Journal of Paleolithic Archaeology (2024) 7:24
https://doi.org/10.1007/s41982-024-00188-w

RESEARCH

A Possible Depiction of a Woolly Rhino from the Late Magdalenian Hunting Camp of Bad Kösen-Lengefeld in Central Germany

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Accepted: 15 July 2024

Abstract

In Central Germany, rhino images were engraved on stone objects during the Magdalenian period, before the global extinction of the woolly rhino around 14,000 cal BP. Our recent excavations, at the Magdalenian open-air settlement site of Bad Kösen-Lengefeld, added to this record, yielding a limestone slab with a presumptive rhino portrait from an exactly stratified, thoroughly documented and well-dated cultural context. Here we present the unique limestone slab with an engraved animal image, unusual because of the head omitted, but — by contrast — aspects of the rear expressed in detail. During the excavation, the limestone slab was found related to a dwelling structure marked by postholes grouped around a central fireplace. Reindeer and horse were hunted close to, and killed at the site, and ice foxes were exploited for their furs. ^{14}C-samples collected from all parts of the settlement attest for a short period of occupation(s) around 15,350 ± 50 cal BP making the rhino portrait one of the latest of its kind, eventually documenting the last sightings of woolly rhino in general, by humans. Moreover, its found context would make this animal portrait a fixture in Magdalenian style chronology.

Keywords Magdalenian culture · RTI imaging · Woolly rhinoceros · Palaeolithic art · Upper Palaeolithic

Introduction

The Eurasian woolly rhino (*Coelodonta antiquitatis*, Blumenbach 1799) achieved its highest population density c. 40,000 years ago, during a moderate phase between the two cold maxima of the last glacial, and the rhino population decreased afterward (Puzachenko et al., 2021). When the last glacial had reached its maximum about 26,000 years ago, the woolly rhinos must have been locally extinct, or they emigrated to the south-west and to the south-east of Europe, because the permafrost areas north of the Alps and in the central mountains were not any more supporting enough pasture to feed large mammals. The period, when most of central Europe became uninhabitable, continued until 19,000 years ago (Maier, 2015). Soon after, human and large mammal resettlement started from south-western and south-eastern Europe (Maier, 2015; Bortolini, et al., 2020). Rare finds of woolly rhinos belong to this pioneer period. The pioneer rhino population which had resettled in central Europe did not persist for a very long time and disappeared around 14,500 years ago (Fahlke, 2009; Lord et al., 2020; Lorenzen et al., 2011; Roca, 2020). Only 500 years later, the woolly rhino became globally extinct when it disappeared from its last refuge in central Siberia (Puzachenko et al., 2021; Rey-Iglesia et al., 2021; Stuart & Lister, 2012).

From the very beginning of Palaeolithic art, woolly rhinos have attracted artists' attention (Braun & Zessin, 2009; Clottes, 2010). The earliest set of cave paintings in France, at Grotte Chauvet (Clottes, 2001), appears to contain many rhino images, and its African counterparts, painted limestone slabs from Namibia's Apollo 11 cave, also feature rhino depictions (Vogelsang, 1998). Since parts of the rhino skeleton occur very rarely among faunal inventories, neither the European woolly rhino nor the African black and white rhinos were supposedly hunted at the time when these early

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Published online: 16 August 2024

Fig. 1 Bad Kösen-Lengefeld. Engraving of an animal, probably a woolly rhino. Detail from limestone slab ID 18398 (see Figs. 2 and 3; photo: courtesy © Archäologisches Landesmuseum Sachsen-Anhalt, J. Lipták)

images were produced, between 40 and 30,000 years ago. Later on, three-dimensional figurative representations of the woolly rhino occurred in the Gravettian period (Braun & Zessin, 2009) and eventually connected with the first invention of fired clay. At the present state of research, the Gravettian period features as the main time range when woolly rhino became an occasional hunting prey. During the Gravettian, humans mastered regular hunts of megafauna, as most notably and much more frequently, mammoth kills have been attested for Gravettian sites (see Nývltová-Fisáková, 2000).

The end of the Gravettian coincided with the Last Glacial Maximum when Central Europe became void of human occupation. Later on, humans returned to Central Europe during the Magdalenian period (Feustel, 1974, 1980; Höck, 2000; Küßner & Jäger, 2015) and abundant rhino images occurred in mobile art (Braun & Zessin, 2009). Though some depictions have also been found in the Central German Magdalenian (Braun, 2018), the rhino appears to have been excluded from hunting prey during this time range (Küßner, 2010; Pasda & Pfeifer, 2019). Recently, we excavated a limestone slab with a very unusual rhino depiction at the late Magdalenian site of Bad Kösen-Lengefeld in Central Germany (Richter et al., 2021; Uthmeier & Richter, 2012).

Materials and Methods

Archaeological Excavation

The large limestone slab bearing the possible rhino image (Figs. 1–4) was found by the archaeological excavation team on 19 August 2015, in square Q56/33 and on Planum 2.2.1. At the moment of excavation, the finely engraved image remained invisible, hidden by the dust still covering the surface of the slab (Fig. 5). As it turned out after cleaning, the upside surface of the slab displayed an engraved image (Fig. 1). Because, during excavation, all limestone slabs must be expected to possibly yield engravings, the slabs were all processed in the same careful way

Fig. 2 Limestone slab ID 18398, found 2015 in square 56/33b of the Bad-Kösen-Lengefeld Magdalenian settlement site (photo: Florian Sauer, University of Cologne)

during excavation. All slabs were superficially dry brushed in situ, photographed as part of a planum map and located in a 3D positioning system by several data points. After its contour line was taken, we removed the slab from the sediment, the lower side carefully dry brushed and the piece bagged and labeled. After excavation, we carefully washed all slabs in pure water to guarantee the best preservation of the original surfaces. Thousands of slabs are to be processed, and slabs have happened to be inspected in detail some years after excavation, in this case, inspection and drawing of the slab were completed by 6 July 2018 (Fig. 3). Excavations ongoing until now have allowed us to collect more information about the neighbourhood of the rhino slab in 2019 and 2021 (Fig. 5) and about the age of the Magdalenian settlement (Fig. 6).

