

**Barbara Witkowska¹, Marcin M. Przybyła², Michał Podsiadło³,
Anita Szczepanek⁴, Piotr Włodarczak⁵**

ABSOLUTE CHRONOLOGY OF THE GLOBULAR AMPHORA FUNERAL COMPLEX AT MALICE, SANDOMIERZ UPLAND

¹ ORCID 0000-0002-1044-2326; Institute of Eastern Studies, Adam Mickiewicz University, Uniwersytetu Poznańskiego 7, 61-614 Poznań, Poland; Institute of Archaeology, Jagiellonian University, Gołębia 11, 31-007 Kraków, Poland; bejotwu@wp.pl

² ORCID 0000-0002-4695-0752; Dolmen S.C., Pl. E. Serkowskiego 8/3, 30-512 Kraków, Poland; megzyk@poczta.onet.pl

³ ORCID 0000-0002-8317-6145 Dolmen S.C., Pl. E. Serkowskiego 8/3, 30-512 Kraków, Poland; thergo@o2.pl

⁴ ORCID 0000-0003-0936-767X; Institute of Archaeology and Ethnology, Polish Academy of Sciences, Centre for Mountains and Uplands Archaeology, Sławkowska 17, 31-016 Kraków, Poland; Department of Anatomy, Jagiellonian University Medical College, M. Kopernika 12, 31-034 Kraków, Poland; anita.szczepanek@uj.edu.pl

⁵ ORCID 0000-0003-0359-7386; Institute of Archaeology and Ethnology, Polish Academy of Sciences, Centre for Mountains and Uplands Archaeology, Sławkowska 17, 31-016 Kraków, Poland; wlodarczak.piotr@gmail.com

ABSTRACT

The article presents new radiocarbon datings made for a funeral complex from Malice, site 1, located on the Sandomierz Upland and related to the Globular Amphora culture. The complex included at least two human graves (features no. 32 and 33) and two animal deposits or sacrificial pits (no. 31 and probably 54). Feature 32 was a collective grave including five burials (of a male, a female and three children), while in Feature 33 the only one disarticulated human skeleton has been excavated. Pit 31 contained at least three animal individuals. It is possible the unexamined Pit 54 also contained animal depositions. The described features probably formed two clusters, each of which

included a human grave and an accompanying pit with animal deposits. Altogether ten radiocarbon dates were obtained with the dated bone samples coming from five human skeletons found in Graves 32 and 33, and animal remains from Pit 31. The calibration results point to the first half of the 3rd millennium BC and stay between 2909 and 2472 BC (with the probability of 95.4%) or more precisely between 2898 and 2490 BC (probability of 68.2%). However, thanks to the stratigraphic documentation it was possible to determine that five deceased from Feature 32 were buried in three phases most likely to ca. 2850–2750 BC. It is highly probable that individual burials were separated by short time intervals. A similar age should be adopted for Feature 31 – a sacrificial pit linked to Grave 32. However, it is not possible to determine with any certainty the age of Grave 33: it could have been contemporaneous with, or slightly younger (ca 2620–2500 BC) than Feature 32.

Keywords: Globular Amphora culture, radiocarbon dating, modelled calibration, funerary rite, collective grave

INTRODUCTION

On the Sandomierz Upland, a number of Globular Amphora culture (GAC) sites have been discovered (Fig. 1) either by chance in most cases or in the course of investigations carried out already in the period between the two world wars [Nosek 1967; Wiślański 1979; Ścibior 1991]. The interwar discoveries yielded above all rich grave goods from the ‘Gajowizna’ cemetery in Złota [Krzak 1977; Witkowska *et al.* 2020] and settlement finds from Mierzanowice, site 1 [Balcer 1963]. Unfortunately, these finds are now incomplete and their documentary do not meet modern methodological standards. For these reasons, to obtain good quality data for the study of the chronometry and biological characteristics of GAC populations on the Sandomierz Upland, a decision was made to hold new excavations as per NSC project no. 2014/12/S/HS3/00355. For this purpose, Malice, site 1 (AZP 89-73/70¹), Obrazów commune (Fig. 2) was selected as it had been known in the professional literature for the discovery of a single GAC human grave – Feature 33 [Kamieńska 1964]. The study of field notes from the investigations conducted in 1960–1962 suggested, however, the existence of a ceremonial-funerary complex, comprising a larger number of features. Actually, the earlier investigations unearthed over 30 archaeological features altogether (Fig. 3) [Kamieńska 1962; 1963; 1967; 1964; 1972] of which four were plausibly linked to the GAC. Of the four, only two were explored then, with only Grave 33 mentioned earlier being published. Orientations, pit shapes and spatial relationships between features

¹ Identification number in Archaeological Record of Poland (in Polish: Archeologiczne Zdjęcie Polski = AZP).

discovered but left unexplored in 1963 suggested their connection to a GAC cemetery. To verify this hypothesis, field works commenced in the summer of 2017.

Their first stage was to locate the locus of previous excavations and rediscover the features left unexplored. This was successfully done, owing to information obtained from villagers, allowing us to locate roughly where the previous excavations took place, and a magnetometer survey that pinpointed the features searched for.

Relying on the reconstructed 1960s are grid, a rectangular trench was delineated, measuring 2.2×3.7 m in which – as expected – Feature 32 was found – a presumed GAC burial. The exploration covered a fragment of its surroundings as well by exposing space to the north, east and south of it. However, no other Late Neolithic features were discovered. In total, the exploration covered an area of over 1.0 are on which 12 settlement-type features were recorded (Fig. 3). Some were examined and materials associated with the late phase of the Mierzanowice culture were recovered. It is to the Early Bronze Age too that most features from the investigations in 1960–1962 are linked. As far as we can tell now, the GAC cemetery was most likely small, consisting of two grave pits and accompanying sacrificial pits or Feature 32 with Pit 31 and Feature 33 whose hypothetical animal deposit (Pit 54) has not been examined.

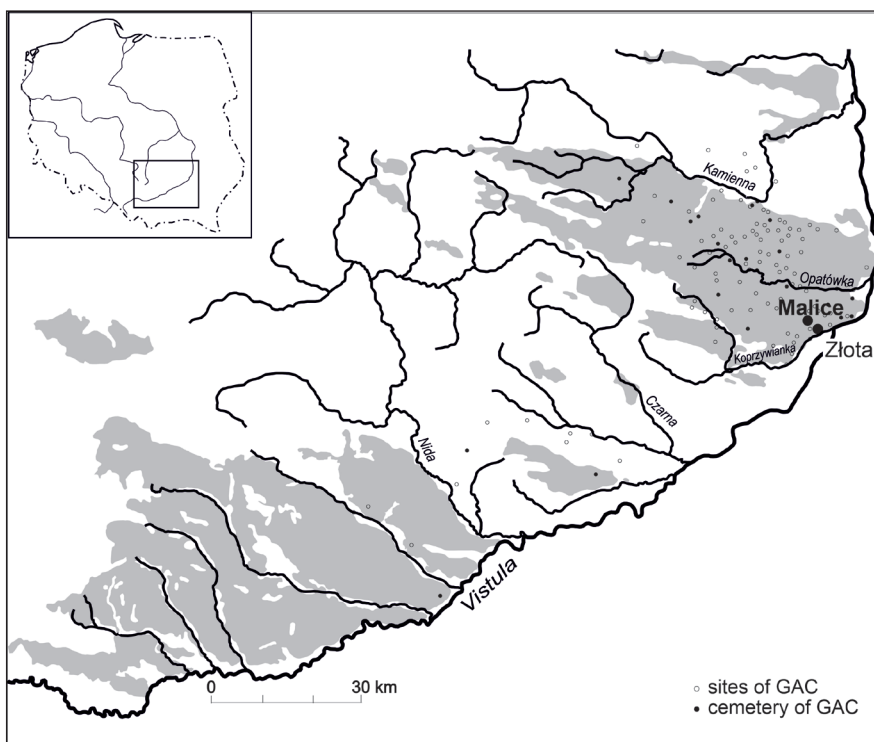


Fig. 1. Malice cemetery (site 1) against the background of other sites of the Globular Amphora culture in Małopolska

