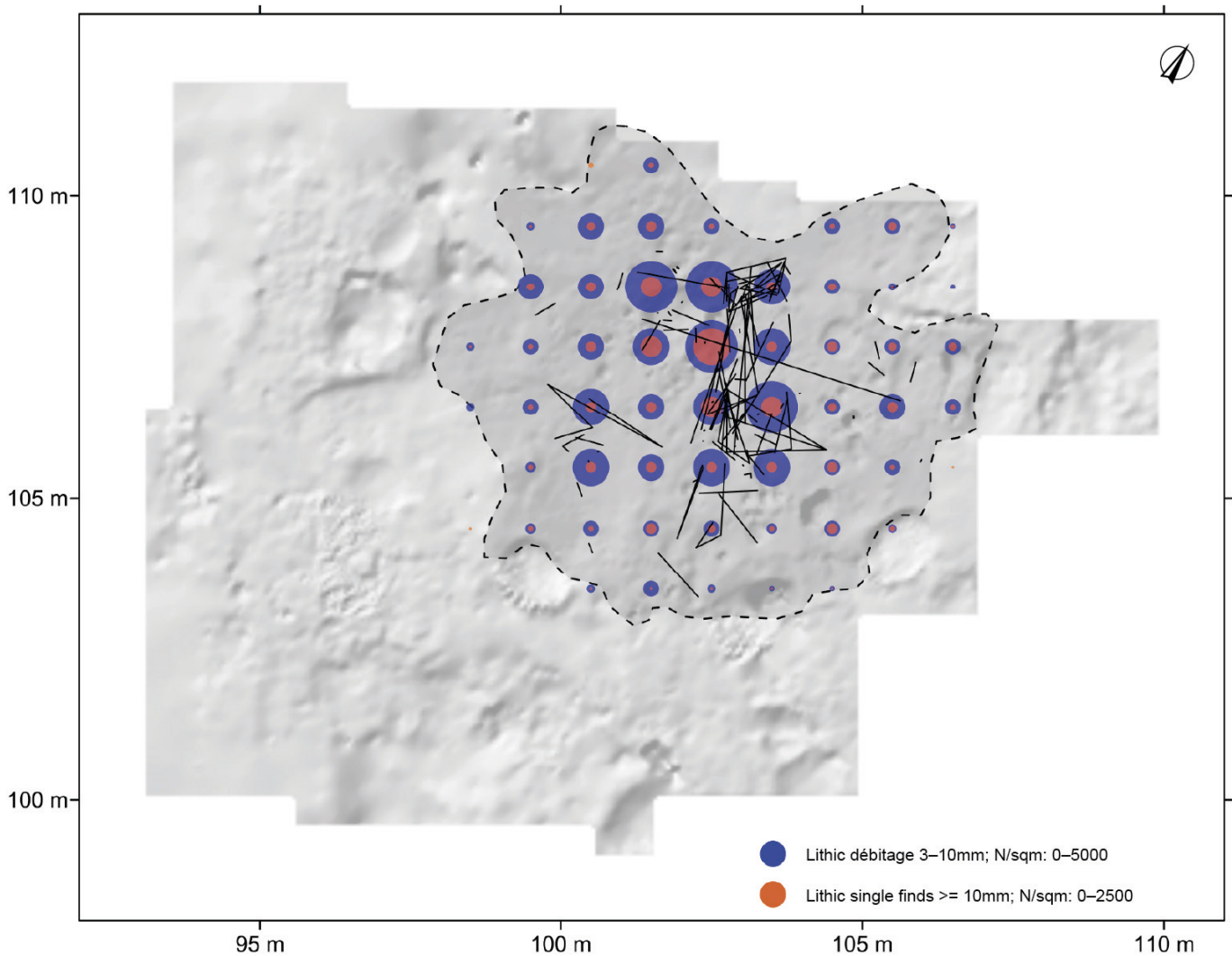


Fig. 6. Surface model of the excavated area at Krems-Wachtberg 2005–2015 and extent of AH 4.4/4.3 with lithic single finds and débitage quantified per m², and refit lines. Author M. Händel.

Obr. 6. Povrchový model zkoumané plochy v lokalitě Krems-Wachtberg 2005–2015 a rozsah vrstvy AH 4.4/4.3 s jednotlivými nálezy štípané industrie a debitáží s kvantifikací na m² a s liniemi zpětného skládání (remontáží). Autor M. Händel.

considering the high degree of fragmentation in the faunal inventory. It is therefore not possible to demonstrate a potential spatial pattern. One noticeable case, however, should be mentioned here: the refitting of two fragments of a horse pelvis (Fladerer et al. 2014), one of which is burnt and was recovered from hearth 1, while the unburnt part derives from the occupation floor south of the hearth (Fig. 7). Apparently, after removal and/or consumption of the meat, the pelvis was destroyed, perhaps to extract the marrow, after which part of the bone was disposed of into the fire and another was discarded onto the occupation floor.

