

## FIELD SURVEY AND MATERIALS

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### EASTERN PERIPHERY OF THE MAGDALENIAN WORLD. WIERZAWICE 31 HUNTING CAMPSITE (SE POLAND)

#### ABSTRACT

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Wierzawice 31 site is one of the easternmost Magdalenian sites, situated in the south-eastern corner of the Kolbuszowa Plateau surrounded, to the east, by the broad San River valley and, on the south, by the sub-Carpathian ice-marginal valley. This archaeological site lies in an area with surface deposits developed as periglacial stratified silty-sandy sediments about 10 m thick, adjoined in the NW by an isolated patch of loess of the island type. The lithic artefacts occur in a small area of about 40 sqm, with the main concentration of artefacts centred around the focus. Almost 70% of the tools are hunting weapon elements. Both technology and tool typology are typical for Magdalenian assemblages. Absolute dating (<sup>14</sup>C and TL) indicates a very young, Allerød age for the site. The raw materials used indicate connections with the northern part of the Sandomierz Upland. Imports of “Volhynian flint” suggest possible contacts with areas beyond the limits of the Magdalenian range.

Keywords: Late Palaeolithic, stone hearth, loess island, slope processes, Sandomierz Basin, Allerød

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## INTRODUCTION

The development of settlement and cultural characteristics of people of the Magdalenian in the eastern part of Central Europe are a subject of interest of researchers dealing with late phase of the Upper Palaeolithic and the early phase of the Late Palaeolithic. Their research has resulted in various studies, including synthetic monographs published in recent years (Połtowicz-Bobak 2013; Maier 2015). Magdalenian territories extending from the eastern part of Germany, to Bohemia and Moravia and eastern Poland represent a complex cultural pattern that, in its essence, is homogeneous in terms of settlement structure, material culture, and economic strategies.

The territories of south-eastern Poland lie at the eastern border of the Magdalenian *ocumene*. It seems that, in this area, the territory controlled by Magdalenian hunters extended to the San River, going beyond it only to a small extent. Alongside the site in Klementowice on the Nałęczów Plateau (Wiśniewski *et al.* 2012; Wiśniewski 2015), these are the easternmost areas inhabited or used by Magdalenian communities. Only a few Magdalenian sites are known in this area, including the campsite in Wierzawice (Fig. 1: A). A few of them, concentrated in the central part of the Sandomierz Basin, in a small part of its subregion known as the Kolbuszowa Plateau, and located at a considerable distance from other sites discovered in southern Poland so far, feature traces of short-term campsites of small groups of hunters, their chronological position being towards the end of Magdalenian settlement in Europe. These sites, namely Grodzisko Dolne (Lubelczyk 1997; Czopek 2003; Połtowicz 2004; Bobak and Połtowicz-Bobak 2011), Łąka 11-16 (Połtowicz-Bobak *et al.* 2014), and Wierzawice (Bobak *et al.* 2010; 2017), are the main subject of this paper. They are located in an area with various surface deposits, which led us to compare the palaeoenvironment of their surroundings.

## LOCATION OF THE SITE

The Wierzawice 31 site is situated in the south-eastern corner of the Kolbuszowa Plateau surrounded, to the east, by the broad San River valley and, on the south, by the sub-Carpathian ice-marginal valley, at present partially used by the Wisłok river (Fig. 1: A, C). This archaeological site lies in an area with surface deposits developed as periglacial stratified silty-sandy sediments about 10 m thick (Wieczorek 2006), adjoined in the NW by an isolated patch of loess of the island type (Fig. 1: A). The boundary between these two sediment types is quite distinct in the terrain (Fig. 1: B-C). The first type is linked with denudation relief and landforms such as residual hills and long slopes dissected by systems of denudation valleys. On the other hand, the area where loess occurs features a varied, deeply dissected erosion-denudation relief with well-developed systems of various types of dry valley forms and anthropogenic gullies. These forms disappear at the boundary of the periglacial rhythmite.



**Fig. 1.** Location of the discussed archaeological sites against the background: A) distribution of loess and sand covers in Poland SE, based on Marks *et al.* (2006); B) geomorphological sketch based on Łanczont *et al.* (2015, modified); C) digital elevation model. Description of signatures marked on the geomorphological map: Holocene: 1 – river valley bottom and terrace 1.5-2 m; 2 – terrace 3-6 m; 3 – terrace 5-8 m; 4 – abandoned meander; 5 – plains of peat and organic-mineral accumulation. Pleistocene terraces: 6 – lower; 8-13 m; 7 – middle; 12-17 m. 8 – edges and erosion undercuts of younger terrace; 9 – higher erosion edges; 10 – erosional-denudation valleys; 11 – loess and loess-like covers; 13 – erosion remnant; 14 – flat-topped bottom of slope; 15 – alluvial fans; 16 – fluvio-glacial plain; 17 – kame terrace; 18 – morainic plateau; 19 – aeolian sandy plain; 20 – site. Illustrated by M. Łanczont and P. Mroczek

The Wierzawice 31 site lies at 188 m a.s.l., in the lower part of the eastern spur of a local hill (culminating at 221.4 m a.s.l.) which forms part of a fragmented glaciofluvial plain extending in the vicinity of a residual moraine dating back to the Sanian glaciation. The foot of a long, gentle hillside, with a gradient of 1.8-2.5° and an E and NE exposure (Holub *et al.* 2017) is bordered by an 8-13 m high erosion-accumulation terrace, correlated with the Vistulian, and forming an elongated 1-1.5 km wide strip in the Wierzawice area (Wieczorek 2006). Its erosional edge was formed by large palaeomeanders that developed in the Late Glacial (Starkel 2001; Szumański 1986). A few levels of erosion-denudation and accumulation low terraces (5-8 m, 3-6, 1-3 m above the present channel of the San river lying at 165 m a.s.l.) can be discerned in the Holocene bottom of the San valley (Fig. 1: B, C).

The site was discovered by S. Czopek from the Institute of Archaeology of the University of Rzeszów in 2009. In the same year, S. Tokarczyk carried out surveys that led to the identification of Magdalenian materials. During systematic investigations conducted in 2009-2012 by the authors of this paper, a perfectly preserved campsite, interpreted as a short-term hunters' campsite inhabited just once, was discovered (Bobak *et al.* 2010; 2017).

## SURFACE DEPOSITS IN THE AREA OF THE WIERZAWICE 31 SITE

The surface sediments with a distinct stratification, investigated to the depth of 2.7 m (Figs 2; 3: A) are carbonate-free sandy silts although a few laminae represent other lithological varieties. The sediment profile consists of three units. The upper unit (from 0.25 to 0.6 m thick) is a degraded (truncated) present soil built of clayey sand and sandy clay where the stratification became illegible due to the impact of pedogenetic processes. The middle unit (about 0.4 m thick), with a predominance of the silt fraction, is a zone of ball-and-pillow structures just over 10 cm in diameter, their primary characteristic being grain-size segregation, interpreted as a result of the secondary selection of material, probably determined by cryogenic processes (Bobak *et al.* 2017). The lower unit (its top part lying at depths ranging from 0.45 to 1.0 m) is a rhythmite consisting of laminae of varying thickness, from 2-5 cm to 10-15 cm, with wavy lamination. The laminae are built of sand of various colours as well as clayey and silty sand with a distinct grain-size segregation; at a greater depth, they transition into yellowish-grey loose quartz sand with individual gravel grains (Fig. 3A). The top part of the lower unit (about 0.1 m thick) is characterised by partially illegible sedimentary structures, slight enrichment with humus (by up to 0.15%), and higher levels of Fe<sub>2</sub>O<sub>3</sub> (by up to 1.6-1.8%) in comparison with the present soil, as well as traces of pedofauna activity. These characteristics would indicate initial pedogenesis (weathering horizon). Stone artefacts occurred in that layer (Fig. 2).

