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Burning the dead: Human bones subjected to fire in southwestern Swedish megalithic graves

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Abstract

In this paper, a series of new radiocarbon dates on burnt human bones recovered from megalithic graves in southwestern Sweden is reported. The purpose was to reveal possible chronological patterns of these depositions. Both the location of the bones within the grave and the characterisation of the burnt bones are discussed. The megalithic graves in the study area were mainly used for successive inhumation burials and have been subjected to extensive reuse throughout prehistory. Burnt human bones have therefore been assumed to originate from later periods when cremation was the dominant burial practice, although indications of Neolithic cremations occur. The radiocarbon dates demonstrate that most of the burnt bones derived from later reuse of the graves. More unexpectedly, several depositions also dated to the Neolithic and Early Bronze Age, confirming parallel practices of inhumation and cremation during these periods. Furthermore, the results indicate that the placement of the burnt bones and the treatment of the human remains to some degree varied over time.

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Further information can be found in the Supplement available as separate download on the article webpage.

Introduction

The conventional view in south Scandinavian archaeological research is that cremations started to replace inhumations in the middle of the Bronze Age (Harding 2000, 112–113; Holst 2013, 105; Montelius 1892, 130; 1917, 30; Weiler 1994, 160). In Neolithic (4000–1700 BC) and Early Bronze Age (1700–1100 BC) contexts (Fig. 1), this consensus often leads to preconceptions of burnt human bones as later Iron Age or Late Bronze Age depositions. However, in recent years an increasing number of radiocarbon dates has shown that human bones exposed to fire are present in the archaeological record in Scandinavia from the Mesolithic and onward. Burnt bones can be associated to various activities and found in many different contexts. In a Swedish framework, Mesolithic cremations occur in Scania, Bohuslän, Östergötland, Falbygden, Dalarna and on Gotland [1]. Furthermore, human remains subjected to fire are known from Trichterbecher (TRB) graves (Apel et al. 1995; Hallgren 2008; Kihlstedt et al. 1997; Lindman 1993) and Sarup enclosures (Andersen 1997), Pitted Ware Culture (PWC) settlements and mortuary houses (Artursson 1996; Larsson, Å. M. 2003), Battle Axe Culture (BAC) ritual contexts (Larsson, L. 2000; Lindström 2000), and in Late Neolithic (2200–1700 BC) and Early Bronze Age depositions and graves [2]. Nevertheless, more systematic radiocarbon dating of burnt human remains is necessary to refine our knowledge of these practices. Radiocarbon analysis of apatite in calcined bones became possible in the late 1990's (Lanting/Brindley 1998) and is regarded as a reliable alternative to date skeletal remains when no collagen remains (Lanting et al. 2001).

1 Larsson, L. 1988; Eriksson et al. 2018; Lindqvist/Possnert 1999; Sjögren pers. comm.; Sjögren/Ahlström 2016; Welin pers. comm.

2 Aleksandersson/Petersson 2010; Ekmyr-Westman 1989; Forsman 2007, 393; Hansen 1937; Sjölin 2010.

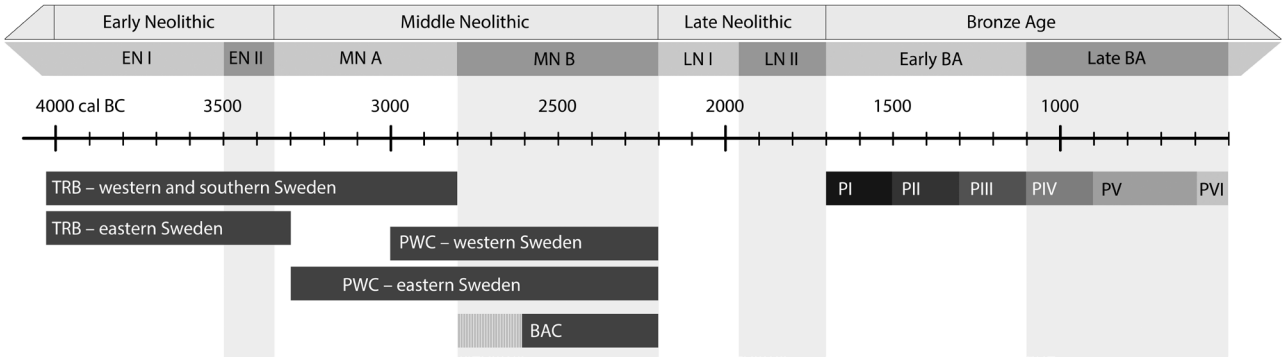
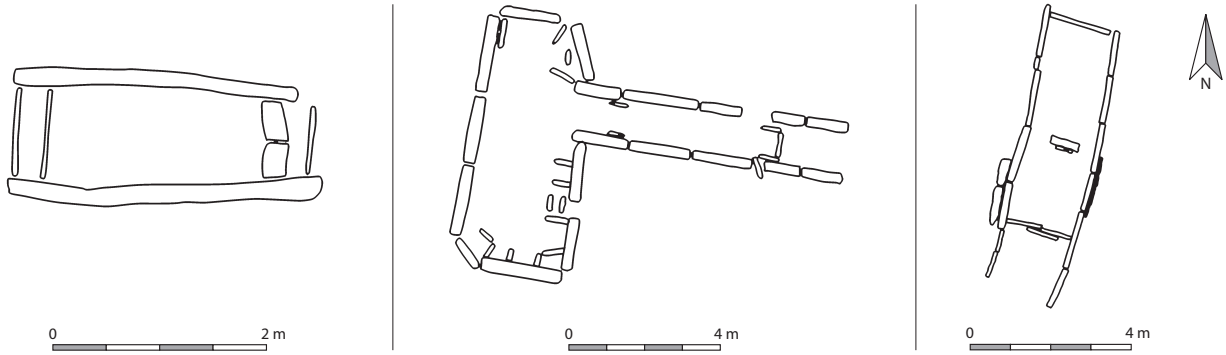


Fig. 1. Chronology of the Neolithic and Bronze Age in Sweden (after Blank et al. 2020, 3 fig. 1).

In this study, I discuss human bones exposed to fire recovered from megalithic graves. In Sweden, megalithic graves are divided into three main types: dolmens, passage graves and gallery graves. The two first types belong to the transition between the Early and Middle Neolithic and the first part of Middle Neolithic, while the gallery graves generally date to the Late Neolithic (Blank et al. 2020). The shape and size differ between the types, although the dolmens and gallery graves sometimes can be difficult to separate (Fig. 2). Middle Neolithic (3350–2200 BC) and Late Neolithic megalithic graves were mainly used for successive inhumation of primary burials (e. g. Ahlström 2009; Sjögren 2003; 2015; Weiler 1994). Recently more elaborate treatments of dead bodies have been suggested (Hollund et al. 2018; Sjögren 2015), indicating more varied mortuary practices than previously thought.

Fig. 2. Examples of the main megalithic grave types from Falbygden. Left: Dolmen (Kinneved 21); middle: Passage grave (Karleby 57); right: Gallery grave (Torbjörntorp 18) (Drawings: M. Blank).



In many of the Swedish megalithic graves, burnt human bones have been noticed in the chambers or in the surrounding cairns/mounds[3]. As megalithic graves have been subjected to intensive prehistoric reuse[4], burnt human remains are commonly interpreted as Late Bronze or Iron Age reuse. Nevertheless, a few depositions of burnt human bones have been suggested to belong to the Middle Neolithic B (2800–2200 BC) and the Late Neolithic/Early Bronze Age (e. g. Kaelas 1967, 289; 305; Persson/Sjögren 2001, 219; Strömberg 1968; 1971). Burnt human bones found in the Bjurhovda and Alby gallery graves, in eastern Sweden, were suggested to date to the Late Neolithic/Early Bronze Age, based on radiocarbon analysis of associated charcoal (Andersson/Boije 2005; Jaanusson 1969, 153–156). One cremated skull bone recovered in the entrance area of the Hindby long dolmen in Scania was radiocarbon dated to the Middle Neolithic B (Burenhult 1973, 103; Persson/Sjögren 2001, 222).

3 E. g. Alexandersson 2005; Andersson 1971; Andersson/Boije 2005; Andersson/Ragnesten 2005; Arne 1909; Burenhult 1973; Cnattingius 1927; Gejvall 1954; Hildebrand 1869; Jaanusson 1969; Johansson 1961; Kaelas 1967; Persson/Sjögren 2001; Strömberg 1968; 1971; Svensson, G. 1957; Weiler 1994.

4 Arne 1909; Blank 2016; Enqvist 1922; Olausson 2014; Sjögren 2003; Strömberg 1971; Weiler 1994.

Research area

The geographical focus of this paper is Falbygden, located in the southwestern inland region of Västergötland (Fig. 3). Falbygden, with one of northern Europe's largest concentrations of passage graves and a large number of gallery graves, is an important area for research of megalithic graves in Scandinavia (Midgley 2008; Scarre 2010; Sjögren 2003; Tilley 1994). Excavations of these graves have been conducted since the middle of the 19th century [5]. In several of the excavated megalithic graves human bones burnt at different degrees and deposited in various parts have been recovered (e.g. Anderbjörk 1932; Blank 2016; Persson/Sjögren 2001; Sjögren 2003; Weiler 1994). According to Weiler (1994, 65), 20 % of the excavated gallery graves in Västergötland contained burnt bone. However, at present, only one single burnt human bone from these graves has been radiocarbon dated. The sample belonged to a Late Bronze Age adult female placed in the cairn of the gallery grave/dolmen Falköping stad 26 (Blank 2017).

