jungstein ITE Journal of Neolithic Archaeology

6 December 2019
doi 10.12766/jna.2019.4

Collective and individual burial practices. Changing patterns at the beginning of the third millennium BC: the megalithic grave of Altendorf

Article history:
Received 1 November 2019
Reviewed 19 November 2019
Published 6 December 2019

Keywords: Germany, Late Neolithic, Wartberg, collective grave, monumental tomb, remembrance, radiocarbon dates

Cite as: *Christoph Rinne, Clara Drummer, Christian Hamann: Collective and individual burial practices. Changing patterns at the beginning of the third millennium BC: the megalithic grave of Altendorf JNA 21, 2019, 75–88 [doi 10.12766/jna.2019.4]*

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Acknowledgements:
The research was funded by the German Research Foundation (DFG), project number 2901391021 – SFB 1266.

Abstract

The re-analyses of the Altendorf gallery grave reveal three different phases of inhumation burial practices: collective burials of a whole community (3250–3100 BC), a hiatus in burial practice (3100–2600 BC), and fewer but continuous single inhumations (2600–1450 BC). These changes can be associated with the abandonment of collective social practices all over Central Europe at the end of the fourth millennium BC, and the establishment of new ideologies and the re-use of older monuments by 2600 BC. In Altendorf, this last phase extends to the next pan-European change in burial practices, and reveals an enduring relationship with a local burial monument.

1. Introduction

The Wartberg style gallery grave of Altendorf in Hesse, central Germany, is one of the typical megalithic graves of the late fourth millennium BC, with a minimum of 235 inhumations and several grave goods consisting of pottery, bone and copper. As Altendorf is one of the better-preserved graves with a few finds documenting its use in the Final Neolithic, the site has been selected as a key site to address questions of transformation from the Late Neolithic Wartberg to the Final Neolithic Corded Ware communities in the German low mountain range[1].

Since their first discoveries, Wartberg gallery graves have been ascribed to the megalithic phenomenon of collective graves. However, their continuation in the Final Neolithic was seldom discussed (Raetzel-Fabian 2002 a, 5; Wiermann 2004, 50, 88; Schierhold 2012, 80 f.). On the contrary, discontinuity between Corded Ware single burials and Wartberg collective burials was emphasised both in respect to the changing burial practices and to changing burial locations. Recent discourses on the appearance of Corded Ware as a migration event have raised the question of continuities or discontinuities of burial practices at gallery graves (Haak et al. 2015; Olalde et al. 2018). We investigate these issues of burial practices at the grave of Altendorf.

Beside the re-evaluation of the archaeological documentation and the reconstruction of burial organisation, interdisciplinary projects for radiocarbon dating and aDNA were established. The sampling strategy was based on the localisation of the skulls and the preservation of the petrous bone as the most promising source for aDNA analysis. After preliminary tests on the aDNA-preservation of six samples, we have thus far taken 71 aDNA and radiocarbon samples from 39 individuals. This paper focuses on a general dating of the grave and its changing inhumation practices through time.

1 The investigation aimed to confirm the results from the site of Niedertiefenbach (Rinne et al. 2016; Rinne et al. 2019). These analyses are part of the sub-project D2 within the Collaborative Research Centre "Scales of Transformation – Human-Environmental Interaction in Prehistoric and Archaic Societies" (CRC 1266, no. 2901391021).

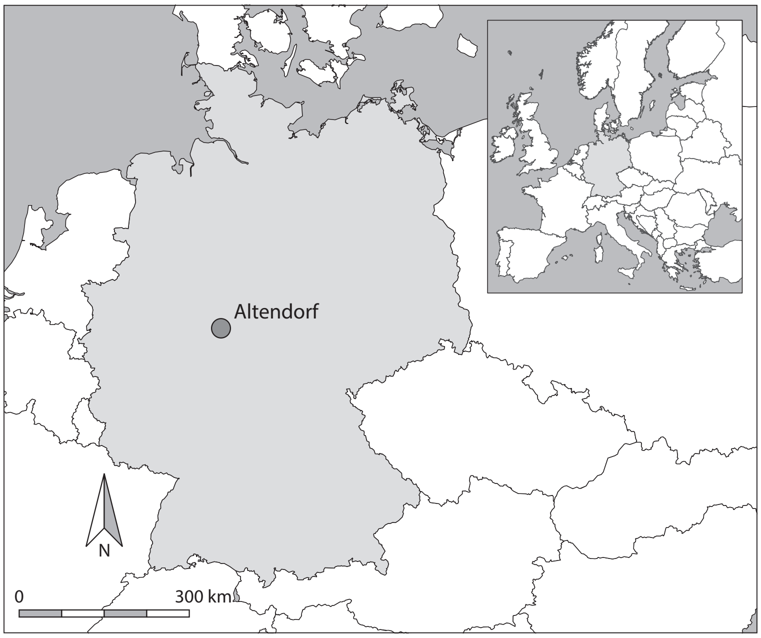

Fig. 1. The geographical location of the site Altendorf in Germany, Hesse.

2. Excavation and Research History

The gallery grave of Altendorf (9.203° E, 51.209° N) is situated 24 km south-west of Kassel in the west Hesse foothills. After its discovery in 1907, some stones were removed before the final excavation of the grave in 1934 (Jordan 1954, 5–6). The documentation comprises many photos, several drawings, and find lists including localisation. The documents in the archives allowed an up-to-date re-working of the evidence by the authors, including 3D reconstruction of the finds location. While several archaeologists had already reviewed the archaeological documentation and the material (e. g. Schierhold 2012), a re-study of the human bones of approximately 235 individuals, in order to improve upon the very basic initial anthropological study (Perret 1937), has not been conducted. Until now, radiocarbon dating was based on only two dates with a wide 2-sigma range between 3350 and 2900 cal BC (UtC-3325, UtC-3326, Raetzel-Fabian 2000, 155).