Thermoluminescence (TL) and optically stimulated luminescence (OSL) dating results conducted at the Lublin laboratory for the sequences of sediments, analysed in 2010-2011 and 2014, indicate that the series under study formed between the Upper Pleniglacial of



Fig. 2. Lithological development of selected sedimentary sequences in the Wierzawice 31 site after Bobak *et al.* (2017, modified). A – lithology and results of dating; B – excavation plan. Illustrated by M. Łanczont and P. Mroczek

the Vistulian and the Late Glacial. The oldest TL dates obtained for the test drilling carried out in 2011 are  $25.2 \pm 4.1$  ka (depth 1.25 m) and  $21.1 \pm 3.3$  ka (2.5 m). In addition, the following OSL ages were obtained for the same samples:  $18.9 \pm 3.0$  ka and  $15.2 \pm 2.4$  ka.

The following TL dates were obtained in two series for samples from the cultural horizon: samples from 2010 are in the timeframe from  $12.6 \pm 1.1$  to  $16.0 \pm 1.4$  ka, the two dates obtained in 2011 were  $12.4 \pm 1.4$  ka and  $12.9 \pm 1.3$  ka (Fig. 2).

The sediments on which the initial soil horizon with the cultural layer developed formed in a cold, periodically humid periglacial climate as a result of the interaction of various slope processes (slope wash, mudflow, solifluction) and, undoubtedly, aeolian processes. Their accumulation was favoured by the simple, slightly convex and divergent shape of the slope with a relatively low gradient and eastern exposure. The sedimentation of slope deposits was probably quite fast and on a mass scale, and their source was located nearby (upper parts of the slope), hence inversions and a high divergence of parallel TL and OSL dates occur. The short-term exposure of the grains to sunlight was sufficient for



**Fig. 3.** Results of physicochemical analyses of selected sediment sequences from the Wierzawice 31 site (A) after Bobak *et al.* (2017, modified) and granulometric characteristics and OSL age of a sediment sequences Grodzisko Dolne III site (B). Explanations of signatures in Fig. 2. Granulometric indices calculated according to Folk and Ward (1957). Illustrated by M. Łanczont and P. Mroczek

the total reduction of previously accumulated energy in grains tested by means of the OSL method but was insufficient in the case of the TL method.

A rather poorly developed weathering and soil horizon with a cultural layer formed during a period of land surface stabilisation during a break in slope sedimentation.

## THE LOESS ISLAND IN THE VICINITY OF GRODZISKO DOLNE

The loess island on which the site in Grodzisko is situated and neighbouring the Wierzawice 31 site is formed by typical carbonate loess (46-70% silt fraction content), locally sandy, and associated with the Vistulian period (Alexandrowicz 2014). The loess is quite thick, from 10 to 15 m. Interstadial fossil soils or sediments occur within the loess cover (Laskowska-Wysoczańska 1971; Wójcik 1999). A malacological analysis was conducted to reconstruct the accumulation environment of the loess in exposures in the vicinity of Grodzisko Dolne (Alexandrowicz 2014). In the part of the sequence the age of which corresponds to the stratified periglacial sediments in Wierzawice, the *Pupilla* fauna association mainly occurs, indicating a continental polar climate, and dry, cold steppe-type habitats, as well as a period of intense loess accumulation that started *circa* 22.0±2.8 ka. The altered climate conditions and the slower loess sedimentation rate led to the development of *Succinella* fauna that predominates in the “aeolian-deluvial” loess (younger from the loess at Grodzisko Dolne) the sedimentation of which began *circa* 18.0±2.8 ka (Wójcik 1999). This association indicates the more humid conditions of a cold climate (Alexandrowicz 1999; 2014). Having an inhibitory impact on the intensity of aeolian processes and erosion processes, these conditions probably led to the loess being locally covered by stratified periglacial slope sediments. This is indicated by the sequence of sediments found in another loess exposure located nearby (Grodzisko Dolne III – N50°10'26"; E22°28'17.5") with quite a shallow but stratigraphically varied profile (>5 m) where laminated silty carbonate sand (Fig. 3: B) dated to 18.0 ka is covered by a top series of carbonate-free slope sediments dated to 17.3 ka and 16.4 ka, analogous to those in Wierzawice (Table 1). The

**Table 1.** Results of the OSL dating of the Grodzisko Dolne III site

Sample (depth) [m]	No Lab. LUB	<sup>40</sup> K [Bq/kg]	<sup>226</sup> Ra [Bq/kg]	<sup>228</sup> Th [Bq/kg]	Dose rate d <sub>r</sub> [Gy/ka]	Equivalent dose d <sub>e</sub> [Gy]	OSL age [ka]
OSL 1 (1.90)	<b>6435</b>	373±7	24.1±2.0	30.2±1.0	2.26 ± 0.18	36.97± 1.15	<b>16.4 ± 1.4</b>
OSL 2 (2.00)	<b>6436</b>	341±7	26.6±2.0	24.6±0.9	2.12 ± 0.17	36.65 ± 1.28	<b>17.3 ± 1.5</b>
OSL 3 (2.30)	<b>6437</b>	365±9	19.6±2.1	29.2±0.9	2.12 ± 0.19	38.23 ± 1.09	<b>18.0 ± 1.7</b>
OSL 4 (2.80)	<b>6438</b>	279±7	26.0±2.1	24.8±1.0	1.91 ± 0.17	33.90 ± 0.99	<b>17.8 ± 1.7</b>
OSL 5 (3.80)	<b>6439</b>	388±9	35.4±2.7	36.9±1.2	2.63 ± 0.21	41.88 ± 1.37	<b>15.9 ± 1.4</b>
OSL 6 (4.75)	<b>6440</b>	336±8	29.9±1.9	25.0±1.0	2.13 ± 0.16	65.69 ± 1.70	<b>30.8 ± 2.5</b>

key characteristics of the sediment sequence from Grodzisko Dolne III is the rapidly changing share of the particular main fractions, very poor sorting, high values of skewness and kurtosis (Fig. 3: B). Such characteristics indicate short-distance transport of the mixed local material, occurring mainly as a result of aeolian and slope processes. The distinct mixing of local material is evidenced by the considerably younger age of the OSL sample (15.9 ka), originating from the depth of 3.8 m.

The two profiles of Grodzisko Dolne and the Wierzawice profile presented here show a high variation of sediments and sedimentation processes within a small area at the same time. The similar time of the accumulation of loess and stratified periglacial slope sediments indicates the strong influence of local conditions (fossil relief and its orientation in relation to loess-forming winds as well as the geology of the bedrock – shallow outcrops of older Pleistocene sediments susceptible to erosion) on the kind of sedimentation processes (Bobak *et al.* 2017). With the change of the climate conditions in the final phase of the Pleniglacial, *circa* 16.0 ka ago, there occurred a certain spatial homogenisation of the formation of surface deposits by slope processes (slope wash and solifluction) in the SE part of the Kolbuszowa Plateau. These processes paused during the Allerød when a group of Magdalenian hunters appeared in the Wierzawice area.

## VEGETATION IN THE ALLERØD AND POST-ALLERØD PERIOD

The vegetation of the Wierzawice area during the late-Glacial warming was reconstructed based on the published palaeobotanical data. The distribution of plant communities was reconstructed taking into account the local determinants of relief such as absolute elevation, slope gradient and exposure, insolation conditions, hydrologic regime, bedrock lithology (Hołub *et al.* 2016, further literature *ibid.*). In the Allerød optimum, dense pine, birch and larch forests predominated in the environs of Wierzawice, with clusters of willow shrubs and ferns and patches of rich steppe. *Heliophyta* grew in very sunny places, while *Selaginella selaginoides* in wet places. The climate of the Allerød optimum was temperate cool, and periodically more dry. During the younger phase of the Allerød, open park birch and pine forests occurred only in sheltered places. The plateaus and slopes were covered mainly by steppe with *Artemisia*, and patches of moss tundra. Willow shrubs grew in wet places near morphological edges, and sedge, horsetail, and ferns grew on peatland. Towards the end of the Allerød, tundra patches with dwarf birch were predominant.

