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THE CHRONOLOGY OF ANGLO-SAXON STYLE POTTERY IN RADIOCARBON DATES: IMPROVING THE TYPO-CRONOLOGY

Summary. In the fourth and fifth centuries AD, the Anglo-Saxon style was introduced in north-western Europe. To what extent immigrants contributed to this process for each region is still debated. How and when the Anglo-Saxon style spread is essential in this debate. Handmade pottery is the most common find category, but so far it can only be dated globally. An earlier and a later style have been postulated and the introduction of this pottery is seemingly not simultaneous in every region. Hitherto this could not be supported by the radiocarbon dates. The present study shows that, with the help of Bayesian modelling, it is possible to substantiate these patterns, which is of utmost importance for understanding migration patterns, contacts and exchange along the southern North Sea coastal regions during this period.

1. INTRODUCTION

During the Migration Period, approximately the fourth and fifth centuries AD, changes in material culture occurred and an expressively decorated pottery style arose in north-western Europe (see Fig. 1, for the regions mentioned in the text). This style is known by the names Anglian, Saxon or Anglo-Saxon in different parts of the southern North Sea coastal area, due to its association with the eponymous population groups. How these changes in material culture took place varied from region to region. An ongoing debate exists about the way the new material culture was introduced, in England, as well as in the Netherlands. Instead of, or in addition to, introduction by immigrants or through importation, the distinct changes in material culture might be explained as stylistic influences within a socio-cultural network (Brugmann 2011; Nieuwhof 2011; 2013; Hills and Lucy 2013; Nicolay 2014). Therefore, the term ‘Anglo-Saxon style pottery’ (ASSP) is preferred here over ‘Anglo-Saxon pottery’.

For England, there are accounts of immigration, and also of co-existence of indigenous populations and newcomers (for instance Härke 2011). In the northern Netherlands, the Holocene coastal area (or terp region – after the artificial dwelling mounds on which people lived) was virtually unoccupied during the fourth century AD, and repopulated by immigrants from the German coastal area in the fifth century; in this same period there was continuous occupation in the adjacent Pleistocene area of Drenthe (Taayke 1996; 2000; Gerrets and Koning 1999;
Bazelmans 2002; Nieuwhof 2008; 2011; 2013). This suggests that immigrants may not be (solely) responsible for the introduction of the new material culture in this region. A regional stylistic development that resulted in pottery of the Anglo-Saxon style can be demonstrated in Drenthe, but also in the northern Netherlands terp region at the few settlements that remained inhabited (Nieuwhof 2008; 2013).

The pottery of the fourth and fifth centuries in the northern Netherlands and north-western Germany is not only very alike on a stylistic level, but also technologically, with high-quality fabrics and finish (Krol et al. 2018). Nevertheless, there are regional stylistic differences (for instance: Genrich 1954; Myres 1969; Schmid 1981). Further study of this variation might provide new information on the possible origin of migrants and on cultural interactions. Earlier stylistic elements represent the emergence of ASSP, either introduced by migrants or adopted by local potters. Later elements represent local or regional developments after the introduction, and interactions during that period. Such temporal considerations are important for further stylistic study. However, so far ASSP

FIGURE 1
Map of the regions within the Netherlands and Belgium, mentioned in the text. The terp region of the northern Netherlands is indicated in grey (topographic map: Esri Nederland and community maps contributors).
can only be imprecisely dated. This is due to, amongst other things, a great variety of stylistic elements without clear typological development and with often long periods of use.

So far, it has not been possible to distinguish phases in the development of ASSP using radiocarbon dates, due to a plateau in the calibration curve for this period (Lanting and van der Plicht 2006, 243–4; 2010, 31; McCormac et al. 2008). In this paper, Bayesian modelling of a corpus of inventoried radiocarbon dates in OxCal (Bronk Ramsey 1995) is used in an attempt to distinguish such phases. The analysis is aimed at answering various research questions. Can a chronological order be shown for the various types of ASSP-forms and decorations? Can the existence of an earlier and a later Anglo-Saxon style be confirmed by radiocarbon dates? When did ASSP go out of use? In order to answer this last question, available dates for the subsequent early-medieval pottery are included in this study.

2. TYPOLOGY AND TRADITIONAL RELATIVE DATES

ASSP is traditionally dated to the period between AD 350 and 550. Undecorated pottery occurs in this same period, but ASSP here refers to well-finished pottery with a distinctive decoration and specific forms. The German typology by Plettke (1921) is still often used for this type of pottery. The basic types are Plettke A2: beakers (Trichterpokale); A4, A5 and A8: wide-mouthed pots; A6 and B2: large narrow-mouthed pots, with simpler decoration and a rounded profile; A7: like A6 but with a biconical profile and often decorated with bosses (Buckel) or stamps; C: carinated bowls (Schalenurnen). Plettke’s chronology has been somewhat improved, by Schmid (2006) amongst others, based on newer dates of metal finds (Böhme 1974; 1987). These dates are still very broad.

The Plettke-typology can be applied to most of the ASSP from other regions; other typologies have been used as well, such as the ones by Myres (1969) for England and by Van Es (1967) for the Netherlands. Some types of decoration are sometimes also thought to have chronological meaning. For example, rosettes and bosses may have come into use in the fifth century (as postulated by Plettke 1921; Krol 2006).

Earlier ASSP, which occurs in the coastal areas of the northern Netherlands, north-western and northern Germany, Jutland and England, is thought to have been produced until the end of the fifth or the early sixth centuries.

Later ASSP is dated to the late fifth and early sixth centuries; it is not included in the Plettke-typology as these later shapes do not (frequently) occur in north-western Germany. Although the existence of a later style is denied by Lanting and Van der Plicht (2010), such a style has been distinguished by several authors (Knol 1993, 54–5; Nieuwhof 2008, 285; 2013, 61). Later ASSP is more uniform in decoration, with rows of stamps or long, vertical bosses and indentations, and groups of vertical lines. It is comparable to the long-boss style, as defined by Myres (1969, figs. 37 and 38) and has a high neck, a rounded or somewhat biconical body and a protruding foot.

In the northern Netherlands, the undecorated ware from the same period is classified in the typology of Taayke (1996) for northern Drenthe, as G7 (large pots), K4 (beakers), S4 (dishes) and S5 (bowls). In Drenthe, these shapes developed from older, Roman Period shapes around AD 300. In the coastal area, they were introduced after the hiatus in occupation, alongside ASSP. The large pots and beakers are occasionally decorated in Anglo-Saxon style. Comparable undecorated ware can be found in other regions as well.
Probably from around the end of the fifth century, ASSP was gradually replaced by a coarser, mostly undecorated type of pottery in a large part of north-western Europe. It is called *Weiche Grauware* (German) or Hessens-Schortens ware (HS; Tischler 1956, 79–87; Bärenfänger 2001). In England, such pots are classified as ASSP. Here, the term ASSP only applies to the earlier, well-finished and decorated ware. HS developed from the fine fabrics of ASSP and type G7. A minority of HS still has fine fabrics (Van Es 1979; Nieuwhof 2013, 61; Krol et al. 2018), and ASSP-decorations are occasionally still found on HS pots. In Germany, HS is usually dated to the seventh or eighth centuries (Stilke 2001). However, it may at least partly also date to the sixth century (Nösler 2017). Attempts to distinguish different subtypes of HS have as yet not been successful (Kuiper 2018).

From c.AD 700, HS is replaced by globular pots, which occur primarily in the northern Netherlands and north-western Germany, but also in Zuid-Holland and parts of Denmark and Belgium (Verhoeven 1998, 4; Dijkstra 2011, 312).

Although ASSP was not introduced simultaneously in all regions, it can be assumed, on account of the intensive contacts that were maintained (Nicolay 2014), that specific pottery types and stylistic elements in different regions are contemporaneous. This makes it possible to use the spread of these stylistic elements to date the migrations and cultural interactions, which they reflect.