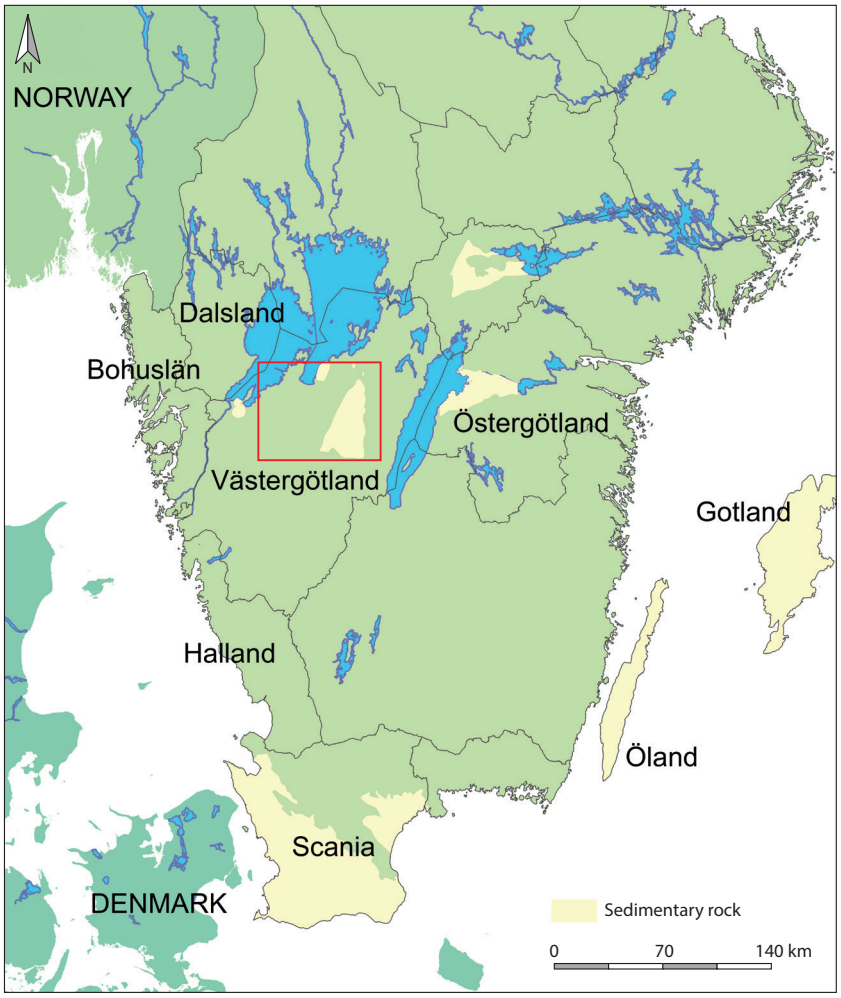


Fig. 3. Southern Sweden. The rectangle corresponds to the extent of Figure 4 (Graphics: M. Blank).

Research objectives

The purpose of this investigation was to trace chronological similarities or differences and contemporaneous variation in the practices of exposing human remains to fire. The aim was addressed through radiocarbon analyses and osteological assessments of burnt human bones recovered in the megalithic graves of Falbygden. Twenty-two burnt bones from 16 graves

5 E.g. Algotsson 1996; Bägerfeldt 1992; Cullberg 1963; Hildebrand 1864; Montelius 1873; Persson/Sjögren 2001; Retzius 1899; Sahlström 1927, 1932; Ullenius 1948.

(including the sample published in Blank 2017) were sampled for radiocarbon analysis. Radiocarbon dates, context and placement of the burnt bones were compared. Some of the questions I attempt to answer are: Can any Neolithic or Early Bronze Age burnt human bones in the megalithic graves be confirmed? If so, were these dry or fresh bones, or bodies exposed to fire? Are the bones a result of intentional burning or not? Is there any sign of burning inside the graves or were they burnt elsewhere? Are there any other indications of burning besides burnt bones? Is there any chronological pattern or variation to the burning practices or placement of the bones? How do the results fit in a more general framework of cremation practices and use of megalithic graves?

Material and methods

Material

In all, 22 burnt human bones from 16 megalithic graves (eight passage graves, seven gallery graves and one gallery grave or dolmen) were sampled for osteological and radiocarbon analysis. Detailed information of the samples and the sites is presented in the Appendix and the Supplement.

The samples consist of eleven long bone pieces, ten skull fragments and one jaw fragment (Supplement) exposed to various temperatures indicated by colours ranging from brown/black (partly carbonized) to white (fully calcined; Stiner et al. 1995). The samples derive from single bones to depositions of bones from several individuals (Appendix). Eleven of the bone depositions could be determined as adult individuals. In two cases, the burnt bones were estimated to belong to individuals of female sex, while in the other cases no sex could be assessed (Supplement).

Most of the megalithic graves (13) included in this study are located in Falbygden, while one grave is found north of and two west of Falbygden (Fig. 4). The remains originate from excavations conducted mostly only in parts of the graves between the years 1868 and 1996 (Appendix).

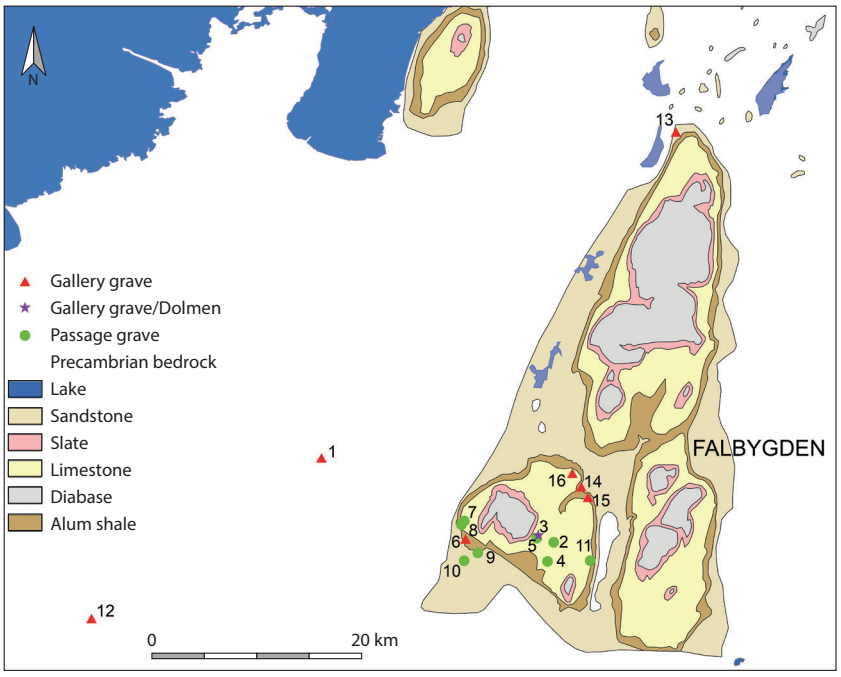


Fig. 4. The sampled megalithic graves in Falbygden and adjacent areas: 1 Edsvära 19; 2 Falköping stad 3; 3 Falköping stad 26; 4 Falköping stad 7; 5 Falköping stad 19; 6 Gökhem Torsagården; 7 Gökhem 24; 8 Gökhem 31; 9 Gökhem 71; 10 Gökhem 78; 11 Karleby 59; 12 Södra Härene 73; 13 Timmersdala 5; 14 Torbjörntorp 18; 15 Torbjörntorp 31; 16 Valtorp 2:2. The numbers correspond to the site numbers in the Appendix and Supplement (Graphics: M. Blank).

Sample selection

A review of bone material in megalithic graves in Falbygden was conducted to evaluate the presence of burnt bones. The aim was to sample all of the contexts in the megalithic graves where burnt bone was found, but the availability of the bones was of course decisive. Documentation of burnt bones does not necessarily imply that the bones were collected and stored, thus depositories were also visited (National Historical Museums [SHM], Tumba; Västergötlands Museum [VGM], Skara; Falbygdens Museum [FM], Falköping; Alingsås Museum [AM], Alingsås). Cases when the burnt bones could be confirmed as human were then chosen. Some of the bones described as burnt were not actually burnt (Vartofta Möleberget gallery grave, SHM 20333). Additional bones were also found while going through the artefact material in the depository at the Swedish History Museum (SHM), Stockholm. These consisted of a cremated skull fragment in the Falköping Blinningsberg megalithic grave (SHM 20317) and two burnt skull fragments in the Torbjörntorp 31 gallery grave (SHM 18522), but these bones were not available for dating.

Methodological considerations

In this study the term burnt bone includes lightly burnt to fully calcined bones (Supplement). Even though not usually recommended, unevenly burnt bones with patches that seemed only slightly exposed to fire were sampled for radiocarbon dating, as these contexts were considered especially interesting. Accurate radiocarbon results can be achieved on scorched bones where collagen of good quality remains, and on the apatite of fully calcined bone. The old wood effect might alter the radiocarbon dates of fully calcined bone (Hüls et al. 2010; Rose et al. 2020; Snoeck et al. 2014; 2016; Zazzo et al. 2012; 2013). However, reliable results can be obtained if one can assume that the wood used in the pyre was approximately contemporary with the deceased, within a few decades (ibid.). Numerous tests on paired samples of cremated bones and associated material indicate that the old wood effect in most cases is insignificant (Hornstrup et al. 2012; Lanting et al. 2001; Olsen et al. 2008; 2011). Even if it is possible that old wood effect may be significant (Rose et al. 2020; Snoeck et al. 2014), it would have a marginal impact on this study as quite large time spans are compared.

The calibrations, plots and models presented in this study were conducted by using the OxCal online software version 4.4.2 based on the IntCal20 atmospheric curve (Reimer et al. 2020). The 2σ-probability interval (95.4 %), recommended by Millard (2014), was used when discussing the radiocarbon results, and the 1σ-probability interval (68.2 %) was added in the figures.

This is a contextual study; for example, we investigate the location and the characterisations of the depositions of burnt bones. The few samples do not allow for any statistical analyses and instead tendencies are discussed. The results from Falbygden are further positioned in a larger geographical framework.

Osteological approaches

Osteological determinations of the bones were conducted by Leena Drenzel and Johnny Karlsson, SHM, Åsa M. Larsson, Riksantikvarieämbetet (RAÄ), Clara Alfsdotter and Astrid Lennblad, Bohusläns Museum (BM), Anna Tornberg and Torbjörn Ahlström, Lund University (LU), Maria Vretemark, VGM

and Aija Macane, University of Gothenburg (GU). The degree of burning was also estimated by the colouring of the bones (e. g. Buikstra/Swegle 1989; Stiner et al. 1995; Ubelaker 1989).