The sparse tundra-steppe vegetation and the climate cooling of the Younger Dryas resulted in the local re-initiation of slope processes in susceptible locations, *e.g.* in Wierzawice. This led to the covering over of the soil that incorporated the cultural layer and the resultant protection of the site and its artefacts against erosion.



## ARCHAEOLOGICAL MATERIAL

The complex consists of ~3,500 lithics (Table 2). No artefacts made of organic material and no faunal remains have been found. The preserved artefacts include stones, some of which are part of a structure identified and interpreted as a hearth. Some stones are fragments of sandstone plates. Traces of hematite also occur in the form of small grains or, more often, dust stains. Individual tools were also covered by concentrations of such dust mixed with sediment.

A vast majority of the artefacts were located *in situ*. Some artefacts, particularly small chips, were obtained while sieving sediments. Since, for objective reasons, it was impossible to sieve during the investigations in 2010 when the main part of the site was explored, it can be assumed that some chips have been lost.

An area covering almost 40 square metres was investigated in the course of fieldwork (Fig. 4). A vast majority of artefacts lay within a limited space up to 5 square metres, in a few small and compact concentrations. Most of these concentrations are associated with the hearth. More dispersed artefacts, rarely forming legible concentrations, are located beyond the hearth. However, one can notice certain correlations that make it possible to formulate hypotheses concerning the spatial planning of the campsite. What is more, in the case of this small and not particularly rich campsite, the analysis can be easier and more legible than in the case of sites which are a palimpsest created by repeated settlement activity at the same site (Ginter and Połtowicz-Bobak 2020).

The assemblage contains all categories of artefacts: 20 cores (less than 0.5%), 103 tools (*circa* 3%), and a total of 3,000 blades, flakes and chips. A vast majority of them have a three-dimensional location within the site's stratigraphy, although some originate from the arable horizon and sediment sieving.

**Table 2.** General structure of lithic artefacts from Wierzawice 31 site

Category of artefacts		Number
Cores		20
Blades, flakes, debris		~3400
tools		103
	Endscrapers	3
	Burins	18
	Perforators	1
	Microliths	65, after refitting – 58
	Truncated blade	4
	Combined tools	1
	Others	11



Fig. 4. Wierzawice, site 31. Planigraphy of the finds. Illustrated by D. Bobak

## RAW MATERIAL

The stone artefacts were made of basically three flint species: erratic flint (the most prevalent, with a share of more than 40%), chocolate flint (about 20%) and Świeciechów flint (more than 5%).

Among these three dominant species, only erratic flint has local origin as it occurs in the Middle Pleistocene glacial till forming the main part of the Quaternary cover of the Kolbuszowa Plateau. The other two kinds originate from areas located about 100 km north of the site. The Świeciechów and chocolate flint probably originate from more than one place. A few artefacts, including cores, have smooth, unworked surfaces, which suggests that they could have been made from fragments found in secondary deposits, or that they could have been lying on the surface over a longer period. It seems that some of them originate directly from the sources.

Other raw materials occur in small amounts. Besides Jurassic flint, present in the form of a few items, a few flint specimens of a probably eastern origin, described as “Vollhynian flint”, are worthy of attention. This arbitrary term is applied to raw materials whose outcrops are located east of the present-day boundaries of the Magdalenian, without determining whether these are Vollhynian or Transdnistrrian materials. One small core seems to have been made of this material. This fact is quite significant, however, because it provides evidence of some contacts between the Magdalenian communities and areas located further east, beyond the territories they inhabited. We do not know what the nature of these contacts was (exchange between groups? penetration of areas located further east?). After the verification of the raw materials, the earlier claim of the presence of Carpathian Bircza flint at the site should be called into question (*cf. Bobak et al. 2017*).

The imports of the key raw materials used at the site are identified by the very clear direction along the north-south axis, linking territories of SE Poland with the northern part of the Sandomierz Basin and the Świętokrzyskie Mountains region. Magdalenian sites, including rich and repeatedly inhabited campsites of the basic type, are known in these areas (Połtowicz 2006; Połtowicz-Bobak 2012; 2020; Schild 2014).

## TECHNOLOGY

In the assemblage, 20 cores (Figs 5, 6, 7: 1, 2, 4) have been identified, 17 of which have been described (the remaining three were inaccessible). Most of them were discarded in residual condition (13 artefacts), usually reduced to a high degree. There is also a small number of forms discarded in the middle of the reduction phase even though usually damaged by the hinge formed during the core reduction. One core was discarded in its early phase of reduction although also in this case it resulted from damage to the knapping surface due to mistakes in processing. The absence of initial products, combined with a small