The Altendorf grave, belonging to the type Züschen, is built of large sandstone slabs with a total area of 17 m × 2.9 m, including a small antechamber. The axial entrance consists of a twofold porthole stone leading to the paved inhumation chamber of approximately 15.4 m × 2 m and 1.4 m height. The pottery consists of eleven vessels with recognizable shape, which typological dating places mainly in the second half of the early Wartberg phase (3250–3000 cal BC). In addition, more than 300 smaller fragments were preserved (Raetzel-Fabian 2002 b; Schierhold 2012, 75 f.; 284). Of these fragments, three decorated sherds of Corded Ware and a rim of a Giant Beaker (*Riesenbecher*) of the Final Neolithic or Early Bronze Age have been identified. While the Wartberg pottery was found on both sides of the entrance, the Corded Ware sherds were found in the posterior part of the chamber, and the fragment of the Giant Beaker in the upper infill in the central part. Thus, the relative dating points towards an inhumation phase in the Late Neolithic with possibly spontaneous secondary inhumation in the Final Neolithic and the Early Bronze Age. It may have been the case that, as proposed by the excavator, the grave had a wooden ceiling, fostering easy access to the posterior part of the chamber for these later burials (Jordan 1954, 9–11; Schierhold 2012, 6, 59).

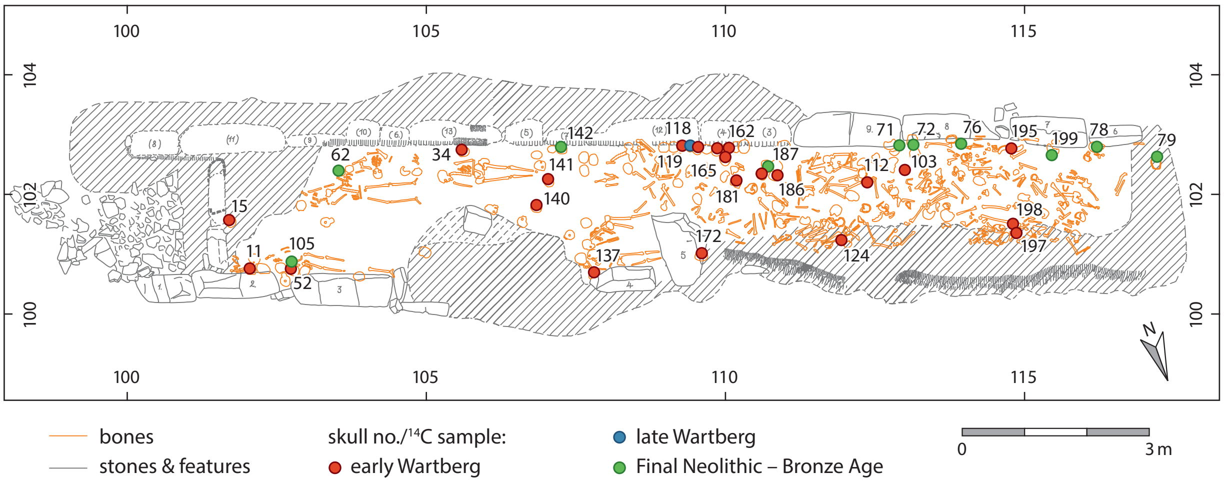

Fig. 2. The Altendorf gallery grave with main features, stones, human bones, and position of dated radiocarbon samples. The archaeological dating of the samples is based on the mean of the 2-sigma range of the unmodelled calibration (base map: Jordan 1954, fig. 1).

During excavation, bones had been documented in different layers but only the skulls had been numbered consecutively. The preservation of the skeletons ranges from disarticulated scattered bones to individuals in an almost entirely articulated anatomic position (Fig. 2). Skeletons were documented from the base pavement at 1.0m up to a depth of 0.4 m. In one case, a skull was found under the shoulder of a nearly complete skeleton; thus articulated bones belong to older as well as younger inhumation activities. In addition, groupings of skulls were documented near the entrance and in the rear part. In general, we expected bone distribution to reflect the deposition process: bones from older inhumations should dominate in the posterior part of the grave in a secondary position, partly articulated bones from intermediate depositions along the sides, and mostly articulated skeletons near the entrance as the latest inhumations. Gathering all information on spatial positions, up to five subsequent deposition activities could be differentiated.

The age determinations for the interred individuals are based on the mandibles: 23 *Infans I*, 20 *Infans II*, 10 *Juvenis*, 169 *Adultus-Maturus* and 13 *Senilis* (Perret 1937, 41). Based on this rough classification a life expectancy at birth (e0) of 34.73 years can be calculated (Tab. 1)[2]. Due to the rough age classification and a supposed uniform distribution, the high number of older individuals leads to a high life expectancy at birth in comparison to other Wartberg burial populations (e0: 29.78; Tab. 2). This is a statistical effect and therefore not significant. While mandibles show a masculinity rate of 1.9 (75 male, 40 female, 15 n. d.), the 59 listed measures according to Martin give a mean rate of 2.3 (quartiles: 1.9, 2.3, 2.8) pointing to a general dominance of male individuals (Perret 1937, tab. II–III). Unfortunately, the sex determination cannot be linked to individuals. Beside this high proportion of males, Altendorf seems to be a standard burial community, spanning several generations during the second half of the older Wartberg phase. Comparable to the grave of Niedertiefenbach, the site is currently undergoing an interdisciplinary, in-depth re-examination (Rinne et al. 2019).