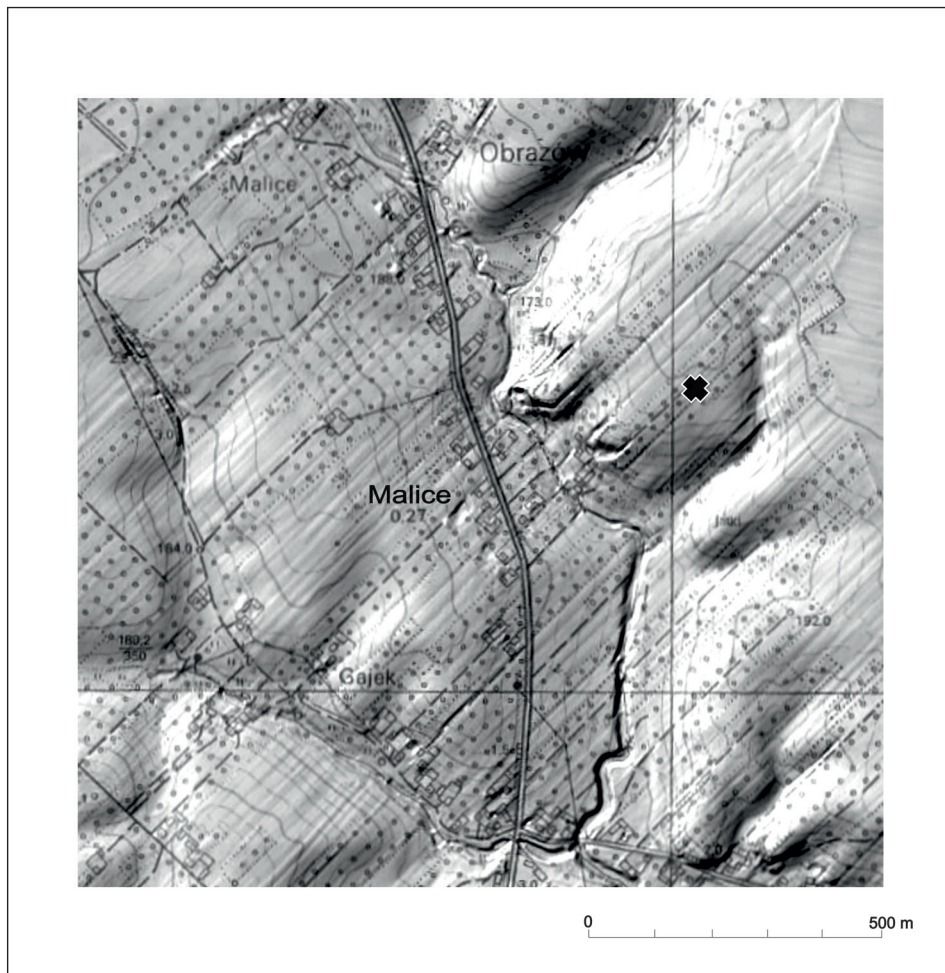


Fig. 2. Location of site 1, Malice, Sandomierz district

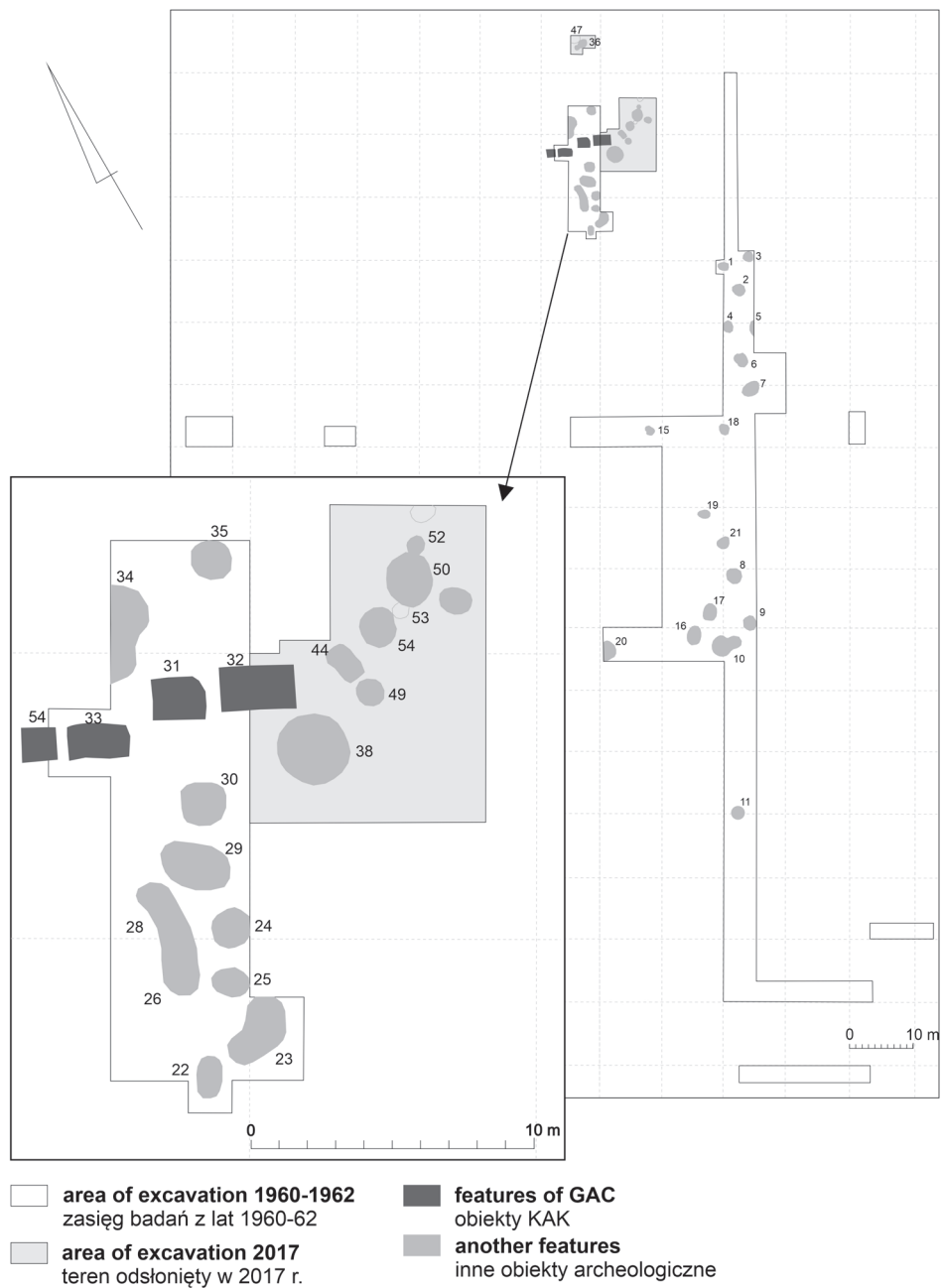


Fig. 3. Malice, site 1, Sandomierz district. Site plan

FEATURE 31 (PIT WITH ANIMAL SACRIFICE)

Although discovered in 1962, the feature has not been published yet. Its pit resembled a square of 130 × 160 cm and 50 cm deep form the ground surface. It was filled with light-brown soil, recorded among numerous animal bones tightly filling its interior. Most of the osteological material has gone missing, preventing any species identification. Relying on a field drawing, the articulated remains of at least three individuals were identified together with a few dozen more animal bones (Fig. 4). Among the bones, a discovery was made of a double-edged bone point 16.8 cm long (Fig. 5: 1). A ¹⁴C age determination was performed on a fragment of a long bone of a small ruminant.



Fig. 4. Malice, site 1, Sandomierz district. Grave 32 explored in 2017 together with sacrificial Pit 31, discovered in 1962

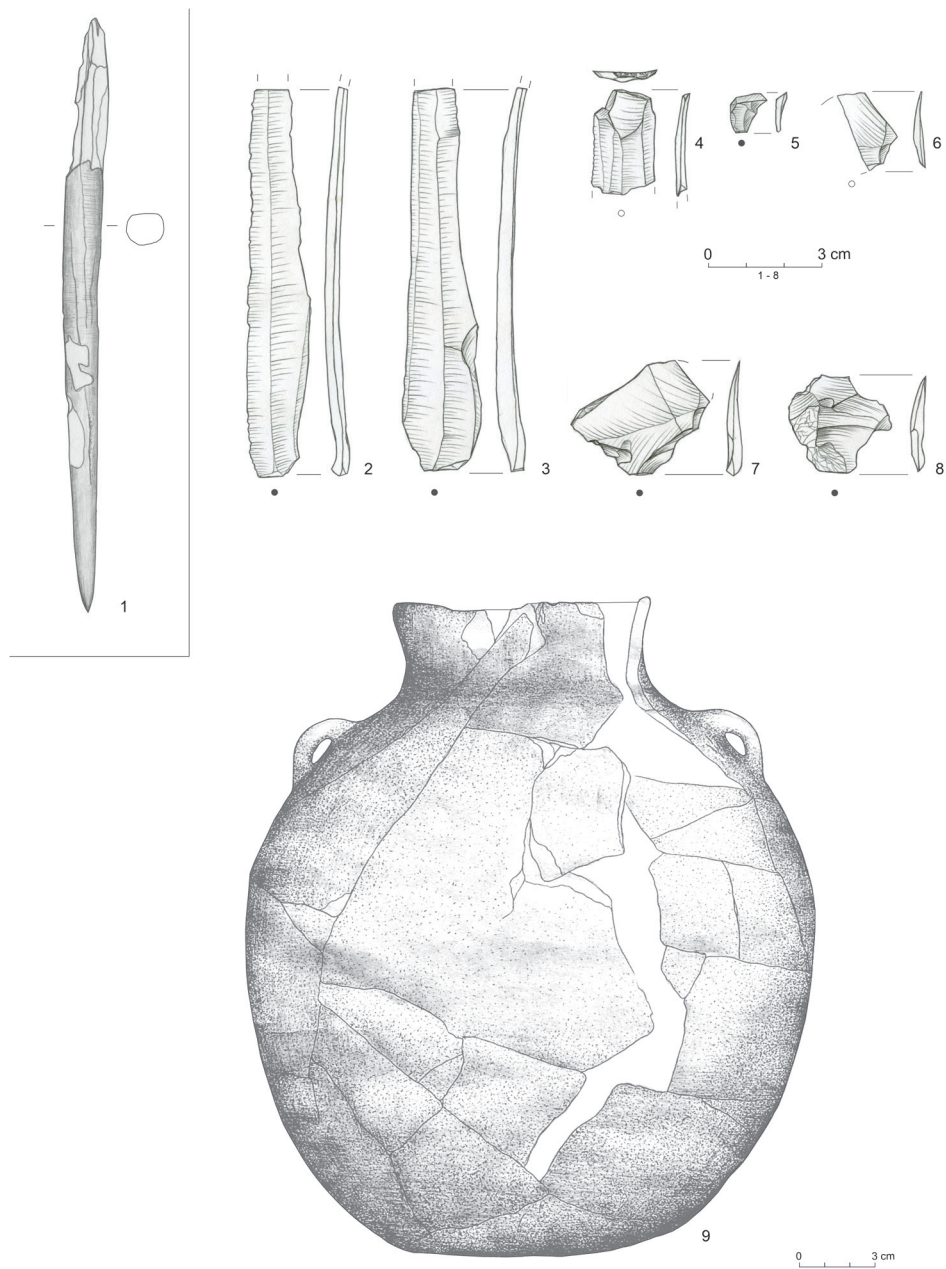


Fig. 5. Malice, site 1, Sandomierz district. Bone point in Pit 31 (1) and grave goods from Grave 32 (2-9). Drawn by B. Witkowska