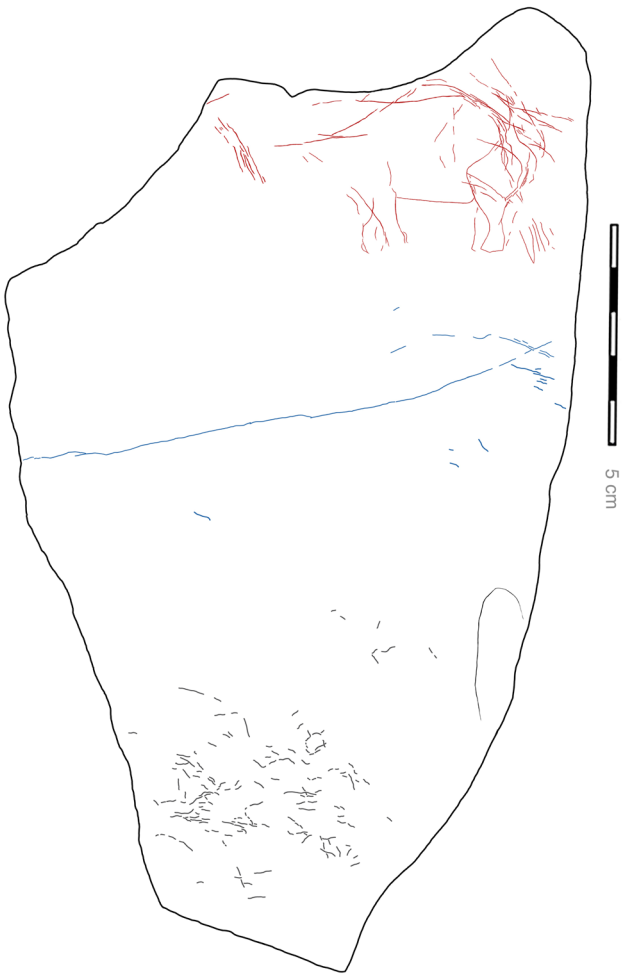


Fig. 3 Bad Kösen-Lengefeld. Sketch of engraved lines possibly representing a woolly rhino (red) and further, yet unidentified motives (blue). Black lines represent natural scratches and fissures. Object ID 18398, size 25×15 cm, indicated scale 3 cm (sketch: Anja Rüschmann, University of Cologne)

Local Find Context

A Cologne-Erlangen team has carried out archaeological research at the Magdalenian open-air site of Bad Kösen-Lengefeld (Saale River Valley) since 2008 (Richter et al., 2021; Uthmeier & Richter, 2012). Surveys and corings indicated the settlement area covering 110 m^2 in total. Excavations uncovered so far 91 m^2 (Fig. 5) of what is now the upper occupation horizon, since a second, very limited lower occupation surface occurred during the 2017 excavations.

The geological sequence comprises 9 m of pure loess (bottom not yet known), with two archaeological horizons in the upper 0.4 m of the sequence (see Uthmeier & Richter, 2012). Whereas the lower archaeological layer seems to appear within one primary deposition phase of loess, the upper (main) archaeological layer is interlacing with a series of thin solifluction horizons, separating the lower and the upper layer by 30–40 cm of mostly reworked loess and sandy loess. Still, the archaeological remnants of the upper (main) layer appear as preserved in the primary position, with hundreds of limestone slabs brought in by humans and representing former settlement features. The primary position of the preserved structures, however, does not imply the completeness of all remnants. A certain lack of small pieces indicates the smaller fraction of lithic finds to have been over-proportionally discharged by low-energy sheet flow events (Richter et al., 2021).

The following observations concern the upper (main) layer (Fig. 5): The northern area of the site (several horse hunting episodes) comprises one well-preserved feature, partially connected with traces of charcoal. Three further stone scatters are visible at the outermost northern periphery, possibly from an earlier occupation phase which would have been exploited by later occupants in order to set up the aforementioned, well-preserved feature of almost quadrangular shape. The northern area of the excavated site displays mostly horse remnants, with parts of the skeletons in anatomical connection. The horse bones indicate on-site killing and dismembering of the animals. Based on the different states of preservation of the stone scatters or structures, we are dealing with one “early horse” and one “late horse” occupation phase at the present state of research (Richter et al., 2021).

The central area of the site shows three more well-preserved stone features (Fig. 5). At the south-eastern corner of the central feature, we excavated a complex fireplace (feature 15), consisting of a shallow pit with some quartz pebbles, covered by a large limestone slab bearing about a dozen of quartz pebbles and then surrounded or covered by further limestone slabs. The central feature is surrounded by something like 30 postholes attesting that a tent had been set up here and was possibly renewed three to five times, given that six to ten postholes were freshly dug for each new tent. In the same area, the

predominant animal prey included horses and reindeer along with many ice foxes, indicating the preferred acquisition of these animals and possible use of their furs.

The southern area (one reindeer hunting episode) is particularly interesting because of one large concentration of limestone slabs, stone tools (many backed bladelets and burins) and reindeer bones (Richter et al., 2021). The representation of body parts would again indicate on-site killing and dismembering of the animals, as already mentioned for the northern area. By contrast, bone preservation is much better in the southern than in the northern area. The space intermediate between the central and southern areas yielded a surprisingly large number of engraved limestone slabs, at least five of them with multiple lines and motives.