ASSP seems to originate in Denmark and northern Germany, then spreads to the northern Netherlands and England (Kennett 1978, 11; Knol 1993, 196–8; Hills and Lucy 2013, 301–20). In the northern Netherlands, it was introduced in the fourth century, where the habitation was continuous in this period (Nieuwhof 2013). Abandoned areas here were repopulated in the course of the fifth century. Lanting and Van der Plicht (2010, 129–34) date the beginning of repopulation c.AD 440 in Friesland, possibly somewhat earlier in Groningen, with reference to the supposed Anglo-Saxon invasion of England as related in historical sources. However, recent research indicates that at least some of the ASSP in England probably dates earlier, c.AD 400/420 (for instance Hills and Lucy 2013). The introduction of ASSP in the terp area of the northern Netherlands, and therefore its repopulation, may even be earlier.

ASSP supposedly went out of use in Germany and Denmark before the end of the fifth century, while it continued in the Netherlands and England. Outside the northern Netherlands, ASSP is sometimes found in the Dutch provinces of Gelderland and Zuid-Holland, and further to the south in Flanders and the north of France, probably no earlier than the late fifth century (Hamerow et al. 1994; Soulat et al. 2012). Here it may have been introduced via England or the northern Netherlands (Dijkstra and De Koning 2017, 62–4). In the (northern) Netherlands, ASSP probably disappeared c.AD 525/550; in England, it remained in use into the seventh century (Myres 1969; Hills and Lucy 2013, 301–20).

### 3. Radiocarbon Dating

The calibration curve of radiocarbon dates from this research period shows a plateau between c.1625 and 1525 BP, which corresponds to the calendar years between AD 420 and 530. That means that results from this period cannot be as precise as we would like them to be (Lanting and van der Plicht 2006, 243–4; 2010, 31; McCormac et al. 2008).

The sample type that is dated is an important factor in the reliability of radiocarbon dates. The natural or inbuilt age of the dated material may result in a date that is older than its context, especially for long-lived wood species such as oak. Oak was often used as construction timber or
ship wood prior to being burnt. This additional age results in the complication known as the ‘old wood effect’ (Lanting and van der Plicht 2006, 243–4; 2012, 290–2).

The ‘old wood effect’ plays an important role when dating cremations, since oak, together with alder, was commonly used as fuel (Van Strydonck et al. 2010; Deforce and Haneca 2011). The results for charcoal and cremated bone from the same cremation can thus be contradictory, and both may be too old (Lanting et al. 2001; Lanting and Van der Plicht 2012, 290–1; Nieuwhof 2015, 237–40); oak charcoal because of its inbuilt age, and cremated bone because during cremation gases are exchanged between the fuel and the carbonate in the bone apatite. The amount of exchange varies (Cherkinsky 2009; Van Strydonck et al. 2010; Olsen et al. 2013; Snoeck et al. 2014). Charcoal from twigs gives the most reliable result, since the ‘old wood effect’ does not apply then (Nieuwhof 2015, 240). If cremated bone is dated, then fully cremated bone with completely recrystallized apatite is the most reliable (Lanting and Van der Plicht 2010). Research also showed the importance of a thorough pretreatment for these samples (Van Strydonck et al. 2010). For all these reasons, dates from cremations must be used with caution.

When the ranges of individual radiocarbon dates are broad, as is the case in this study, Bayesian modelling can be used to estimate the chronological order of previously defined groups of dates, and their collective lifespan. Such modelling can also compensate for inbuilt age (Dee and Bronk Ramsey 2014), but not for the effect of unreliable archaeological contexts. In order to apply this method, it is necessary both to define sound and reliable categories, in this case pottery types, and to have a sufficient number of dates to examine. If only a small sample would be used, earlier or later examples of the pottery types might not be represented, which can influence the results.

4. METHOD

Radiocarbon dates on ASSP and HS-pottery were collected from publications and by contacting researchers and institutions directly. Many of the dates collected have not been previously published, or were published only in ‘grey’ literature. For the Netherlands, an overview of radiocarbon dates of ASSP was published by Lanting and van der Plicht (2010; 2012). For England, lists of dates funded by English Heritage have been published, but there is no overview of other dates (Jordan et al. 1994; Bayliss et al. 2007; 2008; 2012; 2013; 2015; 2017). For other countries there is no such overview, which makes the data less accessible. This leads to an emphasis on the Dutch dates, although a substantial number of dates from England and Germany were obtained (see Table 1). No dates are available for Denmark or northern France and there is only one date available for Belgium.

Most of the dated contexts are cremations (charcoal or bone) (n=103); four are inhumation graves; and the remaining dates are from settlement contexts (n=55; e.g. pottery crust/residue, charcoal from a pit or construction wood). In total 175 dates from 162 contexts were collected.

Table 1 shows the number of dates selected per region and per category. Table 2 shows the information for each date, including typological information. Supplemental Table 3 shows deselected dates, and the reason why they were excluded. Samples may be excluded for the following reasons:

- Dates for contexts that were used for a prolonged period of time (wells, ditches).
- No direct relationship between the context and pottery.
Three different typologies were created (see Figs. 2 and 6). In the first, pots were categorized by general type.

1 Undecorated large pots (G7).
2 ASSP1: Narrow-mouthed pots, with sharp or rounded carination halfway up the body. Long neck, somewhat flaring rim. Width and height comparable. This type represents what is thought to be early ASSP.
3 ASSP2: Narrow-mouthed pots, with rounded carination, above the middle or sometimes halfway up the body. Short neck, usually somewhat flaring. Often taller than wider. This type represents supposedly late ASSP.
4 ASSP3: More or less narrow-mouthed pots with sagging profile.
5 ASSP4: melon-shaped pots, with vertical indentations or bosses, often with foot ring.
6 HS.
7 Decorated HS, in order to determine whether or not decoration akin to ASSP occurs only on earlier HS-pots.
8 HS/EG, an intermediate type between HS and early globular ware.

Beakers and carinated bowls were not included because of an insufficient number of dates, and bowls and dishes because of their long lifespan, covering both ASSP and HS.

Secondly, the ASSP decoration was categorized, by single elements, patterns or the location of decoration on the pot.
The dates, in alphabetical order. Region: BE = Belgium; DR = Drenthe; FR = Friesland; GE = Germany; GL = Gelderland; GR = Groningen; BI = British Isles; ZH = Zuid-Holland. Category: see table 1. General type: ASSP1, ASSP2, ASSP3, ASSP4 = types of ASSP; G7 = type in the typology of Taayke (1996) for Northern Drenthe; HSd = decorated HS; HS/ES = intermediate type between HS and Early Globular ware. * = not modeled in this typology. Sample type: CC = charcoal form cremation; CP = charcoal from pit; CR = cremation remains; CS = charcoal from same structure; CW = construction wood well; TW = twigg well; HU = bone from inhumation; OP = charcoal from oven pit; PC = pottery crust; WO = wood/wooden object. Calibrated dates: OxCal v4.3.2 Bronk Ramsey (2017); r.5 IntCal13 atmospheric curve (Reimer et al., 2013).

| Site and no. | Region | Lab No. | Sample Type | Age (yr BP) | Uncertainty | Calibrated date AD (95.4% confidence) | Category | Type | ASSP decorations | HS Form | Type | Reference |
|-------------|--------|---------|--------------|-------------|-------------|----------------------------------------|----------|------|------------------|--------|------|-----------|
| 1. Aalsum 1920' II.2 | GR | GrA-44824 | CR | 1380 | 35 | 596-760 | HS | HS | B | Lanting and van der Plicht 2010, 147 and fig. 17.21 (after drawing E. Knol) |
| 2. Aalsum 1920' II.21 | GR | GrA-44825 | CR | 1290 | 30 | 664-770 | HS | HSd | B | Lanting and van der Plicht 2010, 142 and fig. 15.12 (after drawing E. Knol) |
| 3. Ballo | DR | GrN-18571 | WO | 1475 | 25 | 548-640 | HS | HS | C*,D* | Lanting and van der Plicht 2012, 310; Van der Sanden 1993, fig. 3 |
| 4. Beetgum-Besseburen 46a-271 | FR | GrA-44419 | CR | 1615 | 35 | 356-542 | AS | ASSP2 | B,D,L | Lanting and Van der Plicht 2010, 142; Knol 2008, 153 (fig.) |
| 5. Beetgum-Besseburen 46a-999 | FR | GrN-16726 | CC | 1565 | 40 | 405-577 | AS | ASSP2 | A,D,F,J,L | Knol 1993, 62 (GrN-16726); Lanting and Van der Plicht 2010, 142 and fig. 15.19 (after Knol 1993, fig. 13) |
| 6. Beetgum-Besseburen 46a-1000 | FR | GrA-44420 | CR | 1595 | 35 | 394-545 | AS | ASSP1 | A,F,K,M | Lanting and Van der Plicht 2010, 142; Knol 1993, fig. 75.1 |
| 7. Beetgum-Besseburen 46a-1001 | FR | GrA-44422 | CR | 1650 | 30 | 264-533 | AS | - | A,E,K,M | Lanting and Van der Plicht 2010, 142; Knol 1993, fig. 75.5 |
| 8. Bloodmoor Hill V7 | BI | GrA-25923 | PC | 1400 | 35 | 584-674 | HS | HS | D | Lucy et al. 2009, tab 6.1 and fig. 4.31 |