3. Sampling and Radiocarbon dating

As of yet, 44 radiocarbon dates are present from Altendorf (Tab. 3), of which 39 have been dated in Kiel. Three further dates by another project in Oxford have not yet been published (OxA-18807, OxA-18808, OxA-18809)[3]. These dates coincide significantly well with the

2 Anthropological life tables are not based on a cohort but are constructed by a hypothetical cohort derived from the time span represented by the inhumation community (e.g. Chamberlain 2006, 28). As shown later this time span is extremely broad in the case of Altendorf.

3 Information kindly provided by Linda Fibiger, University of Edinburgh.

Tab. 1. Life table of Altendorf based on the age classification of the mandibles (Perret 1937. 41). Calculated with the R package mortAAR. x = age interval, a = years within x, Ax = average number of years lived by an individual that died within a specific age class x, Dx = number of deaths within x, dx = proportion of deaths within x (percent), lx = survivorship within x (percent), qx = probability of death within x (percent), Lx = number of years lived within x by those that died within x and those that reached the next age class, Tx = sum of years lived within current and remaining x, ex = average years of life remaining, rel_popx = percentage of L(x) of the sum of L(x).

x	a	Ax	Dx	dx	Lx	qx	Lx	Tx	ex	rel_popx
0–6	7	3.5	23	9.787	100.000	9.787	665.745	3472.979	34.73	19.169
7–13	7	3.5	20	8.511	90.213	9.434	601.702	2807.234	31.118	17.325
14–20	7	3.5	10	4.255	81.702	5.208	557.021	2205.532	26.995	16.039
21–59	39	19.5	169	71.915	77.447	92.857	1618.085	1648.511	21.286	46.591
60–70	11	5.5	13	5.532	5.532	100.000	30.426	30.426	5.500	0.876

Kiel dates for the corresponding individuals and will be discounted in our model to prevent duplication of incidences. The other two already mentioned dates, formerly published by Raetzel-Fabian, were taken from a dog and a human bone and cannot be assigned to a find position or a single individual (Raetzel-Fabian 2000, 70; 155). Of the 39 Kiel dates, one was rejected because the IR-spectrum of the sample suggested a possible contamination. Another sample has a medieval date and possibly originates from a nearby medieval cemetery, which Jordan excavated concurrent with Altendorf. Stable isotope results ($\delta^{13}C$, $\delta^{15}N$ and $\delta^{34}S$) are expressed using δ notation ($\delta = [(Rsample/Rstandard-1)] \times 1000$, and $R = {}^{13}C/{}^{12}C$, ${}^{15}N/{}^{14}N$, or ${}^{34}S/{}^{32}S$) in parts per mille (‰) relative to international standards, Vienna PeeDee Belemnite for $\delta^{13}C$, air N_2 for $\delta^{15}N$, and Canyon Diablo Troilite for $\delta^{34}S$. The results (Tab. 3) are averaged measurements of four aliquots of each sample, with standard deviations < 0.1 ‰ for $\delta^{13}C$ and < 0.2 ‰ for $\delta^{15}N$, and < 0.4 ‰ for $\delta^{34}S$. Final measurement uncertainties are therefore probably better than ± 0.1 ‰ for $\delta^{13}C$ and $\delta^{15}N$, and ± 0.2 ‰ for $\delta^{34}S$. The remaining dates show no differentiation or unexpected values in the isotopic values (Fig. 3).

For the skull distribution, the individual number of each skull was correlated with its position on the site plan or with the location given

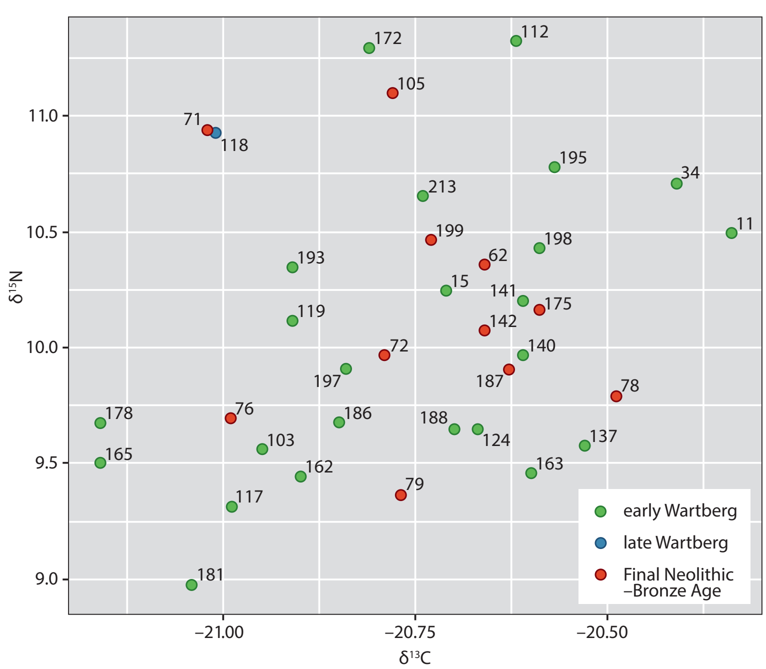

Fig. 3. Bi-plot of $\delta^{13}C$ against $\delta^{15}N$ values differentiated into archaeological phases by the mean of the corresponding calibrated 2-sigma range (for the values see Tab. 3).