Radiocarbon Measurements

According to more than 20 ^{14}C-dates produced from the site (Fig. 6), the principal occupation (upper layer) took place around 15,350 cal BP and would place the Bad Kösen-Lengefeld site into the consolidation phase of the Central European Magdalenian (Magdalenian V), about 500 years after the expansion phase (Jöris, 2021; Küßner, 2010; Küßner & Jäger, 2015; Maier, 2015). The above-mentioned lower layer produced three dates of the same age. There are no differences between the southern (5 values) and northern area (2 values), but dates from the central area (12 values) show a somewhat broader range, beginning with 15,500 cal BP and ending with 15,000 cal BP. This might reflect the redeposition of sediments, caused by humans digging pits and by post-occupational refill of the pits. This would mean that the occupation surface (or parts of it) remained exposed for as long as 350 years before solifluction sediments buried the surface. Consequently, the above-mentioned occupation episodes (1) early horse, (2) late horse and (3) reindeer (three episodes at minimum) would outperform the resolution currently achieved by ^{14}C measurements. Currently, the rhino depiction cannot be tied to one of these occupation phases, and we would estimate 15,350 cal BP as the most probable absolute date connected to the depiction.

RTI Imaging of the Rhino Depiction

In order to capture the intricate detail of the engraving, we decided to capture the rhino image with reflectance transformation imaging (RTI). RTI designates a multi-imaging technique using photos of an object taken from a static position with variable lighting. Each photo shows the object at constant position but illuminated from a different direction. These photos get processed into one single digital image file, in which the user can interactively re-light the object from any direction with the help of viewer software (Duffy et al., 2013; Earl et al., 2010). The advantage of this technology is not only the possibility to interactively re-light the digital image of the object but also to apply certain filters that rely on the calculated normals (perpendicular vectors to the objects' topography) to make the slightest details visible.

To achieve the best results, we used a RTI-dome, a closed hemisphere with pre-installed LED lights, with a diameter of 50 cm to completely exclude any ambient light. We combined the RTI-dome with a mirror-less Nikon Z7 camera,

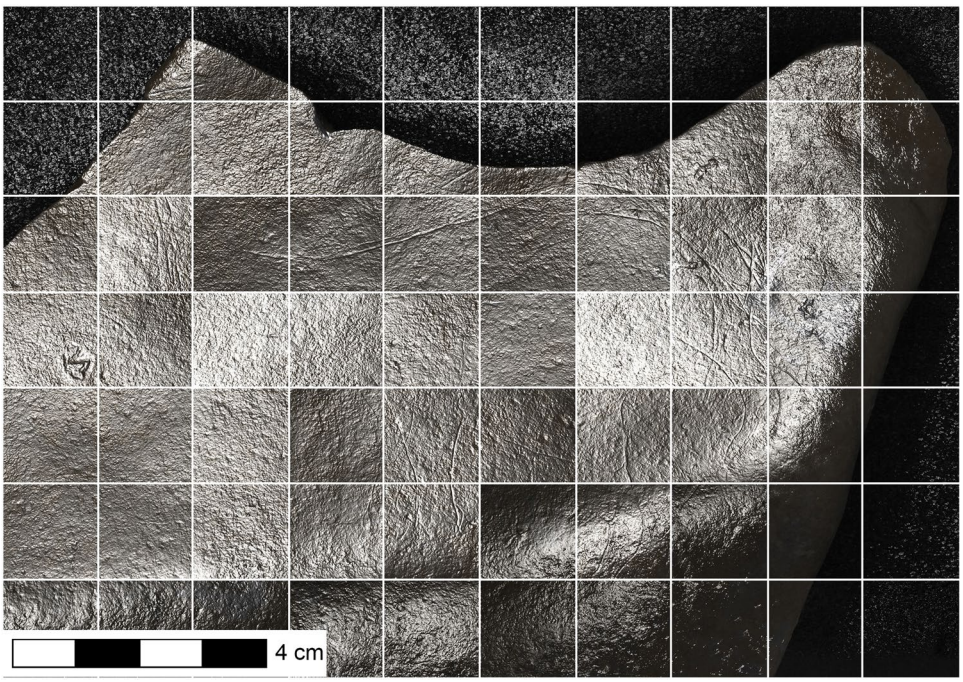


Fig. 4 Bad Kösen-Lengefeld. The same detail as Fig. 1, here taken by RTI imaging system, specular enhancement function in 70 single views, combined (RTI image: Sebastian Hageneuer; processing Sebastian Hageneuer, Florian Sauer, University of Cologne). RTI dataset available at: https://doi.org/10.5281/zenodo.8132815 © Sebastian Hageneuer 2023

equipped with a 50-mm Nikkor lens. A mirrorless camera can drastically reduce the vibration while taking photos. The 50-mm lens can minimize the distortion of the resulting images. For each dataset, 64 photos were taken, colour-corrected and then processed in the RTIBuilder (v2.0.2) software offered by Cultural Heritage Imaging. We produced four datasets: a complete recording of the slab and three detailed datasets of the rhino itself.

The detailed datasets of the rhino showed the best results, given the delicacy of most of the engraving, and certain lines becoming only visible when changing the direction of the light within the viewer software. Additionally, we overlayed a specular enhancement filter and combined different views into one single image, which shows the complete engraving very clearly (Fig. 4). The detailed documentation by reflectance transformation imaging has since substantiated that recording of the smallest details on palaeolithic limestone slabs can be achieved, resulting in detailed visualizations of delicate engravings otherwise hard to detect.