Excellent charcoal preservation allowed for the construction of a floating dendrochronology of more than 500 years. Several subsets, i.e. groups of connected charcoal fragments, were established. It was not very surprising that multiple subsets include charcoal fragments from both hearth 1 and the surrounding occupation surface. Subset 12, however, also includes specimens from hearth 2 (Cichoński et al. 2014). In more detail, the subset includes charcoal fragments from the first utilisation phase of hearth 1, from hearth 2 (of which only the basal layer was preserved), from the occupation surface surrounding the hearth, and from AH 4.11, where post-occupationally redeposited material occurs.

Functional aspects and not refittings connect hearth 1 and the surrounding occupation floor with regard to the production of formed and fired objects made of sediment. A peculiarity of Pavlovian sites is the use of ceramic technology to produce anthropomorphic and zoomorphic figurines (Farbstein, Davies 2015; Svoboda et al. 2015). Gravettian sites of the Russian plain also exhibit this technology, but lack the production of figurines (Zheltova, Yanshina 2015). The sediment used for the production of ceramic objects at the Krems-Wachtberg sites and at Dolní Věstonice was of local provenance (Einwögerer 2000; Neruda et al. 2024). Both WA 1930 and WA 2005–2015 provided ceramic zoomorphic figurines as well as other formed fragments (Einwögerer 2000; Händel et al. 2009b). The sole zoomorphic figurine recovered from AH 4.4/4.3 was found beneath a stone plate at the base of hearth 1. In addition, nine other formed fragments were found in the same archaeological layer (Tab. 1), eight of which were found in hearth 1. Furthermore, dozens of amorphous angular fragments without clear forming traces, most probably fragmented débitage, have been found in and outside the hearth. It seems highly likely that the firing of these objects took place in hearth 1. A connection of this ceramic technology to hearth 1 is also suggested by the figurine's place of discovery beneath a stone at the base of the