Tab. 2. Life table of Wartberg gallery graves excluding Altendorf (Calden I, Calden II, Niedertiefenbach, Warburg I, Warburg III, Warburg IV). Data from: R package mortAAR::gallery_graves; Löwen 1997, tab. 6; Pasda 2000, tab. 7. Heading see Tab. 1.

x	a	Ax	Dx	dx	Lx	qx	Lx	Tx	ex	rel_popx
0–0	1	0.33	1.5	1.35	100	1.35	99.1	2978.33	29.78	3.33
1–4	4	1.33	5.67	5.11	98.65	5.18	380.97	2879.23	29.19	12.79
5–9	5	2.5	7.47	6.74	93.54	7.2	450.85	2498.27	26.71	15.14
10–14	5	2.5	4.35	3.92	86.8	4.51	424.21	2047.42	23.59	14.24
15–19	5	2.5	5.18	4.67	82.88	5.64	402.74	1623.2	19.58	13.52
20–24	5	2.5	19.97	18	78.21	23.02	346.04	1220.47	15.6	11.62
25–29	5	2.5	19.13	17.25	60.21	28.65	257.9	874.42	14.52	8.66
30–34	5	2.5	13.23	11.92	42.95	27.76	184.96	616.52	14.35	6.21
35–39	5	2.5	9.59	8.65	31.03	27.86	133.54	431.56	13.91	4.48
40–44	5	2.5	6.94	6.26	22.38	27.95	96.28	298.02	13.31	3.23
45–49	5	2.5	5.02	4.53	16.13	28.07	69.32	201.74	12.51	2.33
50–54	5	2.5	4.11	3.71	11.6	31.97	48.73	132.42	11.41	1.64
55–59	5	2.5	3.2	2.89	7.89	36.6	32.24	83.68	10.6	1.08
60–64	5	2.5	2	1.81	5	36.12	20.5	51.44	10.28	0.69
65–69	5	2.5	1.36	1.23	3.2	38.46	12.91	30.94	9.68	0.43
70–74	5	2.5	0.73	0.66	1.97	33.33	8.2	18.03	9.17	0.28
75–79	5	2.5	0.45	0.41	1.31	31.25	5.53	9.84	7.5	0.19
80–84	5	2.5	0.55	0.49	0.9	54.55	3.28	4.3	4.77	0.11
85–89	5	2.5	0.45	0.41	0.41	100	1.02	1.02	2.5	0.03

by additional find lists (Fig. 2). Four of 37 skulls could not be localised. Between the front and the rear part of the chamber the proportions of skulls (52:77 = 0.68) and of radiocarbon dates (10:23 = 0.43) are roughly correlated (χ^2 test p-value = 0.3927) and therefore represent the overall distribution of inhumations in the chamber. Considering the dating-distribution of the samples, two spatial patterns can be observed: While samples dating to the Late Neolithic phase are distributed all over the chamber, the samples from the Final Neolithic to the Bronze Age seem to dominate in the rear part. Due to the low number of samples and the unspecific spatial separation in the chamber, statistical tests are not provided. In general, the samples are scattered throughout the whole space and belong to articulated skeletons as well as isolated skulls. In consequence, all 37 dates for 37 individuals incorporated into the chronological model for Altendorf are consistent and reliable.

4. Results: Chronological Models

The archaeological stratigraphy provides no model for a continuous sequence of different inhumation phases. The simple model of deposition along the longitudinal axis, proposed above, is not supported by the radiocarbon dates, as individuals 34, 52, and 140 in the front part fall very early in the sequence. Even a more sophisticated approach postulating depositions from a central point to selected areas along the walls (e. g. Salanova et al. 2017, 61 f.) does not lead to a convincing model. In a third model without preconditions, the 37 dates are considered to be a random sample from a uniform inhumation sequence. The overall dating of the grave could then be illustrated by a sum of the individual calibrations with the assumption that all dates are independent. From an archaeological perspective, this model cannot be true and the visible agglomeration at the beginning as well as the continuous distribution into the Middle Bronze Age do not support this model of independence. In our final working model, the dates are considered as a random sample from an

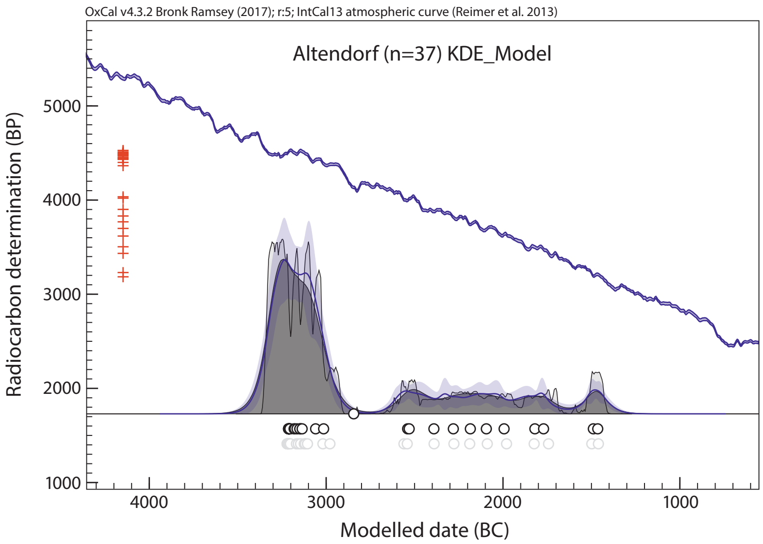

Fig. 4. KDE model of OxCal 4.3 for 37 inhumations in the Wartberg gallery grave of Altendorf (for the dates see Tab. 3). Red cross: mean of radiocarbon date; light grey circle: mean of unmodelled calibrated date; black circle: posterior mean; dark gray distribution: sampled KDE estimated distribution; blue line and lighter blue band: mean ±1σ for snapshots of the KDE distribution generated during the Marcov chain Monte Carlo (MCMC) process; black line: sum distribution of the data for reference.

inhumation history with changing frequencies and possible interruptions. For this, the Kernel Density Estimation (KDE) model of the calibration software OxCal 4.3 was applied (Fig. 4). The KDE model of radiocarbon dates is an alternative for sum calibration, avoiding disadvantages related to the latter method (Ramsey 2017). The model uses the normal kernel and the weighted likelihood for the KDE as provided by the function "KDE_model" of OxCal.