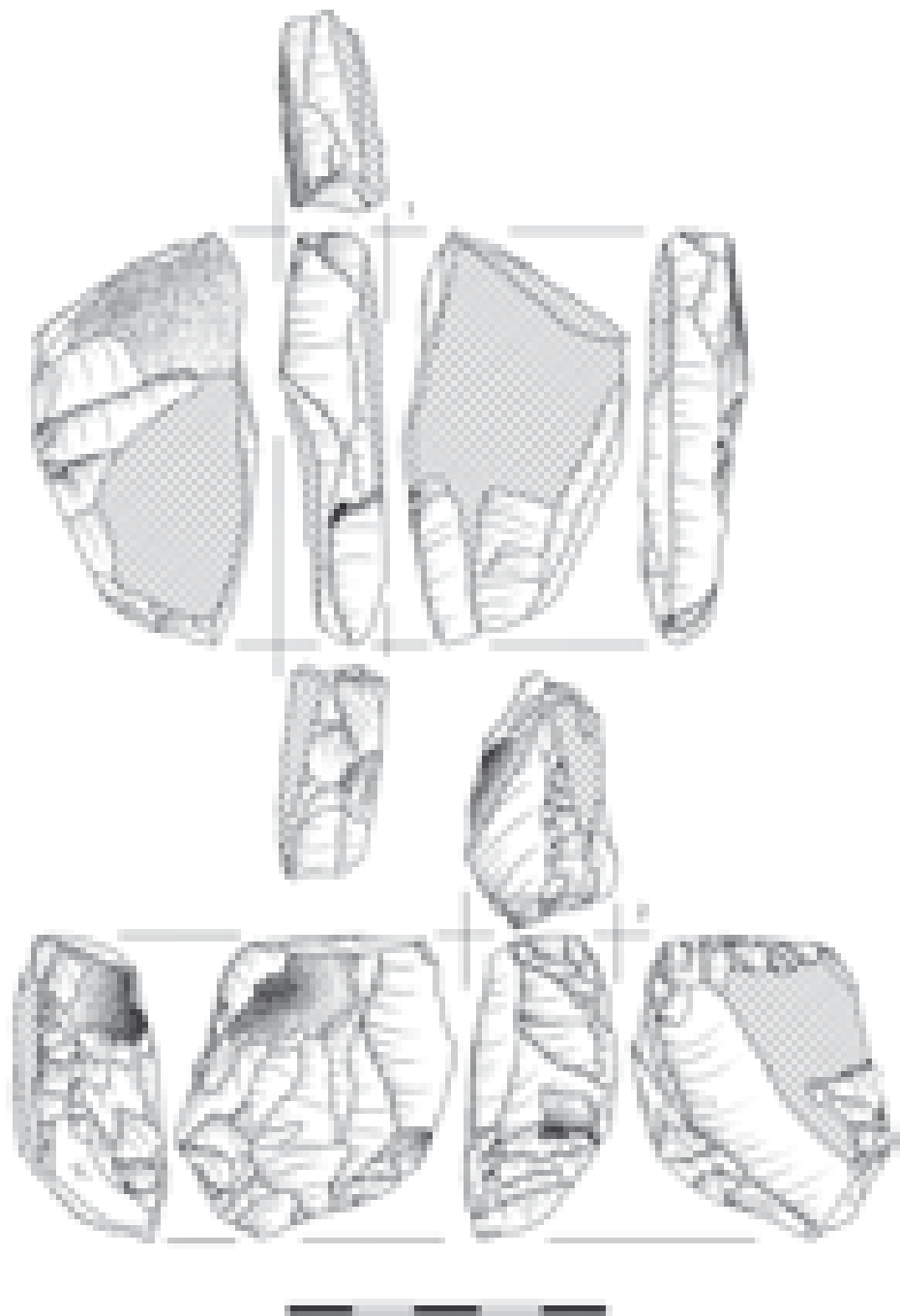


Fig. 5. Wierzawice, site 31. Cores. Illustrated by A. Nowak

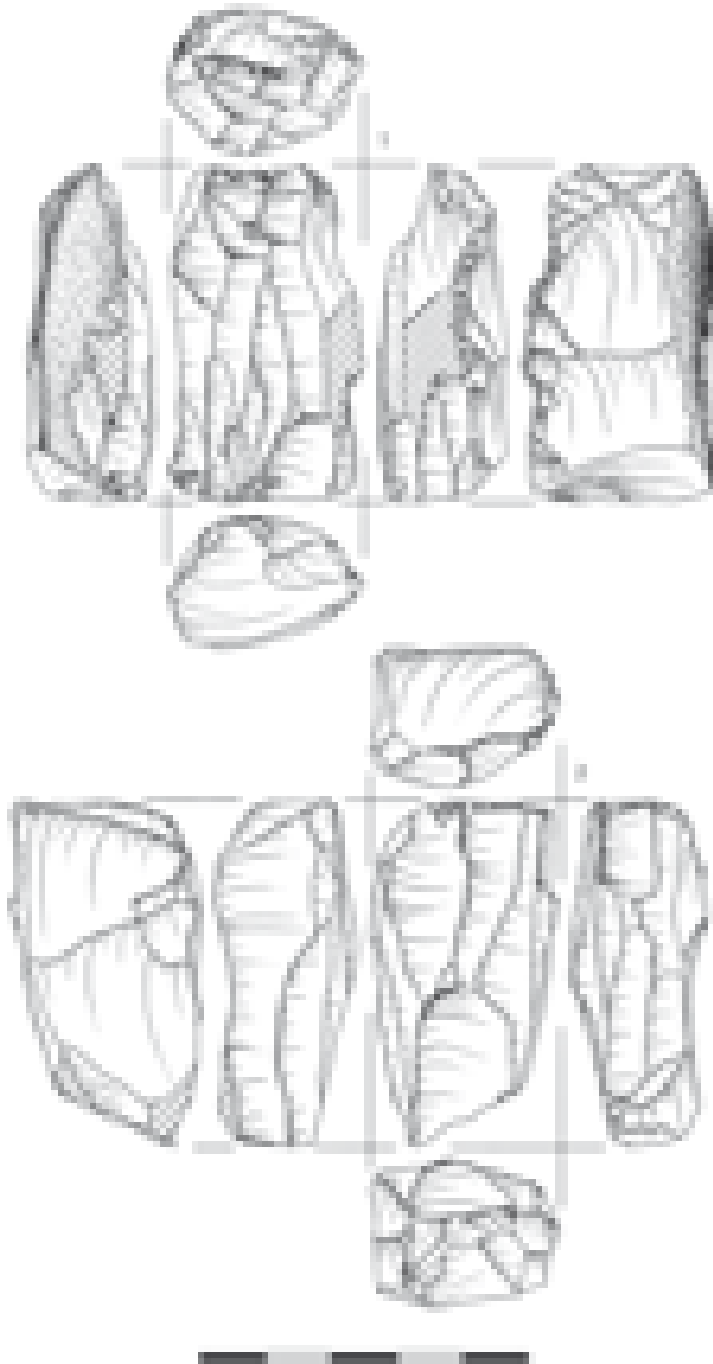


Fig. 6. Wierzawice, site 31. Cores. Illustrated by A. Nowak

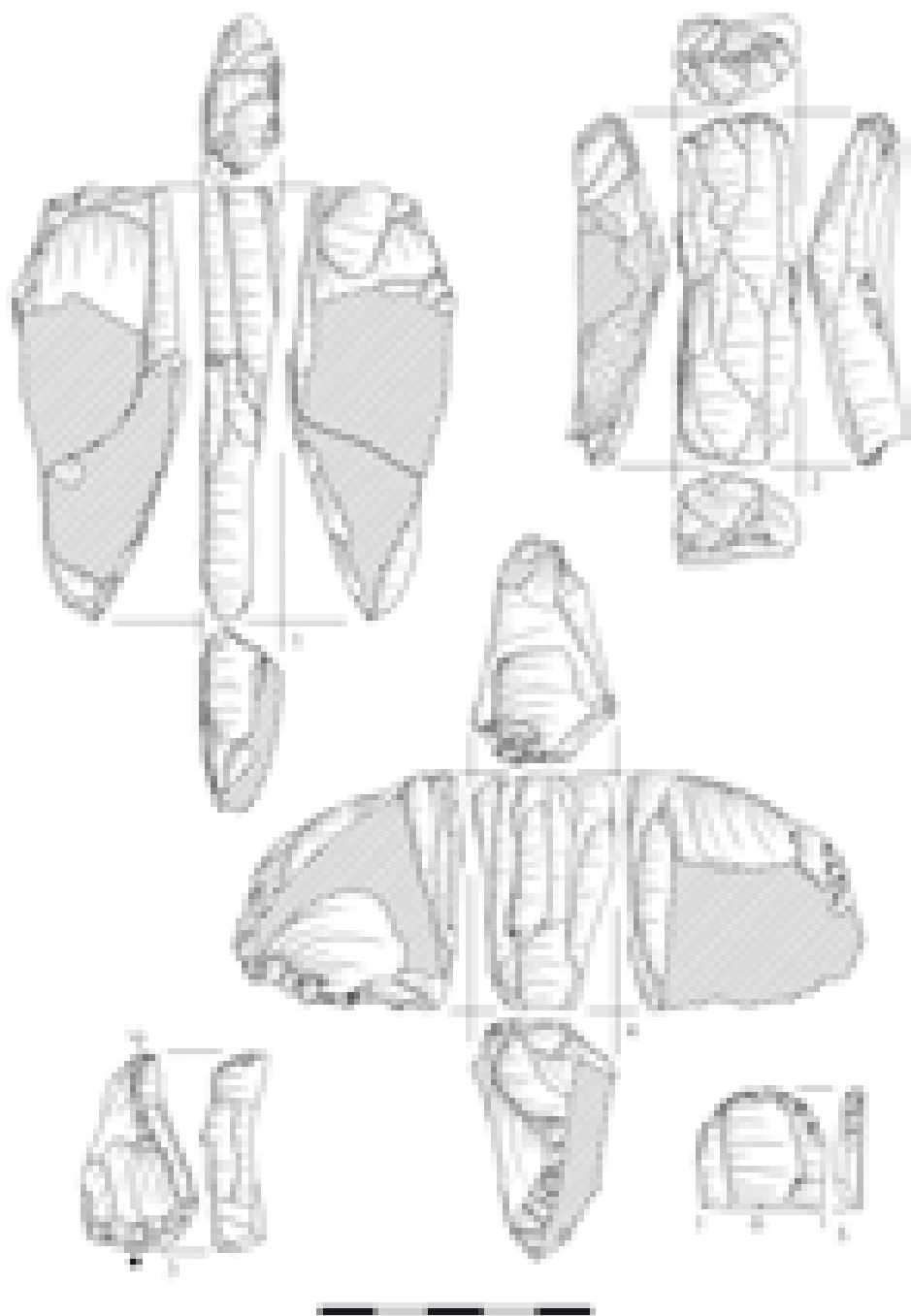


Fig. 7. Wierzawice, site 31. 1, 2, 4 – cores; 3 – burin; 4 – end-scrapers. Illustrated by A. Nowak