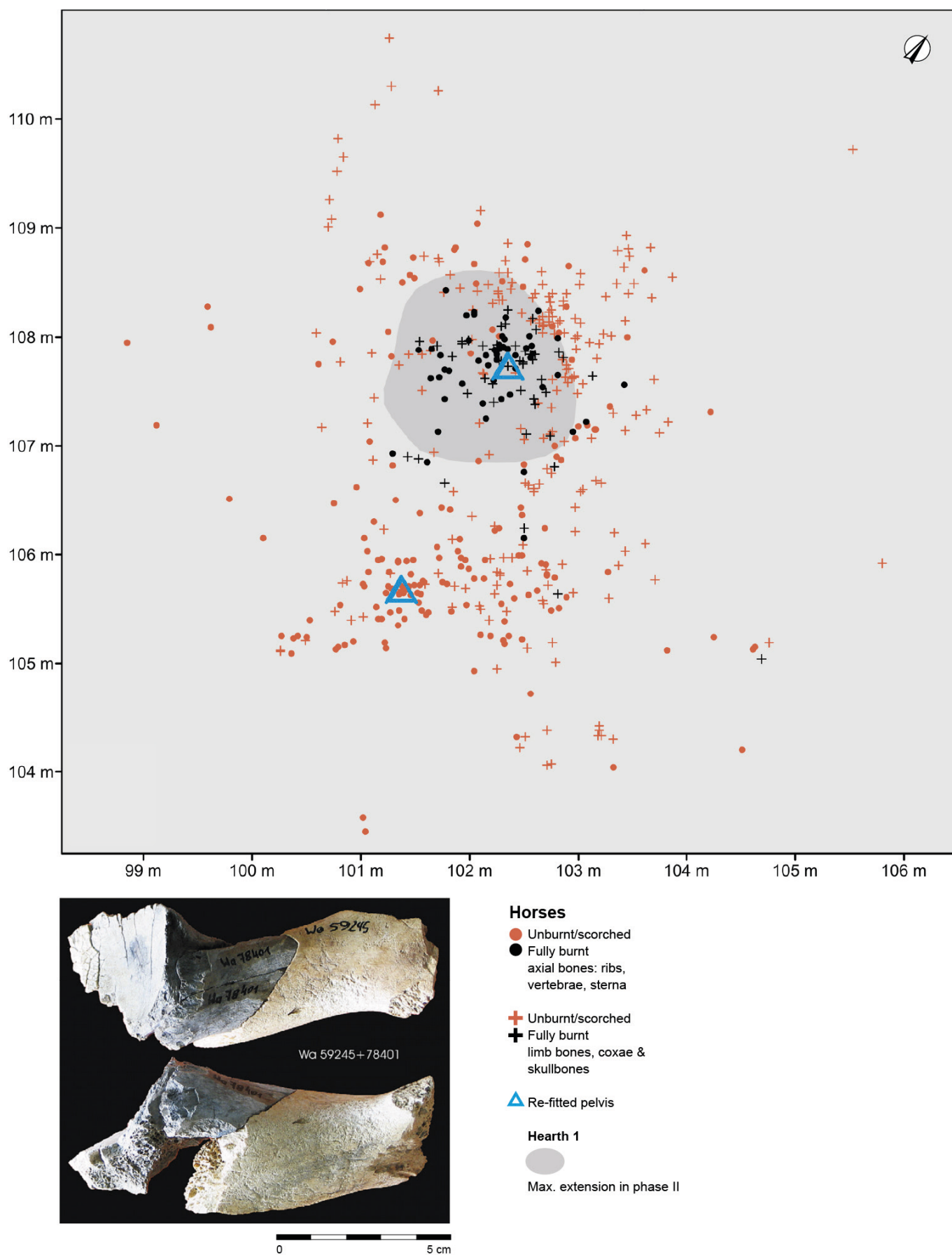


Fig. 7. Distribution of horse remains on occupation floor AH 4.4/4.3. Burnt horse remains are concentrated in hearth 1, and unburnt specimens to the south. A burnt fragment (from the hearth) and an unburnt pelvis fragment were refitted. Photo by Austrian Archaeological Institute of the ÖAW, graphic by M. Händel.

Obr. 7. Distribuce ostatků koně na sídelním horizontu AH 4.4/4.3. Spálené koňské ostatky jsou koncentrovány v ohništi 1, nespálené nálezy pak jižně od něj. Spálený úlomek (z ohniště) a nespálený fragment páne byly zpětně složeny (remontovány). Foto Österreichisches Archäologisches Institut der ÖAW, grafika M. Händel.

hearth, which indicates that it may have been deposited (Fig. 8B). Noticeably, a fragment of yet another, different mobile art object was discovered in the lower hearth fill: a burnt ivory fragment with incisions in a herringbone pattern (Einwögerer et al. 2008b). In this case, however, it must be assumed that the object was disposed of into the hearth. With the exception of oval-shaped ivory beads, which are restricted to burial 1, the most frequent forms of adornments, perforated animal teeth (exclusively fox and wolf) and ivory pins are distributed throughout AH 4.4/4.3.

A functional connection between hearth 1 and the burials is provided by red colour material (Neugebauer-Maresch et al. 2013; Cappa et al. 2019; Simon et al. 2019). In general, colours occur in great variety in AH 4.4/4.3, and include red, yellow, brown, white, and grey pigments. Best documented, however, are red colour materials, which range from raw material pieces to ground powder. Production is evidenced by hammerstones and stone slabs; application by objects made of bone and ivory showing colour traces. Applied red pigments are also represented by large amounts of powdered red colour in the infant burials.

Physical-chemical investigations (XRD, XRF, Raman spectroscopy) of a numerically and spatially representative portion of the colour samples demonstrated that the occurrence of red colour samples containing exclusively the mineral magnetite is bound exclusively to hearth 1, while specimens with only hematite are found throughout AH 4.4/4.3. Samples showing signals for both magnetite and hematite are also found everywhere but occur concentrated in the ground red colour material applied in the burials. It therefore seems likely that the red colour material was brought to the site in the form of hematite, which was partly transformed to magnetite in hearth 1, at a high temperature and under a reducing flame.

7. Discussion

Summarising what has been presented above, it can be stated that occupation layer AH 4.4/4.3 at Krems-Wachtberg was undoubtedly originally created by anthropogenic activities. With very few exceptions, e.g. loess snails, remains of a few intrusive small rodents, and some mineral components of granule to small