(Continues)
| Site and no. | Region | Lab No. | Sample Type | Age (yr BP) | Uncertainty | Calibrated date AD (95.4% confidence) | Category | Type | ASSP decorations | HS Form Type | Reference |
|-------------|--------|---------|-------------|-------------|-------------|---------------------------------------|----------|------|-----------------|-------------|-----------|
| 9. Bloodmoor Hill V15 | BI | OxA-13728 | PC | 1579 | 29 | 412-546 | AS | - | F | | Lucy et al. 2009, tab 6.1 and fig. 4.31 |
| 10. Bloodmoor Hill V20 | BI | OxA-13883 | PC | 1559 | 26 | 424-557 | AS | - | F | | Lucy et al. 2009, tab 6.1 and fig. 4.32 |
| 11. Bloodmoor Hill V45 | BI | OxA-13967 | PC | 1510 | 26 | 431-618 | HS | HS | | D | Lucy et al. 2009, tab 6.1 and fig. 4.35 |
| 12. Bloodmoor Hill V77 | BI | OxA-13707 | PC | 1398 | 25 | 605-665 | HS | HS | | D | Lucy et al. 2009, tab 6.1 and fig. 4.36 |
| 13. Bloodmoor Hill V89 | BI | GrA-25590 | PC | 1425 | 35 | 570-661 | AS | ASSP4 | H | | Lucy et al. 2009, tab 6.1 and fig. 4.37 |
| 14. Bloodmoor Hill V99 | BI | OxA-13752 | PC | 1502 | 27 | 434-632 | HS | HS | | D | Lucy et al. 2009, tab 6.1 and fig. 4.38 |
| 15. Bloodmoor Hill V114 | BI | OxA-13709 | PC | 1459 | 29 | 555-648 | HS | HS | | D | Lucy et al. 2009, tab 6.1 and fig. 4.39 |
| 16. Bloodmoor Hill V125 | BI | GrA-25592 | PC | 1440 | 35 | 561-656 | HS | HS | | A | Lucy et al. 2009, tab 6.1 and fig. 4.39 |
| 17. Bloodmoor Hill V128 | BI | OxA-13726 | PC | 1509 | 27 | 430-622 | HS | HS | | D | Lucy et al. 2009, tab 6.1 and fig. 4.40 |
| 18. Bloodmoor Hill V131 | BI | OxA-14017 | PC | 1697 | 26 | 256-407 | UD | G7 | | | Lucy et al. 2009, tab 6.1 and fig. 4.40 |
| 19. Bloodmoor Hill V143 | BI | GrA-25950 | PC | 1710 | 50 | 172-428 | UD | G7 | | | Lucy et al. 2009, tab 6.1 and fig. 4.41 |
| BE | RICH-23297 | CR | 1622 | 30 | 356-538 | UD | G7 | | | Annaert et al., in prep. |

(Continues)
| Site and no. | Region | Lab No. | Sample Type | Age (yr BP) | Uncertainty | Calibrated date AD (95.4% confidence) | Category | ASSP deconstructions | HS Form | Type | Reference |
|-------------|--------|---------|--------------|-------------|-------------|--------------------------------------|----------|----------------------|---------|------|------------|
| 20. Broechem-Nierlenders 377/1455 | ZH | GrA-44418 | CR | 1550 | 35 | 420-585 | HS | HS | B | Lanting and van der Plicht 2010, 149; Waasdorp and Eimermann 2008, fig. 5.7 |
| 21. Den Haag-Solleveeld V1010 | DR | GrN-8825 | CP | 1570 | 50 | 395-595 | AS,- | - | F | Lanting 1977, fig. 13; Lanting and van der Plicht 2010, 136 |
| | | GrA-44318 | CP | 1590 | 30 | 406-542 | | | | |
| 22. Eursinge 16 (1/17) | DR | GrN-8826 | OP | 1545 | 30 | 425-579 | AS,UD | G7*, A,B | ASSP1*, SCHA* | Lanting 1977, fig. 13; Lanting and Van der Plicht 2010, 136 |
| 23. Eursinge 19 (2/20) | DR | GrN-8826 | OP | 1545 | 30 | 425-579 | AS,UD | G7*, A,B | ASSP1*, SCHA* | Lanting 1977, fig. 13; Lanting and Van der Plicht 2010, 136 |
| 24. Eursinge 26 (2/24) | DR | GrN-7499 | CS | 1460 | 50 | 432-662 | HS | HS | D | Lanting 1977, 242 and fig. 13 (GrN-7499); Lanting and van der Plicht 2010, 136 |
| | | GrA-44317 | CS | 1590 | 30 | 406-542 | | | | |
| 25. Ferwerd-Bunnania II 101bis-1941 | FR | GrA-43426 | CR | 1570 | 35 | 410-564 | AS | ASSP2 | A,E,G,L | Lanting and van der Plicht 2010, 142; Nieuwhof 2015; Knol 1993, fig. 10.6 |
| 26. Flögeln-Voßbarg 27 | GE | Poz-69387 | CR | 1795 | 30 | 132-328 | UD | G7 | | NiHK Wilhelmshaven; Schön 1988, fig. 7 |
| 27. Flögeln-Voßbarg 46 | GE | Poz-69383 | CR | 1840 | 50 | 65-326 | AS | SCHA* | A,J | NiHK Wilhelmshaven; Schön 1988, fig. 8 |
| 28. Flögeln-Voßbarg 58 | GE | Poz-69388 | CR | 1675 | 30 | 258-425 | AS,HS | SCHA*, A,J | HS | NiHK Wilhelmshaven; Schön 1988, fig. 9 |
| 29. Flögeln-Voßbarg 106 | GE | Poz-69386 | CR | 1740 | 30 | 236-386 | AS | ASSP1 | A,B,J | NiHK Wilhelmshaven; Schön 1988, fig. 16 |