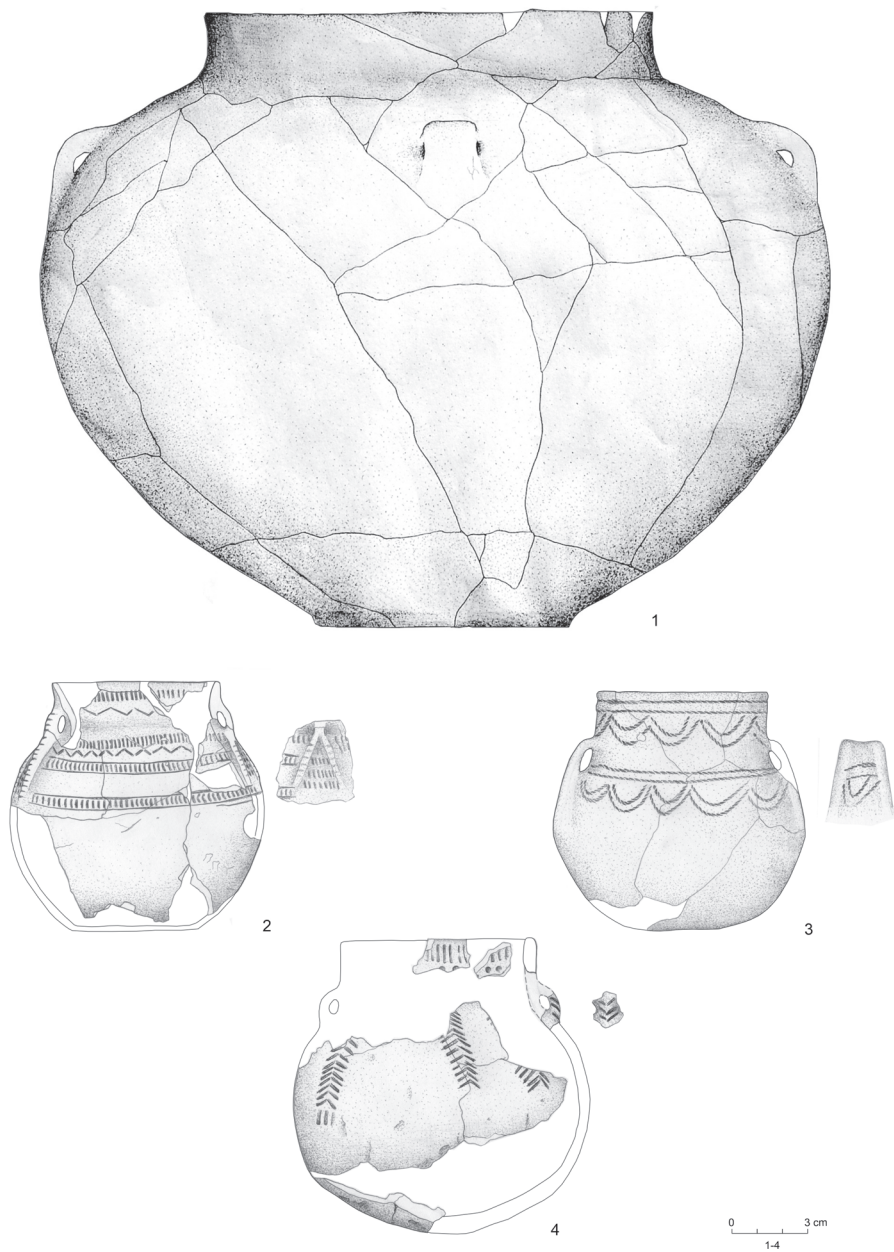


Fig. 6. Malice, site 1, Sandomierz district. Grave 32: grave goods. Drawn by B. Witkowska

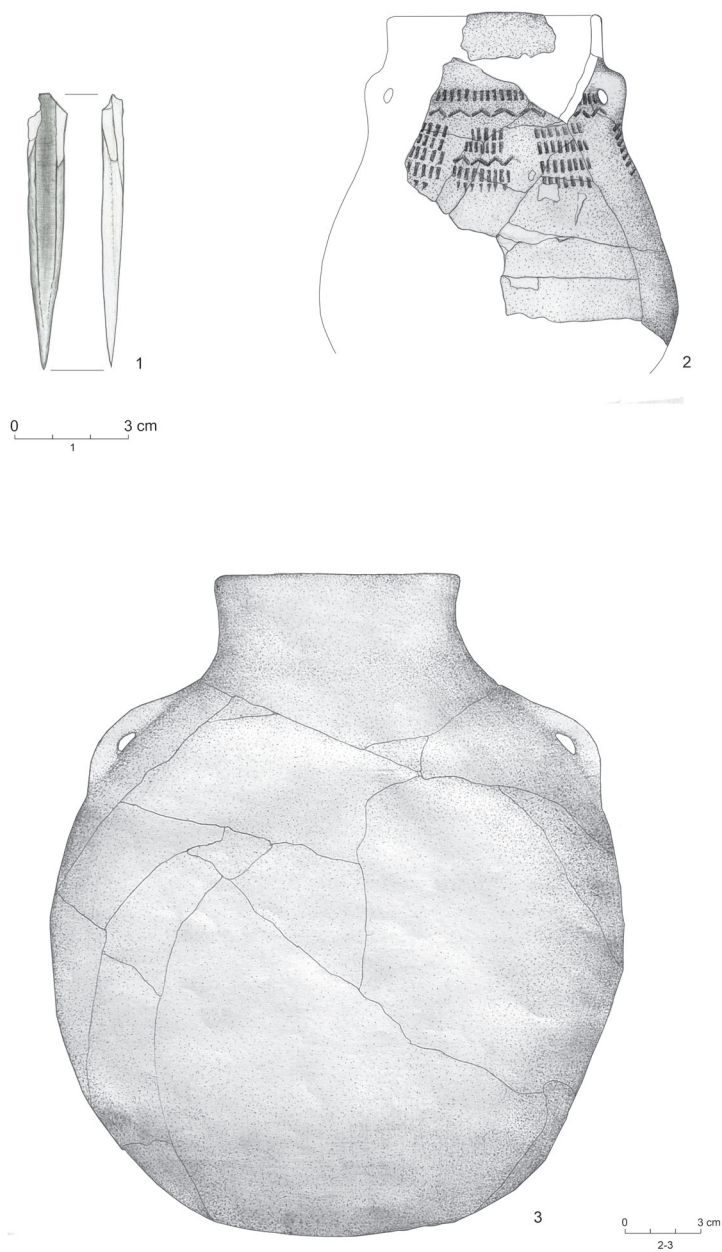


Fig. 7. Malice, site 1, Sandomierz district. Grave 32: grave goods. Drawn by B. Witkowska

FEATURE 32 (GRAVE WITH A HUMAN MULTIPLE BURIAL)

The grave was exposed in 1962 and investigated in 2017. Its pit resembled a rectangle, measuring 160 × 270 cm and oriented NW-SE. Its borders were clearly marked in part by a stone lining surviving as a low kerb of small flat lime stones. In the middle of the shorter south-eastern side, there was a small annex which was found to hold the lower limb bones of one of the buried individuals (Fig. 4).

On a flat unpaved bottom, at a depth of 60 cm, the remains of four individuals were exposed that lay in antipodal position in pairs (Skeletons B–E). Above them, Skeleton A was discovered whose lower limbs were located outside the chamber – in the annex mentioned earlier. A part of this skeleton directly lay on the bones of complete Individual B and the skull of Individual C. Found in the north-eastern part of the feature, the skeletons of Individuals D and E were preserved in a worse state than the other burials.

Skeleton A belonged to a male aged 35–45 years (*Maturus*)² whose intravital body height was about 162 cm.³ The deceased lay crouched on the right side with the upper limbs bent at elbows and pointing towards the face. In spite of the fact that it lay in part outside the grave pit proper, the skeleton was oriented consistently with its longer axis. The head pointed to the NW, with the face directed to the SW. Interestingly, its right tibia was missing, which could not result from natural taphonomic processes as it seems. In the place of the anatomic position of its distal end, the distal epiphysis of a long cattle bone was found.

Almost complete, *Skeleton B* belonged to a female aged about 50–55 years (*Maturus/Senilis*) whose intravital body height was about 153 cm. It lay on its left side, oriented along the longer axis of the grave, contracted. Its head pointed to the SE while the face was directed towards the SW.

The designation *Individual C* was applied to an infant skull placed on its base and resting on the hand of Skeleton B. Its back faced the female's face. The degree of morphological development of the skull bones [Scheuer, Black 2000] suggests that the individual was 3–4 years old (*Infans I*).

The northern part of the feature held two incomplete, relocated no doubt, child skeletons.

Individual D was laid to rest in a crouched position on its right side, with the head pointing NW and the face directed most likely towards the SW. Relying on the degree of dentition [fol. Al Qahtani *et al.* 2010] and the length of femur shaft [Bernert *et al.* 2007], its age was set at 10–11 years (*Infans II*).

² The age of the individuals was determined following White, Folkens 2005.

³ The individuals' intravital body height was determined following Formicolla, Franceschi 1996.

Individual E was a child aged 11–12 years (*Infans II*). Its position is difficult to reconstruct because some skeleton parts have been relocated and the bones have been poorly preserved. The arrangement of the vestiges of upper limbs suggests the position on the right side. Single skeleton bones found underneath those of Individual D suggest that Individual E was deposited first in the grave. Incidentally, part of Individual E's calva was found at a distance from the original position, on the bones of the skeleton of Individual D.

In the northern part of the grave pit, the following grave goods were found: seven vessels (Table 1; Figs. 5–7), two Świeciechów flint blades (both 10 cm long, Fig. 5: 2–3) and an awl made of a small ruminant bone; its reconstructed length is approx. 8 cm (Fig. 7: 1). The vessels were deposited in two clusters, in part on the bones of Individuals D and E. The eastern cluster comprised three vessels (I, V and VII) and the western one – four (II, III, IV and VI). Large vessels were crushed while small ones fragmented, with some shards being clearly relocated. The observed pottery destruction in all likelihood was not intentional or secondary to the interment but rather followed from natural taphonomy and the poor firing of the vessels.