share of *éclat d'amorçage* forms and forms with a large amount of cortex as well as waste from the early phases of core preparation, indicates that the cores were most probably brought to the site already in the form of initially worked pieces or pre-cores, prepared outside the site. At the same time, the strong reduction of the cores and presence of characteristic technical forms indicate an intensive reduction combined with repairs. A definite majority of items do not bear traces of faceting, which, however, is also a result of the high degree of their reduction. The items on which traces have been preserved provide evidence of faceting by creating lateral and, rarely, posterior crested ridges. A vast majority of the backs are flat, natural or partially formed by flake negatives scars. Similarly, pieces of cortex are often visible on the sides. The striking platforms were faceted, shaped, sometimes renewed. In one case, there is an edge platform (one of the platforms of a double-platform core). In the case of double-platform cores, there may be different combinations without a clear domination of any. On the other hand, traces of faceting of platform edges are very rare, which most probably results from the residual state of preservation of the cores.

A similar number of cores with a narrow and broad knapping surface can be observed. Double-platform cores were reduced by means of a series of blows from each side. In most cases, no dominance of either platform can be observed.

The preserved cores are usually small: the largest one is 80.14 mm long, including the refitted plunged blade; the smallest one is 29.79 mm long. The length of most cores ranges from 44 to 65 mm (10 artefacts).

The cores in the assemblage are almost exclusively blade cores (11 items), from which narrow, sometimes very narrow blades (and sometimes bladelets) were obtained. Only two cores can be classified as bladelet cores although it seems that originally they were blade cores as well. There are no classic, small bladelet cores known from most Magdalenian sites. One item has been described as a bladelet/flake core, one as a blade/flake core, and one as a flake core. One core has not been classified because it was burnt to a high degree.

The distribution of the raw materials used is quite striking. The three main species of flint – chocolate, Świeciechów and erratic – are represented in nearly the same proportions: five chocolate flint and five Świeciechów items, and four erratic flint items. They are accompanied by two cores probably made of Volhynian flint. Both of them are small blade cores; one was made without precision and bears no trace of platform edge faceting. Another item, burnt to a high degree, has not been identified. A white discolouration of the surface suggests that it is most probably erratic flint (Bobak *et al.* 2008).

Double-platform cores are the dominant category (10 items against three single-platform cores and four with a changed orientation) with shared knapping surfaces, both narrow and broad, with neither surface being clearly dominant. Knapping surfaces rarely encompassed the side or sides of a core. The knapping of both platforms usually occurred in a series starting from both of them (nine artefacts). An alternating knapping of both platforms is visible in only two cases. A question thus arises about how many of the cores identified as double-platform could have actually been cores with a changed orientation.

Their intentionally double-platform structure is suggested by the fact that in most cases, these platforms are equal; a distinct dominance of one of them is visible in just two cases.

The cores were intensively reduced by means of typical repairs such as regeneration and rejuvenation of the platforms, platform edge faceting, or forming secondary crested ridges. In most cases, hinges or badly damaged edges of the platforms are visible on the knapping surfaces. This damage was frequently the reason for discarding an item and, in a few cases, changing the orientation.

One splintered piece and eight splintered flakes have been identified.

In the debitage group, more than 700 blades along with bladelets and more than 1,000 flakes were identified; other items are unidentified fragments, pieces, technical forms (nearly 60) and numerous chips. Some chips and small flakes were obtained through sieving. It is worth noting that the number of blades is only slightly higher than the number of flakes. There are very few *éclat d'amorçage* products and artefacts with the cortex percentage greater than 50%, while artefacts devoid of cortex account for more than 55%. These characteristics indicate that the initial working took place outside the site, which confirms the conclusions based on the analysis of the cores. The faceted butts are more numerous than the flat ones (44% and 28% respectively). The characteristics of proximal parts indicates the use of soft-hammer percussion. The occurrence of *en éperon* butts has been documented. The unidirectional pattern of the negative scars that is clearly predominant on the upper surfaces of blades and flakes (nearly 90%) and contradicts the clearly confirmed double-platform structure of the cores should be linked with the serial reduction of the cores.

## TOOLS

The composition of the tool group is very characteristic. Backed blades and bladelets (Figs. 8: 5-16; 9) are the most prevalent, accounting for more than 65% of all tools (65 items, *i.e.* 68%; after refitting – 58 items). Burins, the second largest group, are much less numerous (Figs. 7: 3; 8: 1-4), with a total of 18 items (18%). The other tools include a small number of truncated blades (four items), end-scrapers (three items) (Fig. 7: 5), retouched blades and flakes (seven items), and a few examples of serrated tools, borers, combined tools (scraper + burin), and three fragments of unspecified tools.

The most numerous category of tools, *i.e.* backed blades and bladelets, consists of several varieties, differing with regard to the number and location of retouched edges, and kinds of retouch (Figs. 8: 5-16; 9).

Ordinary backed bladelets, accounting for more than 50% of all backed pieces, are the most numerous. Another, much less numerous group consists of backed pieces with a retouch of the other edge (slightly above 20%), including a few items with a semi-steep retouch to the lower surface, accompanied by a small number of backed pieces with a re-