(Continues)
| Site and no. | Region | Lab No. | Sample Type | Age (yr BP) | Uncertainty | Calibrated date AD (95.4% confidence) | Category | Type | ASSP decorations | HS Form | Type | Reference |
|-------------|--------|---------|-------------|-------------|-------------|---------------------------------------|----------|------|-----------------|---------|------|-----------|
| 30. Flögen-Voßbarg 151 | GE | Poz-69385 | CR | 1785 | 30 | 135-332 | AS | - | BJ,M | NiHK | Wilhelmshaven; Schön 1988, fig. 21 |
| 31. Friens 172-31 | FR | GrN-16727 | CC | 1320 | 50 | 615-859 | HS | HS | | Knol 1993, 63; Lanting and Van der Plicht 2010, fig. 17.13 (after drawing E. Knol) |
| 32. Helpman GR | GrA-44146 | CR | 1560 | 35 | 415-575 | AS | ASSP2 | A,G | Van Es 1978/8 fig. 2; Lanting and Van der Plicht 2010, 142 |
| 33. Hogebeintum 28-158 | FR | GrN-16076 | CC | 1500 | 35 | 430-642 | HS | HS | | Knol 1993, tab. 4; Lanting and Van der Plicht 2010 fig. 17.8 (after drawing E. Knol) |
| 34. Hogebeintum 28-159 | FR | GrN-16721 | CC | 1730 | 60 | 136-419 | HS | HS | | Knol 1993, tab. 4 (GrN-16721), fig. 13; Lanting and Van der Plicht 2010, 147; Nieuwhof 2015, 240 |
| | | GrA-23454 | CR | 1540 | 45 | 416-608 | | | | | |
| 35. Hogebeintum 28-299 | FR | GrN-16722 | CC | 1900 | 70 | 49 BC-321 | HS | HS | | Knol 1993, tab. 4 (GrN-16722), fig. 13; Lanting and Van der Plicht 2010, 147 |
| | | GrA-23455 | CR | 1515 | 45 | 427-630 | | | | | |
| 36. Hogebeintum 28-328 | FR | GrN-16540 | CC | 1505 | 40 | 429-640 | HS | HS | | Knol 1993, tab. 4; Lanting and Van der Plicht 2010, fig. 17.7 (after drawing E. Knol) |
| 37. Hogebeintum 28-333 | FR | GrN-16723 | CC | 1470 | 50 | 430-659 | HS | HSd | | Knol 1993, tab. 4; Lanting and Van der Plicht 2010, fig. 17.8 (after drawing E. Knol) |
| 38. Hogebeintum 28-373a | FR | GrN-16724 | CC | 1450 | 45 | 474-665 | AS | ASSP1 | A,B,J | Knol 1993, tab. 4 (GrN-16724), fig. 13; Lanting and Van der Plicht 2010, 142; Nieuwhof 2015, 240 |
| | | GrA-43431 | CR | 1625 | 35 | 347-538 | | | | |
| Site and no. | Region | Lab No. | Sample Type | Age (yr BP) | Uncertainty | Calibrated date AD (95.4% confidence) | Category | Type | ASSP decorations | HS Form Type | Reference |
|-------------|--------|---------|--------------|-------------|-------------|--------------------------------------|----------|------|-----------------|-------------|-----------|
| 39. Hogebeintum 28-422 | FR | GrN-16078 | CC | 1645 | 25 | 337-530 | AS | ASSP1 | A,B,J | Knol 1993, tab. 4 (GrN-16078); Lanting and Van der Plicht 2010, 142; Nieuwhof 2015, 240 |
| | | GrA-44840 | CR | 1705 | 35 | 249-405 |
| | | GrA-43255 | CR | 1855 | 30 | 82-234 |
| 40. Hogebeintum 28-430 | FR | GrN-16541 | CC | 1280 | 50 | 655-875 | HS | HS | - | Knol 1993, tab. 4 and fig. 13.11 |
| 41. Hogebeintum 28-458 | FR | GrN-16079 | CC | 1325 | 45 | 625-775 | HS | HS | B | Knol 1993, tab. 4; Lanting and Van der Plicht 2010, fig. 17.16 (after drawing E. Knol) |
| 42. Hogebeintum 28-459 | FR | GrN-16080 | CC | 1750 | 35 | 176-390 | AS | ASSP2 | A,E,G,K | Knol 1993, tab. 4 (GrN-16080), fig. 13; Lanting and Van der Plicht 2010, 142; Nieuwhof 2015, 240 |
| | | GrA-23456 | CR | 1575 | 40 | 400-567 |
| 43. Hogebeintum 28-463 | FR | GrN-16725 | CC | 1285 | 40 | 655-863 | HS | HS | C | Knol 1993, tab. 4; Lanting and Van der Plicht 2010, 17.15 (after drawing E. Knol) |
| 44. Hogebeintum 28-469 | FR | GrN-16542 | CC | 1335 | 40 | 639-770 | HS | HS | D | Knol 1993, tab. 4; Lanting and Van der Plicht 2010, fig. 17.12 (under wrong number, after drawing E. Knol) |
| 45. Hogebeintum 28-499 | FR | GrN-16081 | CC | 1475 | 35 | 474-652 | HS | HS | B | Knol 1993, tab. 4; Lanting and Van der Plicht 2010, fig. 17.11 (under wrong number, after drawing E. Knol) |
| 46. Hogebeintum 28-508 | FR | GrN-16082 | CC | 1550 | 40 | 418-594 | HS | HS | B | Knol 1993, tab. 4; Lanting and Van der Plicht 2010, fig. 17.1 (after drawing E. Knol) |

(Continues)
| Site and no. | Region | Lab No. | Sample Type | Age (yr BP) | Uncertainty | Calibrated date AD (95.4% confidence) | Category | Type | ASSP decorations | HS Form Type | Reference |
|-------------|--------|---------|-------------|-------------|-------------|----------------------------------------|----------|------|-----------------|-------------|-----------|
| 47. Hogebeintum 28-525 | FR | GrN-16544 | CC | 1270 | 40 | 662-868 | HS | HS | C | Knol 1993, tab. 4; Lanting and Van der Plicht 2010, fig. 17.17 (after drawing E. Knol) |
| 48. Hogebeintum 28-527 | FR | GrN-16545 | CC | 1300 | 40 | 648-800 | HS | HSd | C | Knol 1993, tab. 4; Lanting and Van der Plicht 2010, fig. 17.14 (after drawing E. Knol) |
| 49. Hogebeintum 28-809  | FR | GrN-16083 | CC | 1510 | 25 | 431-615 | HS | HS | C | Knol 1993, 62; Lanting and Van der Plicht 2010, fig. 17.4 (after drawing E. Knol) |
| 50. Hogebeintum 28-811 | FR | GrN-16547 | CC | 1515 | 45 | 427-630 | HS | HS | C | Knol 1993, tab. 4; Lanting and Van der Plicht 2010, fig. 17.2 (after drawing E. Knol) |
| 51. Leermens 1968/VI.131 | GR | GrA-43693 | CR | 1525 | 30 | 428-604 | HS | HSd | B | Lanting and van der Plicht 2010, 142 and fig. 15.13 (after drawing E. Knol) |
| 52. Marssum V853-2 | FR | GrA-61791 | PC | 1684 | 42 | 242-505 | UD | G7 | | Hielkema 2015, tab 6.2 and fig. 7.27b |
| 53. Marum 1975-III-2 | GR | GrA-32130 | CR | 1310 | 25 | 658-768 | HS/EG | HS/EG | | Groenendijk and Knol 2007, 100; Lanting and Van der Plicht 2010, fig. 17.20 (after Groenendijk and Knol 2007, fig. 2) |
| 54. Middels Osterloog 2411/6:124.1 | GE | Poz-68799 | PC | 1325 | 30 | 650-768 | HS/EG | HS/EG | | NiHK Wilhelmshaven; Bärenfänger and Schwarz 1999, fig. 3 |
| 55. Middels Osterloog 2411/6:124.3 | GE | Poz-68798 | PC | 1910 | 80 | 94 BC-326 | HS | HS | A | NiHK Wilhelmshaven; Bärenfänger and Schwarz 1999, fig. 3 |

(Continues)
| Site and no. | Region | Lab No. | Sample Type | Age (yr BP) | Uncertainty | Calibrated date AD (95.4% confidence) | Category | Type | ASSP decorations | HS Form Type | Reference |
|------------|--------|---------|--------------|-------------|-------------|-------------------------------------|----------|------|------------------|--------------|-----------|
| 56. Midlaren 1856/IV.2 | DR | GrA-43415 | CR | 1720 | 35 | 242-396 | AS | ASSP1 | A,C,D,J,M | Lanting and van der Plicht 2010, 142; Nieuwhof 2013, fig. 12.1 (after drawing Ypey) |
| 57. Midlaren 1856/IV.3 | DR | GrA-43416 | CR | 1690 | 35 | 253-419 | AS | ASSP1 | A,B,C,J,M | Lanting and van der Plicht 2010, 142; Nieuwhof 2013, fig. 12.7 (after drawing Ypey) |
| 58. Midlaren 1856/IV.4 | DR | GrA-43418 | CR | 1615 | 35 | 356-542 | AS | ASSP2 | A,E,G,K | Lanting and van der Plicht 2010, 142; Nieuwhof 2013 fig. 12.6 (after drawing Ypey) |
| 59. Midlaren 1856/IV.5 | DR | GrA-43419 | CR | 1620 | 35 | 350-540 | AS | ASSP1 | A,B | Lanting and van der Plicht 2010, 142; Nieuwhof 2013, fig. 12.2 (after drawing Ypey) |
| 60. Midlaren 1856/IV.8 | DR | GrA-43689 | CR | 1590 | 30 | 406-542 | AS | ASSP1 | A,J | Lanting and van der Plicht 2010, 142; Nieuwhof 2013, fig. 12.3 (after drawing Ypey) |
| 61. Midlaren 1856/IV.10 | DR | GrA-45176 | CR | 1625 | 35 | 347-538 | AS | ASSP1 | A,E,G,K | Lanting and van der Plicht 2010, 142; Nieuwhof 2013, fig. 13.12 (after drawing Ypey) |
| 62. Midlaren de Bloemert 88A-79-2582 | DR | GrA-28354 | CR | 1745 | 35 | 180-394 | AS | SCHA* | A,C,K,M | Tuin 2008, tab. 26.3; Nieuwhof 2008, fig. 14.12 |
| 63. Monster h1956/7.9 | ZH | GrA-44831 | CR | 1540 | 30 | 426-588 | AS | ASSP2 | A,G,L | Lanting and van der Plicht 2010, 145; Waasdorp and Eimermann 2008, fig. 5.10 (after Braat 1956, fig. 22.9) |
| 64. Monster VIII | ZH | GrA-44414 | CR | 1560 | 30 | 420-565 | AS | - | A,G,L | Lanting and van der Plicht 2010, 145; Waasdorp and Eimermann (Continues) |