Discussion

The Bad Kösen-Lengefeld rhino depiction is unique (Fig. 3), particularly because of the most prominent decisive feature of *Coelodonta antiquitatis*, the two horns, completely lacking, and the whole animal appears without any head and neck. By contrast, the artist described the rear of the animal in particular detail. Generally, the perspective would appear as side-face, two-dimensional and plain, and the third dimension is only indicated by the animal's right hind leg partially cut by the left hind leg. This is to evoke the impression of the left hind leg closer to the reader and the right hind leg behind it. The headless animal appears slowly walking from right to left, its tall trunk and its four short, obese legs illustrating a corpulent body shape, contrasted by a tiny little tail. The entire animal was, at first glance, depicted in a simplified manner. No hair coat was depicted, for example. The rear legs, however, were executed in surprising detail, such as the precise placement and shaping of the knee of

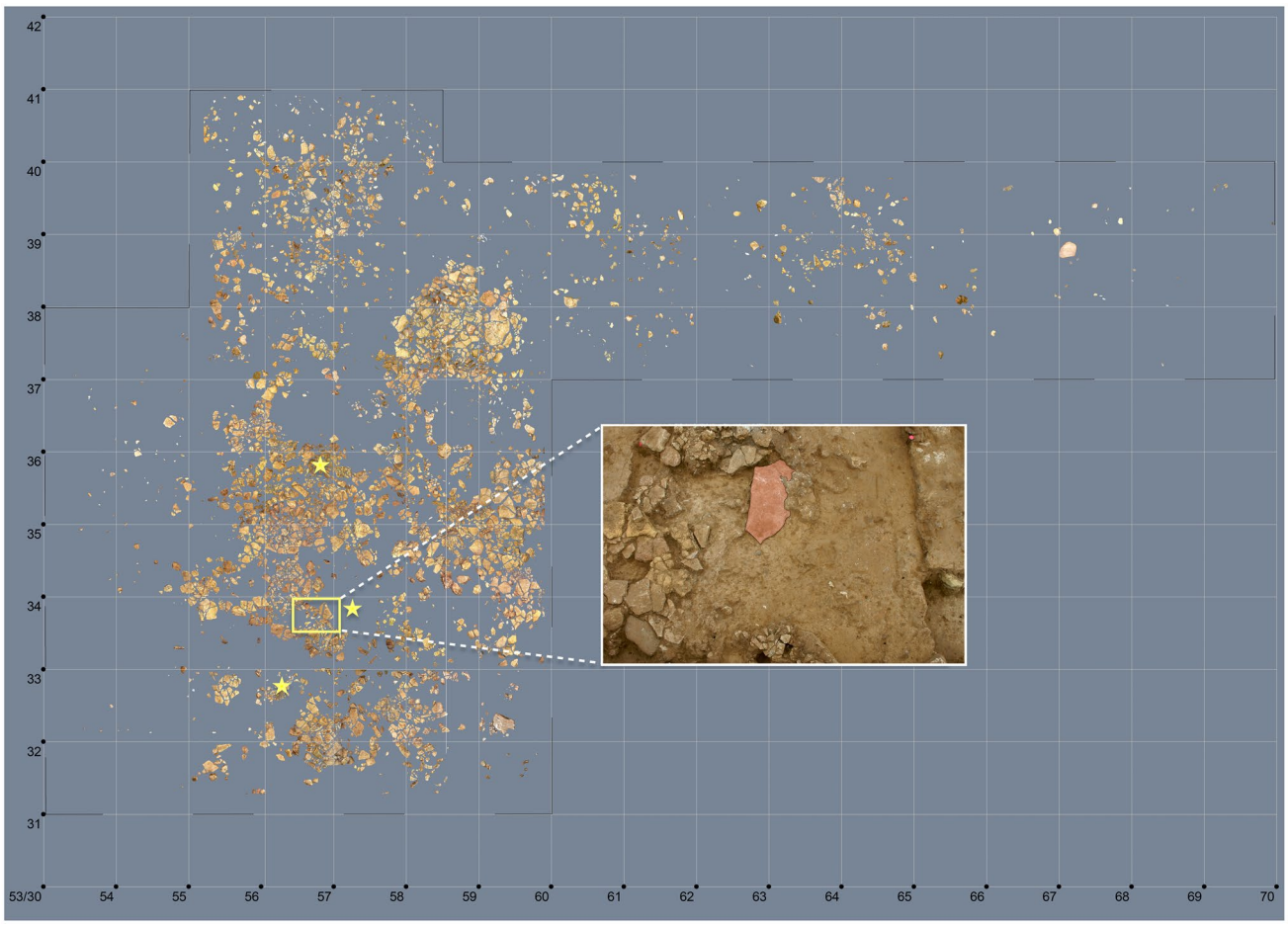
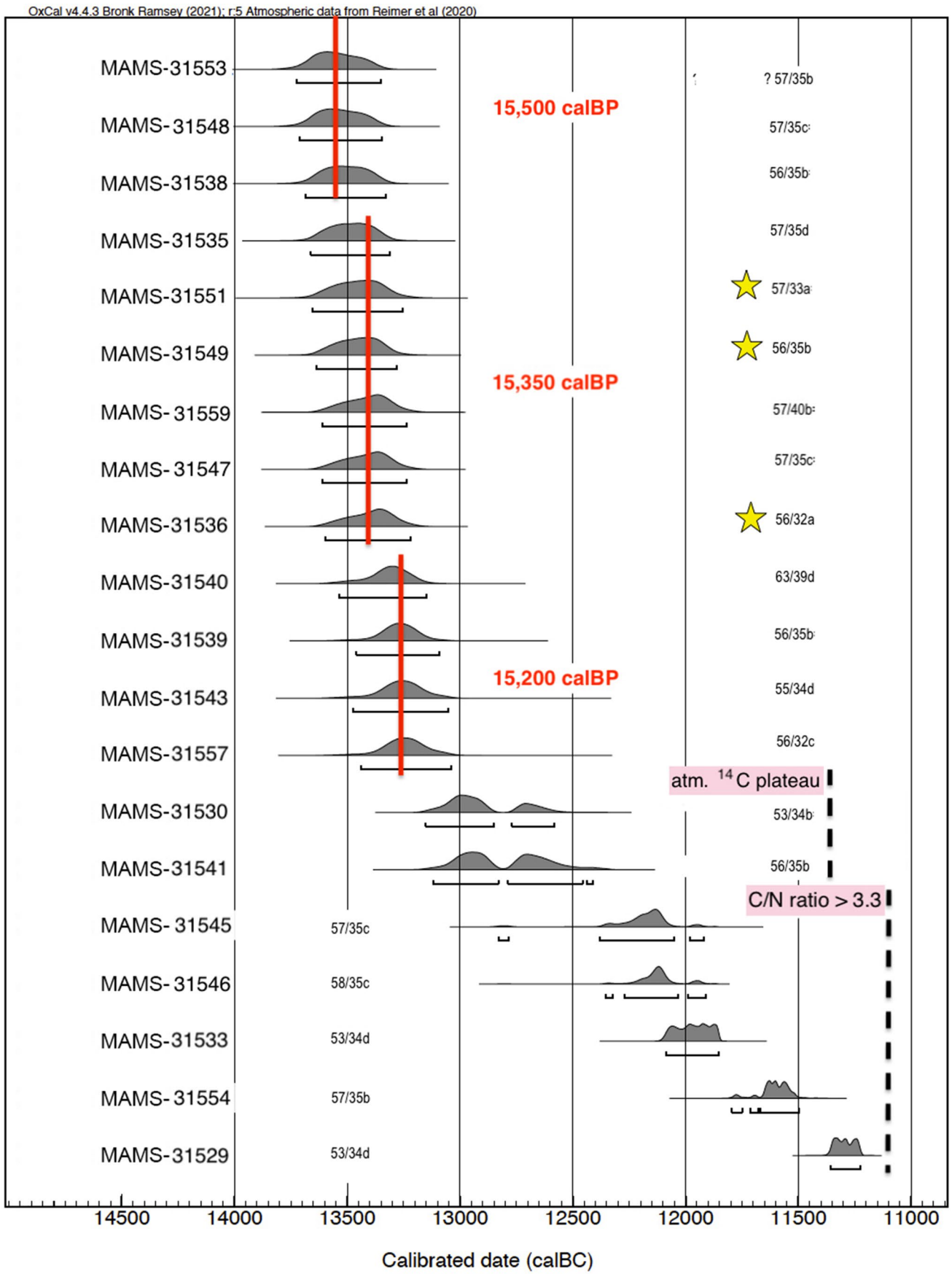