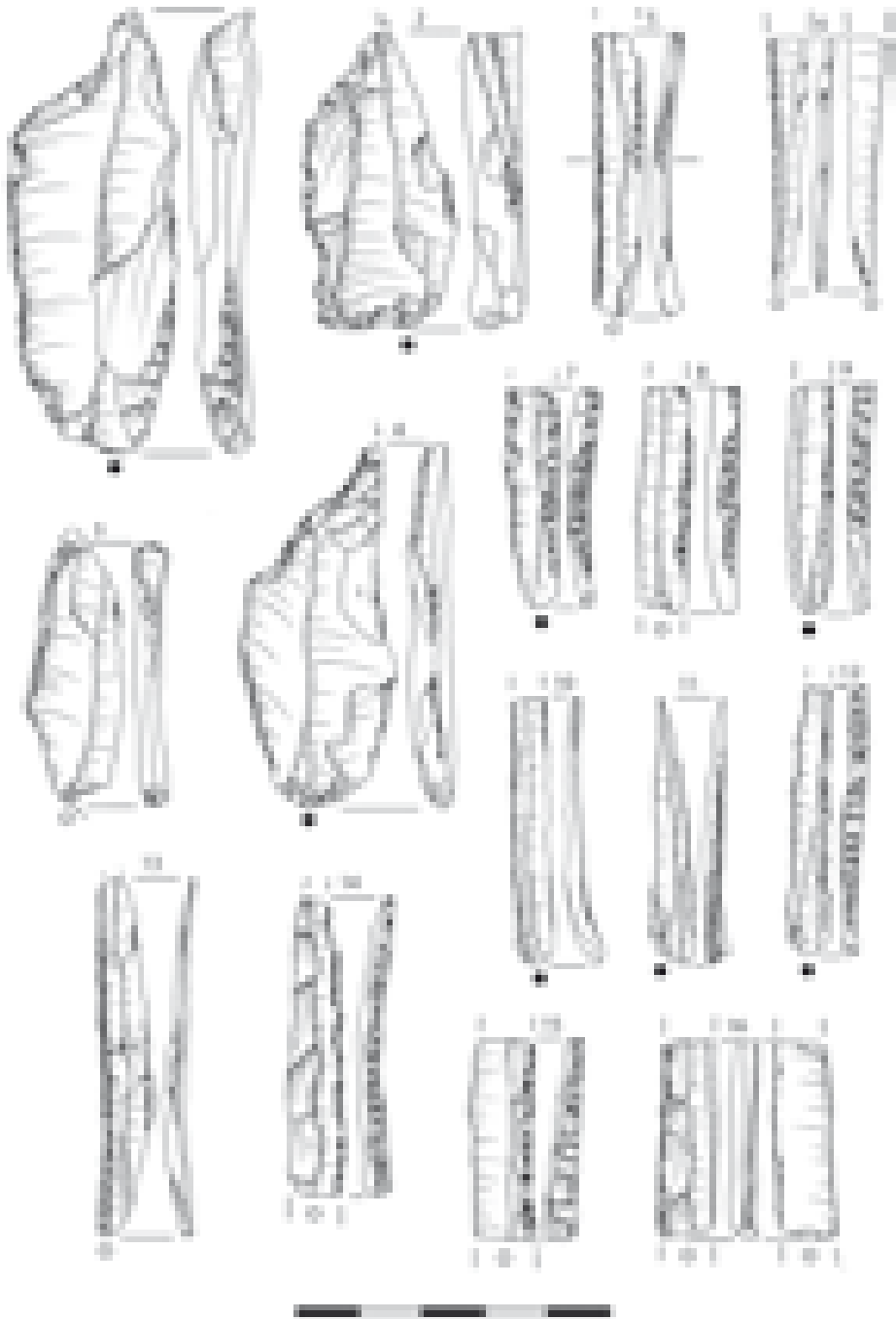


Fig. 8. Wierzawice, site 31. Tools: 1-4 burins; 5-16 backed pieces. Illustrated by A. Nowak



Fig. 9. Wierzawice, site 31. Tools – backed pieces. Illustrated by A. Nowak

touch of the shorter edge and an alternating retouch. There are no rectangles or backed blades with an arched back. The retouches are quite varied: steep or semi-steep, from thick to thin, exclusively unidirectional (from the lower to the upper surface). This diversity of retouch may also result from the fact that the backed blades and bladelets preserved in the assemblage represent different phases of production that was taking place on site, in the immediate vicinity of the hearth. This is indicated by refitting. Backed pieces were made on bladelets and long narrow blades that were intentionally broken – both before and after retouching a back. It seems that repairing and preparing of new hunting weapons were among the most important actions carried out during a short stay at the Wierzawice camp-site. Some of the preserved artefacts do not show any traces of wear (Bobak *et al.* 2017).

Burins are the second most numerous category of tools although they are much less numerous than the backed blades and bladelets. Burins on truncations with straight or oblique truncations are predominant in this category (Fig. 7: 3). A group of burins of the Lacan type is particularly worthy of attention: four whole artefacts and three fragments of truncations were identified and can probably be linked to this type of tools. At least two (and perhaps three) burins of the Lacan type were made from blades struck off the same erratic flint core (Fig. 8: 1-2, 4).

Types other than burins on truncations are represented by just two dihedral burins (one doubled) and a burin on a truncation coupled with a dihedral one (Fig. 8: 3).

The truncations of truncated blades are analogous to the truncations of Lacan-type burins, which can raise the question whether these may be fragments of other burins of this type. Due to the characteristic way of creating Lacan-type burins, where the burin blow is followed by the truncation, it can be assumed that these are indeed truncated blades.

A small number of end-scrapers form another group. Among them, one small artefact with a simple scraping surface is worthy of special attention. It was made from a shortened blade (Fig. 7: 5). This form is interesting because it is the only example of a tool having features characteristic of assemblages linked to the youngest phases of the Magdalenian or Epimagdalenian, as is the case, for example, in the highest Magdalenian layers in the Kůlna Cave in Moravia (Valoch 1988). The other end-scrapers are ordinary blade forms.

Given the tool set observed in the assemblage, there is a relatively large number of retouched blades and flakes, i.e. uncharacteristic forms, undoubtedly created *ad hoc* to perform specific, usually short-lasting actions.

It is worth noting that other forms characteristic of the Magdalenian, particularly borers, combined tools and splintered pieces, are practically not represented in the assemblage.

The tools forming the assemblage are thus dominated by one group, *i.e.* backed blades and bladelets, commonly interpreted as pieces of weaponry, in this case, hunting weaponry. Burins, almost exclusively burins on truncations, form another, less numerous group. This composition is very characteristic.

Microscope observation of the tools confirms that the backed blades and bladelets were used as insets in hunting weapons. Many of the investigated artefacts show traces of use,

including the characteristic impact signs, while other backed pieces and some burins show clear traces of the processing of organic materials, which indicates the processing of the carcasses of hunted animals. A zone in the western part of the campsite is perhaps a remnant of such a place, as suggested by the stains of hematite dust and lumps of dye discovered there (Bobak *et al.* 2017). A few artefacts were found whose edges were covered with hematite dust. A relatively large number of burins as well as backed pieces, though distinctly less numerous than in the central part of the campsite, were also found in that zone.

Other tools are represented by a small number of artefacts; no traces of wear were found on the investigated examples of debitage (*ibid.*). Some backed blades and bladelets bear traces of wear or impact, but there is a large number of backed pieces devoid of such traces. This group includes artefacts that were certainly produced at the site. Backed pieces and refitted pieces sometimes show different stages and the method of production.

## THE SPATIAL AND FUNCTIONAL ARRANGEMENT OF THE SITE

Wierzawice 31 is an example of a small, short-term hunting camp site inhabited most probably over a short period of time by a small group of Magdalenian hunters. Its central point is a very well-preserved stone hearth, surrounded by concentrations of flint artefacts and other stones (Figs. 4; 10).

The hearth is built of granite pebbles and sandstone slabs which form a legible oval structure measuring 95 × 60 cm (the outer circumference). The main traces of burning are pieces of charcoal, highly washed out and mixed with sediments. A small number of burnt flints, mainly small flakes and chips, were found within the structure and in its immediate vicinity. Some stones forming part of the structure also bear traces of the impact of fire. It is worth noting that these traces mainly occur on the lower parts of the stones. No burning traces were found in the sediments. The hearth is not sunk into the ground. The observations conducted indicate similarities between the Wierzawice hearth and other Magdalenian sites where hearth-covering stone structures occur, *e.g.* at Monruz or Champréveyres in Switzerland (Bullinger *et al.* 2006, see for further literature; Leesch *et al.* 2010).

The presence of stones is very clearly limited to the zone of the hearth and its immediate vicinity. Outside the oval structure, the stones are within one metre and co-occur with flint concentrations (Figs 11, 12). These are typically sandstone slabs, some of which are broken pieces of one slab. It is not clear whether they were linked with the hearth structure or whether they had a different function (pads? seating?). Traces of wear visible on some slabs suggest that at least some of them were used for a different purpose, not as structural elements of the hearths or possibly other structures. However, there is a lack of evidence to identify traces of a residential structure at the site. No permanent structures (*e.g.* post-holes) that could be linked to a shelter structure were found, and the pattern of lithic artefacts does not indicate that either.