(Continues)
| Site and no. | Region | Lab No.  | Sample Type | Age (yr BP) | Uncertainty | Calibrated date AD (95.4% confidence) | Category | Type | ASSP decorations | HS Form Type | Reference |
|-------------|--------|---------|-------------|-------------|-------------|---------------------------------------|----------|------|-----------------|-------------|-----------|
| 65. Odoorn 100 | DR | GrN-10943 | CS | 1495 | 35 | 432-644 | AS | - | F | 2008, fig. 5.9 (after Braat 1956, fig. 21) | Waterbolk and Lanting 2002, 569; Lanting and Van der Plicht 2010, 136 and fig. 11 |
| 66. Odoorn 158 | DR | GrN-10944 | OP | 1490 | 30 | 436-644 | AS, HS | HSd, SCHA* | A | D | Waterbolk and Lanting 2002, 569; Lanting and Van der Plicht 2010, 136 and fig. 11 |
| 67. Odoorn 165 | DR | GrN-10945 | OP | 1665 | 50 | 249-535 | AS | ASSP3 | A, G, L | Waterbolk and Lanting 2002, 569 (GrN-10945); Lanting and Van der Plicht 2010, 136 and fig. 11 |
| 68. Odoorn 1966:171 | DR | GrN-6624 | CP | 1645 | 30 | 332-534 | UD | G7 | Waterbolk 1973, 37; Lanting and Van der Plicht 2010, 136; Van Es 1979, figs. 4 and 10 |
| 69. Odoorn 1966:230 | DR | GrN-6625 | CS | 1310 | 25 | 658-768 | HS | HS | - | Waterbolk 1973, 37; Van Es 1979, fig. 6 |
| 70. Oosterbeintum grave 140 | FR | GrA-48239 | CR | 1490 | 40 | 430-648 | HS | HS | D | Lanting and Van der Plicht 2012, 288; Knol et al. 1997, 378 (fig.) |
| 71. Oosterbeintum grave 160 | FR | GrA-48240 | CR | 1725 | 40 | 230-405 | AS | ASSP1 | A, J | average: Lanting and Van der Plicht 2012, 288; Knol et al. 1997, 382 (fig.); Nieuwhof 2015, 240; values for separate dates provided by CIO Groningen |
| 72. Oosterbeintum grave 241 | FR | GrA-48831 | HU | 1355 | 30 | 625-764 | HS | HS | D | Lanting and Van der Plicht 2012, 288; Knol et al. 1997, 384 (fig.) |

(Continues)
| Site and no. | Region | Lab No. | Sample Type | Age (yr BP) | Uncertainty Calibrated date AD (95.4% confidence) | Reference |
|-------------|--------|---------|-------------|-------------|-------------------------------------------------|-----------|
| 73.         | Oosterbeintum | FR GrA-48337 | HU | 1235 | 30 686-880 HSEG HSEG | Lanting and Van der Plicht 2012, 208; Knol et al. 1997, 390 (fig.) |
| 74.         | Oosterbeintum | FR GrN-14448 | CC | 1385 | 40 577-761 HSEG HSEG | Knol et al. 1997, tab. 1, 400 (fig.) and 403 |
| 75.         | Oosterbeintum | FR GrN-16441 | CC | 1545 | 35 423-589 HS HS | Knol et al. 1997, tab. 1, 402 (fig.) and 404 |
| 76.         | Oosterbeintum | FR GrA-48234 | CR | 1475 | 40 434-653 HS HSEG | Lanting and Van der Plicht 2012, 302; Knol et al. 1997, 406 (fig.) |
| 77.         | Oosterbeintum | FR GrN-14254 | CR | 1475 | 40 434-653 HS HSEG | Lanting and Van der Plicht 2012, 302; Knol et al. 1997, 406 (fig.) |
| 78.         | Oosterbeintum | FR GrA-48237 | CR | 1540 | 40 580-659 AS ASSP 3 F,I,L | Lanting and Van der Plicht 2012, 302; Knol et al. 1997, 374 (fig.) |
| 79.         | Oosterbeintum | FR GrA-48234 | CR | 1540 | 40 580-659 AS ASSP 3 F,I,L | Lanting and Van der Plicht 2012, 302; Knol et al. 1997, 374 (fig.) |
| 80.         | Rijnsburg | ZH GrA-45317 | CR | 1540 | 40 580-659 AS ASSP 3 A,B,L | Lanting and Van der Plicht 2012, 302; Knol et al. 1997, 374 (fig.) |
| 81.         | Rijnsburg | ZH GrA-4834 | CR | 1540 | 40 580-659 AS ASSP 3 A,B,L | Lanting and Van der Plicht 2012, 302; Knol et al. 1997, 374 (fig.) |

(Continued)
### TABLE 2 (Continued)

| Site and no. | Region | Lab No. | Sample Type | Age (yr BP) | Uncertainty | Calibrated date AD (95.4% confidence) | Category | Type | ASSP decorations | HS Form Type | Reference |
|--------------|--------|---------|--------------|-------------|-------------|----------------------------------------|----------|------|------------------|--------------|-----------|
| 82. Rijnsburg h1913/11.81 | ZH | GrA-44835 | CR | 1495 | 35 | 432-644 | HS | HS | | C | Lanting and van der Plicht 2010, 149 and fig. 17.24 (after drawing M. Dijkstra) |
| 83. Rijnsburg h1921/10.1 | ZH | GrA-45518 | CR | 1510 | 45 | 428-637 | AS | ASSP4 | H,L | | Lanting and van der Plicht 2010, 149 and fig. 17.25 (after drawing M. Dijkstra) |
| 84. Rijnsburg h1925/2.14 | ZH | GrA-44836 | CR | 1510 | 35 | 428-634 | AS | ASSP3 | F | | Lanting and van der Plicht 2010, 145 and fig. 15.28 (after drawing M. Dijkstra) |
| 85. Saksenoord 442/518/519 | FR | Poz-81078 | WO | 1540 | 30 | 426-588 | UD,HS | G7*, HS* | | A | GIA (T. Varwijk) |
| 86. Southampton 5114 | BI | GU-9323 | CC | 1420 | 45 | 553-670 | AS | ASSP4 | H,L | | Birbeck et al. 2005, tab. 1 and fig. 10 © Wessex Archaeology |
| 87. Tynaarlo Westeres 1970-IX-2 | DR | GrA-43675 | CR | 1570 | 30 | 416-557 | AS | ASSP2 | A,D,E,F,L | | Lanting and van der Plicht 2010, 142; Van Vilsteren 1993, fig. 4 |
| 88. Tynaarlo Westeres 1986-II-25 | DR | GrA-43677 | CR | 1570 | 35 | 410-564 | AS,- | - | A,G,L | | Lanting and van der Plicht 2010, 142; Van Vilsteren 1993, fig. 4 |
| 89. Ulrum-De Capel 1 | GR | GrA-44423 | CR | 1255 | 30 | 672-868 | HS/EG | HS/EG | | | Knol 1995, fig. 2; Lanting and Van der Plicht 2010, 147 |
| 90. Ulrum-De Capel 2 | GR | GrA-44594 | CR | 1405 | 35 | 580-670 | HS/EG | HS/EG | | | Knol 1995, fig. 2; Lanting and Van der Plicht 2010, 147 |