In several cases the bones were evaluated by two osteologists (Supplement). The bones from Gökhem 31, 71 and 78 were previously analysed by Leif Jonsson and Maria Vretemark (Bågenholm et al. 1993; Sjögren 1992; Wattman 1993). For this study, Maria Vretemark conducted complementary evaluations of the collected bone material. In Gökhem 31, three burnt bones were determined as human in the excavation report (Wattman 1993, 21). However, of the six included samples from Gökhem 31 and 71, five did not have a sample number, which might indicate that these bones were not previously analysed or that they were included in the reported groups of undetermined bones.

Several experimental studies of burnt bone demonstrate that cracks and fractures on the cremated bone vary depending on whether it was burned in a dry or fresh state. Variations in colour and cracks between fresh bone with and without flesh when exposed to fire also occur (e. g. Buikstra/Swegle 1989; Dehaan 2008; Schultz et al. 2008). In some bone elements, curved and elliptical fractures are more marked in fresh bones than in dry bones. Defleshed but still fresh bones are more evenly burnt and usually display fewer cracks than fleshed bones. The burning of dry bone will result in few fractures, mainly along the length of the bone instead of across it. Curved fracturing and uneven colouring are indications of bones being burnt with intact soft tissue (Larsson, Å. M. 2009, 302–307). Estimations of the status of the skeletons at the time of burning were made on most of the burnt bones in this study by Åsa M. Larsson. To evaluate the status of the bones at the time of burning, bones from the entire body are ideal, which was not possible in this study. Instead single or several bones from the same skeletons were assessed.

Laboratory procedures

The radiocarbon analyses were performed by the 14Chrono Centre, Queens University, Belfast. For collagen, Belfast applies a standard AAA (acid-alkali-acid) pretreatment after Longin (1971) and ultrafiltration (Brown et al. 1988) using a Vivaspin® filter cleaning method based on Bronk Ramsey et al. (2004).

Regarding the cremated bones a Dremel®tool is used to clean the sample and 2–5 grams of it are ground in a mortar and pestle. The sample is then cleaned by using several methods including vacuum filtering, deionized water, and acetic acid (Lanting/Brindley 1998; Lanting et al. 2001).

For more details regarding the combustion and graphitization see Slota et al. (1987), Reimer et al. (2015) and Vogel et al. (1987). Measurements of $^{14}C/^{12}C$ and $^{13}C/^{12}C$ ratios by AMS are conducted on an NEC 0.5 MV compact accelerator. In addition, %C, %N, $\delta^{13}C$ and $\delta^{15}N$ are measured in collagen samples on an isotope ratio mass spectrometer, EA-IRMS (Thermo Delta V elemental analyser).

For most of the samples (15), colour charts were employed as a guide to assess if proper cremation conditions had prevailed leading to a sufficient degree of crystallinity. Furthermore, the osteological estimations of the burning of the samples that were dated all suggest that they were fully calcined (Supplement). Thus, these datings can be considered reliable.

The crystallinity index (CI) was reported for four of the samples (Supplement), as these ones were analysed after their acquisition of an FTIR (Fourier transform infrared). After pretreatment and before dating, the CI is determined for the cremated bone samples. CI values provides a semi-quantitative way to estimate the structural order (the size and atomic order of a crystal) in bone. The CI value increases with burning intensity

(Person et al. 1995). The CI value was measured by FTIR spectroscopy to check on the degree of cremation. Calcined bones with CI values below 5 were not dated, as the cremation temperature would not have exceeded 600 °C. Higher CI values suggesting higher temperature would render the samples inert to exchange with other carbon sources, while dates from samples exposed to lower temperature should not be relied upon (Olsen et al. 2011).

Results

Of the 22 samples, 17 were successfully radiocarbon dated, one sample on collagen and the rest on apatite (Fig. 5; Supplement). However, the sample dated on collagen must be considered with caution as no C:N was reported and there is a possibility of low collagen quality or contaminants for example from soil (further discussed below). The five unsuccessful samples either yielded too small amounts of collagen or were not fully calcined for obtaining a reliable apatite dating. The 17 samples originate from twelve different megalithic graves and the dates extend from the transition between the Early Neolithic and Middle Neolithic to the Late Iron Age (Fig. 5; Supplement).

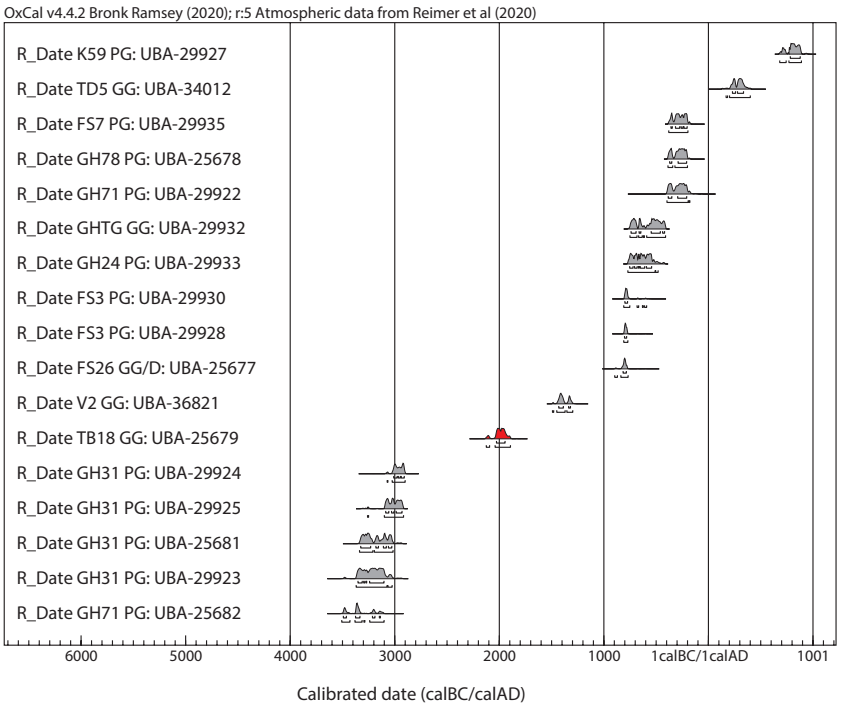


Fig. 5. Radiocarbon dates of burnt human bones based on data from the Supplement. PG passage grave; GG gallery grave; D dolmen. Red: sample dated on collagen; grey: samples dated on apatite (OxCal vers. 4.4.2; Bronk Ramsey 2009).

The cremated human remains with the earliest dates, belonging to the TRB period (3500–2900 cal BC), were recovered from two passage graves located in Gökhem (Fig. 5). These bones were all fully calcined and exposed to temperatures above 700 °C (Supplement). At least two of the bones show indications of not being dry when burnt and one bone was probably cremated with soft tissue (Appendix). The only sample dating to the Late Neolithic (c. 2000 cal BC) was recovered from the Torbjörntorp 18 gallery grave and was only locally/half carbonized and probably burnt at moderate temperature (c. 500 °C). It cannot be ruled out that this sample was contaminated but the bone was recovered from a closed grave which did not show any signs of later reuse (Ullenius 1948). The unburnt bones and artefacts

indicated that the grave was used in the Late Neolithic and the first part of the Early Bronze Age (Blank et al. 2020). Thus, a Late Neolithic date seems credible and the bone is therefore discussed in the text as possibly Late Neolithic. The sample belongs to an adult individual. The uneven burning and the fracturing and cracks of the different bone elements from this individual indicate burning of a fleshed body (Appendix). A sample of a calcined cranium fragment recovered from the Valtorp gallery grave dates to the Early Bronze Age (c. 1400 cal BC). These seven samples can be considered to belong to the main burial sequence of the graves, as they are contemporary with the successive inhumation burials in passage and gallery graves (Blank et al. 2020). However, the sample from Gökhem 71 dating to c. 3500–3100 cal BC, which was recovered below the mound behind the chamber at a depth of 0.85 m, derives from an earlier settlement layer (Persson/Sjögren 2001).

The remaining ten samples are instead considered as later depositions, indicating reuse of the graves. Five samples from five depositions in four graves (two passage graves, one gallery grave and one gallery grave/dolmen) date to the Late Bronze Age (Fig. 5). These bones were cremated at an estimated temperature of at least 700 °C. Four of these bones showed fractures indicative of being cremated fresh with adhering soft tissue (Appendix). Another four samples from three passage graves and a gallery grave date to the Early Iron Age. These bones were fully calcined and two of them were probably burnt while still fresh, possibly with soft tissue (Appendix). Another sample, which was recovered from the Karleby 59 passage grave, dates to the Late Iron Age (c. 800 cal AD; Fig. 5). This bone was also calcined and is estimated to have been cremated fresh with flesh. Considering these ten cremated bones, the reuse of megalithic graves was concentrated to the Late Bronze Age c. 900–400 cal BC and to the Pre-Roman Iron Age c. 400–200 cal BC (Fig. 5).

The samples dating to the Early Neolithic/Middle Neolithic and Middle Neolithic A (3350–2800 cal BC) seem to consist of single scattered fragments. All the Middle Neolithic A bones were recovered from the entrance area along with burnt and unburnt flint, pottery sherds, burnt animal bones, and a few unburnt human bones (Fig. 6; Appendix). The two Late Neolithic and Early Bronze Age burnt human bones were found inside the chambers, while the samples dating to the Late Bronze Age with known location were deposited in the mounds or cairns of the megalithic graves (Fig. 6). The Early Iron Age samples derived from the mounds/cairns, entrance area and the chamber. At least half of the Late Bronze Age and Early Iron Age samples were found as closed deposits of cremated bone in pits or pottery vessels. In most cases the Late Bronze Age and Early Iron Age depositions consisted of cremated bones from large parts of a skeleton. However, in Falköping stad 7, a deposition of a single skull fragment (Early Iron Age) in the chamber occurred (Appendix), and in Timmerdala 5 only a few cremated bones (Early Iron Age) were placed in a pottery vessel inside the chamber. The skull fragment from Falköping stad 7 is the only bone with indications of being cremated dry (Appendix). The Late Iron Age sample from Karleby 59 was found at the bottom of the passage grave chamber within an assemblage of burnt bones from three individuals (Fig. 6; Appendix).