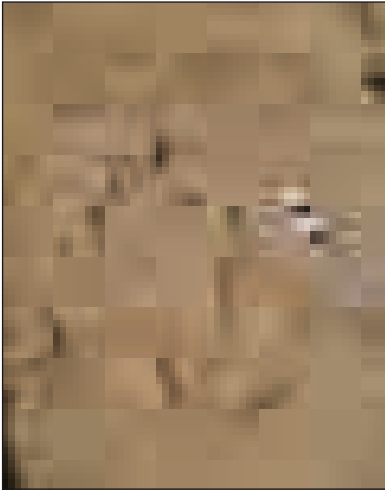


Fig. 10. Wierzawice, site 31. Hearth remains during excavations. Photo by D. Bobak

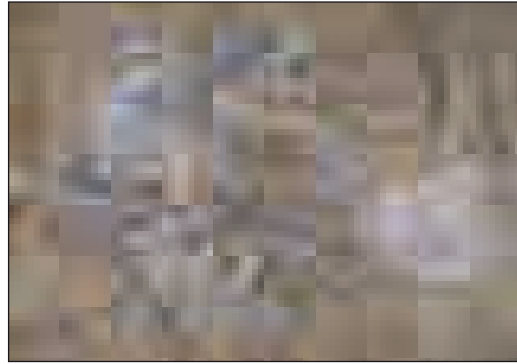


Fig. 11. Wierzawice, site 31. Concentration of artefacts. Photo by D. Bobak



Fig. 12. Wierzawice, site 31. Concentration of artefacts. Photo by D. Bobak

A considerable amount of information on the site's spatial and functional arrangement can be obtained from the observation of the distribution of lithic artefacts (Fig. 4). What can be clearly seen is the close connection of the backed blades and bladelets with the hearth. Most of the backed blades and bladelets occur around the hearth. What is more, many of them form small but dense concentrations of backed pieces, some of which can be refitted. There is no doubt that it was a place where hunting weapons were produced and repaired. A small number of cores also occur in the vicinity of the hearth: two lying separately, another three – concentrated, closely linked with the accompanying backed blades and bladelets. These cores are almost exclusively residual blade (often narrow blade) cores or bladelet cores; they are accompanied by blades and production debris. The other cores lie at a greater distance, about two metres from the concentration of cores around the hearth. Two concentrations can be observed here: one in the eastern part, the other in the southern part, on the periphery of the campsite. These two concentrations of cores seem to indicate places of raw material working and debitage production, *i.e.* something like small workshops. The cores lying by the hearth, among backed pieces and numerous pieces of debitage, should be linked with the production of backed blades and bladelets.

Individual tools and pieces of debitage or waste scattered along the boundary should be interpreted as products that were lost or moved there by accident.

The western part of the site also merits attention. The numerous traces of hematite occurring there, whether in the form of grains or dust stains in the sediments, certainly mark a boundary of an activity – probably related to organic material processing (animal carcasses or hides?), which could be confirmed by the relatively numerous burins in this part of the site. Traces of ochre suggesting this kind of activity occur only in one part of the site, but it is worth noting that they are less than two metres away from the hearth, *i.e.* in the immediate vicinity of the camp's centre around which the life of the inhabitants revolved. Such distinct zones of organic material processing are also known from other, larger Magdalenian sites where organic matter processing zones are located at the periphery of camp sites (Julien 1984; 1989; Julien *et al.* 1988). In the case of Wierzawice, we can identify such a separate zone although it is not located at the periphery. This results from the small size of the camp site and, above all, from its role of a short-term hunting campsite where activities were limited to the preparation and repair of weapons and, as seems likely, flaying the killed animals. This purpose of the site is evidenced by the absence of domestic tools, alongside the arguments mentioned above.

## SETTLEMENT CHRONOLOGY OF THE SITE

Two radiocarbon dates (Poz-36901: 11,560±40 uncal BP and Poz-41200: 11,080±130 uncal BP) as well as the series of TL and OSL dates mentioned above were obtained at the Wierzawice site (Fig. 2). These dates enable a preliminary determination of the chronology of settlement activity at this site. The calibrated radiocarbon dates are in the range from 13,470 BP to 12,710 BP (with a significance level of 95%). The TL dates obtained from the settlement layer indicate quite a broad timeframe encompassing the end of the Pleniglacial and the entire Late Glacial period.

In order to determine the time of the site's functioning with greater precision, an attempt was made to model that period by means of Bayesian age modelling, carried out using OxCal ver. 4.3 software (Bronk Ramsey 2009a). The IntCal13 calibration curve was used (Reimer *et al.* 2013). All dates (<sup>14</sup>C and TL) from the cultural layer and the TL date from the eastern profile from 2010 were used to build the model (Figs 2; 13). The profile was selected because the sequence of the greatest number (3) of pre-settlement dates for which a stratigraphic account can be reconstructed originates from this profile. The date 16,000±1,400 BP was excluded from the cultural layer dates as an evident outlier (which was also confirmed by the outlier analysis, cf. Bronk Ramsey 2009b). In consequence, the period preceding Magdalenian settlement was determined by three TL dates, and the duration of settlement was determined by two <sup>14</sup>C dates and six TL dates. The objective of the modelling was to establish the broadest possible timeframes in which the Magdalenian settlement episode may have occurred.

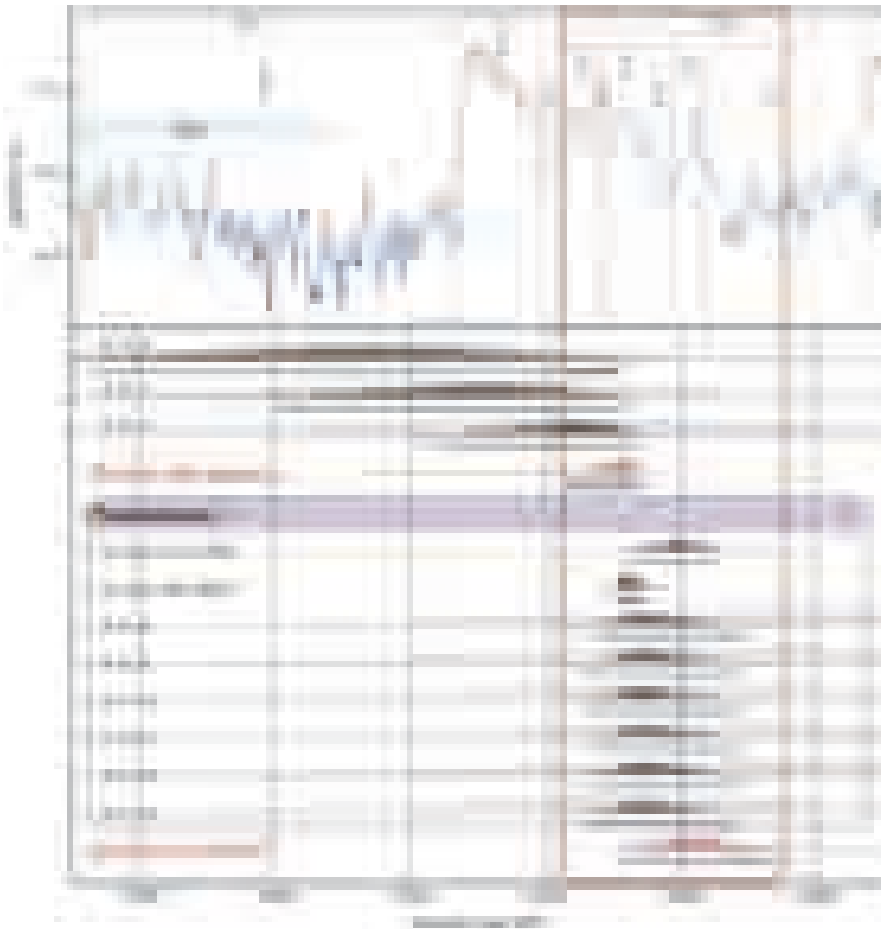


Fig. 13. Bayesian modelling of the site chronology. Illustrated by D. Bobak

The modelling result is shown in Fig. 13. The information obtained makes it possible to date the earliest possible beginning of settlement at the study site to the period between 13,880 BP and 13,290 BP, and the end of settlement to the period between 13,400 and 12,220 BP, *i.e.* from the start of GI-1c3 to the first half of GS-1. According to the sedimentological survey, the cultural layer at the site should be linked with a pause in slope sedimentation and the resulting stabilisation of the terrain, during which a poorly developed weathering/soil horizon formed. This allows us to limit the upper time limit to the period before or to the very beginning of the last Dryas.