(Continues)
| Site and no. | Region | Lab No. | Sample Type | Age (yr BP) | Uncertainty | Calibrated date AD (95.4% confidence) | Category | Type | ASSP decorations | HS Form | Type | Reference |
|-------------|--------|---------|-------------|-------------|-------------|--------------------------------------|----------|------|------------------|---------|------|-----------|
| 91. Wageningen 1928/3.8 | GL | GrA-45521 | CR | 1500 | 45 | 428-644 | AS | ASSP2 | A,E,G,L | - | Lanting and van der Plicht 2010, 142; Van Es 1964, fig. 94.5 |
| 92. Wasperton cremation 3 | BI | OxA-15962 | CR | 1609 | 32 | 389-540 | AS | - | F | F | Carver et al. 2009, tab. 4.1, 344 (fig.) |
| 93. Wasperton cremation 14 | BI | GrA-32242 | CR | 1550 | 30 | 423-574 | AS | ASSP2 | F,J | - | Carver et al. 2009, tab. 4.1, 348 (fig.) |
| 94. Wasperton cremation 20 | BI | OxA-15964 | CR | 1735 | 55 | 139-411 | AS | ASSP1 | A,F,J | - | Carver et al. 2009, tab. 4.1, 351 (fig.) |
| 95. Wierum well 2-2 | GR | GrN-29174 | SW | 1310 | 20 | 660-767 | HS | HS | - | - | Nieuwhof 2006, tab. 3.3 and fig. 4.2 |
| 96. Wijndalum-Tjitsma 4840/95b | FR | GrA-44595 | CR | 1780 | 35 | 134-339 | AS | ASSP1 | A,B,D,L,M | - | Lanting and Van der Plicht 2010, 142 and fig. 15.23 (after drawing J. de Koning) |
| 97. Wijndalum-Tjitsma 6438/6451 | FR | GrA-1531 | PC,OP | 1470 | 30 | 545-645 | UD,HS | HS*, HSt*, G7* | A*,D* | Gerrets and De Koning 1999, 97; Taayke, forthcoming (drawing J. de Koning) |
| 98. Wijster grave VII | DR | GrA-23496 | CR | 1750 | 50 | 138-394 | UD | G7 | - | - | Lanting and Van der Plicht 2010, 147; Van Es 1967, fig. 272 |
| 99. Wijster-Looveen 1926/IV221 | DR | GrA-13369 | CR | 1600 | 40 | 383-557 | AS | ASSP2 | E,F,L | - | Lanting and van der Plicht 2010, 142; Van Es 1967, fig. 278.1; values for separate dates provided by CIO Groningen |
| 100. Zeyen-Rhee 1937/VIII.134 | DR | GrA-23497 | CR | 1650 | 50 | 257-539 | AS | - | A,F,L | - | Lanting and van der Plicht 2010, 142; Van Es 1967, fig. 160.17 |
| | | GrA-45178 | CR | 1550 | 35 | 420-585 | - | A,F,L | - | - | |
FIGURE 2
Overview of the pottery types in the typologies for general type, ASSP decoration and HS-subtype. (Drawing: first author, based on the pots in the sample).
A: Two or more horizontal lines and often cordons around the neck.
B: Regular pattern of lined chevrons, often under or between horizontal lines.
C: Rosettes.
D: Hängende or Stehende Bogen (the German technical term; in English: swags or arcs).
E: Round/vertical bosses.
F: Stamps.
G: Vertical bundles of lines, often combined with vertical elongated bosses or indentations.
H: melon-shaped pots, with vertical indentations or bosses (see ASSP4).
I: Decorated zone that is completely filled in with stamps or impressions.
J: Decoration limited to the upper part, above or on carination.
K: The widest part of the pot is emphasized.
L: Decoration not limited to upper part.
M: Decorated cordons around the neck.

As multiple types of decoration usually occur on one pot, most pots are included in more than one category.

In the third typology, subtypes were defined within HS, based on the shapes of the pots.
A: Wide-mouthed, relatively tall pots, small out-flaring rims.
B: Narrow-mouthed, tall pots, more or less out-flaring neck.
C: (Relatively) wide-mouthed pots, out-flaring neck, height and width comparable; sometimes more or less rounded carination.
D: Bowls with short, out-flaring rim.

Some well-dated contexts include more than one pot. If these pots belong to more than one category in the same typology, this can compromise the ability of the model to distinguish between the different types. For example, if a date relates to pots of different HS-subtypes, it is excluded from the model for HS-subtypes, as otherwise that date would be included in different categories within the same model. As the different pots to which this date relates all fall into the category of HS-pots in the model for general types, the date represents only one category in the model for general types. Therefore the date can be included in the model for general types, but not in the model for HS-subtypes. These cases are indicated in Table 2. As most ASSP-pots have more than one type of decoration, it is not necessary or possible to leave out such dates in the model for ASSP-decoration.

A Bayesian model for each typology was prepared in OxCal (version 4.3). Because of its large size, the ASSP-decoration model tended to run best when split into smaller components (see Supplementary Information). The models were all configured in the same manner and followed the approach taken by several previously published studies (e.g. Dee et al. 2014; Wengrow et al. 2014). All dates for each typology were modelled as single-Phase Sequences, where the Phase was enclosed by a start and end Boundary. It is important to emphasize that no assumption was built into the models a priori about the likely ordering of each of the different groups of dates.

All three models employed OxCal’s outlier analysis to mitigate the impact of any wayward individual results, and to combat the above-mentioned issue of inbuilt age. Radiocarbon results on materials that were likely to be short-lived, such as pottery crusts, were subject to the General Outlier classification (Bronk Ramsey 2009). The dates on cremation remains, charcoal,
and wood are all susceptible to inbuilt age. For these, the Charcoal Plus Outlier model was employed, a technique that has been shown to counteract this problem, where sufficient numbers of dates are available (Dee and Bronk Ramsey 2014). A Sum function was embedded in each Phase. This function generated an estimate of the average date for each group. That is, an average date for each general type, each type of ASSP-decoration, and each subtype of HS-pot. In the final step, these averages were interrogated by OxCal’s Order function, which produced a mathematical estimate of their most likely ordering.

5. RESULTS

5.1. General types

Based on the OxCal model, the chronological order of the typology of general types is: G7, ASSP1, ASSP2, ASSP3, ASSP4, HS, HS decorated, HS/EG (Fig. 3). Supplemental Tables 4–6 show the percentages of likelihood of the chronological order. The model shows the overlap between G7 and the earlier ASSP, as well as the contemporary occurrence of HS and the later types of ASSP. Type G7 begins c.AD 300. As indicated by the probability distribution, this type appears to belong to the fourth and early fifth centuries, but the number of dates is not very large (n=7; the distribution of the collective dates ranges from c.300–450). ASSP1 (with a range of c.300–500) starts to become significant c.AD 325, with a peak in the first half of the fifth century, and a possible continuation until around AD 500. The distribution of ASSP2 (c.450–575) starts in the middle of the fifth century, with its peak in the first half of the sixth century. This type seems to go out of use before the last quarter of the sixth century. The distributions of ASSP3 and ASSP4 show a less clear peak, at least in part due to the small number of dates (respectively six and four dates from four and three pots, both with a wide range, between c.425–700) and do not have a clear cut-off point. It seems likely, however, that these types had very little to no overlap with ASSP1, but coincided only with ASSP2. They are likely to belong to the (later) sixth and the first three quarters of the seventh centuries. Although the conclusions drawn about the duration of the types must be treated as a best estimate, their chronological order seems to be reliable, especially the chronological difference between ASSP1 and ASSP2 (n=17 and n=14).

Only one pot from Germany, an ASSP1-pot, could be included in this model. The number of dates from Gelderland and Zuid-Holland is small, but these are all of ASSP2 and later types. From Friesland, Drenthe and England, dates from both earlier and later ASSP are available.