The KDE model should reflect the expected distribution of the dating for all 235 inhumations based on the dates obtained so far. This distribution can be separated into three sections: a first phase with intensive use between 3350 and 3100, hardly reaching 3000 cal BC; an intermediate hiatus between 3000 and 2600 cal BC; and a subsequent third phase with a low but constant and regular inhumation history until 1500 cal BC.

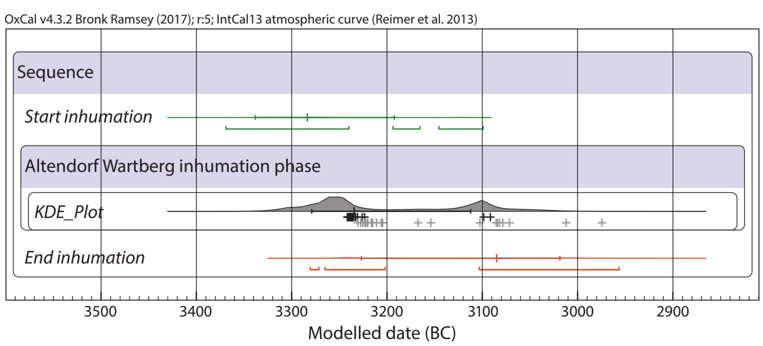

Fig. 5. Dating model for an independent Wartberg inhumation phase in Altendorf based on 26 radiocarbon dates (for the dates see Tab. 3). Green and red: boundaries with 2-sigma ranges; grey cross: median of the likelihood distributions of the calibrated date; black cross: median of the marginal posterior distribution for each dated event.

Based on the result of the KDE model of the entire data set, which suggests continuous inhumation with changing frequencies, a further statistical model is provided to illustrate the archaeological model of two independent inhumation phases separated by a hiatus. For this case, it can be expected that the minimum number of individuals (MNI) of 235 separates according to the proportion of the radiocarbon dates (26:11) into 165 inhumations during the Wartberg phase and 70 inhumations during the later phase. These inhumation activities are modelled as two separate sequences, each with one phase comprising the dates in a KDE plot and flanked with boundaries (Fig. 5–6). The Wartberg inhumations agglomerate with their posterior medians before 3200 cal BC, with only two medians closer to approx. 3100 cal BC (Fig. 5). By omitting the later radiocarbon

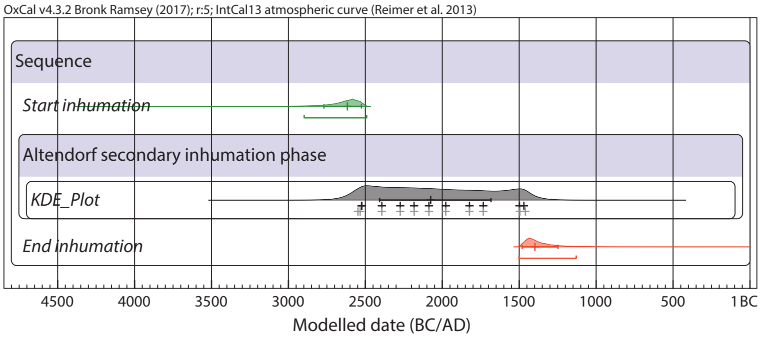

Fig. 6. Dating model for an independent secondary inhumation phase in Altendorf based on 11 radiocarbon dates (for the dates see Tab. 3). Additional information see Fig. 5.

dates as an independent second phase, this shift of the statistical outcome could be expected. Due to the calibration curve, the boundaries for the first inhumation phase spread over the entire Wartberg phase, but point towards a start after 3300 cal BC and a possible end shortly after 3100 cal BC. The 200 year usage would represent six to seven generations based on a life expectance at birth of 30 years with an estimation of a living population with 27 persons (e.g. Acsádi/Neméskeri 1970, 65).

The second inhumation phase in Altendorf extends over more than a millennium (Fig. 6). According to the proportion of radiocarbon dates, only 70 inhumations cover this long time span. Thus, it is unlikely that an entire living population is represented. This behaviour has to be explained differently and must be based on other motivations than using the grave for a whole community. The modelled KDE plot and the correlated boundaries suggest a start around 2600 cal BC and an end between 1500 and 1400 cal BC. Over this time-span inhumations are spread in nearly equidistant intervals. Due to this constant, low-level frequency, the changes between the unmodelled and the posterior medians are minor. By excluding the very short intervals at the beginning and the end, the median of the intervals is 106 years or approx. 3 generations. If we expect a uniform distribution of 70 inhumations over 1150 years, the interval between them is reduced to 16 years. By doing so, the data suggest either funeral events with two persons per generation or funeral events of smaller groups with up to eight dead in every third generation. In both cases only parts of a larger community would have been buried (e.g. Furholt 2012, 123). Considered as a whole, three different social practices are visible at Altendorf: the use as a collective burial place over two centuries (approx. 8 generations) in the Late Neolithic, the burial hiatus at the site for five centuries (approx. 17 generations) between 3100 and 2600 cal BC, and the use for a selected group of dead at regular intervals for more than a millennium (approx. 38 generations) from 2600 to 1450 cal BC.

5. Interpretation: Social discontinuities and remembrance

The three phases of different social practices detected in the gallery grave of Altendorf can be placed in a broader context, but also allow a detailed insight into the continuities in social practice of long-term traditions in respect to their local transformations.

The first phase shows an inhumation period during the second half of the early Wartberg, which is well known from other gallery graves in the central German uplands (Raetzel-Fabian 2002 a; 2000; 1997; Rinne et al. 2016). The end of this phase precedes the general change to late Wartberg (3000 BC) with new stylistic elements, e. g. Globular Amphorae and Bernburg pottery, and the presence of hilltop settlements (e. g. Schwellnus 1979, 4; 35). The change is visible in the adjacent region as well, although with a shift towards 3000 BC (Raetzel-Fabian 2001, 323; 1997, 165 f. tab. 45), and might be linked to a similar pattern in the gallery grave of Bury in France (Salanova et al. 2017, 59 f. fig. 2; 2018, 7 f. fig. 6).