Fig. 5 Bad Kösen-Lengefeld. General site plan of limestone structures with a large cooking place (feature 15) in the central-western part of the site. The insert shows the limestone slab (cf. Figure 2), in its original in situ position and at the moment of excavation, as discovered from the southern fringe of feature 15 (see yellow frame). Yellow stars indicate ^{14}C-samples close-by (see Fig. 6). Site plan by Jürgen Richter/Joel Orrin, arranged by Anja Rüschmann, University of Cologne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◂**Fig. 6** Bad Kösen-Lengefeld. MAMS radiocarbon measurements, all from faunal remains found in stratified context (original quarter square metres indicated in each line). Bottom scale displays calibrated results (calBC, Gaussian distributions calBC, with brackets indicating $2-\sigma$ variation). Additionally, red lettering shows calBP mean values (red lines show an earlier, a central and a later range of dates). The results cluster around 13,400 calBC (in red: 15,350 calBP). All these results appear as almost statistically synchronous and would suggest a short time span of human occupation(s). Some younger dates (see MAMS-31530 and below) have resulted from bad resolution (caused by the 13–12.5 ka calBC plateau of atmospheric radiocarbon) and by C/N ratios indicating bad collagen preservation. MAMS radiocarbon measurements: Ronny Friedrich/Curt-Engelhorn-Centrum für Archäometrie, Mannheim

the left hind leg. Anatomically, the rear extremities of the rhinoceros' natural role model consist of elongated feet and elongated lower limbs, consequently with the peaked knees very closely attached to, and almost disappearing under the animal's tall, fleshy belly. The shape of the knee, along with the general outline of the body, would indicate rhino as the animal species addressed. Eventually, the artist expected the Magdalenian reader of this image to correctly assign this animal as a rhino rather by the knee than by the horn. The artist elegantly drew fine, single-track lines which allowed for such sophisticated execution of the knee. In general, the lines were rather delicately scribed than engraved, with a minimum of force involved. The lines were quickly sketched and no corrections were made. The Bad Kösen-Lengefeld images appear as light sketches, drawn from the wrist. To the left of the image, the fine lines disappear delicately, thus confirming the image ending here and the neck and head part missing by the voluntary intention of the artist, not by fragmentation or natural erosion. To the right, a bundle of lines appears either as unrelated to the rhino, or indicating the existence of a second depiction not yet deciphered, or, as a third option, the lines would deliver alternative executions of the rhino's rear. Such alternative lines might indicate movement of the rear and of the tail, tentatively illustrating the animal straightening or rising, then standing on the hind legs. In order to allow for such alternative reading of the image, we refrained from selecting single lines as the supposedly best representation of the animal's rear.

Doubts About the Species Depicted

Because the head with the characteristic horns had not been depicted by the Magdalenian artist, the reading of the image as a rhino image needs some more consideration. The engraved image displays a tall, heavy mammal walking on short, thick legs with blunt-shaped feet. This would allow for attribution to rhinos as well as to other Quaternary pachyderm species such as an elephant or a hippopotamus. If *Elephas antiquus* and *Hippopotamus* would be excluded as both interglacial species absent from the Magdalenian (glacial) environment, the body of the mammoth would also display similarities matching the depicted animal. However, if we compare the construction plans of the legs, the mammoth features column-like legs, the lower and upper limbs straightly shaped, all carrying an equal load of the massive body. Rhinos, by contrast, show an angular structure of the legs, the hind legs prepared to enhance the power of forward mobility. And, moreover, only the rhino displays a very short upper hind limb, positioning the knee at an elevated point of the leg, very close to the trunk of the animal. The mentioned attribute is not present in pachyderm species other than the rhino. Attributions to any other large mammals also appear as unlikely. Magdalenian brown bear images, for example, would feature differing shapes of legs and paws, possibly with claws (see Magdalenian bear images catalogued by Braun & Zessin, 2008). Given the Magdalenian (glacial) context of the depiction, the woolly rhino would remain as the animal species most probably depicted on the Bad Kösen-Lengefeld limestone slab. The animal depiction appears as ambiguous because it does not fit with modern expectations how certain animals should be conceptualized by the artists, in our own eyes. Our perception, as modern readers, is biased by modern categories, such as the expectation that a "rhino" must be classified by its horn. However, our hypothesis supposes that the Magdalenian reader would have been capable of identifying this animal depiction as a rhino based on the proportions of the body, the shape of the legs and the particularly characteristic hind knee.