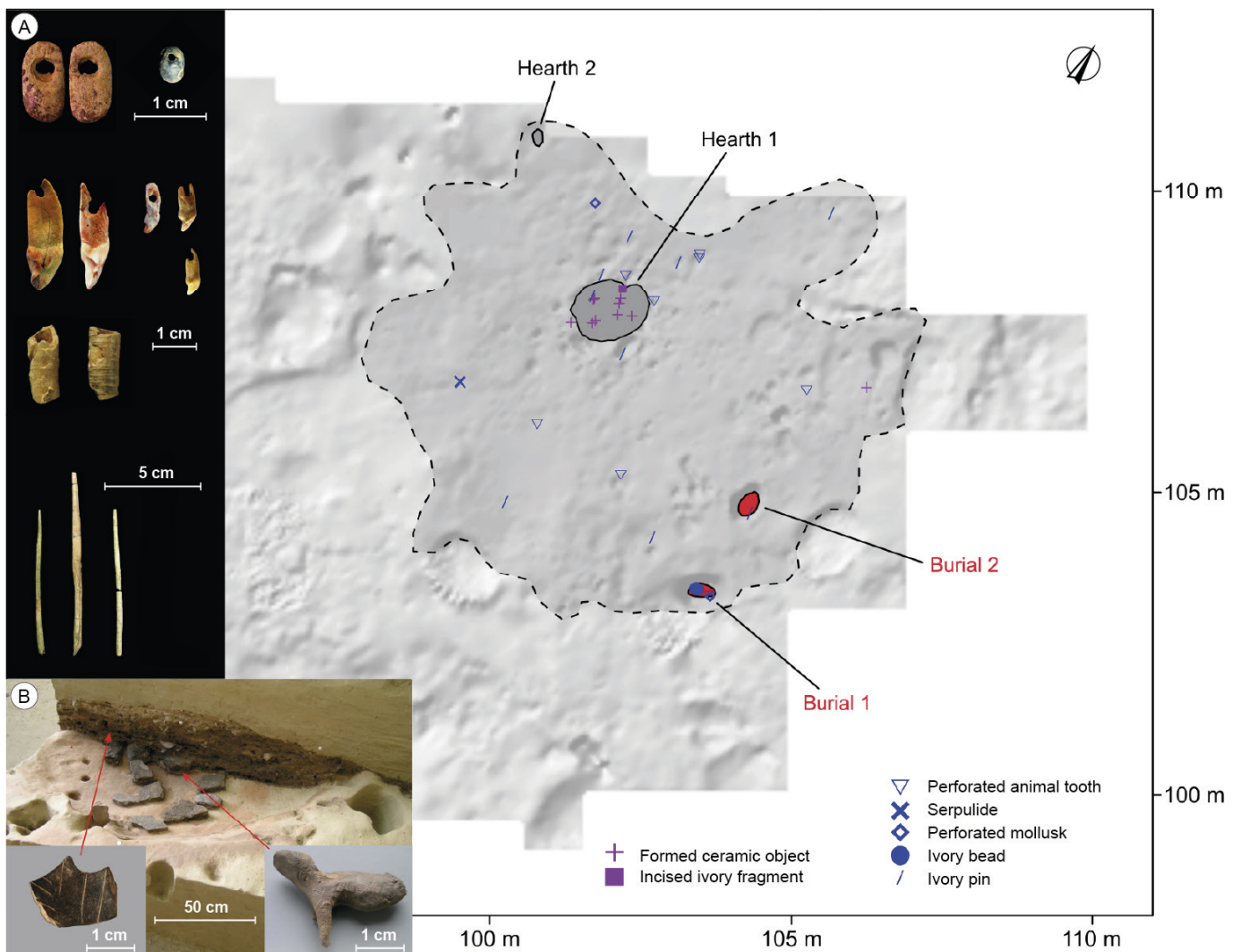


Fig. 8. Surface model of the excavated area at Krems-Wachtberg 2005–2015 and extent of AH 4.4/4.3 with distribution of adornments and mobile art. Ivory beads occur exclusively in burial 1 whereas formed ceramic objects are associated with hearth 1, with one exception. A – adornments include perforated objects, serpulids, and ivory pins. B – an ivory fragment with incisions and a zoomorphic figurine produced using ceramic technology were found in the lower utilisation phase of hearth 1. Photo by Austrian Archaeological Institute of the ÖAW, graphic by M. Händel.

Obř. 8. Povrchový model zkoumané plochy v lokalitě Krems-Wachtberg 2005–2015 a rozsah vrstvy AH 4.4/4.3 s distribucí ozdob a projevů umění. Korálky z klů se vyskytují výhradně v pohřbu 1, zatímco tvarované keramické předměty jsou s jednou výjimkou spojeny s ohništěm 1. A – ozdoby zahrnují perforované předměty, serpulidy (schránky rournatců) a jehlice z klů. B – fragment klu s vrypy a zoomorfní keramická figurka byly nalezeny ve spodní fázi využívání ohniště 1. Foto Österreichisches Archäologisches Institut der ÖAW, grafika M. Händel.

pebble size, all objects, i.e. inclusions in the sediment's matrix, were selected and transported into the camp by humans: complete and partial carcasses of hunting prey, lithic raw material including stone slabs and larger pebbles (Brandl et al. 2014; Thomas 2023), wood, colour material, mollusc shells, and fossils. Comprehensive activities carried out on site resulted in the modification of these objects by manipulation of their physical and/or chemical properties: knapping, cutting, scraping, crushing, carving, and of course burning. In a number of cases, target and semi-finished products are documented together with debris, allowing for the reconstruction of the relevant chaînes opératoires. These can be reconstructed not only for lithic tools (Tab. 4), but also for products made of mammoth ivory, in particular adornments, beads and pins (Fig. 8A) and art (Fig. 8B), but also tools such as projectile points, spatulas, and a punch, which occur with tusk fragments and ivory shavings. The production of intense red colour and extraction of marrow and fat from animal bones were discussed above. To some degree exceptional is only the production of ceramic figurines, because it is based upon locally available raw materials (see above).

In addition, the occupation layer also displays constructed features. Foremost, these include the hearths, in particular hearth 1, for which a shallow pit was dug and which exhibits tiling with stone plates, as well as the burials, which show not only dug pits but also a more elaborated grave architecture in the case of the twin burial where the grave pit was sealed by a mammoth scapula. Other constructed features include a range of pits and postholes, some of which are connected to hearth 1.