The extraordinary duration and the regular intervals of burials on a low but constant level in the last phase in Altendorf are highly interesting, as it coincides with a fundamental change in burial practices in south central Europe (Falkenstein 2012, 330; 334–336; 338). Moreover, the re-establishment of burial practices after four centuries in a subterranean chamber, which is not visible in the landscape, has to be integrated into current theories on monuments, cultural memory, and identities (e. g. Furholt/Müller 2011; Veit 2005). First, we have to address the hiatus of approximate five centuries or 17 generations. A rediscovery of the grave would not necessarily explain its re-use for inhumations. Thus we can imagine persistent memory of the place or even the monument itself, although it was not directly visible above-ground.

In any case – forgotten and rediscovered, as topos or known site – it is obvious to link both sets of funeral activities and to suggest a "hidden chain of tradition" (Veit 2005, 32). Taking into account the temporal dimension of at least 13 generations, a genealogy could bridge this "floating gap" (Assmann 2007, 50 f.). The placing of bodies in an obviously older chamber have to be seen as a conscious act of remembrance by the latter actors, or more straightforwardly, we can interpret this behavior as an expression of a historical awareness (Veit 2005, 25). This conscious act can then be encompassed in the frame of cultural memory (e. g. Assmann 1988, 13–15), even though the interwoven complexity of the ethnic, religious and political context forming the multiple cultures of memory (Oesterle 2005) remains invisible. The inhumation site of Altendorf is only one piece of a former social memory, showing a long-lasting place for burials after a break over generations, which was somehow integrated in the social memory and therefore did not get lost.

To provide reasons why Altendorf was not used as a grave for a certain time is difficult. The available data provide hints how to bridge the hiatus of five centuries. First we can mention the 101 skulls, which are documented in the drawings; in comparison to this number, postcranial bones seem to be underrepresented. This might be caused by excavation methods as well as documentation strategy, as both focused on the crania. However, the 235 jaws providing the MNI point towards a different interpretation. Skull and jaw are easily separated during natural disarticulation (Hill 1979), thus if both are found in equal numbers, the deposition of complete bodies can be expected. If – on the contrary – jaws are underrepresented in plastered skulls, we might deduce an intentional removal of the crani in Altendorf for a separate deposition (e. g. Kuijt 2008, 179 f. tab. 2). Consequently, there is neither clear evidence for the burial deposition of single skulls in the grave chamber, nor for their intentional exclusion. Skulls from both inhumation periods have been deposited alongside the chamber walls, indicating a similar emphasis on skulls in social organisation of the burials. On the other hand, the skulls do not exhibit traces of manipulations or plastering that would give us a hint for an individualisation or transformation into a *'pars pro toto'*. It is tempting to deduce an idea of ancestry from the special deposition in groups and a genealogy bridging the gap mentioned above.

At least two critical points have to be mentioned, however:

1. The missing depositions of skulls during the hiatus.
2. Skulls from 101 individuals out of 235 in total can be explained by decomposition or burial rituals, but do not represent a selection of those whom later generations consider as important and ancestors (Whitley 2002, 122). The place of burial is therefore not based on ancestor worship.

The regular inhumation of selected individuals in the gallery grave during one millennium cannot be explained easily. The known number of 11 individuals, and the estimated number of 70 individuals out of 235 are very low for this time span. In any case, they cannot represent an entire living community. To evaluate the selection rate, we have to compare these values with a living population, focusing on the tumulus culture (Görner 2002, 152 f.; e.g. Nikulka 2016, 135 f.). The area of Altendorf has no Bronze Age burials within a radius of approx. 10 km (Görner 2002, 26 f.). The next sites with eight and twelve tumuli are located near Wolfhagen, 12 km north of Altendorf, and form part of a smaller agglomeration in the northern part of Hesse. Taking into consideration general approximations of group size, life expectancy, and frequency of primary and secondary inhumations, we can expect 56 to 81 deceased persons per group in 250 years, who would be buried in 11 to 19 tumuli (Görner 2002, 265 f.). If we generalise these estimations for the entire second inhumation phase of one millennium, the secondary inhumations in Altendorf would represent one quarter of a standard burial community.

6. Conclusion

During the early Wartberg phase, shortly after 3100 cal BC, the burial community stops inhumation in the gallery grave of Altendorf. Inhumations seem to disappear, while pottery of a younger Wartberg style still can be found in the surrounding hilltop settlements (Raetzel-Fabian 2001, 320). At the suggested end of the transformation into the Final Neolithic, the burial of inhumation start again in Altendorf. The temporal extent of this hiatus over more than four centuries and the persistence of knowledge of the subterranean gallery grave in cultural memory is intriguing. The second fascinating aspect concerns the long duration of the subsequent maintenance of a specific burial behaviour in the region over more than one millennium until 1500 cal BC. The site of Altendorf demonstrates the impressive temporal dimension a transformation can have in a very small area, and the complexity of traditions and cultural memory even on a sub-regional scale.

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Tab. 3. List of radiocarbon data. c = collagen, b = bone, hb = human bone, BA = Bronze Age, eW = early Wartberg, lW = late Wartberg, radon = http://radon.ufg.uni-kiel.de, Fibiger = project L. Fibiger.