Magdalenian Rhino Images Compared

Rhinos were less frequently depicted in Upper Palaeolithic art than horses, reindeer and bison. Images of the woolly rhino occur in 24 archaeological sites (Fig. 7) — mostly in caves — throughout SW-Europe and Central Europe (Braun & Zessin, 2009; Clottes, 2010; Petrognani & Robert, 2020). The Central European rhino depictions occur exclusively on mobile objects.

The late Magdalenian open-air settlement site of Gönnersdorf (Rhineland-Palatinate) delivered an exceptionally large number of 17 schist plaquettes bearing rhino images (Bosinski, 2008a, 2008b). Eleven items display only the animals' heads, while six items bore images of complete animals. The most complete Gönnersdorf rhino (Fig. 8A) differs considerably from the Bad Kösen-Lengefeld item (Fig. 8B), as the centre of the body, the trunk is executed in an exaggerated scale compared to the animal's small extremities, with the front part and shoulder even more enlarged. The overall proportions of the Bad Kösen-Lengefeld rhino coincide more closely with nature than the Gönnersdorf item does. The Gönnersdorf rhino bears

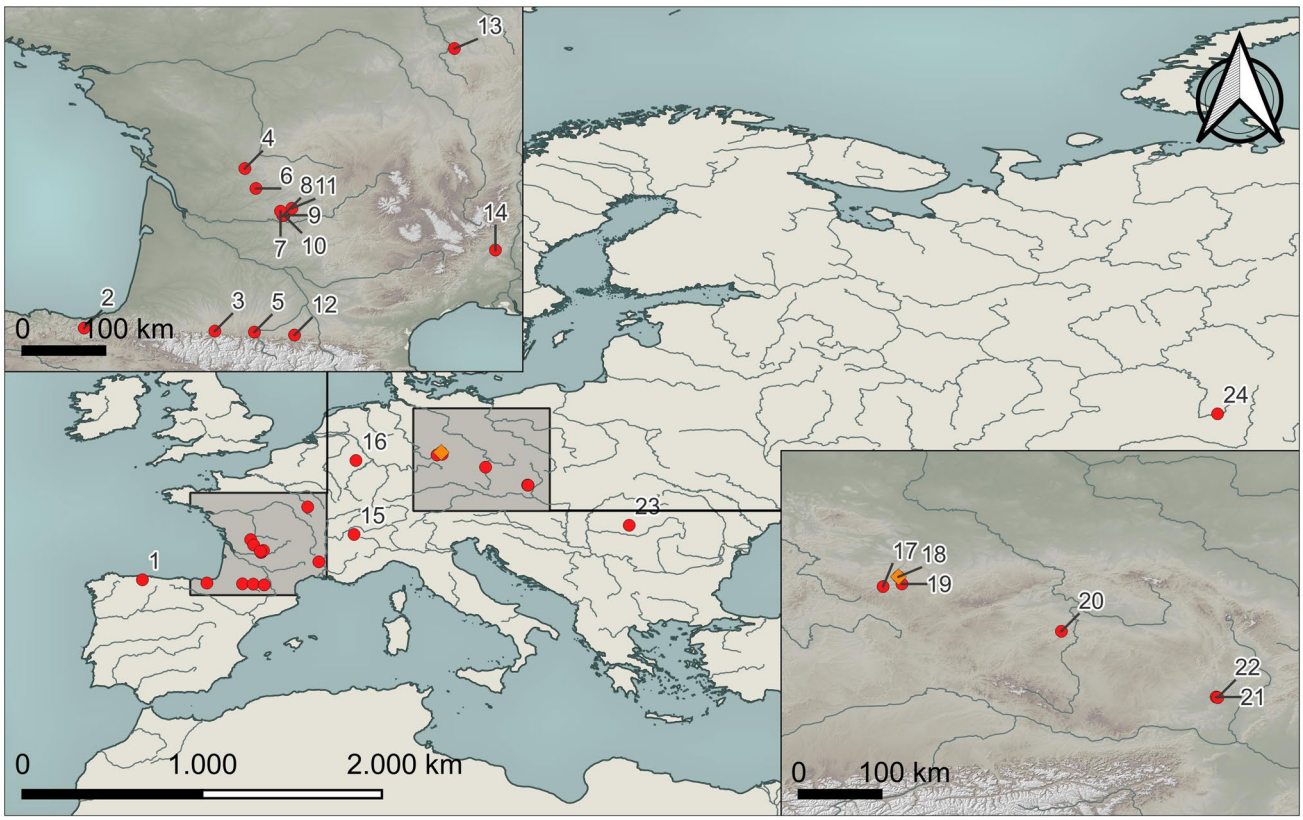

Fig. 7 Palaeolithic depictions of rhinos in Europe (see Tab 1 for site numbers and references). Insert maps show SW-France and Central Germany with Bad Kösen-Lengefeld (18)