Indications that fresh bones were cremated with adhering soft tissue are observed in samples dating to all periods (Appendix). In several cases only single bones were evaluated, which makes these observations tentative. Ideally, bones from the entire skeleton need to be considered to make a reliable estimation of the state of the human remains prior to burning. In the Late Neolithic case different bone elements from the same individual showed signs that the skeleton had been exposed to fire while the soft tissue still remained (Appendix). Even though burned animal bones, flint and other artefacts in some cases were found in the same contexts

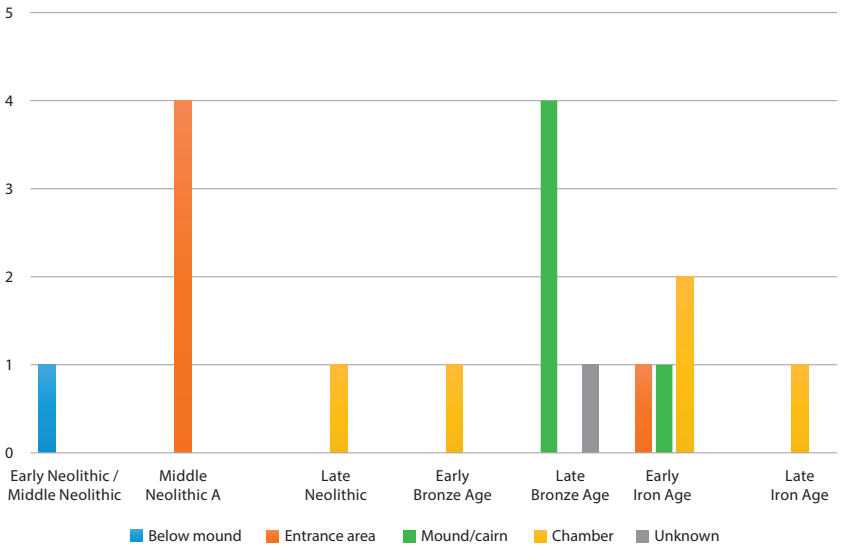


Fig. 6. Dated cremated human bones by context and period (Graphics: M. Blank).

as the burnt human remains, no traces of burning were observed in the chambers, cairns, or mounds. Thus, the cremations/burning of bones/bodies as well as animals and artefacts most probably took place elsewhere before they were deposited in the graves (with one possible exception – see below).

The five undatable samples exposed to relatively low temperatures (carbonized but not fully calcined) were recovered from the chambers of the graves. In two cases, the contexts indicate a possible Iron Age date (Karleby 57 and Södra Härene 7; Appendix). In two other megalithic graves (Falköping stad 19 and Torbjörntorp 31) the related artefacts strongly point towards Late Neolithic or possibly Early Bronze Age dates (Appendix). The fifth sample derives from the Edsvära 19 gallery grave, and the typological dates of the artefacts are Late Neolithic/Early Bronze Age. This grave is the only example where burning inside the grave could be a possible explanation for the burnt remains (Appendix). Whether this was intentional or not is considered in the discussion section. According to the fractures and cracking of these bones they were most probably burnt fresh with remaining soft tissue.

Discussion

Regarding Falbygden, Sahlström (1940, 20) and Weiler (1994, 160) argued that cremation was introduced in the middle of the Bronze Age. However, Weiler (1994, 158) also suggested that burning of human remains was practised to some degree already during the Late Neolithic/Early Bronze Age. In this study, new radiocarbon dates suggest that a large part of the burnt human bones recovered from the megalithic graves derives from reuse in the Late Bronze Age and Iron Age (10 of 17 dated samples). However, burnt human remains from the Early Neolithic/Middle Neolithic, Middle Neolithic A, Late Neolithic, and Early Bronze Age, which are contemporaneous with the inhumation burials from the main burial phases (Blank et al. 2020) are also present.

Chronological patterns

Some tendencies of when, where, and how the bones have been deposited can be discerned, although the sample size is small.

In the TRB period scattered cremated bones were deposited in the entrance area. These bones were fully calcined and burnt at temperatures above 700 °C. The bones were probably exposed to fire while still fresh and some even with adhering soft tissue.

The possible Late Neolithic sample originates from an assembly of burnt human remains from a single individual and the Early Bronze Age bone was recovered along with half a kilo of cremated bones which might derive from the same individual (Appendix). Both the Late Neolithic and the Early Bronze Age depositions were found in the chambers. In the Late Neolithic, the bones were exposed to low temperatures, while in the Early Bronze Age the bones were burnt at a relatively high temperature. The Late Neolithic bones were burnt with intact soft tissue. The bones from the Early Bronze Age context also showed indications of being cremated fresh and at least partly fleshed (Appendix).

In the Late Bronze Age clearly demarcated depositions of cremated human bones representing burials in the mounds and cairns occurred. In the Early Iron Age, both single cremated bones and defined depositions of a cremated skeleton were placed in mounds/cairns, entrance areas and chambers. The youngest Early Iron Age bone and the only bone dating to the Late Iron Age were recovered in the chambers. The Late Iron Age calcined sample derived from a deposition of unevenly burnt bones belonging to several individuals. The bones dating to the Late Bronze Age and Early Iron Age were all fully calcined after exposure to high temperatures. Indication of fresh burnt bones with soft tissue occurred both during the Late Bronze Age and Early Iron Age.

Early and Middle Neolithic cremations

The most likely scenario of the Early Neolithic/Middle Neolithic cremated human bone from Gökhem 71 is that it originates from activities related to the earlier settlement layer identified below the mound. Burnt human remains at Neolithic settlements are present in other regions (Artursson 1996; Larsson, Å. M. 2003). According to Å. M. Larsson (2003), at Bollbacken PWC site the depositions of human burnt bones derived from cremated dry skeletons. The sample from Gökhem 71 was fully calcined, but it could not be determined whether it originated from a primary cremation or a secondary burning of dry or fresh bone.

Regarding the cremated bones dating to the Middle Neolithic A bones recovered from the entrance areas of the passage graves, one possibility is that they originate from older burials that have been cleared out of the grave to make place for new burials and then being burnt and placed by the entrance. Another possibility is that these bones were part of rituals that took part in front of the passage opening and relating to the inhumation burials inside the grave. Several of the bones indicate that they were exposed to fire when still fresh and fleshed (Appendix). Thus, it is unlikely that the bones derive from cleared out skeletal remains. However, the bones may still be fresh and even have partially remaining soft tissue after some time in a megalithic grave, especially if the bodies were wrapped (Ahlström 2009; Hollund et al. 2018; Larsson, Å. M. 2009, 302; Sjögren 2008). The cremation of bodies or fresh bones is here considered the most likely hypothesis. The cremated bones may have been part of rituals taking place in the entrance area. Another possibility is that the remains originate from individuals that demanded a different burial treatment than the ones placed inside the grave.

To better understand the finds of calcined human remains by the entrance of the Gökhem 31 passage grave, the cremated human bones from the entrance area are plotted together with a cremated pig bone

(GrA-14299) and an unburnt human tooth (UBA-29924) from the same area (Fig. 7). The cremated human bones are older than both the cremated pig bone and the unburnt human tooth. The five cremated bones (human and pig) may represent the use span of the entrance area (Middle Neolithic A to Middle Neolithic B) including depositions of burnt bones and flint, and pottery sherds. The time span coincides with the main period of use in most of the passage graves (Blank et al. 2020; Sjögren 2011). The unburnt human remain also fits within this time frame. This tooth might also originate from a burial in the passage, moved by later animal activities. Cremated animal bones and flints are common finds in the entrance area of the passage graves in Falbygden (Persson/Sjögren 2001; Sjögren 2003), but no evidence of burning at site has been documented (Persson/Sjögren 2001, 222; Wattman 1993, 28).

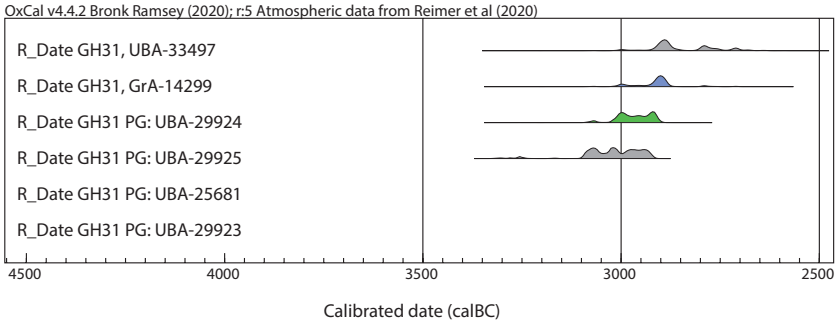


Fig. 7. Calibrated radiocarbon dates (95.4 % and 68.3 %) from bones in the entrance area of the passage grave Gökhem 31 (GrA-14299: Wattman 1993; UBA-29924: Blank et al. 2020; else see Supplement). Blue: cremated pig bone; grey: cremated human bone; green: unburnt human bone (OxCal vers. 4.4.2; Bronk Ramsey 2009).

Instead of viewing the Middle Neolithic cremated human bones as an independent burial practice, Hansen (1937) suggested that these bones in passage graves derive from human sacrifices while L. Larsson (2000) emphasized that they were part of ritual activities. Ritual activities such as feasting in connection to the building of graves and burial ceremonies are/were common in ethnographic contexts (e. g. Dournes 1975; Hutton 1921). In some examples these feasts took place at the burial sites (Dournes 1975).

In Falbygden, the entrance depositions mainly consist of burnt flint, fragmented pottery, and burnt bone from domestic animals, while unburnt bone from wild animals and humans are found inside the chambers and passages (Persson/Sjögren 2001, 219). Entrance depositions are also frequent in passage graves in Scania and Denmark (Bagge/Kaelas 1950–1952), although here cremated human bones rather than animals have been proposed to be more frequent (Persson/Sjögren 2001). A common view is that the finds in the entrance area were deliberately fragmented or destroyed, partly by fire (Burenhult 1973; Larsson, L. 2000; Persson/Sjögren 2001, 46; Strömberg 1968). According to Holten (1994) deliberate fragmentation of both artefacts and human remains in the entrance depositions and the chambers of megalithic graves is a common ritual tradition in the Scandinavian Middle Neolithic. Intentional fragmentation of artefacts has also been discussed in other Neolithic contexts (e. g. Chapman 2000) and the fragmentation of objects in burial contexts are in some cultures necessary for passing into the afterlife (e. g. Dournes 1975).