In addition, the grave pit fill was found to contain five Świeciechów flint flakes (Fig. 5: 4–8). Their connection to the grave goods is not certain, but – on account of raw-material identity – it seems probable though. Among them, there is a fragment of a truncated piece (Fig. 5: 4).

Radiocarbon dates were obtained for bones from the burials. For the most part, these were fragments of human ribs. Only in the case of Individual C, was a fragment of a skull bone used. The state of preservation of Individual E's skeleton prevented sample collection for dating.

Grave 33

A partially stone-paved human grave with the vestiges of a stone lining was explored in 1963 [Kamieńska 1964: 31–33, Fig. 2]. The grave pit, measuring 160 × 330 cm, extended NW–SE (Fig. 8). Inside, at a depth of 60 cm, a disarticulated human skeleton was found and a cluster of animal bones of various species (the author of the field investigations believed these to be the remains of cattle and sheep/goat). The bones have gone missing.

On a stone pavement in the eastern part of the feature, there were found a large beaker ornamented with cord impressions (Table 1; Fig. 9: 2) and two other vessels omitted from the 1964 publication (Table 1; Figs. 9: 3; 10: 3), a striped-flint axe (Fig. 10:2), single Świeciechów-flint blade (Fig. 10: 1) and a double-edged bone point analogous to the artefact discovered in Feature 31 (Fig. 9: 1).

The human remains and most animal bones from the feature have gone missing, preventing any specialist analyses. To determine their absolute age, a surviving bone of a small ruminant was used after it had been stored together with other artefacts from the feature.

Table 1

Malice, Sandomierz district, site 1. Vessels from Features 32 and 33.

No. of feature and vessel	Vessel	Handles	Height (cm)	Diameter (cm)			Wall thickness (mm)	Bottom thickness (mm)	Clay admixture	Decoration	Figure
				rim	belly	bottom					
32/I	amphora	2	26	10, 5	22,5		4-5	7	white stone > 1 mm	-	5:9
32/II	amphora	4	24,5	18	31,5	10	5-7	8	pinkish stone > 3 mm	-	6:1
32/III	amphora	2	26,5	10	22,5		4-5	8	white and pinkish stone > 3 mm and sand	-	7:3
32/IV	amphora	2	~12	8	12		5	8	pinkish stone > 3 mm	engraved and stamp	7:2
32/V	amphora	2	10	7	10	5	3-4	3	white and pinkish stone > 3 mm and sand	engraved, stamp, plastic strip	6:2
32/VI	amphora	2	9,5	7	10,5	4	4	4	sand	corded	6:3
32/VII	amphora	2	> 20	8,5	14,5	-	5-7	-	pinkish stone > 2 mm	stamp	6:4
33/I	beaker	-	27, 5	15	24	8,5	5-6	8	white stone	corded	9:2
33/II	indefinite	-	< 20	-	27	10	5	6		-	10:3
33/III	indefinite	-	-	-	13,5	10	5	7		-	9:3

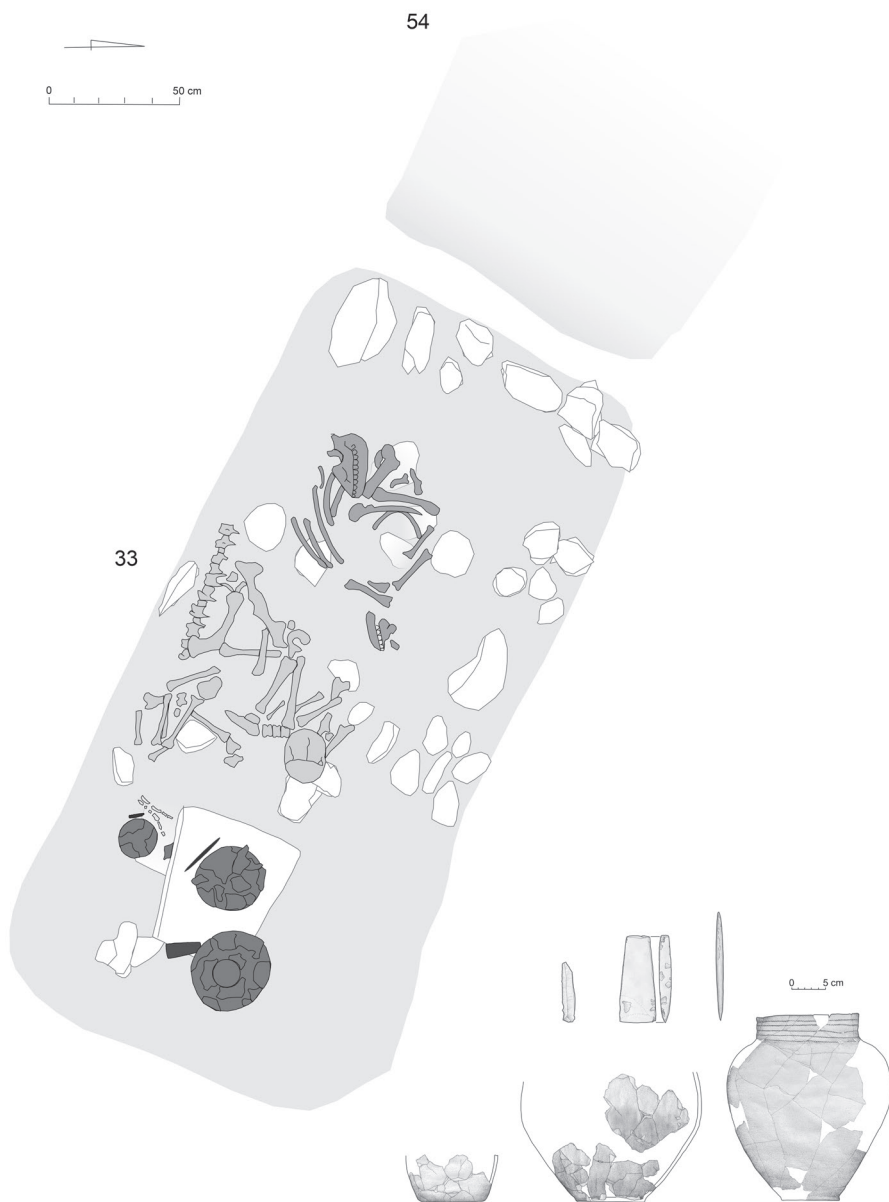


Fig. 8. Malice, site 1, Sandomierz district. Grave 33 explored in 1962 together with hypothetical Sacrificial Pit 54. Foll. Kamińska 1964, modified

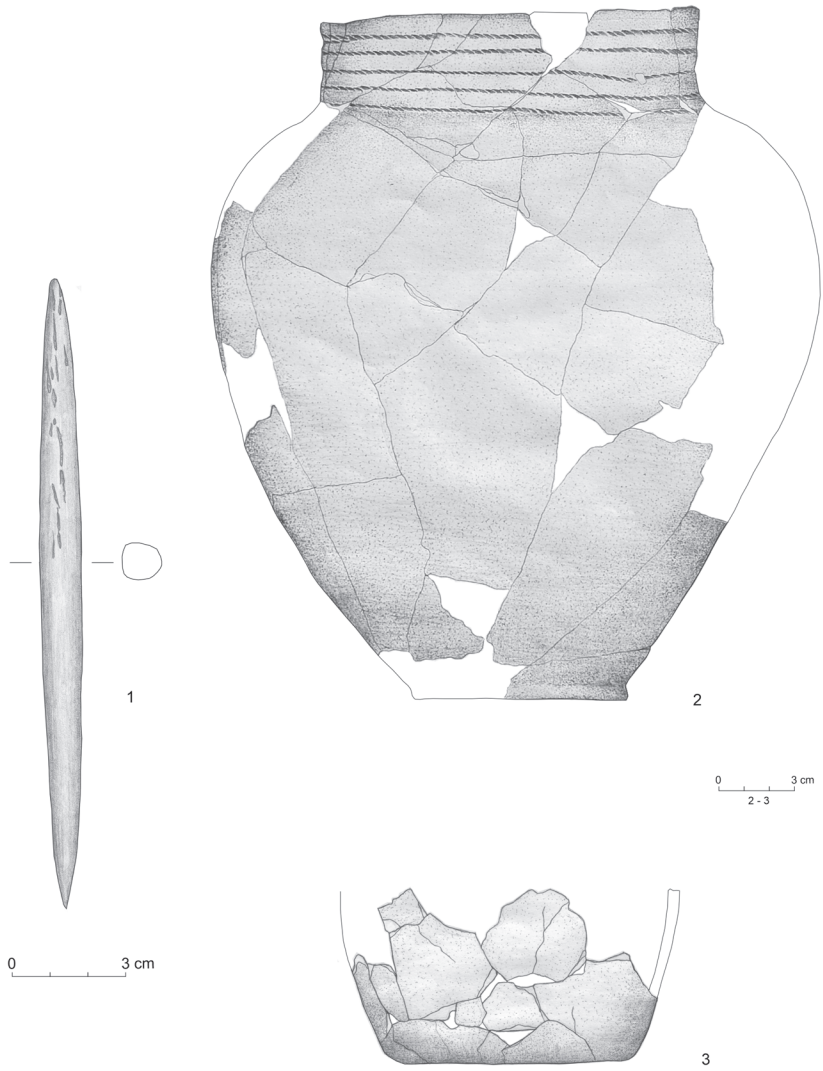


Fig. 9. Malice, site 1, Sandomierz district. Grave 33: grave goods. Drawn by B. Witkowska