Although the occupation layer is truncated and therefore obviously incomplete, integrating the evident anthropogenic features with large find objects and activity zones provides a basic understanding of the camp's spatial organisation (Fig. 9). Analyses of faunal remains and the chipped stone assemblage determined the main zones of lithic production, horse butchering, and marrow and/or fat extraction. The latter activity is supported by the presence of two large objects (Fig. 3e): a stone plate, hypothesised to have served as a working slab or anvil for bone fragmentation, and the proximal part of a mammoth ulna with impact marks suggesting that the extraction process was

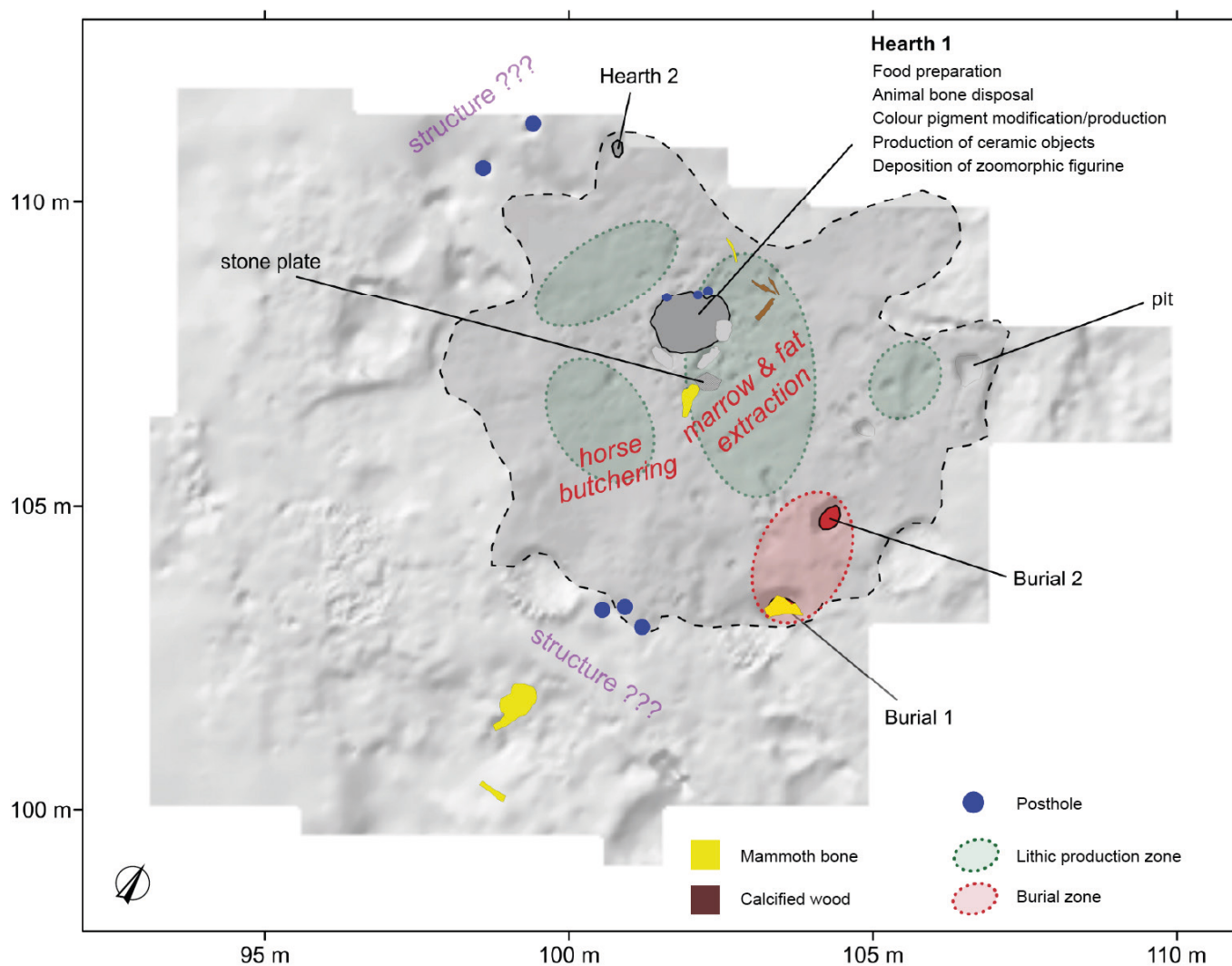


Fig. 9. Surface model of the excavated area at Krems-Wachtberg 2005–2015 and extent of AH 4.4/4.3. Shown are all evident anthropogenic structures (burials, hearths, pits and postholes) and large finds (mammoth bones, calcified wood, a stone slab) from the occupation layer and surrounding AH 4.11. It is highly probable that the postholes outside of AH 4.4/4.3's limits are connected to the same occupation. It is also likely that the mammoth skull did not move much from its original position, and is therefore also connected to the same occupation. Author M. Händel.