The number of available HS-dates was considerable (n=40). The graph suggests that HS (c.525–725 and 550–775 for decorated HS) starts to occur around AD 525 and does not overlap with the undecorated ware of the previous period, represented by G7, and hardly with ASSP1. The HS subtypes, however, show a wider range with a small amount of overlap with G7 as well, especially HS A (c.400–650, the peak starting only around 525; Fig. 3), which is more in accordance with the common occurrence of associated finds of HS and G7 (see below). HS overlaps with ASSP2, and even more so with ASSP3 and 4. The undecorated HS, with the largest number of dates, comes to an end in the first quarter of the eighth century. HS is occasionally still decorated with remnants of Anglo-Saxon style elements; these decorations occur during the whole period of use of HS. That the distribution of decorated HS continues into the late eighth century is possibly caused by the relatively small number of dates (n=8), further weighted by two relatively late examples of HS included in this type, which may not be representative (Table 2, nos. 89 and 73). Six dates of the intermediate type between HS and early globular ware are included in the sample.
The results seem to indicate that the transition to early globular ware started as early as the second half of the seventh century, but certainly took hold from at least AD 700 onwards.

(c.650–775/800). The results seem to indicate that the transition to early globular ware started as early as the second half of the seventh century, but certainly took hold from at least AD 700 onwards.
5.2. ASSP decoration

Based on the OxCal model, the chronological order of the types of decoration on ASSP is: C, M, J, B, K, D, A, E, G, F, L, H and I (Fig. 4). The ordering is less clear and shows more overlap than was the case for the general types. The types J, B, D and A show a very wide range, covering the whole period of use of ASSP. These, therefore, cannot be used as a chronological distinguishing mark. Types C (with a range between \( c.<300–425 \)) and M (rosettes and decorated cordons around the neck; \( c.<300–500 \)) are relatively early types of decoration, concentrated to before \( c.\text{AD 450} \), although it must be remarked that C is only represented by four dates. The shape of the probability distributions of types E and G, both characteristic elements of the long-boss style, are nearly similar and cover the greater part of the fifth and the earlier part of the sixth centuries (in both cases covering \( c.400–575 \)).

Types F, L, H and I have a wider range. It seems that these types of decoration do not occur before the second half of the fifth century, especially H and I, although it should be stressed that these two types are only represented by four dates each (three and two pots respectively). However, the basic division into earlier and later types seems to be reliable. The early types of decoration occur mostly on the early types of ASSP and the later types of decoration mostly on the later types of ASSP.

5.3. HS subtypes

Based on the OxCal model, the chronological order of these types is: A, D, B, C (Fig. 5). However, they overlap almost completely. The peak of type A (\( c.400–650 \), the peak starting only around 525) roughly covers the first half of the peak of the other types, but also has the smallest number of dates (n=5). The early start of this type may reflect its typological connection to the G7-type, while type D (\( c.550–675 \)) may be a slightly later development. The narrow-mouthed pots of type B (\( c.525–775 \)) may have succeeded ASSP2. The peak of type C (\( c.625–725 \)) is relatively late, around AD 650. This wide-mouthed type seems to descend from the ASSP-carinated bowls, but the graph indicates that these may not be related. The ranges of the HS-types overlap with the later ASSP-types.

6. DISCUSSION

Bayesian modelling is the most mathematically sound means of summarizing the different groups of data and hence offers the possibility to discern at least basic patterns in the same. However, the relatively small number of dates, considering the large research area and time-span, and the broadness of the two-sigma ranges of the underlying radiocarbon dates are limiting factors. Moreover, even though the pottery-types were defined as consistently and objectively as possible, focussing on morphological elements, any classification is always subjective to a certain degree (Whittaker et al. 1998, 184; Santacreu et al. 2016). There is a wide variety of pottery shapes and decoration of ASSP, which have to be compressed into a few basic types to have a sufficient number of dates per type. A different categorization could be argued, which would change the input, and therefore the results, of the OxCal model.

Despite these possible objections to Bayesian modelling of this dataset, trends in the development of the pottery of this period have become clear. Although conclusions about the durations of the pottery types must be drawn with caution, their chronological order, especially
Calibrated date ranges for the datasets for the ASSP-decoration typology and the amount of dates per type, in chronological order. The data were modelled in OxCal (version 4.3; Bronk Ramsey 1995) and interrogated by OxCal’s Order function. [Colour figure can be viewed at wileyonlinelibrary.com]
the division between the earlier and later Anglo-Saxon style, and the succession of G7 by HS clearly shows in the graphs. The assumed relationship between HS-type C and the ASSP-carinated bowls was disproved. The carinated bowls-like shapes of HS C may rather be considered a stage in the development towards globular pots. Some of the types of decoration on ASSP can be divided into earlier and later patterns, but not all. Individual elements were in use for a long period of time and the variety of decoration patterns is wide.

Local differences in style and pottery types cannot be reflected in such a compressed typology. Moreover, although this study includes a considerable number of radiocarbon dates, the dataset is not evenly distributed, probably because the selection of the sampled material is often driven by the necessity of dating sites and contexts, rather than by dating the pottery itself. This sporadic distribution of dates means that not all types and stylistic elements are represented equally well. Many of the dated samples come from cremation burials, which leads to an underrepresentation of vessel types common in this period, such as carinated bowls (Schalenurnen) and beakers.

The date of introduction of ASSP differs by region (Kennett 1978, 11; Knol 1993, 196–8; Hills and Lucy 2013, 301–2; Nieuwhof 2013, 54). It likely first occurred in Jutland and north-western Germany, followed by the northern Netherlands and England, and only later spread to Zuid-Holland, Gelderland, Flanders and northern France. The available radiocarbon dates of ASSP do not represent every region equally well. There are no dates of ASSP from Denmark, Belgium or northern France. There are only two dated pots from the province of Groningen, one from Gelderland and five from Zuid-Holland. The emphasis of the available dates for ASSP lies on the northern Netherlands (41 selected dates), especially Friesland, followed by England (eight selected dates) and Germany (six selected dates). Nevertheless, the results match the spread of ASSP in the order as stated above.
FIGURE 6
The pots from the selected dates. The sources of the drawings are listed in Table 2
FIGURE 6 (continued)
The spread of the Anglo-Saxon style reflects the cultural changes during this period. The onset of ASSP seems well represented in the data. ASSP1 occurs in Germany (one dated pot) as well as the northern Netherlands (twelve dated pots) and England (one dated pot). The four pots from Germany that were included in the model for ASSP-decoration were ornamented with early decorative motifs. Pottery characteristics that are defined here as belonging to ASSP2 are hardly known in Germany. Bärenfänger mentions one pot from Nordorf (Bärenfänger 2001, 253, figs. 2–3). The later ASSP2 seems to be a development in the regions to which ASSP had spread. From Friesland, Drente and England, dates from both earlier ASSP1 and later ASSP2 are available, as well as from HS. In Groningen, ASSP was common and already occurred in fourth century contexts in the terp of Ezinge, as archaeological dates have shown (Nieuwhof 2013). In Gelderland and Zuid-Holland, the dated ASSP-pots are of the ASSP2, ASSP3 and ASSP4-types. This represents the actual situation, as earlier ASSP (ASSP1) is unknown here and only later ASSP and HS occur.

That later ASSP is hardly found in Germany suggests it is more likely to be introduced to Zuid-Holland and Gelderland, and possibly Flanders and north-western France as well, from England or the northern Netherlands rather than directly from the homelands of the Angles and Saxons. Based on prestigious metal finds, Nicolay (2005; 2014) suggests strong influences from Southern Scandinavia during this period. Previous research suggests little evidence of Scandinavian influence in the ASSP of the Netherlands (Krol 2006). For England such influences seem to be more common, especially for Jutland (Myres 1969; Hills and Lucy 2013, 313–14). However, prestigious metal objects and pottery may not have functioned in the same way within socio-political networks. The prestige objects amongst the metal finds are principally part of a political exchange network of an elite society, under strong Scandinavian influences (Nicolay 2005; 2014), which does not extend to Flanders or northern France. These regions were part of the Frankish realm from the late fifth century (Nicolay 2014, 350–2). The ASSP2-pottery in Zuid-Holland, Gelderland, Flanders and north-western France may represent contacts between these regions and Anglo-Saxon communities in England during the end of the fifth and the early sixth centuries, thus showing that these communities were not only focused on the northern socio-political network under Scandinavian influence, but also had contacts with the Frankish world, or even settled there. Further stylistic research is needed to distinguish the cultural interaction that played a role in the distribution of the pottery.