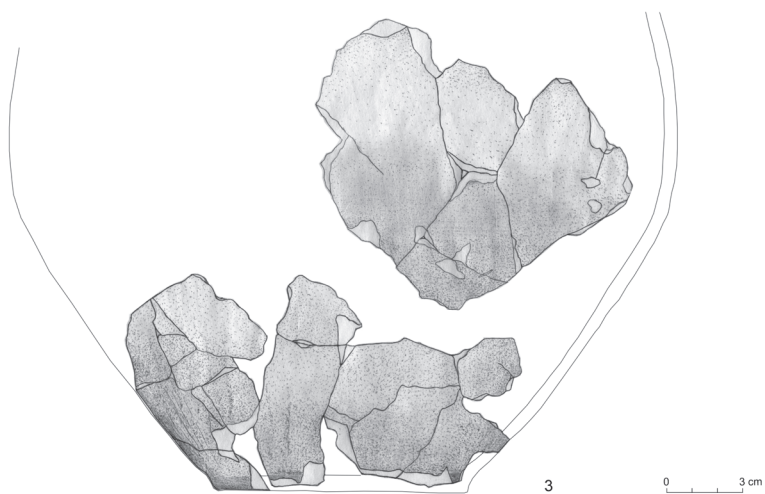
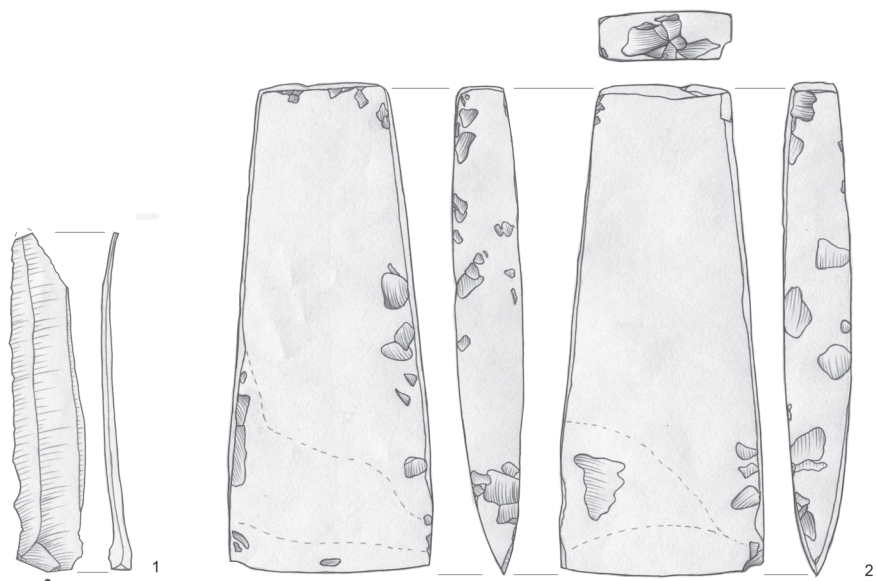


Fig. 10. Malice, site 1, Sandomierz district. Grave 33: grave goods. Drawn by B. Witkowska

FEATURE 54 (PIT WITH A HYPOTHETICAL ANIMAL SACRIFICE)

Moreover, during the 2017 excavations, a feature was successfully located that had been partially exposed in the 1960s (at that time, it was not numbered). It could have been a sacrificial pit linked to Grave 33 (Fig. 8), but it was not possible to confirm that this had actually been its function due to site inaccessibility, ruling out excavations (the feature is located in an orchard now). Due to the fact that artefacts are buried shallowly and the damage done by tree roots, the feature has certainly been badly damaged by now if not almost destroyed.

DESCRIPTION OF THE CEMETERY

The structure of Malice cemetery graves was typical of the Małopolska GAC. These were limestone-lined pits but not forming compact cists. Stones lined only parts of pit walls and paved pit bottoms (in Feature 33) or merely formed vestigial wall linings (in Feature 32). An analogous structure was shared by Nałęczów-type GAC graves [Ścibior 1991], exemplified by features in the nearby ‘Gajowizna’ cemetery in Złota. Despite the absence of a stone lining forming a cist, there are reasons to believe that in the case of the Malice grave, we are dealing with an originally empty chamber in which successive burials could be placed and, possibly, where corpses placed earlier could be manipulated. The existence of such a chamber is suggested by the arrangement of human bones. It testifies to the presence of an empty space when dead bodies were decomposing. Furthermore, the grave was presumably covered with a timber roofing, but all traces of it are gone as a result of, possibly, site erosion and natural conditions. In such a case, the stones at the pit bottom had more of a ritual role than a structural one. The structure of the grave is unusual in that it has an ‘annex’ on its SE side, occupied by a part of the skeleton of Individual A. The annex must be all that is left of an entrance shaft, leading to the burial chamber from its shorter south-eastern side. What is noteworthy is the similarity of this design to one found in the niche graves of the Złota culture. Actually, it cannot be ruled out that the Malice grave had an analogous structure: a narrow and short shaft and a long shallowly dug niche. However, the destruction of the ceiling portion of the feature prevents its reliable reconstruction.

The arrangement of human burials in Feature 32 tells us that it was used in several phases (Fig. 11). Field investigations and anthropological analyses helped reconstruct the sequence of interment of individuals and deposition of grave goods. With the highest probability, the chamber was used in three stages:



Fig. 11. Malice, site 1, Sandomierz district. Grave 32. Reconstruction of body arrangement

1. First, the two child burials were interred (Skeletons D and E). There are reasons to believe that Individual E is the older of the two; his skull could have been damaged when Individual D was buried.
2. Next, Individual B (a female aged 50-55 years) was placed in the feature and the skull of Individual C (a child aged 3-4 years) was deposited on her hand. The absence of his long bones and the mandible or mandibular teeth shows that the deposition of the calva alone in the grave was intentional. The preservation of some articular connections in Individuals D and E, in turn, suggests that the redeposition of their remains took place in the early stage of decomposition.
3. Finally, in the grave, the dead body of an adult male (Skeleton A) was interred. It was placed at a higher level of the feature, partially outside the original pit, which points to a certain lapse of time between the older collective burial (the remains of a female with children and grave goods) and the interment of the male. Furthermore, the arrangement of his lower limbs and pelvis, which were found slightly higher than his skull, suggests that the individual was deposited in an empty chamber and not one filled with earth. His remains were put to rest on the bones of Individuals B and C. Since he lay partially on the fallen-off stones of the lateral lining, it can be assumed that he was deposited in the grave after it had been originally sealed, but before it was intentionally filled with earth or as a result of natural sedimentation. Single stones found underneath Skeleton B prove that the lateral lining was reconstructed each time a dead body was buried. The arrangement of the skeletons and the manner of their deposition suggest that an entrance was located at the south-eastern side of the chamber. The small annex, in which a part of Individual A lay, must be interpreted as a kind of entrance pit – a vertical shaft. It gave easy access to the burial crypt without the need to disturb its ceiling. The burial of the male was the last event in the history of feature use for funeral purposes.

RELATIVE CHRONOLOGY

An attempt to establish a relative chronology of the GAC features at Malice relies primarily on the study of pottery from Graves 32 and 33. A beaker from Grave 33 (Fig. 9: 2) deserves special attention as it is rare in funerary features. On the Sandomierz Upland, we know of only four such vessels originating from such a context. They were discovered on sites in Jastków, Opatów district [Nosek 1967: 167, Fig. 112], in the ‘Gajowizna’ cemetery [Krzak 1977: 28, Fig. 30] and in a grave from Wąworków, Opatów district (unpublished materials from the collections of the State Archaeological Museum in Warsaw) and Grave 107 from

Mierzanowice [Bąbel 1979, Fig. 30]. Only the latter two, however, can be considered good analogies to the Malice specimen. Slightly more – seven beakers – were discovered in graves from the Lublin Upland, but only three constitute tolerable analogies to the specimen from Grave 33. These are vessels from Grave 1 on Site 4 in Klementowice, Grave IV on Site 16 in Las Stocki and a grave on Site 6 in Mętów [Bronicki 2016: 95, 135, 156; Fig. 47: 1, 86: 1, 107: 1]. Besides the grave context, this vessel type is found in settlement pits, e.g. Site 1 in Mierzanowice [Balcer 1963: Table IV:4, IX:8] or *Nad Wawrem* in Złota – located not far from the Malice cemetery (unpublished materials from the collections of the State Archaeological Museum in Warsaw) [Florek, Witkowska 2021]. Generally, GAC beakers are good chronological markers. In this case, the form of the vessel and the ornament of a horizontal cord impression clearly assign Grave 33 to the later stages of the GAC, most likely to its Phase III [Nosek 1967: 393].

The set of amphorae found in Grave 32 is typical of GAC grave complexes. Most amphorae, however, are not highly chronologically sensitive. Six – despite certain differences – represent the same variety, IA according to Wiślański [1966], or globular or ovate amphorae with a clearly marked neck, coming in two classes: IA1 (smaller ornamented specimens, Fig. 6: 2–4) and IA2 (two unornamented ovate amphorae, Figs. 5: 9 and 7: 3). Neither class is of any taxonomic or chronological value, though, because they comprise the most distinctive ceramic artefacts, common to the entire GAC oecumene [Nosek 1967: 133, 220, 239, Figs. 81:9; 157:17-18; 171:14; Krzak 1977: 28, 53, Figs. 31, 69]. A slightly rarer specimen, Vessel VII (Fig. 7: 2) is assigned to amphora class IA4 on account of its low position of the broadest part of belly. Analogies to it come mostly from Kujawy and Wielkopolska [Wiślański 1966: 27; Nosek 1967: 99, Fig. 46: 2]. Single specimens, however, are found on the Lublin Upland as well [Bronicki 2016: 105, 192, Figs. 58:1, 143:1]. Class IA4 enjoys relatively early chronology within the GAC as it emerges already in its Phase II. However, it does appear too in graves dated to later periods. An unornamented amphora, bearing field number II, belongs to type IIA, variety ‘c’ or is a flat-bottomed amphora with a very broad low neck – a so-called ‘Kujawy amphora’. It finds also many analogies in the Małopolska GAC, including the nearby settlement in Mierzanowice [Nosek 1967: 176, 234, Figs. 118:7; 167:11]. As was the case with Grave 33, the dating of this inventory too relies mainly on vessel ornamentation, specifically the presence of cord impressions that are considered a marker of GAC late phases [Wiślański 1966: 76; 1979: 279; Szymt 1996: 34-35]. They are found, arranged in festoons, on the small amphora no. VI (Fig. 6: 3).