Obr. 9. Povrchový model zkoumané plochy v lokalitě Krems-Wachtberg 2005–2015 a rozsah vrstvy AH 4.4/4.3. Zobrazeny jsou všechny zřetelné antropogenní objekty (pohřby, ohniště, jámy a kůlové jamky) a velké nálezy (mamutí kosti, kalcifikované dřevo, kamenná deska) ze sídelní vrstvy a okolní vrstvy AH 4.11. Je vysoce pravděpodobné, že kůlové jamky mimo hranice vrstvy AH 4.4/4.3 souvisejí se stejným osídlením. Je také pravděpodobné, že se mamutí lebka příliš nevdálila od své původní polohy, a proto rovněž souvisí se stejným osídlením. Autor M. Händel.

Context	N > = 1 cm	Modified	Gravette points	Point	Microgravette	Micродenticulate	Microlith	Backed bladelet	Pointed blade	Endscraper	Burin	Truncation	Retouched pieces	Notched piece	Combination tool	Splintered piece	Discard	Scraper	Dufour bladelets	Reference
WA-AH 4.4/4.3	9169	121	1	1	6	6	3	27	0	14	14	9	30	3	3	1	3	0	0	Thomas 2023
WA-AH 4.11/4.01-4.22	34008	684	11	6	24	22	7	105	4	45	113	65	245	14	8	4	11	0	0	Thomas 2023
WA 1930	1582	133	1	0	11	2	0	12	0	4	10	10	66	6	0	0	0	1	11	Einwögerer 2000

Tab. 4. Chipped stone artefacts of occupation layer AH 4.4/4.3 and other Pavlovian contexts at Krems-Wachtberg (Einwögerer 2000; Thomas 2023).

Tab. 5. Štípané kamenné artefakty ze sídelní vrstvy AH 4.4/4.3 a dalších kontextů z období pavlovienu v lokalitě Krems-Wachtberg (Einwögerer 2000; Thomas 2023).

not terminated. The close proximity of the two burials suggests a burial zone. Hearth 1 displays comprehensive insights in diverse and highly complex activities: food preparation and the disposal of animal bones, the production of high-intensity red-colour material, the production of figurative ceramic objects, and the deposition of a zoomorphic ceramic figurine. Food preparation is suggested by the three pits along the hearth's east edge. Three larger pieces of calcified, i.e. unburnt, wood north of the hearth probably represent unused fuel. A tusk fragment to the west of the wood can be interpreted as unused raw material for the production of tools or ornaments. Unfortunately, little can be said about hearth 2 because the occupation layer is highly eroded here, so that only its base was preserved. It seems, however, that the hearth, unlike hearth 1, lacks the placement of stone slabs at its base, but it is unclear how much of the hearth is missing. It therefore remains unknown whether it functioned as a satellite to hearth 1 or had a high degree of complexity of its own, potentially with a different range of functions.

In total, more than two dozen small pits have been documented around hearth 1. Most of these do not qualify to be interpreted as intentionally dug: some look more like drip holes, other are probably crotovinas. Three small postholes (diameters 5–15 cm; depths 8–15 cm), however, include remains of wedges or burnt posts and run in a line along the northwest edge of the hearth. This suggests the former presence of a small superstructure such as a windscreen or smoking rack. Small pits in the immediate vicinity of hearths have been observed at more or less contemporaneous sites, like Grub-Kranawetberg (Antl-Weiser 2008) and Zaraysk (Lev 2002). While their interpretation is unclear at Grub-Kranawetberg, the features at Zaraysk can be interpreted as postholes based on regular morphology and an inclination towards the hearth. Tentatively, they could therefore support the idea of a smoking rack. At Krems-Wachtberg, the posthole positions suggest an alternative interpretation: they could also have supported a small windscreen, based on their position northwest of the hearth, and analyses of the silt particle orientation in the loess, which show a clear preferential northwest to southeast direction of the lineation supporting prevailing winds from the northwest (Zeeden et al. 2015).

Two pits with sizes similar to the burial pits and the presumable cooking pits at hearth 1 (max. extent 30–45 cm) are located in the northeast part of the preserved occupation layer on either side of a lithic production zone. Context and finds provide no indication of a potential function. Due to comparatively large sizes, it can be practically ruled out that they operated as postholes. Postholes with dimensions (diameters 10–20 cm; depths 12–20 cm) theoretically capable of securing posts large enough to carry a more substantial construction were only recorded at the fringes of and outside the occupation layer. Attribution to the same occupation as represented by AH 4.4/4.3

seems likely based on the composition of their fills, given that the top parts of the postholes were truncated by post-occupational sedimentary processes. Taking their positions on the slope into account, this appears plausible, based on the formation model.

The features most likely to be postholes are grouped in two sets: two are located west of hearth 2, and three very close together in the southern part of the excavated area. Noticeable is the proximity of the latter to an almost entirely preserved mammoth skull. The size and weight of the skull suggest that it was probably not moved (much) by post-occupational slope processes. The skull can therefore be taken as an indicator of the minimal extent of the original occupation surface to the south. Furthermore, refits of lithics between AH 4.4/4.3 and AH 4.11 under consideration of the natural slope to the south and southeast indicate that the occupation surface extended farther to the west and southwest, most probably beyond the limits of excavation.