As already mentioned, the only previously radiocarbon dated cremated human bone from the entrance area of a Swedish megalithic grave is a skull fragment recovered from the entrance area of the Hindby long dolmen. The bone was suggested to date to the Middle Neolithic B (Burenhult 1973, 103; Persson/Sjögren 2001, 222). It is worth noting that this radiocarbon date is rather old and has a large standard deviation (±110), and might as well be dated to the last part of the Middle Neolithic A. According to

L. Larsson (2000, 607) the cremated bones recovered in the entrance areas of Scanian megalithic graves originate from ritual practices in the late TRB tradition and not to the earliest use of megalithic graves. Cremated human bones from several megalithic graves in Scania (Ramshögen passage grave, Gillhögen passage grave and Trollasten dolmen) have been suggested to date to the Middle Neolithic B and the Late Neolithic based on the artefacts from the same contexts (Burenhult 1973; Strömberg 1968; 1971, 116–120). According to L. Larsson (2000), the ritual practice of burning flint and human bones was continued in the Battle Axe Culture (BAC) tradition. This can be exemplified at Kverrestad, Scania where a number of pits with burnt flint, fragmentary pottery, burnt human bones and BAC artefacts have been found (ibid.). Similar pits with cremated human bones, charcoal and BAC artefacts were documented in a mortuary house in Turinge, Sörmland (Lindström 2000). In the present study, cremated human remains in the entrance could be dated to the early part of the Middle Neolithic A for the first time.

Late Neolithic and Early Bronze Age cremated bones

Scorched bones are difficult to date (see above, Methodological considerations). In this study, only one unevenly and lightly burnt bone could be radiocarbon dated, which resulted in a Late Neolithic date although not fully reliable. But burnt and unburnt Late Neolithic artefacts recovered along with human bones burnt at a relatively low temperature indicated Late Neolithic dates of several of these depositions (see above, Results). Kaelas (1967, 305) suggested that scorched human bones in Scandinavian gallery graves probably date to the Late Neolithic/Early Bronze Age. Hansen (1937) described a cairn floor in north eastern Scania with incompletely cremated human bones along with flint daggers and pottery typologically dating to the Late Neolithic. He suggested that the incomplete burning resulted from lacking know-how of cremation and should be regarded as the start of cremation burials that became common in Bronze Age period III (Hansen 1937). Today we know that cremations were practised already during the early Mesolithic. But this does not mean that the construction of effective cremation pyres was common knowledge in the Late Neolithic or Early Bronze Age. However, a fully calcined skull fragment dating to the Early Bronze Age was recovered in the Valtorp 2 gallery grave along with other cremated bones also burnt at a relatively high temperature (Appendix). Furthermore, fully cremated human bones from various Late Neolithic and Early Bronze Age contexts are known from other regions (see below). Maybe it was not the intention to fully cremate the Late Neolithic bones, but rather a result of an intentional treatment of specific bodies.

Scorched bones have also been proposed to result from unintentional damage to the grave related to natural fires or later activities involving fire (Weiler 1994, 160). Later is here referred to as from later periods, and the activities are exemplified by for instance the construction and use of ovens in or close to the graves (Weiler 1994; 1996). If this was the case, the bones would have been burnt dry, but this study provides no indications of such a burning dating to the Late Neolithic or the Early Bronze Age (Appendix). From the Edsvära 19 gallery grave unevenly burnt bones, charcoal as well as fire-damaged artefacts were recovered (Appendix). Anderbjörk (1932, 160) suggested that successive burning of bodies took place in this grave. Traces of burning were observed in the chamber of the Hemsjö 35 gallery grave, Västergötland (Weiler 1994, 160). A charcoal layer was documented in the Björkön gallery grave, Dalsland (Stjernquist 1950, 14). Several of the flint flakes and a few bones from this grave were also exposed to fire (SHM 24218). These examples may result from intentional burning related to the abandonment or to the initiation of the graves. Destruction

and burning of megalithic graves when they were abandoned are known from other European regions (Chambon 2003, 205; Leclerc/Masset 1980). In the Annelund gallery grave, Uppland, some of the recovered human bones were lightly burnt, which was interpreted as a result of setting the cist on fire at the point of abandonment (Andersson/Hjärthner-Holdar 1989, 210). However, if connected to the abandonment in the Edsvära case, this must have included a last burial or taken place in a limited time after the last inhumation burial as the bones indicate burning of a fleshed body (Appendix).

Intentional burning might also have been part of later reuse of the gallery graves. In the examples above no indications of later use were seen. Nevertheless, in the Gudhem 159 gallery grave B, traces of fire, burnt charcoal and animal bones were recovered in the chamber above the Late Neolithic/Early Bronze Age layer and interpreted as later reuse (Hjolman 1995). According to Artelius (2013, 348), in Halland, south-western Sweden, various ritual activities involving digging, rebuilding, and burning in/on older burial monuments were common during the Iron Age.

However, in the two gallery graves in Torbjörntorp (18 and 31), Falbygden, where scorched bones were found no traces of fire could be observed in the graves (Appendix) and the bones must have been burnt elsewhere. The bones from the individual in Torbjörntorp 18 also indicate that the skeleton was burnt with soft tissue still intact (Appendix). In this gallery grave, the earliest of 34 radiocarbon dates belongs to the individual exposed to fire. The burnt and cremated human bones in Torbjörntorp 31 were recovered in the bottom layer of the grave along with a few burnt artefacts, which belonged to an individual's personal adornment and equipment (Appendix). A possible interpretation might be that the initial burial in these graves was subjected to fire. In any case, I suggest that the burnt human remains in gallery graves originate from burials where dead bodies intentionally were exposed to fire and not from unintentional burning.

In the case of Torbjörntorp 18, large parts of a whole skeleton were recovered, in the Valtorp 2 gallery grave c. 0.5 kg of human burnt bone and in Torbjörntorp 31 only a few skull bones were recovered. In the case of Torbjörntorp 31, and in other cases where only small amounts of burnt human bones occur, some bones may have been neglected during excavation and some might have been removed by later activities. It is also possible that only small quantities of bones were retrieved from the pyre. Variations in the cremation practices and the amount of retrieved and deposited bones during Bronze and Iron Age have been proposed for example by Kaliff (1995). Several of the graves have not been fully excavated (e. g. Falköping stad 19) which may have resulted in only a few bones being collected (Appendix). Another explanation might be that the burnt bones from an individual were divided between several different depositions, like the late Middle Neolithic ritual pits in Kverrestad as proposed by L. Larsson (2000).

As already mentioned, radiocarbon analyses of charcoal indicate the presence of Late Neolithic/Early Bronze Age cremations in gallery graves in eastern Sweden (Andersson/Boije 2005; Jaanusson 1969, 153–156). Furthermore, typological dating of depositions of burnt human remains to the Late Neolithic/Early Bronze Age have been suggested in several gallery graves from several Swedish regions (e. g. Cnattingius 1927; Hildebrand 1869; Svensson, G. 1957; Strömberg 1982). Cremated human remains in flat graves and burial pits in eastern Sweden and Scania and in mounds and urn graves in Denmark have also been radiocarbon dated to this time span[6]. Furthermore, in a couple of pits with cremated human bones, one at the west coast (Ragnesten/Kegel 2017) and one in Småland (Nordström 1996), hazelnut and charcoal were dated to the Late Neolithic. Thus, the burning of human remains seems to have been a widely spread phenomenon in South Scandinavian during Late Neolithic and Early Bronze Age.

6 Alexandersson/Petersson 2010; Arcini/Svanberg 2005; Ekmyr-Westman 1989; Feville/Bennike 2002; Forsman 2007; Olsen et al. 2008; Sjölin 2010.

Fire might also have been used to treat dead bodies or bones in other ways that can be more difficult to detect. Oestigaard (2000; 2013, 503) discusses treatment of cadavers at low temperatures and proposes that it was not part of the burial practices, but rather the preparation of sacrificial meals to the gods. Preparing bodies for eating has also been suggested for Middle Neolithic Åland (Nunez 1995). Fire is in some cultures used to destroy the body with the purpose of setting the spirit free (e. g. Kaliff 1997; Oestigaard 2015) and can also be used as a way of removing the soft tissue from the bones (Larsson, Å. M. 2009, 376–392). In northern India, there are ethnographical examples of placing fireplaces next to temporarily inhumed bodies to speed up the process of decay and to rapidly recover bone relics when the soft tissue is gone (Shyam Singh, pers. comm.). Fire or heat can be used to accelerate or to avoid the decomposition of a corps, which in many cultures is associated with polluting qualities and danger (Douglas 1966; Hertz 1960). However, fire or heat can also be used to preserve a body (smoking and drying).

Complex mortuary practices involving various depositions of inhumation burials, cremated bones, mummifications and curation of burnt and unburnt bones have been suggested during British Chalcolithic and Early Bronze Age (Booth/Brück 2020; Parker Pearson et al. 2005; Smith et al. 2016). Mechanical skeletonization of bodies deposited in gallery graves has been suggested by Stensköld (2004), although without any osteological argumentation. No cutmarks on the skeleton material have been observed in the Late Neolithic and Early Bronze Age material recovered from the megalithic graves in Falbygden (Ahlström 2009; Alfsdotter 2014; Blank et al. 2018; Lennblad 2015; Retzius 1899). On the other hand, skeletonization by other means (open-air burials, heat, fire etc.) or intentional regulation of the decomposition cannot be ruled out. Histological analysis of human bones recovered in megalithic graves in Falbygden indicated more variation in the extent of bioerosion (from extensive to none) in the Late Neolithic than in the Middle Neolithic A bones (Hollund et al. 2018). The variation seemed to be independent of the specific grave and may therefore be related to mortuary practices, such as wrapping of and possible conservation treatment of dead bodies. Bioerosion was only absent in the bones dated to the Late Neolithic/Early Bronze Age and is related to natural or artificial mummification (for more details see Hollund et al. 2018). Thus, more varied treatments of dead bodies in the Late Neolithic and Early Bronze Age than in the Middle Neolithic A can be suspected, although variation in the Middle Neolithic A also occurs.