When it is assumed that all the features exposed in the cemetery at Malice are chronologically proximal, seen in its regular layout, and relying on a typological analysis, its chronological position must be considered relatively late with respect to the general GAC development scheme. The age of the finds coincides most likely with Sub-phase IIIa or the period to which most funerary sites of the GAC Sandomierz-Opatów subgroup are assigned.

For the GAC features from the Malice cemetery, altogether ten radiocarbon dates were obtained with the dated bone samples coming from five human skeletons found in Graves 32 and 33, and animal remains from Pit 31 (Table 2; Fig. 12). Although most osteological material collected during old investigations had been lost, it was possible nonetheless to date all the explored GAC features. The only exception being Skeleton E, in collective Grave 32, whose state of preservation prevented the collection of a suitable sample. The radiocarbon age determinations of the remaining four skeletons from this feature were duplicated. For this reason, the chronological models presented below show results that have been averaged, using the R_Combine function in the OxCal software. The purpose has been to narrow down absolute age ranges for particular samples. In a single case only, the radiocarbon ages of two samples from the same burial clearly differed from each other (Skeleton A). In three instances, the result pairs were very close indeed.

The calibration results of the obtained dates are quite consistent with one another: all point to the first half of the 3rd millennium BC and stay between 2909 and 2472 BC (with the probability of 95.4%) or more precisely between 2898 and 2490 BC (probability of 68.2%). In all probability, the time when the Malice cemetery was used was much shorter, covering an indeterminate period within the above given range. The considerable breadth of probability ranges, determined for each sample, is a result of a marked plateau in the calibration curve, covering about two centuries – 2870–2670 BC [Furholt 2003; Włodarczak 2007: 37]. Its

Table 2

Malice, Sandomierz district, site 1. Radiocarbon dates for GAC features. Calibration in OxCal v4.3.2 [Bronk Ramsey 2017], IntCal13 calibration curve [Reimer *et al.* 2013]

Feature	Skeleton	No lab.	¹⁴ C Date BP	BC (68,2%)	BC (95,4%)	Combine Date BP
31		Poz-94493	4135±35	2862–2631	2873–2588	
32	A	Poz-94494	4165±35	2874–2670	2882–2631	4113±25
	A	Poz-94495	4060±35	2831–2494	2850–2478	
	B	Poz-94496	4215±35	2893–2712	2904–2678	4220±25
	B	Poz-94497	4225±35	2898–2761	2909–2680	
	C	Poz-94499	4130±35	2861–2627	2872–2582	4123±25
	C	Poz-94500	4115±35	2856–2601	2871–2575	
	D	Poz-94501	4090±35	2847–2574	2864–2495	4107±23
D	Poz-94502	4120±30	2856–2624	2866–2579		
33		Poz-94503	4040±35	2619–2490	2835–2472	

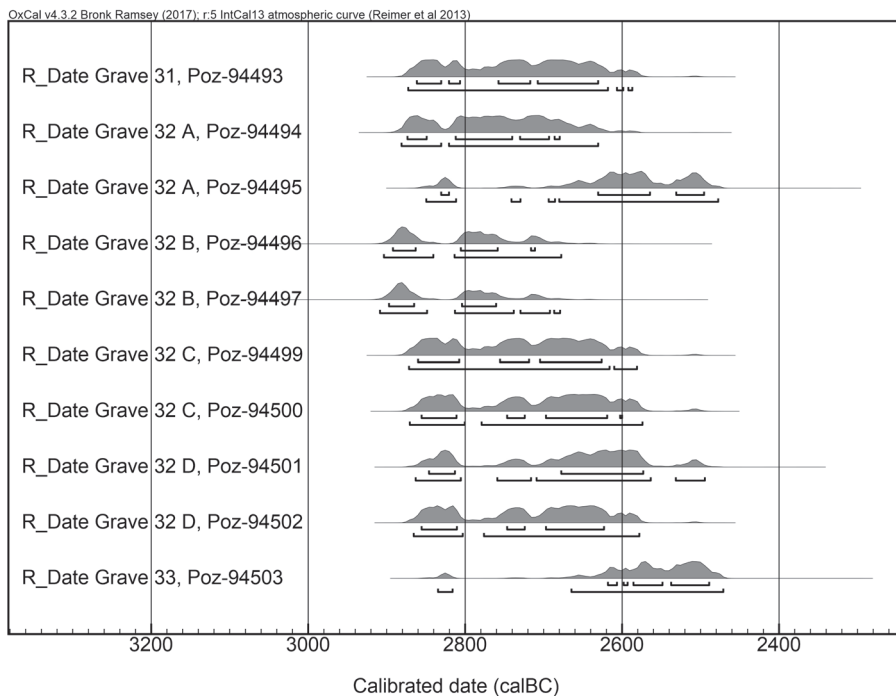


Fig. 12. Malice, site 1, Sandomierz district. Calibration of radiocarbon dates for human bones from Graves 32 and 33, and animal bone from Pit 31. Calibration in OxCal v4.3.2 [Bronk Ramsey 2017], IntCal13 calibration curve [Reimer *et al.* 2013]

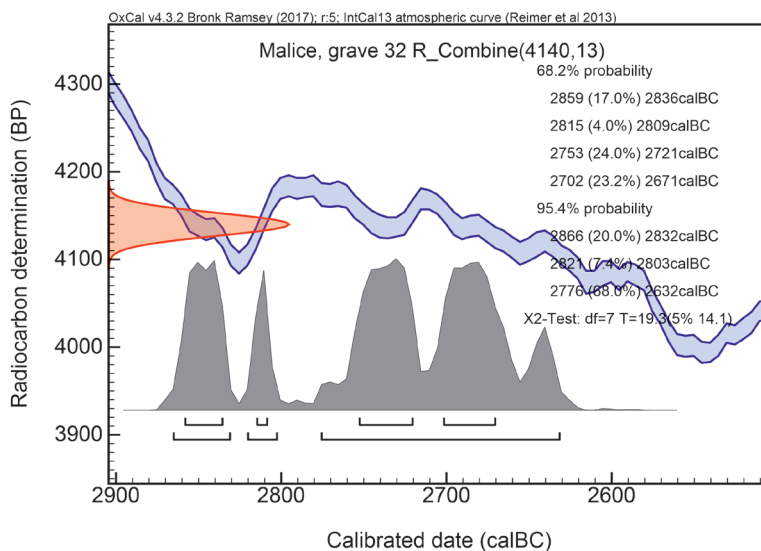


Fig. 13. Malice, site 1, Sandomierz district. Calibration of an averaged dating result (R_Combine) for eight radiocarbon determinations related to Grave 32. Calibration in OxCal v4.3.2 [Bronk Ramsey 2017], IntCal13 calibration curve [Reimer *et al.* 2013]

time span makes it possible to set the absolute age of samples at similar values in spite of the fact that the radiocarbon age values (BP) obtained for them differ widely. It is also for this reason that an alternative proposal is possible, namely one assuming that all the three features under discussion are contemporaneous. The chronological models presented below were designed with the use of the calibration software v4.3.2 [Bronk Ramsey 2017] and calibration curve IntCal13 [Reimer *et al.* 2013].

It is crucial to narrow down the absolute dating range of Grave 32 for which eight ^{14}C determinations were obtained (two for each of the four individuals; no determination for Individual E). Assuming that all the determinations are correct and simultaneous (or rather that the individuals were interred at short time intervals that are insignificant for the present study), we arrive at an averaged result of 4140 ± 13 BP (Fig. 13), indicating the range of 2859–2671 BC (at the probability of 68.2%). What is more, the younger portion of this range (2753–2671 BC) attracts a clearly broader probability range.

Next, a similar absolute age approximation can be performed in respect of Features 31 and 32 or a human grave and a sacrificial pit linked to it. An averaged result (R_Combine) for two age determinations is 4139 ± 13 BP (2859–2670 BC); it is almost identical to the result for Feature 32 itself. In turn, in respect of Grave 33, holding a single male burial, a slightly younger determination was obtained: 4040 ± 35 BP, or 2619–2490 BC (at the probability of 68.2%). When a broader probability range is adopted (95.4%), the respective ranges change as follows: 2835–2817 BC (3.5%) and 2665–2472 BC (91.9%). The former permits a synchronisation of Feature 33 with Features 31 and 32, while the latter – indicates its younger chronological position (Fig. 14). Assuming the contemporaneity or chronological proximity of the complex of Features 31 and 32 as well as Feature 33, the obtained result is hardly acceptable.

Thus, the determination obtained in respect of Grave 33 clearly differs from the other results. With a higher probability, it indicates that this burial is younger than the funeral complex formed by Features 31 and 32. It is possible, however, that it is a quirk that would not be borne out if determinations for Grave 33 were duplicated (*see* the question of the difference between the results for Burial B in Feature 32 discussed below). Judging by the regular layout of the funeral complex, one can assume that Features 32 and 33 do not differ much in terms of age. At a low goodness of fit (16.1%), the possibility of such a contemporaneity can be calculated to have occurred somewhere between 2850–2632 BC. However, accepting this model prevents any precise dating of the cemetery in question.

Moreover, when building models, the sequence of human burials in Grave 32 can be accounted for: first Individual D, followed by Individuals C and B and finally Individual A. Although there are no reliable data available to determine

the time intervals between the deposition of particular burials, the very sequence is a stratigraphic fact that can help in model building. In the future, the estimation of these intervals will be helped by the results of genetic studies, determining the degree of kinship between the buried individuals.

The oldest dates for the Malice cemetery were obtained for the skeleton of Individual B from the collective burial – a woman deposited in the upper portion of the grave pit – while the youngest date from this feature refers to child remains designated as Individual D. In the light of stratigraphy and anthropological observations, the latter individual was deposited in the grave in the first phase of its use (*see above*). These are respectively the following combined dates: 4220 ± 25 BP and 4107 ± 23 BP. They apparently differ widely, but in reality they produce clearly overlapping calendar age ranges, owing to the plateau in the calibration curve mentioned earlier. It is possible, therefore, to build a model accounting for the sequence of the three stratigraphically marked phases (Fig. 15).