Lab Code	Lab Nr	BP	Std	Mat	Indiv	Comment	Dating	CO_2 Graphit	pMC†	C:N	C %	N %	δ13C	δ13C std	δ15N	δ34S	S	from	to	conf	mean
KIA	52610	4474	25	c/hb	11	CRC1266 – D2	eW	3.0 mg C/1.0 mg C	57.23 ± 0.22	3.18	40.06	14.68	–20.34	0.40	10.50	8.46	249	–3337	–3029	95.5	–3183.0
KIA	52611	4438	26	c/hb	15	CRC1266 – D2	eW	3.1 mg C/1.0 mg C	57.02 ± 0.24	.	40.53	15.05	–20.71	0.40	10.25	5.29	211	–3328	–2936	95.5	–3132.0
KIA	52612	4495	35	c/hb	34	CRC1266 – D2	eW	3.1 mg C/1.0 mg C	57.15 ± 0.22	3.17	39.23	14.43	–20.41	0.30	10.72	8.54	224	–3352	–3037	95.5	–3194.5
KIA	52613	4510	30	c/hb	52	CRC1266 – D2	eW	2.9 mg C/1.0 mg C	57.04 ± 0.21	.	47.32	.	.	0.34	.	.	.	–3352	–3099	95.5	–3225.5
KIA	52614	4020	35	c/hb	62	CRC1266 – D2	BA	3.3 mg C/1.1 mg C	60.62 ± 0.24	3.16	39.91	14.75	–20.66	0.26	10.36	8.12	0.21	–2624	–2468	95.5	–2546.0
KIA	52615	3230	27	c/hb	71	CRC1266 – D2	BA	3.3 mg C/1.0 mg C	66.89 ± 0.22	3.16	38.76	14.30	–21.02	0.27	10.94	9.02	235	–1607	–1433	95.5	–1520.0
KIA	52616	3901	28	c/hb	72	CRC1266 – D2	BA	2.8 mg C/1.1 mg C	61.53 ± 0.21	3.14	37.65	14.00	–20.79	0.17	9.97	9.02	231	–2469	–2299	95.5	–2384.0
KIA	52617	3185	26	c/hb	76	CRC1266 – D2	BA	3.0 mg C/1.0 mg C	67.27 ± 0.22	3.17	39.77	14.60	–20.99	0.11	9.70	8.52	222	–1502	–1417	95.5	–1459.5
KIA	52618	3769	27	c/hb	78	CRC1266 – D2	BA	3.1 mg C/1.0 mg C	62.55 ± 0.20	3.15	40.67	15.05	–20.49	0.16	9.80	7.21	215	–2287	–2061	95.5	–2174.0
KIA	52619	3618	27	c/hb	79	CRC1266 – D2	BA	2.9 mg C/0.9 mg C	63.74 ± 0.21	3.15	40.47	14.99	–20.77	0.11	9.37	8.59	223	–2112	–1896	95.5	–2004.0
KIA	52621	4527	28	c/hb	103	CRC1266 – D2	eW	3.2 mg C/1.0 mg C	56.92 ± 0.20	3.14	40.45	15.02	–20.95	0.20	9.56	7.65	231	–3359	–3104	95.5	–3231.5
KIA	52622	4035	35	c/hb	105	CRC1266 – D2	BA	3.1 mg C/0.9 mg C	60.51 ± 0.24	3.18	38.49	14.12	–20.78	0.13	11.10	8.01	254	–2834	–2471	95.5	–2652.5
KIA	52623	4486	29	c/hb	112	CRC1266 – D2	eW	3.2 mg C/1.0 mg C	57.21 ± 0.20	3.13	39.23	14.60	–20.62	0.28	11.33	7.62	218	–3345	–3037	95.5	–3191.0
KIA	52624	4439	27	c/hb	117	CRC1266 – D2	eW	2.8 mg C/0.9 mg C	57.54 ± 0.19	3.14	39.64	14.73	–20.99	0.10	9.32	7.82	228	–3329	–2934	95.5	–3131.5
KIA	52625	4365	30	c/hb	118	CRC1266 – D2	lW	3.0 mg C/1.0 mg C	58.09 ± 0.21	3.27	40.02	14.26	–21.01	0.40	10.93	8.78	278	–3087	–2906	95.5	–2996.5
KIA	52626	4480	35	c/hb	119	CRC1266 – D2	eW	2.9 mg C/0.9 mg C	57.25 ± 0.22	3.15	39.64	14.70	–20.91	0.57	10.12	7.96	228	–3342	–3029	95.5	–3185.5
KIA	52627	4400	30	c/hb	124	CRC1266 – D2	eW	3.1 mg C/1.0 mg C	57.81 ± 0.21	3.14	39.54	14.68	–20.67	0.61	9.65	7.90	208	–3262	–2917	95.5	–3089.5
KIA	52628	4490	30	c/hb	137	CRC1266 – D2	eW	3.1 mg C/1.0 mg C	57.18 ± 0.21	3.14	39.21	14.57	–20.53	0.24	9.58	8.81	225	–3348	–3090	95.5	–3219.0
KIA	52629	4525	30	c/hb	140	CRC1266 – D2	eW	3.2 mg C/1.1 mg C	56.94 ± 0.21	3.13	39.73	14.80	–20.61	0.29	9.97	8.06	214	–3358	–3103	95.5	–3230.5
KIA	52630	4433	29	c/hb	141	CRC1266 – D2	eW	3.1 mg C/1.0 mg C	57.59 ± 0.21	3.14	40.27	14.98	–20.61	0.20	10.21	7.42	0.21	–3327	–2928	95.5	–3127.5
KIA	52631	3699	29	c/hb	142	CRC1266 – D2	BA	3.2 mg C/1.0 mg C	63.1 ± 0.22	3.14	39.49	14.68	–20.66	0.24	10.08	8.30	253	–2198	–1981	95.5	–2089.5
KIA	52632	4490	30	c/hb	162	CRC1266 – D2	eW	3.4 mg C/1.1 mg C	57.17 ± 0.21	3.14	40.06	14.89	–20.90	0.31	9.45	7.79	243	–3348	–3090	95.5	–3219.0
KIA	52633	4435	30	c/hb	163	CRC1266 – D2	eW	2.8 mg C/0.9 mg C	57.57 ± 0.21	3.13	37.68	14.04	–20.60	0.30	9.46	7.84	238	–3329	–2929	95.5	–3129.0
KIA	52634	4450	35	c/hb	165	CRC1266 – D2	eW	1.9 mg C/1.0 mg C	57.48 ± 0.22	3.13	39.83	14.84	–21.16	0.43	9.50	7.81	239	–3337	–2939	95.5	–3138.0
KIA	52636	4445	28	c/hb	172	CRC1266 – D2	eW	3.1 mg C/1.0 mg C	57.5 ± 0.20	3.14	40.00	14.85	–20.81	0.57	11.30	7.74	262	–3332	–2942	95.5	–3137.0
KIA	52637	3504	27	c/hb	175	CRC1266 – D2	BA	3.3 mg C/1.1 mg C	64.65 ± 0.21	3.15	40.78	15.11	–20.59	0.45	10.17	8.50	239	–1904	–1747	95.5	–1825.5
KIA	52638	4481	29	c/hb	178	CRC1266 – D2	eW	2.9 mg C/1.0 mg C	57.25 ± 0.20	3.16	38.59	14.26	–21.16	0.29	9.68	8.07	239	–3340	–3031	95.5	–3185.5
KIA	52639	4453	28	c/hb	181	CRC1266 – D2	eW	3.0 mg C/1.0 mg C	57.45 ± 0.20	3.12	39.33	14.69	–21.04	0.21	8.98	9.12	221	–3336	–3016	95.5	–3176.0
KIA	52640	4435	35	c/hb	186	CRC1266 – D2	eW	2.9 mg C/1.0 mg C	57.57 ± 0.23	3.14	40.62	15.10	–20.85	0.25	9.68	8.68	235	–3330	–2926	95.5	–3128.0
KIA	52641	3434	25	c/hb	187	CRC1266 – D2	BA	3.0 mg C/1.0 mg C	65.21 ± 0.20	3.14	40.08	14.87	–20.63	0.20	9.91	9.17	221	–1876	–1662	95.5	–1769.0
KIA	52642	4476	28	c/hb	188	CRC1266 – D2	eW	3.1 mg C/1.0 mg C	57.28 ± 0.19	3.15	40.91	15.12	–20.70	0.25	9.65	7.13	256	–3339	–3029	95.5	–3184.0
KIA	52643	4469	26	c/hb	193	CRC1266 – D2	eW	2.8 mg C/1.0 mg C	57.33 ± 0.18	3.15	38.47	14.25	–20.91	0.22	10.35	7.18	229	–3336	–3027	95.5	–3181.5
KIA	52644	4495	27	c/hb	195	CRC1266 – D2	eW	3.1 mg C/1.0 mg C	57.15 ± 0.19	3.16	38.95	14.40	–20.57	0.22	10.78	7.80	234	–3342	–3097	95.5	–3219.5
KIA	52645	4502	26	c/hb	197	CRC1266 – D2	eW	2.8 mg C/0.9 mg C	57.10 ± 0.18	3.14	40.51	15.07	–20.84	0.24	9.92	7.74	222	–3347	–3099	95.5	–3223.0
KIA	52646	4491	26	c/hb	198	CRC1266 – D2	eW	3.1 mg C/1.0 mg C	57.17 ± 0.18	3.15	40.84	15.12	–20.59	0.11	10.43	7.80	241	–3341	–3095	95.5	–3218.0