Late Bronze Age and Iron Age reuse

Several of the cremated bones dating to Late Bronze and Iron Age indicate that they were burned fresh or even fleshed (Appendix). Most of the samples during both these periods belong to depositions of one to three cremated individuals placed in a limited area. However, a couple of Early Iron Age bones seem to have been single cremated skull fragments put in the grave chambers, of which one might have been cremated while dry (Appendix).

In addition to the confirmed Late Bronze and Iron Age cremations in this study, other indications of burials dated to these periods also occur in the megalithic graves of Falbygden. Outside the chamber of the Karleby 105 passage grave, a bronze awl was found with some cremated bones, which was interpreted as a Bronze Age burial (Blank 2017). In the chamber of the Blinningsberg megalithic grave a cremated skull fragment may be related to the Iron Age pottery sherds found in the same context (SHM 20317). A probable Iron Age burial was recovered from the mound of Gökhem 94:1 (Frälsegården) consisting of some Iron Age pottery sherds accompanied

by cremated human bones (Sjögren 2008). Furthermore, a small stone cist with cremated bones and two Late Bronze Age pottery vessels as well as artefacts from period IV/V was recovered on top of the passage of the passage grave Vartofta-Åsaka 8. Iron Age pottery sherds, cremated bones and a glass bead were found in its mound (Montelius 1874). Other megalithic graves with burial depositions dating to Late Bronze Age and Iron Age are Norra Lundby 41:1, Norra Lundby 103:4, and Valstad 8:1 (Blank 2016; 2017; Persson/Sjögren 2001).

In Falbygden, radiocarbon dates on inhumation burials in megalithic grave chambers also confirm Late Iron Age reuse for burials (Blank 2016; Blank et al. 2020). A radiocarbon dated bovine bone recovered in the chamber of the Karleby 71 gallery grave further corroborates the Late Iron Age reuse of megalithic chambers (ibid.). During the Late Bronze Age and Iron Age different parts of passage graves were reused: While in the Late Bronze Age the focus of the reuse seems to have been the mound, the Iron Age reuse was found in different parts of the grave (Blank 2016). In the Gökhem 17 passage grave, an Early Iron Age inhumation burial was recovered from across the passage (Bägerfeldt 1992). A similar pattern of reuse can be observed when the depositions of burnt bones, unburnt human bones and artefacts are compared.

Some of the suggested reuse of megalithic graves for Late Bronze and Iron Age burials in other regions are: The Resmo passage grave, Öland, and the Burs gallery grave, Gotland, the Tågarp passage grave, Scania, and Säve 92, Bohuslän, where cremated human bones have been recovered as well as Late Bronze and/or Iron Age pottery vessels and/or artefacts (Andersson 1971; Arne 1909; Burenhult 1986; Strömberg 1971). Thus, depositions of cremated human remains dating to the Late Bronze and Iron Age seem to be a general phenomenon in Swedish megalithic graves. Furthermore, the Iron Age reuse of megalithic graves and Bronze Age mounds seem to have encompassed a large variation of activities, such as depositing human and animal remains, reconstructing and adding elements to the grave, connecting the graves to other features, the construction of hearths etc. (e. g. Artelius 2013; Blank 2016).

Burnt human remains

Cremations are and have been practised for religious beliefs, functional reasons and to maintain ethnic and group identity etc. (e. g. Århem 1988; Kaliff/Østigård 2013). It is important to recognise that there is a multitude of ethnological examples of how and why fire is and has been used in mortuary practices [7].

The burning of human bones during the Neolithic and Early Bronze Age can be considered a non-normative or at least a complementary practice (as well as placing burials in megalithic graves during the Late Bronze and Iron Age). Burial practices are often considered to be tightly connected to identity. Thus, individuals from diverse locations and/or from various groups within the society may have had their specific way of treating dead bodies. A deviating practice, as in this case cremation/burning, of certain bodies may be a manifestation of the person's social status, high or low, or that the person is an outcast or stranger (e. g. Dournes 1977, 267–268; Oestigaard 2015; Shay 1985; Ucko 1969). It could also reflect that the body or death was considered abnormal or dangerous and therefore must be treated differently (e. g. Douglas 1966, 40; Dournes 1975; Hutton 1927). In many cultures, unnatural death, for example by accident or sickness, is considered dangerous (e. g. Dournes 1975; Jouin 1949, 120).

The subjection to fire can be a method to shorten the time for transforming a body into bones. This might be connected to functional reasons but

7 E. g. Århem 1988; Conklin 1995; Kaliff/Østigård 2013; Larsson, Å. M. 2009; Larsson/Nilsson Stutz 2014; Oestigaard 2013; 2015.

also to beliefs related to death and liminality. This goes back to the concept of death described by Hertz (1960) as a long and transformative process resulting in prolonged mortuary practices which are/were common in several cultures (e. g. Bloch 1988; Dournes 1975; Hutton 1921). This has also been treated in "Les rites de passage" (van Gennep 1960) where the ritual is separated in three different phases: separation from the society, a period of transition/liminality and the incorporation/reintegration into the society with a new status. The decomposition or destruction of the flesh of a cadaver has often been considered as being part of the liminal and dangerous stage of the transformation of the dead from body into skeleton or social being into an ancestor (e. g. Hertz 1960; Nilsson Stutz 2003, 95; Oestigaard 2013). Maybe the burnt human remains dating to the Middle Neolithic A, Late Neolithic and Early Bronze Age deposited in the megalithic graves should be understood in the framework of elaborate mortuary practices when different positionings and sometimes various types of wrappings of bodies and fire was used to manipulate the putrification of the dead.

Conclusions

By radiocarbon dating burnt human bones recovered from megalithic graves, this study could for the first time confirm depositions of cremated bones from the early phase of use (Middle Neolithic A) in the entrance area of passage graves. The scattering of the bones and the context suggest a ritual aspect of the phenomenon. A cremated human remain in a TRB settlement context below another passage graves was dated to the transition between the Early and Middle Neolithic.

Furthermore, the depositions in the chambers of two gallery graves of a possible Late Neolithic individual exposed to fire and of cremated remains dating to the Early Bronze Age were demonstrated. Indications of a systematic use of fire, as a complementary mortuary practice as well as part of rituals of burning in gallery graves during the Late Neolithic/Early Bronze Age were also suggested.

A tentative interpretation is that cremated human bones were part of ritual practices such as feasting and offerings related to burials in front of the megalithic graves during the Middle Neolithic, while in the Late Neolithic/Early Bronze Age specific individuals were burnt and fire was sometimes used in the initial stage and/or when the grave was abandoned.

Most of the burnt human remains originated from later depositions during the Late Bronze Age and Iron Age, with higher frequencies c. 900–750 cal BC and c. 300–200 cal BC. During these periods, cremations were the dominant burial practice. The cremated bones dating to the Late Bronze Age and Iron Age mostly consist of graves or burial depositions of cremated bones from single individuals, although one bone dating to the Late Bronze Age originates from an assembly of burnt human bones from three individuals. In two cases dating to the Early Iron Age single or few cremated skull fragments have been placed in the chambers of megalithic graves.

The use of fire can also be observed on stone and flint objects, animal bones as well as on the grave *per se* in some gallery graves. The bones in this study originate from a variety of intentional events and practices, although with some chronological differences. Furthermore, the tendencies observed during the Late Bronze Age and Iron Age are in accordance with a general reuse of these graves.

The Middle Neolithic A calcined bones from fresh bones, possibly fleshed, were deposited in the entrance areas of the passage graves. In the Late Neolithic and Early Bronze Age burnt human remains were buried in the chambers. One Late Neolithic skeleton indicates that the entire body was burnt at a relatively low temperature elsewhere, before it was placed in the

grave. Other possible examples of Late Neolithic human bones burnt at low temperatures also occur, indicated by associated burnt Late Neolithic artefacts. In the Late Bronze Age cremation burials were placed in mounds/cairns of megalithic graves, while in the Iron Age different parts of the graves were used for deposits of cremated human remains. Most of the Late Bronze Age and Iron Age bones indicate cremations of fresh and even fleshed bones.

This study demonstrates that more systematic radiocarbon dating of cremated bones in megalithic graves, as well as in other Neolithic and Early Bronze Age contexts would be required to better understand the complex mortuary and ritual practices during different periods.

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Appendix: Site and sample information

This appendix contains brief descriptions of the graves and excavations along with information of the samples from each site. The sites are presented in an alphabetical order, by parish and RAÄ (Riksantivarieämbetet/Swedish National Heritage Board) number and site name (https://app.raa.se/open/fornsok), which correspond to the denominations used in the Supplement. The numbers in parentheses refer to the ones used in Figure 4 and are also found in the Supplement under „Site no.".

Edsvära 19:1, Kleakulle gallery grave (1)

Karl Esaias Sahlström excavated this grave in 1929. The grave measured 11 × 2 m and is located in the centre of a one-meter high mound. A large number of flint daggers (19), flint arrow heads, flint scrapers, amber beads, flint blades, slate pendants and pottery vessels were recovered along with unburnt and burnt human bones and charcoal (Anderbjörk 1932, 25; Sahlström 1929). According to Sahlström (1929) the grave contained a 2 dm thick layer of burnt bones and charcoal along with a fire damaged flint dagger. Furthermore, several of the artefacts recovered from the grave were exposed to fire.

In this study, a cremated skull fragment as well as an unburnt long bone were sampled, but no result was obtained due to poor collagen preservation and too low burning temperature. Two cremated bones were examined from the grave. The colours of the bones imply a high burning temperature, although the crystalline index of 4.9 of the skull fragment indicates a temperature slightly lower than 500 °C. The long bone has exfoliation of the surface and elliptical fracture as well as deep latitude cracks. These indications and the lack of a black or steel blue core, strongly suggest that it was burnt while still fresh with remaining soft tissue

(Larsson, Å. M. pers. comm.; 2009, 306). Also, the cracking of the skull fragment indicated burning of fresh bone (Larsson, Å. M. pers. comm.).