To explain the clear difference between the older determinations for Individual B and the other dates for Grave 32, one may quote the age of buried individuals. Skeleton B belonged to a female aged 50–55 years, thus, much older than Individual C, a child aged 3–4 years, placed at the same stratigraphic level. The difference may justify making a correction following from the slowing rate of ^{14}C replenishment in the human body with age [Goslar *et al.* 2015: 265]. For an individual aged 50–55 years such a correction should be 30 ± 10 years (Fig. 16) [Geyh 2001]. Hence, after making the correction, the absolute age range for Individual B is 2876–2756 BC (68.2%), only slightly younger than the one previously determined (2894–2765 BC). Allowing for the above correction and the contemporaneity of Burials B and C, we arrive at a range of 2863–2751 BC. In respect of older Burial D, the range is 2860–2819 BC, while for younger Burial A the range is 2850–2628 BC.

When this is kept in mind, a model of three phases of burial deposition occurring in close succession seems plausible. To present it, the function ‘sequential phases’ in the OxCal software was chosen (Fig. 17). The model selects the older portion of probability ranges for most of results. This reflects the stratigraphic position of skeleton B (second phase) for which the oldest determinations were obtained. If this seems plausible, the dating is narrowed down to about one century.

In sum, it can be generally claimed that Grave 32 at Malice is dated most likely to ca 2850–2750 BC. Moreover, it is highly probable that individual burials were separated by short time intervals. A similar age should be adopted for Feature 31 – a sacrificial pit linked to Grave 32. However, it is not possible to determine with any certainty the age of Grave 33: it could have been contemporaneous with, or slightly younger (ca 2620–2500 BC) than Feature 32.

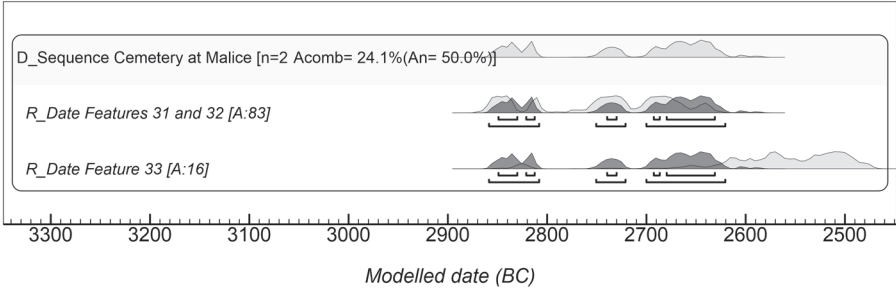


Fig. 14. Malice, site 1, Sandomierz district. Attempt to synchronise the age of Features 31, 32 and 33. Calibration in OxCal v4.3.2 [Bronk Ramsey 2017], IntCal13 calibration curve [Reimer *et al.* 2013]

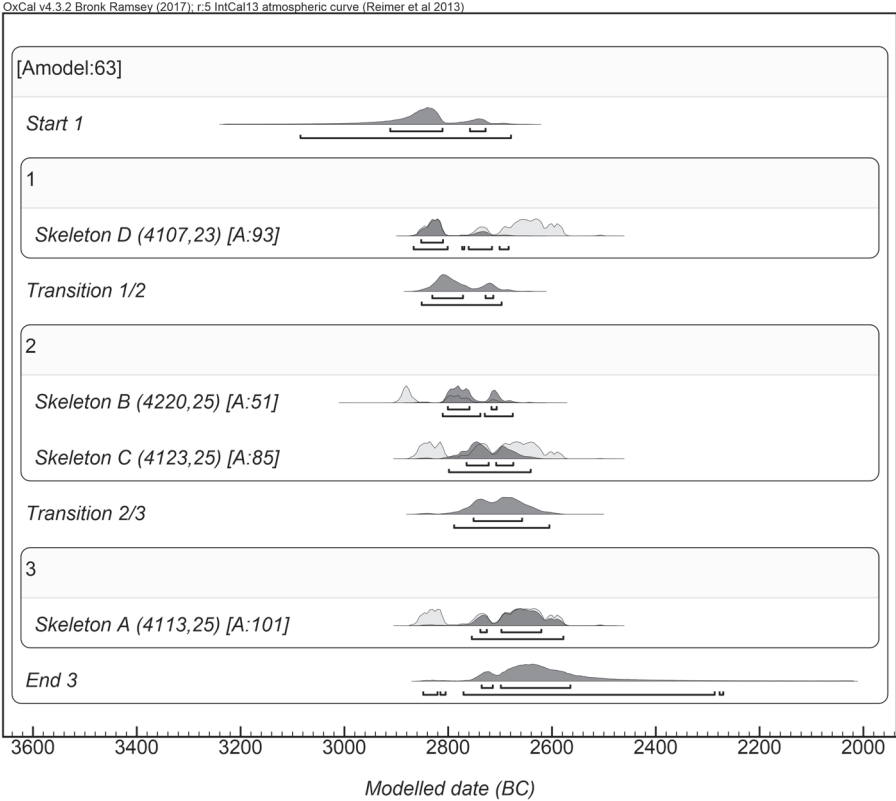


Fig. 15. Malice, site 1, Sandomierz district. Grave 32. Attempt to construct a sequential model of use of the grave in three phases (*see* comments in text). Calibration in OxCal v4.3.2 [Bronk Ramsey 2017], IntCal13 calibration curve [Reimer *et al.* 2013]

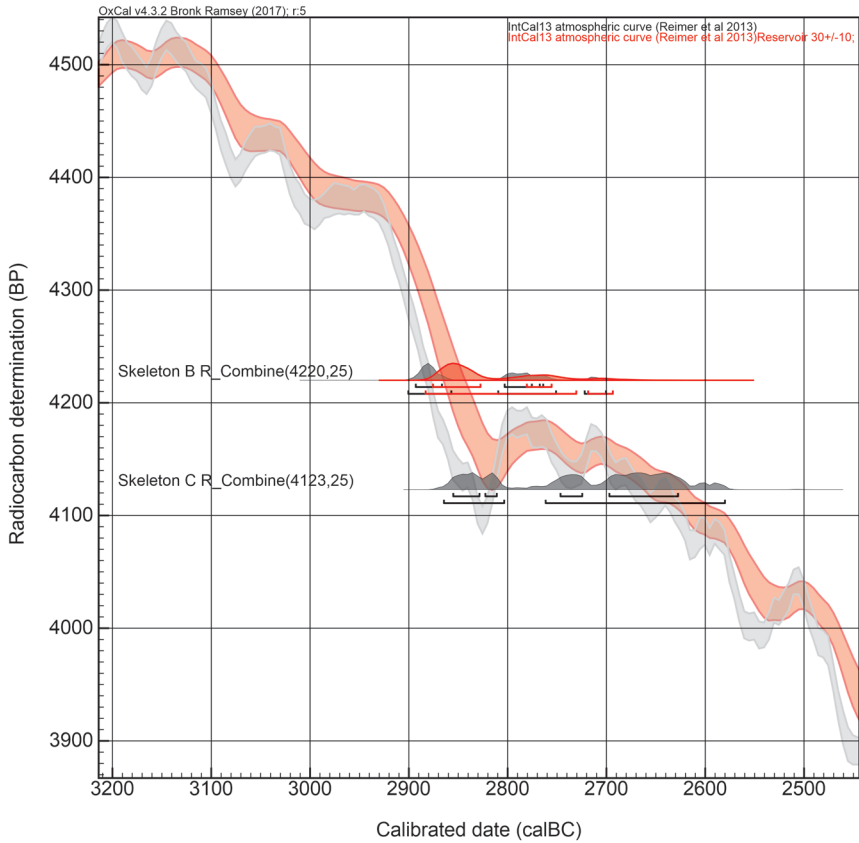


Fig. 16. Malice, site 1, Sandomierz district. Grave 32. Allowing for the age of Burial B (of a woman aged 50-55 years) in relation to the age of contemporaneous Burial C (of a child aged 3-4 years). Calibration in OxCal v4.3.2 [Bronk Ramsey 2017], IntCal13 calibration curve [Reimer *et al.* 2013]

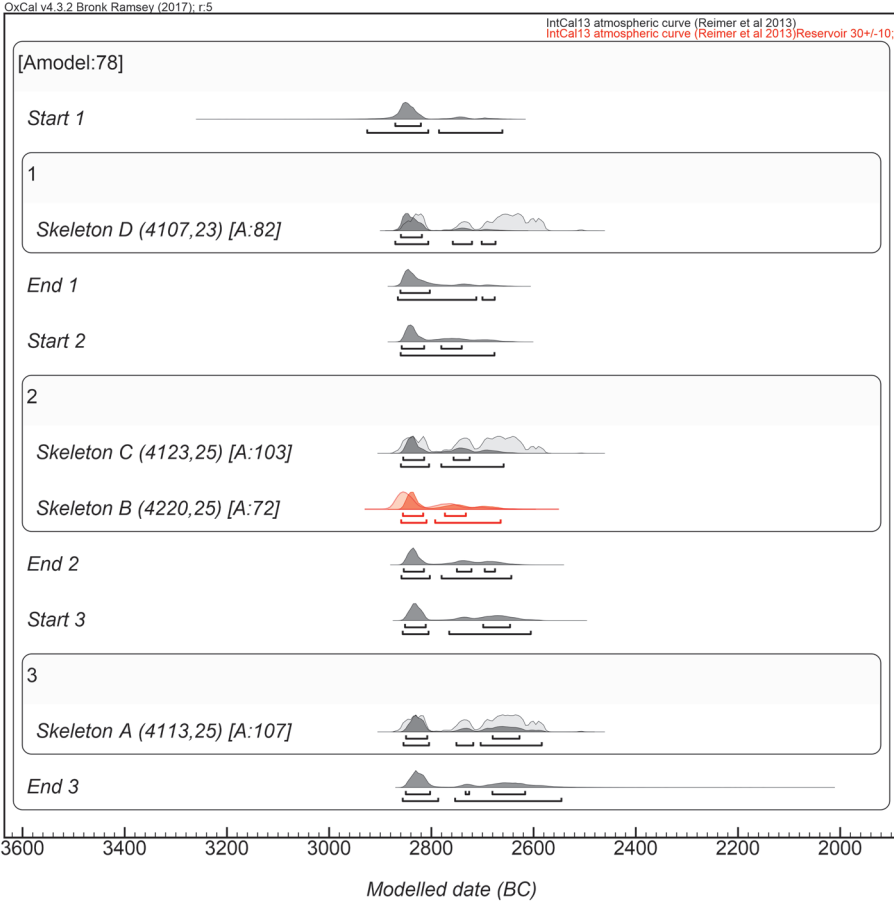


Fig. 17. Malice, site 1, Sandomierz district. Grave 32. Allowing for the age of Burial B (of a woman aged 50-55 years) in relation to the age of contemporaneous Burial C (of a child aged 3-4 years). Calibration in OxCal v4.3.2 [Bronk Ramsey 2017], IntCal13 calibration curve [Reimer *et al.* 2013]