Such a young age may give rise to some doubts and questions about the possible errors in absolute dating. In this case, errors may result mainly from the contamination of sam-

ples leading to younger dates. It may be the case with radiocarbon dates, but it is another matter with TL dates. Such dates can become younger only during sediment bleaching, which occurred long after the deposition of the layer. In the case of dates originating from below the settlement layer, such a possibility can be ruled out; the spatial distribution of the artefacts shows that they were covered by an intact layer of Magdalenian settlement. Thus, there is no physical possibility of the bleaching of grains from layers located below the layer containing remnants of the Magdalenian campsite that would produce a measurement that would yield an age younger than the settlement.

Similarly, it is not possible to obtain younger dates from the settlement layer. The processes that would cause the above would also have to have disrupted the preserved spatial arrangement of the campsite, which is not the case, as we know. Therefore, it seems that the obtained  $^{14}\text{C}$  dates as well as the TL ones should be regarded as reliable.

## DISCUSSION AND SUMMARY

The characteristics of the assemblage as well as the distribution of the settlement remains indicate that the Wierzawice site should be interpreted as a short-term camp site, probably inhabited by a small group of hunters. It is one of the very few Magdalenian sites in south-eastern Poland (Fig. 14) represented exclusively by poor sites, most probably

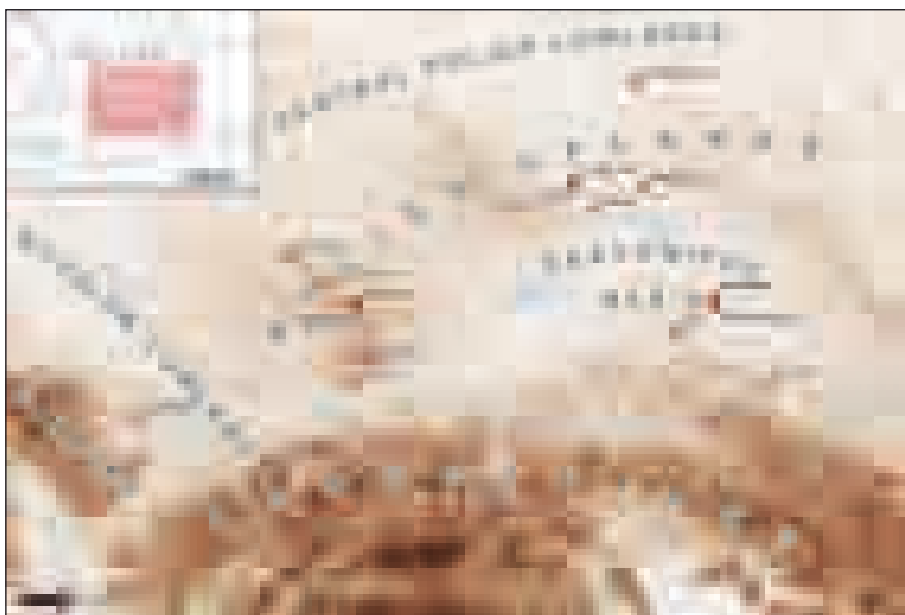


Fig. 14. Magdalenian sites in Southern Poland mentioned in text. Illustrated by D. Bobak



documenting short-term stays, (Łanczont *et al.* 2002; Połtowicz-Bobak 2012; 2013; Połtowicz-Bobak *et al.* 2014) and probably one workshop on the new discovered site in Stare Baraki (Wiśniewski 2020). The Wierzawice site is the richest and best preserved site known in this area (Bobak *et al.* 2017).

Grodzisko Dolne and Łąka, located on the Kolbuszowa Plateau, are the closest sites to Wierzawice. They were dated to the warm periods of the Late Glacial: the Allerød in the case of Grodzisko Dolne and Wierzawice (Połtowicz 2006; Bobak *et al.* 2010; 2017; Bobak and Połtowicz-Bobak 2013; Połtowicz-Bobak 2013), and the second half of the Bølling/beginning of the Allerød in the case of the Ůrka site (Połtowicz-Bobak *et al.* 2014). It should be stressed that absolute dates obtained with physical methods are available only for the Wierzawice site. The materials from Grodzisko Dolne form a very poor assemblage (40 items) that includes two cores and a few tools: end-scrapers, burins, borers, and backed pieces including arched backed blades (Czopek 1999; Połtowicz 2006). Its chronological position, linked with the Allerød, based on typological premises, is not certain.

The Łąka site features a small assemblage of nearly 200 artefacts, including four cores, one pre-core and 38 tools, including a large series of end-scrapers, burins, and borers; there are no backed blades or bladelets (Połtowicz-Bobak *et al.* 2014).

The materials from the Łąka and Grodzisko Dolne sites include end-scrapers with an almost 1: 1 length to width ratio, often associated with assemblages of such a young age. Only one such artefact can be found at Wierzawice. However, at Grodzisko and, above all, at Łąka, these artefacts are accompanied by tools made from regular, long blades. The Łąka assemblage contains classic Magdalenian blade cores.

It is also worth noting that artefacts in all of these three assemblages were made from a whole range of different materials, among which chocolate, erratic and Świeciechów flint predominates – proportionally more numerous at Wierzawice and less numerous at Łąka. The share of Jurassic flint is higher at Łąka. The percentage share of raw materials at Grodzisko Dolne is more difficult to estimate due to the small size of the assemblage. A few flint artefacts of probably eastern origin (“Volhynian” flint) have been found at Grodzisko Dolne and Wierzawice, and a limno-quartzite originating from the south (Slovakia?) has been discovered at Łąka. These imports may be an important piece of evidence indicating the possible directions of contacts maintained by the Magdalenian communities.

All these sites, similarly to the other Magdalenian sites in this part of Poland, are remnants of small campsites inhabited for short periods. The Wierzawice campsite is the most legible, obviously: its layout and assemblage composition allow for an unequivocal interpretation. In the case of the Łąka site, it was probably a campsite, probably inhabited for a short time as well, but rather of a domestic type, which is indicated primarily by the composition of the assemblage, with a predominance of domestic tools and absence of weapons (backed blades and bladelets). The Grodzisko Dolne site, due to the small number and fragmentary character of its assemblage, cannot be defined in functional terms. The Hłomcza site in the Carpathians is also a short-term campsite of a domestic type (Łanczont

*et al.* 2002), probably older than the sites from the Kolbuszowa Plateau discussed here. However, although the above-mentioned sites in the region did not function at the same time, it seems that within a broader timeframe, they are linked with the phase of a certain stabilisation of the land surface and homogenisation of environment conditions in the Kolbuszowa Plateau, where intensive aeolian and slope processes occurred simultaneously in the broadly defined pre-Allerød period.

The territories of south-eastern Poland definitely constitute the eastern borderland of the Magdalenian. Nonetheless, it seems that the area was an integral part of the territories inhabited and used by Magdalenian hunters and strongly linked with the settlement centre on the northern part of the Sandomierz Upland (Połtowicz-Bobak 2020). Perhaps the peripheral character of settlement can explain such a young age of the Wierzawice site and perhaps some of the neighbouring sites as well. Perhaps this area offered favourable conditions for the Magdalenian traditions to survive further into the Allerød Interstadial, when areas lying further west were already within the range of the ABP technocomplex traditions (also present in the territory of the present-day Rzeszów region) (Bobak and Połtowicz-Bobak 2011). This very young age is definitely one of the most interesting problems related to the eastern borderland of the Magdalenian.

The question of contacts with areas east of the present-day borders of Poland remains open. One cannot rule out that the line of the San river, surely an important transport route but also demarcating the eastern boundaries of the Magdalenian, will turn out not to have been an impassable border but just another barrier crossed by the carriers of Magdalenian, or at least its tradition.

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