Falköping stad 3:1, Hjälmarsrör passage grave (2)

The passage grave was partially excavated by Hans Hildebrand in 1868, and by the University of Gothenburg (GU) in collaboration with Västergötlands museum (VGM) in 1994, 1995 and 1998 (Axelsson/Persson 1995; 1999; Strinnholm 1996). The grave was surrounded by a mound 24 m in diameter and measured 5.6 × 2.5 m. During the excavation in 1868, a large number of unburnt human bones were found accompanied by animal bones, numerous amber beads, flint blades and flint flakes. Most of the skeletons were shovelled back into the chamber.
In 1994 the entrance area and parts of the mound was excavated. In the mound four secondary graves were found and suggested to date to the BA and IA (Strinnholm 1996). The inhumed bones date from the ENII/MNA to MNA/MNB, while an unburnt bone from one of the secondary burials in the mound was dated to the medieval period (1030–1210 cal AD [95.4 %]; Blank et al. 2020). Grave pit A1 contained cremated remains from an adult individual estimated to an age of 40–60 years. Grave A2 contained cremated bones from an individual of an age of c. 30–50 years (Strinnholm 1996, 36).

In this study a humerus bone and a cremated skull fragment from graves in the mound A1 and A2 were dated to LBA period V (811–592 and 811–771 cal BC [95.4 %]). Grave A2 is younger than A1, as it intersected and disturbed this grave and the date of the two graves could be narrowed down to 811–771 cal BC. The two bone fragments were calcined white indicating a temperature of at least 700 °C. The humerus bone has a distinct elliptical fracture. This type of fractures might occur when a fresh bone still surrounded by soft parts are cremated, as the internal temperature do not quite reach the same high temperature as the surface (Larsson, Å. M. pers. comm.; 2009, 306).

Falköping stad 26, Järnvägens/Rantens gallery grave/dolmen (3)

In 1951, Karl Esaias Sahlström and Einar Magnusson restored this grave (Sahlström 1951), which in 1995 was excavated and removed (Algotsson 1996). It consisted of a 2.6 × 1.8 m large open chamber constructed by three limestone slabs and was placed in a low stone setting. From the grave, an axe shaped amber bead and a flint flake were recovered along with commingled inhumed skeletons dated to the MN (Blank et al. 2020).

Furthermore, a secondary burial of a cremated individual dated to LBA period V (Blank 2017) was found in the covering stone setting. The individual was estimated to be an adult female (Algotsson 1996). The fractures of the cremated bone indicate a cremation of fresh bones possibly with soft tissue (Larsson, Å. M. pers. comm.).

Falköping stad 7:1, Frugården passage grave (4)

An excavation of the passage grave was conducted in 1870 (Werner 1873). The rectangular chamber (5.3 × 2.3 m) with slightly pointed ends and a passage situated at the northern part of the long side was surrounded by a mound. The chamber was divided by small red limestone slabs into 18 niches. Unburnt skeletal remains were recovered from the chamber and pendants, amber beads, bone awls and flint tools were also found. Furthermore,

a single cremated skull fragment was recovered from niche C inside of the chamber (Werner 1873).

The skull fragment, which was calcined white and thus burnt at an assumed temperature of 700 °C or higher, was sampled and dated to the Pre-Roman period, EIA (380–197 cal BC [95,4 %]) in this study. The slightly blue nuance on the inside of the skull bone might indicate that it was cremated when completely dry and without soft tissue, although this cannot be determined (Larsson, Å. M. pers. comm.).

Falköping stad 19:1, Lusthushögen passage grave (5)

The passage grave consists of a c. 6 × 2 m large chamber with a centrally placed passage in the eastern wall, surrounded by a mound. The grave was partly excavated by Hans Hildebrand 1868 (Werner 1870). A bone needle, sherds from a LN pottery vessel, a cranium fragment and three burnt human bones were recovered.

A lightly burned (brown, black and blue), half carbonized skull fragment was sent for radiocarbon dating. Unfortunately, not enough collagen was preserved, and the temperature was too low to analyse the apatite.

Gökhem wihout no., Torsagården gallery grave (6)

Only three limestone slabs located below ground remained when excavated in 1947 (Sahlström 1947). The grave was originally constructed as a closed about 1.7 × 0.4 m large chamber, oriented North–South. A skeleton from an adult male in a supine position on his back was found in the chamber. A flint dagger (Lomborg type I) and a bone awl were placed on the hip of the male. Underneath the feet of the buried man, bones from one or two children were recovered (ibid.). The adult male dated to the LN II and the child to LN I/LN II (Blank et al. 2020).

A few cremated bones were also recovered, but the exact location of these are unknown. They might originate from the low cairn that covered the grave. One of the cremated human bones dated to the LBA, period V/VI (Blank 2017). The sample was fully calcined and probably burned at a temperature of at least 700 °C. A lot of cracks were observed on the skull fragment. It seems that the upper layer has reached a higher temperature faster than the lower one. Some deformation of the bone in a deep crack were also noted. The cracks and deformation indicate that the bone was fresh and surrounded by soft tissues when cremated (Larsson, Å. M. pers. comm.; see Larsson, Å. M. 2009, 305 fig. 10.4).

Gökhem 24, Ledsgården passage grave (7)

In 1936, Hilding Svensson conducted a series of archaeological investigations and excavations at Ledsgården in Gökhem parish, Falbygden (Svensson, H. 1936). He excavated the remains of a small cairn located on the northern part of the mound of Ledsgården passage grave. Within the assembly of stones cremated human bones were found along with pottery sherds (ibid.).

In this study, a white calcined skull fragment from this deposition was dated to the LBA period V/VI (771–482 cal BC [95.4 %]). Due to the cracking and the white colour of the bone an estimated burning temperature of at least 800 °C was suggested (Larsson, Å. M. pers. comm.). The fractures, called deep checking are indicative of the bone being cremated fresh with adhering soft tissue (Larsson, Å. M. 2009, 306 fig. 10.11).

Gökhem 31:1, Nästegården passage grave (8)

In 1985–1987, the GU in collaboration with VGM excavated parts of the entrance area and mound of this passage grave (Persson/Sjögren 2001; Wattman 1993). The grave, with an about 8×2.5 m large chamber and a 6.5 m long passage, is surrounded by a mound. In front of the entrance TRB pottery sherds, burnt and unburnt flint, human bones (a few burnt), burnt and unburnt animal bones and a few fragments of burnt bone points were found. For more details about the excavation, grave construction and content see Persson/Sjögren 2001 and Wattman 1993.

In a previous study (Blank et al. 2020) an unburnt human bone recovered from the entrance area was dated to the transition between the MN A and the MN B. Furthermore, a cremated pig bone from the entrance area was dated to the latest part of MN A (Sjögren 2003, 98). In this study, three cremated human bones from the area in front of the entrance were radiocarbon dated to the MN A (Supplement). A temperature of at least 700–800 °C can be assumed and the curbed fractures observed on two of the bones indicate that the bones were not dry when burnt (Larsson, Å. M. pers. comm.). At least one of the bones with elliptic fractures was cremated with remaining soft tissue (Larsson, Å. M. pers. comm.).

Gökhem 71:1, Hovmansgården passage grave (9)

The grave consists of a 6×2.5 m large chamber with a 6 m long passage, placed in a mound. Parts of the 22 m in diameter large mound, and the entrance area were excavated by the University of Gothenburg in collaboration with Skara Museum in 1985–1986 (Bågenholm et al. 1993). Underneath the mound a Neolithic settlement layer was documented. This layer contained pottery sherds, flint, burnt and unburnt bones. In front of the façade slab in the entrance area, a stone paved floor was found. An entrance cairn was observed on top of this floor. Here, flint, pottery sherds (TRB), flint flakes and blades, and human bones (burnt and unburnt) were recovered. The animal bones, flint and pottery sherds were found in the same area while the unburnt human bones were concentrated closer to the passage and thus might represent burials from the passage (Bågenholm et al. 1993; Persson/Sjögren 2001).

An unburnt human bone found in the entrance area was dated to the last part of the MN to the LN, with a large standard deviation and span between 2479 and 1984 cal BC (95.4 %; Bågenholm et al. 1993).

We sampled a burnt skull fragment recovered from the cultural layer below the mound, behind the grave chamber. The bone was white calcined and burnt at a high temperature and dated to the EN II/MN A, 3508–3103 cal BC (95.4 %). Furthermore, a fully calcined human long bone burnt at a temperature of c. 800 °C from the entrance area was sampled. The bone exhibited deep checking fractures indicating that it was fresh and fleshed when cremated (Larsson, Å. M. pers. comm.; 2009, 303; 306 fig. 10.11f). This bone dated to the Pre-Roman period, EIA, 397–178 cal BC (95.4 %).

Gökhem 78:1, Ormarör passage grave (10)

The passage grave is surrounded by a mound and the c. 5–6 m long chamber is oriented South–North. The passage was most probably placed centrally at the eastern chamber wall (Persson/Sjögren 2001, 120). The chamber of the passage grave was partly excavated by Göran K. Troili in 1882 and the mound including the entrance area was partly excavated by VGM and the archaeological department, GU in 1985 (Persson/Sjögren 2001; Sjögren 1992).

During the excavation in 1985, three trenches were opened with the purpose of establishing the original surface, examine the construction of the mound, and locating and investigating the entrance area.

In trench number I, in the southeastern part of the mound a sandstone slab with cup marks was found. Furthermore, below a small stone concentration a layer with cremated bones was found and interpreted as an IA grave (Persson/Sjögren 2001, 121–124; Sjögren 1992, 8). Below the mound a few pottery sherds, flint and burnt bones, some which might originate from the above burial.

From trench III undecorated pottery sherds possibly of BA or IA origin were recovered. Furthermore, a bronze buckle and a flint sickle were found in the mound indicating later activities (Persson/Sjögren 2001, 124).

We sampled a human long bone recovered from the suggested IA grave in the mound. According to the osteological analysis the bones belong to a female estimated to 30–50 years old by Maria Vretemark, VGM (Persson/Sjögren 2001, 124; Sjögren 1992, 17). The elliptical fractures of the bone indicate cremation of fresh bone and even of bone with soft tissue. The body must have been burnt for a considerable time at high temperature, at least 700 °C (Larsson, Å. M. pers. comm.). The bone dated to the Pre-Roman period, EIA, 388–201 cal BC (95.4 %).