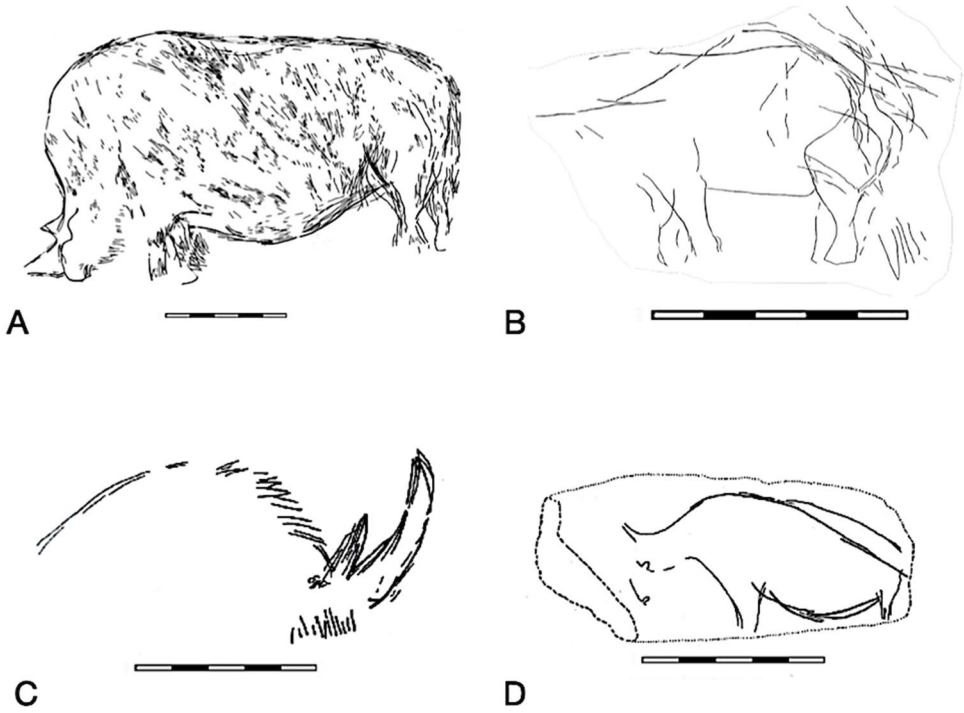

Fig. 8 Rhino images decorating mobile art objects from Central Europe. Gönnersdorf, slab 89 (**A**), Bad Kösen-Lengefeld (**B**), Kniegrotte (**C**) and Teufelsbrücke (**D**). Scale 5 cm (different scales combined and adapted for better comparison. Each scale indicates 5 cm. Gönnersdorf 22.5 cm; Bad Kösen 8.5 cm). Sources: **A** from Bosinski (2008a, 2008b), **B** this paper, **C** from Feustel (1974), **D** from Wüst (1998)

its woolly fur, thoroughly indicated by dozens of short strokes covering the whole body, whereas the Bad Kösen-Lengefeld animal is portrayed from a larger distance with the hair not particularly visible.

The Gönnersdorf art inventory, with its hundreds of depictions, yields detailed hints on the rules followed by late Magdalenian artists (Bosinski & Fischer, 1974; Bosinski, 2008a, 2008b): First of all, human males were excluded from the depictions. Secondly, animals had to be strictly side-view, either complete (head-plus-trunk) or incomplete and abbreviated (only head, no trunk). Thirdly, depictions of women had to be strictly side-view, abbreviated (only trunk-and-legs, no head) and sometimes abstract. Women's legs are often bent, the knee visible.

If the Gönnersdorf rules of depiction would have been equally valid at Bad Kösen-Lengefeld, the Lengefeld rhino would represent a remarkable exception from the rule, delivering one headless depiction of an animal side-view, widely unknown in the whole entire corpus of Magdalenian art, not to be explained by limited space or surface erosion of the image-bearing stone slab. Given headlessness featuring as a common attribute of female

Table 1 Complete list of known woolly rhino images occurring in the Palaeolithic art of Europe, with either approximate age estimation (*asterisk: chronological frame suggested by cultural attribution of the find context) or related ^{14}C-dates (** double asterisk/bold mode: mean age of local ^{14}C dates resulting from archaeological find context and/or mean age of direct ^{14}C date of image). The Bad Kösen-Lengefeld rhino image appears as the latest item connected to precise dates

No	Site name	Mode	Attribution	Dates (cal BP)	Source
1	Las Caldas	Engraved sandstone slab	Solutrean and Magdalenian	*23,000–14,500	Corchón Rodríguez (1998)
2	Ekain	Parietal painting	Magdalenian	*21,000–14,500	Altuna (1996)
3	Grotte des Espélugues	Engraved stone slab	Magdalenian	*21,000–14500	Nougier and Robert (1957)
4	Abri Le Rebières II	Engraved bone	Aurignacian and Gravettian	*42,000–23,000	Paillet (1993)
5	Grotte Les Trois-Frères	Parietal painting	Magdalenian	*21,000–14,500	Begouen and Breuil (1958)
6	Grotte Le Placard	Engraved projectile point	Badegoulian-Magdalenian	**21,000	Delage (2018); Breuil (1958); Clottes et al. (1991)
7	Grotte de Rouffignac	Parietal painting	Magdalenian	*21,000–14,500	Plassard (1999)
8	Grotte Les Combarelles	Parietal engraving	Magdalenian	*21,000–14,500	Barrière (1997)
9	Grotte Les Combarelles II	Parietal engraving	Magdalenian	*21,000–14,500	Barrière (1997)
10	Grotte Font de Gaume	Parietal painting	Magdalenian /ancien	*21,000–14,500	Nougier and Robert (1957)
11	Grotte de Lascaux	Parietal painting	Badegoulian-Magdalenian	**21,500–21,000	Langlais and Ducasse (2019); Aujoulat (2004)
12	Grotte de Gourdan	Engraved stalagmite	Magdalenian	*21,000–14500	Nougier and Robert (1957)
13	Arcy-sur-Cure, Grotte du Trilobite	Engraved bone	Gravettian	*35,000–23,000	Breuil (1906)
14	Grotte Chauvet	Parietal painting (rhino: 65 items)	Aurignacian	**37,000–33,500	Quiles et al. (2016); Clottes (2001)
15	Grotte de la Colombière	Engraved pebble (rhino: 7 items)	Magdalenian	**17,920–16,060	Sieveking (1986)
16	Gönnersdorf	Engraved schist slab (rhino: 17 items)	Magdalenian	**16,500–15,500	Bosinski (2008a, 2008b)
17	Teufelsbrücke (collapsed cave)	Engraved pebble	Magdalenian	*17,000–14,500	Braun and Zessin (2009), after Wüst (1998)
18	Bad Kösen-Lengefeld	Engraved limestone slab	Magdalenian	**15,350	This paper
19	Kniegrotte (Cave)	Engraved antler	Magdalenian	**17,000	Höck (2000); Feustel (1974)
20	Derava Cave	Engraved schist slab (rhino: 2 items)	Magdalenian	*17,000–14,500	Bosinski (2008a, 2008b), Valoch and Laznickova-Galetova (2009)
21	Dolní Vestoniče	Clay sculpture	Gravettian	**31,000	Fewlass et al. (2019); Valoch and Laznickova-Galetova (2009)
22	Pavlov	Clay sculpture	Gravettian	**30,000	Fewlass et al. (2019); Svoboda (2005)
23	Coliboaia Cave	Parietal painting	Aurignacian and Gravettian	*42,000–23,000	Gely et al. (2015)
24	Kapova Cave	Parietal painting	Magdalenian	**19,600–16,000	Ruiz-Redondo et al. (2020); Ščelinskij and Širokov (1999)