Given the preserved occupation layer's extent and lack of postholes in AH 4.4/4.3, it is highly unlikely that a superstructure requiring postholes could have extended across the entire preserved occupation layer. Such a structure would have had to span almost 10 m. Preliminary interpretations of the occupation layer at an early state of excavation had still considered the possibility that AH 4.4/4.3 represents the remains of an inside space, i.e. a dwelling (e.g. Händel et al. 2008). This initial interpretation was based on the excellent state of preservation and on the observation in a profile that the area may have been intentionally levelled (however, this observation could not be confirmed by excavation). The initial interpretation also relied on published observations made at contemporaneous Pavlovian sites in south Moravia such as Dolní Věstonice II and Pavlov I describing round- to oval-shaped features with hearths and/or find concentrations, both in depressions or on flat surfaces, with diameters of 4–6 m and sometimes marked by postholes or pits in circular arrangements. These structures were referred to as settlement units or more neutrally as depression features, and often interpreted as dwellings (e.g. Svoboda 1991; 2005; Klíma 1995; 1997a).

Some Pavlovian sites also have large (up to 0.5 m in size) spatula- or shovel-shaped objects made of mammoth bones that have been interpreted as tools used for digging (Klíma 1997b), although Brühl (2005) reports an absence of specific use traces. On the other hand, the morphology of some of the pits at Krems-Wachtberg does indeed suggest the use of such tools (Fig. 3d). Experiments demonstrated that such tools can be used for digging pits, and also for extracting grass sod. Based on the considerations that large quantities of hides would be required for covering a superstructure such as a tent or yurt, a dwelling type often reconstructed for Upper Palaeolithic sites, and that it is hardly plausible that such a high number of hides could have

been either transported over longer distances, or otherwise acquired in a short period of time by hunting, Einwögerer and Händel (2004) suggested the construction of a dwelling that does not require postholes and is made of an easily available and ubiquitous material: grass sod. Experimental reconstruction was carried out with a school class at the Niederösterreichisches Landesmuseum für Urgeschichte (MAMUZ Schloss Asparn/Zaya) in Lower Austria in 2003. Despite encountering a range of technical difficulties, the experiment demonstrated that the construction of a grass sod dwelling is feasible with the tools represented at Pavlovian sites, and that this can be accomplished within a realistic timeframe of only a few days. In order to support this idea, however, the archaeological record should show a shallow mound of allochthonous sediment, or remnants of it, atop an occupation layer, together with clear boundaries around it. This is not documented for Krems-Wachtberg and, according to the author's knowledge, neither for any other Upper Palaeolithic site. Grass sod dwellings in the Upper Palaeolithic, although technically feasible, remain without support.

The record thus suggests that the occupation layer most probably does not represent the inside of a dwelling. Even when considering the postholes in the southeast and west, a superstructure spanning the entire extent of the occupation layer would not be feasible without the use of one or more central posts stabilised by postholes. At the same time, there is no evidence for a free-standing construction: no allochthonous sediment atop the occupation layer and no structural elements such as large bones in the required quantity or meaningful arrangement. In addition, no latent dwelling structure can be reconstructed from the finds' distributions because AH 4.4/4.3 is truncated by post-occupational periglacial processes. Dwellings could therefore only have been located outside of the preserved occupation layer. The postholes identified to the west and south, the latter group with a mammoth skull nearby (Fig. 9), may suggest the former presence of superstructures of some kind. However, due to the limited preservation, this evidence allows only cautious speculation. Any hypothetical reconstruction of a dwelling would remain untestable and is therefore not pursued here.

Dwellings may have been located in other parts of the Wachtberg area, or they may not have been present at all. Alternative forms of shelter are also conceivable, particularly solutions that would have been effective in maintaining body warmth even under winter conditions. One possibility is the use of sleeping bags or bivouac-like coverings, which would have been economical and compatible with a highly mobile lifestyle. However, when considering the infants in the burials, especially the child who survived for three to four months and exhibited signs of poor health (Teschler-Nicola et al. 2020), it appears highly unlikely, at least from a modern perspective, that an infant could have survived several months during winter or early spring under stadial conditions without the protection of a more substantial habitation structure.

8. Conclusion

The Krems-Wachtberg record suggests that occupation layer AH 4.4/4.3 most likely represented an outdoor space, as there is no evidence indicating that it was enclosed within a dwelling. Consequently, all activities documented in this layer appear to have taken place in the open. This is remarkable, as the assemblage seems to encompass the full range of activities potentially represented by the material culture of this period, including both profane and symbolic practices. These activities show a spatially discrete distribution and can be attributed to different zones (Fig. 9).