Tab. 3. Continued. List of radiocarbon data. c = collagen, b = bone, hb = human bone, BA = Bronze Age, eW = early Wartberg, lW = late Wartberg, radon = http://radon.ufg.uni-kiel.de, Fibiger = project L. Fibiger.

Lab Code	Lab Nr	BP	Std	Mat	Indiv	Comment	Dating	CO_2 Graphit	pMC†	C:N	C %	N %	δ13C	δ13C std	δ15N	δ34S	S	from	to	conf	mean
KIA	52647	3831	23	c/hb	199	CRC1266 – D2	BA	.	.	3.13	40.01	14.93	−20.73	.	10.47	5.77	205	−2434	−2199	95.5	−2316.5
KIA	52648	4501	26	c/hb	213	CRC1266 – D2	eW	2.9 mg C/0.9 mg C	57.10 ± 0.18	3.14	39.90	14.83	−20.74	0.14	10.66	6.69	209	−3347	−3098	95.5	−3222.5
KIA	52620	1190	26	c/hb	97	CRC1266 – D2	.	3.0 mg C/1.0 mg C	86.23 ± 0.28	.	45.69	.	−20.20	0.26	.	.	.	730	938	95.5	834.0
OxA	18807	4501	33	c/hb	11	Fibiger	.	.	.	.	.	.	.	.	.	.	.	−3351	−3095	95,4	-3223
OxA	18808	4523	33	c/hb	137	Fibiger	.	.	.	.	.	.	.	.	.	.	.	−3359	−3100	95,4	−3229,5
OxA	18809	4533	33	c/hb	140	Fibiger	.	.	.	.	.	.	.	.	.	.	.	−3362	−3104	95,4	-3233
UtC	3325	4500	70	c/b	.	radon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
UtC	3326	4500	70	c/b	.	radon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Imprint

ISSN 2197-649X

Layout draft: Holger Dieterich, Ines Reese
Technical edition: Ralf Opitz
Language revision: Nicole Taylor, Nils Müller-Scheeßel

Published by the Institute of Prehistoric and Protohistoric Archaeology, Kiel University;

For further information consult www.jna.uni-kiel.de