representations in Magdalenian art, the informed reader would have had to understand the Lengefeld rhino image connected to female representations (Jöris, 2021). The intentionality of headlessness in the Bad Kösen-Lengefeld rhino image appears, moreover, as corroborated by the uniquely detailed narration of the rear of its body, multiple outlines of the rear part possibly evoking movement and upright straightening or rising of the body. Here, we try to follow up features of the Magdalenian "visual culture" of the makers instead of expecting a "naturalistic" representation of a notional, objective reality. As we explain here, based on the Gönnersdorf record, the aspect of "headlessness" supposedly transported an important message (unknown to us, but repeatedly connected with human females). This message was specifically rooted in the late Magdalenian set of cultural rules, valid during the first half of the 16th millennium BP, in western and Central Europe. Given the artists' intention to communicate this message, the head had to be omitted, including the rhino's horn.

Within the mentioned rules, huge variations occurred, compared to the Bad Kösen-Lengefeld item, even in short time intervals and in closely neighbouring spaces: The nearby Teufelsbrücke site delivered a complete rhino image contrasting with its enlarged front part of the body (Fig. 8D). Nevertheless, the Bad Kösen-Lengefeld and Teufelsbrücke items share the distant perspective with no hair indicated and the obliquely designed dorsal line. Both items have also been attributed to the latest part of the regional Magdalenian. Exaggeration of the front part, attribution of two horns and an indication of hair commonly appear both in Gönnersdorf and Kniegrotte (Fig. 8 A and C), both presenting more intimate, more close perspectives on the animal, and both attributed to an earlier stage of the Central European Magdalenian. Thus, distant perspective and balanced body proportions might have evolved during the last stage of the Magdalenian. Here, we limit our comparisons to well-dated objects of regional mobile art, because comparable images in cave art (see Table 1) usually do not allow for sufficient precision of dating, achieved independently from the evaluation of style.

Conclusions

The hunter-gatherers of Bad Kösen-Lengefeld were among the last human beings to encounter face-to-face with the woolly rhino. The last animals of this kind, having existed in eastern Germany, must have led an isolated life. The last moment of their existence was documented by an artist on a limestone slab from Bad Kösen-Lengefeld along with some pieces of art from neighbouring sites from approximately the same epoch. The last woolly rhinos were not hunted. Consequently, remnants of their skeleton have been very rarely found at settlement sites of the central German Magdalenian. On the other hand, humans were familiar with those animals and created pictures of them, such as the rhino image from the Bad Kösen-Lengefeld excavation. Here, the rhino is represented in a very unusual way, without head and without characteristic horns, whereas the woolly rhino "role model" bore two horns on its skull usually kept very close to the soil. Possibly, the headless appearance of the animal meant to indicate some relation to the headless women of Magdalenian art. The Bad Kösen-Lengefeld animal represents the last of its kind which ever came to the sight of humans, at 15,350 cal. BP. Consequently, Palaeolithic humans were among the last eyewitnesses able to report these animals' physical appearance. Among those images which were discovered from exactly dated contexts, the Bad Kösen-Lengefeld item appears as the last testimonial of the woolly rhinoceros provided by humans.

Acknowledgements The authors would like to thank all field directors, staff and students having participated in fieldwork since 2008. We are grateful to Harald Meller and Dietrich Mania who initiated research at Bad-Kösen-Lengefeld. Marcel Schemmel and Mateo Vega Martinez checked hundreds of limestone pieces in order to identify engraved lines. Ronny Friedrich and Elka Duberow (CEZA/Mannheim) were responsible for radiocarbon dating. Anja Rüschmann deciphered and transformed engraved features into line drawings. The state heritage office "Landesamt für Denkmalpflege und Landesmuseum für Vorgeschichte Sachsen-Anhalt", the University of Cologne and the Friedrich-Alexander University of Erlangen Nürnberg generously provided the excavation budget for 16 years of fieldwork.

Author Contribution Conceptualization: Jürgen Richter; Investigation—excavation: Jürgen Richter, Joel Orrin, Florian Sauer; Investigation—RTI: Sebastian Hageneuer; Data processing, images, maps: Jürgen Richter, Florian Sauer, Joel Orrin, Sebastian Hageneuer; Writing—original draft preparation: Jürgen Richter and Sebastian Hageneuer. Writing—review, and editing: Jürgen Richter and Florian Sauer. Funding acquisition, resources and supervision: Jürgen Richter.

Funding Open Access funding enabled and organized by Projekt DEAL. The excavations at Bad Kösen-Lengefeld were funded by the Landesamt für Archäologie Sachsen-Anhalt and by the University of Cologne, with contributions by the Friedrich-Alexander University Erlangen-Nürnberg.

Data Availability Corresponding Dataset available at https://doi.org/10.5281/zenodo.8132815

Declarations

Competing Interests The authors declare no competing interests.

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