The highest intensity, complexity, and diversity of activities are connected to Hearth 1 and its immediate surroundings. Spatial interpretations should consider that the occupation layer becomes increasingly truncated toward its edges (Fig. 3), a process that results in a progressive reduction of information at the margins. However, the distributions of faunal remains and lithic artefacts (Fig. 4), and particularly of ornaments (Fig. 8), indicate that the substantial loss of information likely affects only the outermost c. 0.5 m of AH 4.4/4.3. Despite this reduced information, the available data still allow the anthropogenic features located at the periphery, most notably burial 1 and hearth 2, to be connected with activity areas in the central part of the occupation layer.

Spatial differentiation is most evident in the burial zone, where an overlap with other activities is minimal. It is also notable that all three individuals were facing east. In the double burial, however, the infants' heads were positioned to the north, whereas the third individual in burial 2 had its head oriented to the south. Whether this orientation was intended to have the individuals facing towards something, such as the rising sun, or away from something, e.g. the activity areas of the living, cannot be conclusively determined. Nevertheless, it is clear that directional orientation was considered meaningful and likely played a role in structuring the spatial organisation of the camp.

Overall, the well-defined spatial patterning observed in occupation layer AH 4.4/4.3 suggests a duration of occupation that was long enough for this complex organisation to develop, yet not so prolonged that it was obscured by substantial spatial shifts in activity areas. Following this reasoning, repeated occupations can be regarded as highly unlikely for layer AH 4.4/4.3. Instead, the three utilisation phases identified for hearth 1 are better interpreted as an expression of internal complexity within a single occupation event rather than evidence for multiple occupations.

When considering all Pavlovian contexts documented in the Wachtberg area, namely Krems-Wachtberg 1930 and Krems-Wachtberg 2005–2015, or the local Early Gravettian occupation more broadly, it becomes evident that the pattern of sites and archaeological layers can only be explained as the result of multiple occupation events. The presence of a superordinate social system underlying these repeated occupations, at least for the Pavlovian contexts of the Wachtberg area, is suggested by site-specific and regional intra-site comparisons. This is suggested not only by the material culture associated with both profane and symbolic activities, but also by the results of ancient DNA analyses conducted on the human remains (Fu et al. 2016).

Since the regional archaeological record does not indicate a decline in human occupation during the later Pavlovian, the absence of an Upper Palaeolithic presence in the Wachtberg area after occupation phase III can most plausibly be explained by changing social preferences.

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Resumé

Studie se zaměřuje na prostorovou organizaci gravettské sídelní vrstvy na lokalitě Krems-Wachtberg (Dolní Rakousko; obr. 1), zkoumané v letech 2005-2015, která náleží k ranému horizontu pavlovienu a je chronostratigraficky zařazena do mladší fáze gravettien v intervalu přibližně 33500-31000 cal BP (obr. 2). Lokalita je mimořádně významná nejen objevem dvou dětských pohřbů, ale především zachováním *in situ* sídelní plochy propojující pohřby s dalšími jednoznačně identifikovatelnými strukturami, jako jsou ohniště, jámy a křulové jamky (obr. 3; 4). Tyto kontexty, spolu s bohatým archeologickým a bioarcheologickým materiálem, dokládají široké spektrum každodenních i symbolických aktivit.

Nejvyšší intenzita a diverzita činností byla soustředěna v okolí centrálního vícefázového ohniště 1, které představuje zásadní organizační prvek sídelní plochy (obr. 4; 9). Analýzy distribuce štípané industrie, jejích skládanek a pozůstatky zvířecího osteologického materiálu prokazují existenci funkčně diferencovaných zón, včetně dílenských prostorů a míst pro zpracování kořisti a extrakce tuku a morku (obr. 5-7). Výrazně oddělenou oblast tvoří pohřební areál se dvěma dětskými hroby, jejichž konečná podoba byla výsledkem komplexních rituálních sekvencí zahrnujících opakované otevření hrobu a použití červeného barviva (obr. 3f, 8).

Sídelní vrstva AH 4.4/4.3 byla částečně redukována postdepozicičními sedimentárními procesy, zejména periglaciálními svaňovými jevy a eolickou akumulací, které vedly k její fragmentaci a překrytí redeponovanými sedimenty (obr. 3). Tyto procesy jsou zároveň zodpovědné za mimořádně dobrý stav zachování lokality. Přestože část archeologického záznamu byla zřejmě ztracena, dochovaný segment umožňuje detailní analýzy.

Důležitým závěrem je absence dokladů pro existenci nadzemní obytné struktury v rámci zachované plochy. Distribuce struktur i nálezů nenaznačuje přítomnost obydlí, a proto je pravděpodobné, že veškeré identifikované aktivity probíhaly v otevřeném prostoru. Případné obytné struktury mohly ležet mimo hranice dochované vrstvy (obr. 9).

Celkové prostorové uspořádání nálezů ukazuje na jednorázovou, relativně krátkodobou, avšak intenzivní sídelní epizodu, během níž se rozvinula komplexní organizace prostoru zahrnující jak subsistenční, tak symbolické činnosti. Lokalita Krems-Wachtberg tak představuje klíčový pramen pro poznání sídelních strategií a sociální organizace populací pavlovienu ve středodunajské oblasti.

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