Karleby 59:1, Logårds kulle passage grave (11)

Oscar Montelius and Gustaf Retzius excavated the passage and part of the chamber of this grave in 1874. It is surrounded by a mound and consists of an 11 × 2.5 m large chamber and an 8 m long passage. The chamber was divided in niches. Several layers of inhumed human bones were observed in the chamber and in the passage (Retzius 1899, 64). The burials were accompanied by animal bones, tooth pendants, bone awls, small bone cylinders, a bone needle, amber beads, two tanged blade flint arrowheads (type A), and an adze. Retzius (ibid.) describes 39 skulls in the chamber and 24 skulls in the passage. The inhumations date to the MN A and the LN/EBA (Blank et al. 2020).

An assembly of burnt human bones assumed to belong to three individuals (two adults and a child) was recovered from the bottom of the chamber. The bones were burnt at different degrees, some were fully calcined while others were only scorched and partly burnt (Retzius 1899, 64). A lightly burnt mandible was sampled but did not yield enough collagen. A calcined tibia bone was also sampled and date to the transition between the Vendel period and the Viking Age, 683–890 cal AD (95.4 %). The cremation temperature of the tibia bone was estimated to 600–800 °C and it exhibited cracks along and across the bone. Some curbed cracks and some deformations in the cracks were observed. Thus, the bone was suggested to have been cremated when fresh with intact soft tissue (Larsson, Å. M. pers. comm.).

Södra Härene 73:1, Ingmarstorp gallery grave (12)

In 1950, Per Lundström excavated this gallery grave (Oldeberg 1954). The slightly trapezoidal grave was about 8 × 2 m large. The western part of the grave had been damaged by modern gravel extraction. In the northern part of the grave an oven from historical times was documented. Thirty litres of mostly calcined (white) but also half calcined and carbonized (black, blue) bones were recovered from a pit in the southern part of the chamber. No artefacts and no charcoal were found in this pit. Thus, the bones cannot be dated by related artefacts and the bones were probably burned elsewhere. Below the oven, at the bottom of the grave chamber a layer of

dissolved skeletal remains with a few unburnt human remains, and artefacts occurred. The layer was concentrated to the northern part of the grave. The artefacts consisted of nine flint daggers, two bifacial spear heads (flint and slate), five bifacial flint arrow heads, four slate pendants, one amber bead, a few flint scrapers and flakes, and sherds from numerous decorated and undecorated pottery vessels. The pottery was typologically dated to the LN, EBA and LBA (ibid.). Thus, the grave was used during these periods. However, no burnt bones occurred in the bottom layer where the artefacts and unburnt bones were recovered.

The 30 litres of bones consisted of both humans and animals. The cremated human bones originated from an estimated number of six individuals (both male and females) (Gejvall 1954). According to Gejvall (1954), the bones are likely to date to the IA. In this study a calcined human skull fragment was sent for radiocarbon analysis. Unfortunately, the CI value was too low for radiocarbon dating.

Timmersdala 5:1, Timmersdala skolhus gallery grave (13)

The rectangular gallery grave, 6.5 × 1.5 m large, is oriented North-North-East–South-South-West and constructed by limestone slabs. Karl Torin excavated the grave in 1877. The chamber is divided into two chambers and an ante-chamber. In the inner and largest room several layers of unburnt human bones were observed. Some of the bodies seem to have been placed sitting down, while others were put in a supine position. The bones were accompanied by decorated pottery vessels, flint daggers, bifacial flint arrow heads, bone awls, some animal bones, and a drilled bear tooth. Furthermore, an undecorated pottery vessel containing a few cremated bones was found in this chamber. From the smaller room, only unburnt human remains were recovered, while the ante-chamber was empty (Torin 1877).

A calcined skull fragment most probably belonging to the deposition of the pottery vessel with cremated bones, was sampled for radiocarbon dating. The bone dated to the late part of the Roman period, EIA, 170–401 cal AD (95.4 %). It is not possible to say anything about the status of the skull fragment at the time of burning (Larsson, Å. M. pers. comm.).

Torbjörntorp 18:1, Lilla Balltorp gallery grave (14)

This gallery grave was excavated and moved by Gunnar Ullenius in 1948. The 7.5 × 2.2 m large grave consists of a chamber and an ante-chamber divided by two slabs with a port-hole. For more information considering the excavation and construction of the grave see Ullenius 1948. The chamber contained two small gold rings, a small bronze ring, a circular slate pendant, slate buttons, two small bone cylinders, shaft hole axes, a flint chisel, 17 flint daggers (Lomborg types III–V), amber beads, slate pendants, bifacial flint arrowheads (and a few roughouts), bone needles, bone awls, pottery vessels, flint flakes, flint scrapers, a polished flint axe fragment, some burnt flint flakes (Blank et al. 2020; Ullenius 1948). Furthermore, fragmented inhumed human bones, one assembly of burnt human bones and some animal bones were recovered from the chamber (Blank et al. 2020, appendix 2; Ullenius 1948). The only finds from the ante-chamber consisted of a small spiral shaped bronze bead and a flint scraper (ibid.).

Osteological analyses were performed by Ahlström (2009), Lennblad (2015) and Storå (Blank et al. 2021). Lennblad (2015) estimated inhumations of about 80 individuals (men, women, and children) and a cremation of one adult individual. In a previous study (Blank et al. 2020), 33 unburnt

human remains from at least 23 individuals were dated to c. 2000–1500 cal BC. The assembly of burnt bones belongs to an adult individual and the burnt flint flakes may have been exposed to fire along with the burnt body. No traces of fire in the grave was observed (Ullenius 1948).

The skeletal remains of the individual exposed to fire were slightly burnt to half calcined. The long bones were unevenly burnt shifting from brown to black with rather straight fractures, indicating burning at low temperature. The skull fragments are rather well burned on the outside but poorly burned on the inside. According to Å. M. Larsson (pers. comm.), this kind of burning most probably results from a burning at relatively low temperature of a body with intact soft tissue including the brain. The unevenly burnt bones also indicate that the bones still had soft tissue when exposed to fire. The temperature did probably not exceed 500 °C (Larsson, Å. M. pers. comm.). Collagen from an unevenly and slightly burnt femur bone from this individual was dated to the transition between LN I and LN II, 2125–1894 cal BC (95.4 %).

Torbjörntorp 31:1, Berga gallery grave (15)

Berga gallery grave was excavated 1927 by Karl Esaias Sahlström, and in 1928 moved to a nearby location by Hilding Svensson. The 2.9 × 1.8 m large grave consisted of a chamber and an ante-chamber (Sahlström 1927). The grave contained: flint daggers (one Lomborg type II and four type III), a strike-a-light, flint scrapers, flint flakes, bifacial flint arrowheads, a tang of a flint blade arrowhead, a relatively small shaft hole axe, amber beads, a burnt slate pendant, pottery sherds, bone awls, a bone chisel and bone needles. Furthermore, animal bones, cremated skull fragments, and commingled skeletal remains from about 30 individuals (men, women, and children) were collected (Blank et al. 2020; Sahlström 1927; Svensson, H. 1928; Tornberg 2018). No traces of fire in or around the graves were documented (Sahlström 1927; Svensson, H. 1928).

Osteological analyses were performed by Tornberg (2018) and Alfsdotter (2014). A total number of 21 unburnt human remains from at least 16 individuals indicated a use of the grave chamber for successive burials between c. 2100 and 1500 cal BC (Blank et al. 2020). In addition, a child jaw recovered within the chamber was dated to the Migration period, LIA (Blank et al. 2020).

During an investigation in 2018 of the finds from the gallery grave stored at the depository of SHM in Stockholm, one half-carbonized and one half-calcined skull fragments were observed. These two bones were found at the bottom of the gallery grave along with a burnt slate pendant. Furthermore, one bifacial arrowhead also found in the bottom layer and a tang of a blade arrowhead of unknown location were exposed to fire. The bones could not be analysed, but instead a lightly burnt, half carbonized skull fragment (SHM bone id. 143:3, sample no. TB31:X in Supplement) identified during osteological analysis was sent for radiocarbon dating. Unfortunately, the sample did not yield enough collagen.

Valtorp 2:2, Rössberga gallery grave (16)

During Carl Cullbergs excavation in 1962, remains of a damaged gallery grave was found 30 m east of the passage grave. The grave originally covered by a cairn was oriented East-North-East–West-South-West and measured at least 3.5 × 1 m (Cullberg 1963, 120). Undecorated pottery sherds, a slate pendant, a piece of a ground stone axe, flint flakes and blades, and cremated and inhumed human remains were recovered from this grave (ibid. 119–121). One unburnt tooth found in the grave was previously dated to the EN/MN A

(Blank et al. 2020). About half a kilo of cremated human bones were recovered from the chamber. Even though no detailed osteological study of these bones has been conducted, the amount and the occurrence of different bone elements may indicate that they originate from one individual.

In this study, a white calcined skull fragment burnt at c. 700 °C was dated to the EBA period II, 1492–1298 cal BC (95.4 %). The skull fragment, as the other burnt bones from the same context, was not cleaned after the cremation (a common practice during the LBA). Unfortunately, no indications of the status of the skull fragment at the time of burning could be observed (Larsson pers. comm.). However, in the other cremated bones recovered from the same context deep checking, curved fractures and steal blue cores were observed. These charectaristics indicate a cremation of a body at least partially fleshed (Larsson, Å. M. pers. comm.).

Abbreviations

EN: Early Neolithic
MN: Middle Neolithic, MN A: Middle Neolithic A, MN B: Middle Neolithic B
LN: Late Neolithic
BA: Bronze Age, EBA: Early Bronze Age, LBA: Late Bronze Age
IA: Iron Age, EIA: Early Iron Age, LIA: Late Iron Age
BAC: Battle Axe Culture
PWC: Pitted Ware Culture
TRB: Funnelbeaker/Trichterbecher

ATA: Antikvarisk-topografiska arkivet (archieves) at RAÄ
GU: University of Gothenburg
RAÄ: Riksantivarieämbetet/Swedish National Heritage Board
SHM: The Swedish History Museum – The National Historical Museums
VGM: Västergötlands museum

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