CONCLUSIONS

The radiocarbon dating results of the Malice materials are part of an entire series of determinations for other GAC graves on the Sandomierz Upland discovered in cemeteries in Mierzanowice and Sandomierz-Kruków, and the Gajowizna site [Witkowska *et al.* 2020; Witkowska 2021]. Similar absolute age determinations were obtained for GAC settlement features in Mierzanowice, Gałkowiec-Ocin and Złota – Nad Wawrem [Florek, Witkowska 2021]. A series

of radiocarbon dates obtained for GAC burial bones fits into the intervals of 2889–2578 BC (68.2%) or 2900–2497 BC (95.4%). These dates mark no doubt the timeframe of GAC settlement on the Sandomierz Upland. At present, the unfavourable course of the calibration curve mentioned earlier prevents any determination of chronological positions of individual sites in the development scheme of the Sandomierz-Opatów subgroup. Furthermore, for the same reason, the relationship of the Malice necropolis to the nearby GAC cemetery at the *Gajowizna* site or the *Nad Wawrem* settlement in *Złota* is made indeterminable.

It would be interesting, because of the design of Feature 32 resembling that of niche graves, to compare the Malice age determinations to the chronology of the *Złota* culture. However, the available pool of 14 radiocarbon dates relating to the latter culture [Włodarczak 2019: 192, Table 4] falls on a curve plateau too (excluding the controversial much older date from the *Salve Regina Mount*, Sandomierz), which greatly hampers the construction of the sequences of cultural changes. The tracking of possible directions of mutual borrowings would call for a significant narrowing-down of the ranges of calibrated absolute age determinations of *Złota*-type complexes.

Grave 32 at Malice, explored in 2017, is the only feature that owing to its stratigraphic documentation and subsequent analyses could be dated with greater accuracy. This illustrates the need to find more GAC complexes, using modern-day research methods that allow researchers to collect comprehensive data. They, in turn, could lead to plausible reconstructions of prehistoric reality, including chronometric findings.

ACKNOWLEDGEMENTS

The excavations and specialist analyses of materials retrieved at Malice were financed with funds provided by the NSC project no. 2014/12/S/HS3/00355 entitled ‘The Sandomierz-Opatów group of the Globular Amphora culture’, headed by Dr Barbara Witkowska. In the field work, next to the authors of the present article, archaeology students, Maciej Burza and Jakub Gądek, took part, to whom we give our thanks. A word of sincere thanks is deserved too by the good people of Malice and among them the owner of the field we explored, Mr Zdzisław Sapielak, and his neighbours whose hospitality and interest in the region’s prehistory contributed to the success of the investigations.

REFERENCES

- Al Qahtani S. J., Hector M. P., Liversidge H. M.
2010 Brief Communication: The London Atlas of Human Tooth Development and Eruption. *American Journal of Physical Anthropology* 142: 481–490.
- Balcer B.
1963 Osada kultury amfor kulistych na stanowisku I w Mierzanowicach. *Materiały Starożytne* 9: 99–142.
- Bąbel J.
1979 Groby neolityczne ze stanowiska I w Mierzanowicach, woj. tarnobrzeskie. *Wiadomości Archeologiczne* 44: 67–82.
- Bernert Zs., Évinger S., Hajdu T.
2007 New data on the biological age estimation of children using bone measurements based on historical populations from the Carpathian Basin. *Annales Historico-Naturales Musei Nationalis Hungarici* 99: 199–206.
- Bronicki A.
2016 Obrządek pogrzebowy kultury amfor kulistych na Wyzynie Lubelskiej. In: P. Jarosz, J. Libera, P. Włodarczak (Eds) *Schylek neolitu na Wyzynie Lubelskiej*: 45–256. Kraków.
- Bronk Ramsey C.
2017 OxCal v4.3.2. Oxford (www.rlaha.ox.ac.uk).
- Florek M., Witkowska B.
2021 Absolute chronology of settlement remains of the Globular Amphora culture in Sandomierz Upland (Gałkowice-Ocin, Mierzanowice, *Złota-Nad Wawrem*). *Baltic-Pontic Studies* 25: 159–188.
- Formicolla V., Franceschi M.
1996 Regression equations for estimating stature from long bones Early Holocene European samples. *American Journal of Physical Anthropology* 100: 83–88.
- Furholt M.
2003 *Die absolutchronologische Datierung der Schnurkeramik in Mitteleuropa und Südsandinavien*. Universitätsforschungen zur Prähistorischen Archäologie 101. Bonn.
- Geyh M.A.
2001 Bomb radiocarbon dating of animal tissues and hair. *Radiocarbon* 43: 723–730.

Goslar T., Klochko V.I., Koško A., Włodarczyk P., Żurkiewicz D.

- 2015 Chronometry of late Eneolithic and 'Early Bronze' cultures in the middle Dniester area: investigations of the Yampil barrow complex. *Baltic-Pontic Studies* 20: 256–291.

Kamińska J.

- 1959 Osada kultury nadcisańskiej w Malicach, pow. Sandomierz. *Materiały Archeologiczne* 1: 45–62.
- 1962 Sprawozdanie z badań osady neolitycznej w Malicach, pow. Sandomierz. *Sprawozdania Archeologiczne* 14: 52–55.
- 1963 Sprawozdanie z badań ekspedycji neolitycznej w 1961 r. *Sprawozdania Archeologiczne* 15: 47–50.
- 1964 Sprawozdanie z badań archeologicznych na stanowisku neolitycznym w Malicach, pow. Sandomierz w 1962 r. *Sprawozdania Archeologiczne* 16: 30–34.
- 1967 Z badań nad kulturą lendzielską w Małopolsce. *Archeologia Polski* 12(2): 257–279.
- 1972 Osada neolityczna w Malicach, pow. Sandomierz. *Sprawozdania Archeologiczne* 24: 327–339.

Krzak Z.

- 1977 Cmentarzysko na Gajowiznie pod względem archeologicznym. In: J. Kowalczyk (Ed.) *Cmentarzysko kultury amfor kulistych w Złotej Sandomierskiej*, 9–79. Warszawa – Kraków – Gdańsk.

Nosek S.

- 1967 *Kultura amfor kulistych w Polsce*. Wrocław-Warszawa-Kraków.

Reimer P.J., Bard E., Bayliss A., Beck J.W., Blackwell P.G., Bronk Ramsey C., Buck C.E., Cheng H., Edwards R.L., Friedrich M., Grootes P.M., Guilderson T.P., Haflidason H., Hajdas I., Hatté C., Heaton T.J., Hoffmann D.L., Hogg A.G., Hughen K.A., Kaiser K.F., Kromer B., Manning S.W., Niu M., Reimer R.W., Richards D.A., Scott E.M., Southon J.R., Staff R.A., Turney C.S. M., van der Plicht J.

- 2013 IntCal13 and Marine13 Radiocarbon Age Calibration Curves 0–50,000 Years cal BP. *Radiocarbon* 55(4).

Szmyt M.

- 1996 *Spolecznosci kultury amfor kulistych na Kujawach*. Poznań.

Ścibior J.

- 1991 Kultura amfor kulistych w środkowowschodniej Polsce. In: J. Gurba (Ed.) *Schylek neolitu i wczesna epoka brązu w Polsce Środkowowschodniej*, 47–65. Lublin.

White T., Folkens P.

2005 *The Human Bone Manual*. Burlington, San Diego. London.

Wiślański T.

1966 *Kultura amfor kulistych w Polsce północno-zachodniej*. Wrocław – Warszawa – Kraków.

1979 Dalszy rozwój ludów neolitycznych. Plemiona amfor kulistych. In: W. Hensel, T. Wiślański (Eds) *Prahistoria ziem polskich. II. Neolit*, 261–299. Wrocław.

Witkowska B.

2021 Radiocarbon dating of the archival funeral complexes of the Globular Amphora culture in Sandomierz Upland: sites at Mierzanowice, Sandomierz and Złota-Gajowizna. *Baltic-Pontic Studies* 25: 7–47.

Witkowska B, Czebreszuk J., Gmińska-Nowak B., Goslar T., Szmyt M., Ważny T.

2020 The cemetery of the Globular Amphora culture community in the Złota-Gajowizna site in the light of radiocarbon analysis and dendrochronology. *Sprawozdania Archeologiczne* 72(2): 259–284. DOI: <https://doi.org/10.23858/SA/72.2020.2.0XX>

Włodarczak P.

2007 Problem chronologii radiowęglowej kultury ceramiki sznurowej w świetle dendrochronologicznych datowań późnoneolitycznych osad palafitowych ze Szwajcarii. *Archeologia Polski* 52: 35–80.

2019 Grób 15 z Wilczyce na tle środkowoeuropejskim: odmienność i reguła w rytuale pogrzebowym małopolskiej kultury ceramiki sznurowej. In: P. Włodarczak (Ed.) *Wilczyce, stanowisko 10. Norma i precedens w rytuale pogrzebowym małopolskiej kultury ceramiki sznurowej*. Ocalone Dziedzictwo Archeologiczne 9, 169–201. Kraków – Niepołomice – Pętkowice.