Lanting and Van der Plicht (2010) suggest HS was introduced in the early fifth century. However the OxCal model implies that it did not emerge before c.AD 500, a conclusion substantiated by a large number of dates (n=48; c.525–775, if likely starting slightly earlier for subtype A). This is also supported by the fact that it is generally found with the later Anglo-Saxon types. HS seems to have directly followed the end of the G7-type, but, as G7 and HS sometimes occur together in the same contexts, it is certain that these types overlapped. This is illustrated by a find from Wijnaldum (Table 2. 96. Wijnaldum-Tjitsma 6438/6451), where sherds of several complete G7 and HS-pots together formed the pavement of a hearth, representing a single event (Taayke forthcoming). A gradual transition of G7 to HS is supported by the gradual change from finer to coarser fabrics (Krol et al. 2018).

Contrary to the common view, HS seems to start in Germany around AD 500 as well, at least to a small degree. Only two dates from Germany are available, but the two-sigma ranges for these two dates fall before AD 500.

Although it is not possible to make a detailed typo-chronology based on the available radiocarbon dates, the basic division into earlier and later types is an important result, which
supports the earlier, but still controversial identification of these categories on stylistic grounds. The recognition of earlier and later ASSP-styles, and the different starting dates for ASSP in each region, are of utmost importance in understanding migration patterns, contacts and exchange and their chronology along the southern North Sea coastal regions between the fourth and eighth centuries AD.

7. CONCLUSIONS

To date, ASSP can only be dated globally; the existing relative typologies are not fixed by scientific dating. This study confirms the division between early and late types of ASSP. The division applies to the development of the shape of the pots, as well as some types of decoration. The study shows that early ASSP was in use in the 4th and 5th centuries, while later ASSP began around 450 and probably went out of use after the first half of the sixth century, at least in the Netherlands. The intermediate types between ASSP and the following HS (ASSP3 and 4) continued into the later sixth century. The results show no clear chronological development for the HS-types.

According to present opinion, the Anglo-Saxon style was not introduced in every region at the same time and also remained in use longer in some areas than in others. Although the quantity of data is not large, the results are in line with this idea. The pots from Germany are only in the early style, which is commensurate with the idea that the Anglo-Saxon style went out of use earlier in this region. Usable dates from Denmark are not available. In the northern Netherlands, both earlier and later ASSP occurs. Archaeological data show that the style was introduced and adopted here in the 4th century. Most dated pots from England are of the later types, but one pot is of an early type. Although the central and western Netherlands are not well represented in the sample, it is clear that only the later ASSP and intermediate types between ASSP and HS are found here. Dates from northern France are lacking and only one date from a G7-pot is available for Belgium, but here only the later ASSP-types are found. This indirectly confirms that the Anglo-Saxon style only occurred later in these regions. The results provide the necessary information for further stylistic analysis, comparing pottery from different regions.

Bayesian modelling of radiocarbon dates of pottery has the potential to contribute even more to an understanding of the changes that occurred in the so-called Migration Period than the limited dataset of this study allows. For the future, we recommend radiocarbon dating of pottery from this period as a common practice, in particular outside the northern Netherlands, to acquire a fuller picture of the spread of ASSP and thereby of migration patterns and connectivity in the southern North-Sea coastal area.

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REFERENCES

ANNAERT, R., BRAEKMANS, D., COOREMANS, B., CRYNS, J., DEBRUYNE, S., DEFORCE, K., ERVYNCK, A., HANECA, K., LENTACKER, A., LINDERS, L., MATHIS, F., QUINTELIER, K., SNOECK, C., CLAEYS P., VAN GILS M., VAN HEESCH J., VANDERSMISSEN I., VRIELENCK O., WATZEELS, S., WALTON ROGERS, P. and THOMPSON, M. (in prep): Het vroegmiddeleeuwse grafveld van Broechem (gem. Ranst-prov: Antwerpen). Spiegel van het leven in de noordelijke periferie van het Frankische koninkrijk of een poort naar symboliek en ideologie van het vroegmiddeleeuwse begravingsritueel?

BÄRENFÄNGER, R. 2001: Befunde einer frühmittelalterlichen Siedlung bei Esens, Ldkr. Wittmund (Ostfriesland). Probleme der Küstenforschung im südlichen Nordseegebiet 27, 249–300.

BÄRENFÄNGER, R. and SCHWARZ, W. 1999: Ostfriesische Fundchronik 1998 – 7. Middels-Osterloog FStNr. 2411/6:124, Gemeinde Stadt Aurich. Siedlungsspuren aus der Völkerwanderungszeit und dem Frühmittelalter. Ender Jahrbuch für historische Landeskunde Ostfrieslands 78, 265.

BAYLISS, A., BRONK RAMSEY, C., COOK, G. and VAN DER PLICHT, J. 2007: Radiocarbon Dates from Samples Funded by English Heritage under the Aggregates Levy Sustainability Fund 2002-4 (Swindon).

BAYLISS, A., COOK, G., BRONK RAMSEY, C., VAN der PLICHT, J. and MCCORMAC, G. 2008: Radiocarbon Dates from Samples Funded by English Heritage under the Aggregates Levy Sustainability Fund 2004-7 (Swindon).

BAYLISS, A., HEDGES, R., OTLET, R., SWITSUR, R. and WALKER, J. 2012: Radiocarbon Dates from Samples Funded by English Heritage between 1981 and 1988 (Swindon).

BAYLISS, A., BRONK RAMSEY, C., COOK, G., MCCORMAC, G., OTLET, R. and WALKER, J. 2013: Radiocarbon Dates from Samples Funded by English Heritage between 1988 and 1993 (Swindon).

BAYLISS, A., BRONK RAMSEY, C., COOK, G., MCCORMAC, G. and MARSHALL, P. 2015: Radiocarbon Dates from Samples Funded by English Heritage between 1993 and 1998 (Swindon).

BAYLISS, A., BRONK RAMSEY, C., COOK, G., MCCORMAC, G. and VAN der PLICHT, J. 2017: Radiocarbon Dates from Samples Funded by English Heritage between 1998 and 2003 (Swindon).

BAZELMANS, J. 2002: Die spätrömerzeitliche Besiedlungslücke im niederländischen Küstengebiet und das Fortbestehen des Friesennamens. Ender Jahrbuch für historische Landeskunde Ostfrieslands 81, 7–61.

BIRBECK, V., SMITH, R.J.C., ANDREWS, P. and STOODLEY, N. 2005: The Origins of Mid-Saxon Southampton: Excavations at the Friends Provident St. Mary’s Stadium, 1998–2000 (Salisbury).

BÖHME, H.W. 1974: Germanische Grabfunde des 4/bis 5. Jahrhunderts zwischen unterer Elbe und Loire (Munich, Münchner Beiträge zur Vor- und Frühgeschichte 19).

BÖHME, H.W. 1987: Gallien in der Spätantike. Forschungen zum Ende der Römerherrschaft in den westlichen Provinzen. Jahrbuch des Römisch-Germanischen Zentralmuseums Mainz 34, 770–3.

BRAAT, W.C. 1956: Brandgraven uit de 7e eeuw in de duinen bij Monster. Oudheidkundige Mededelingen uit het Rijksmuseum van Oudheden te Leiden 37, 82–91.

BRONK RAMSEY, C. 1995: Radiocarbon calibration and analysis of stratigraphy: The OxCal program. Radiocarbon 37(2), 425–30.

BRONK RAMSEY, C. 2009: Dealing with outliers and offsets in radiocarbon dating. Radiocarbon 51(3), 1023–45.

BRONK RAMSEY, C. 2017: Methods for summarizing radiocarbon datasets. Radiocarbon 59(2), 1809–33.

BRUGMANN, B. 2011: Migration and endogenous change. In HAMEROW, H., HINTON, A. and CRAWFORD, S. (eds.), The Oxford Handbook of Anglo-Saxon Archaeology (Oxford), 30–45.
CARVER, M., HILLS, C. and SCHESCHKEWITZ, J. (eds.), 2009: Wasperton: a Roman, British and Anglo-Saxon Community in Central England (Woodbridge).

CHERKINSKY, A. 2009: Can we get a good radiocarbon age from ‘bad bone’? Determining the reliability of radiocarbon age from bioapatite. Radiocarbon 51–2, 647–55.

DEE, M.W. and BRONK RAMSEY, C. 2014: High-precision Bayesian modelling of samples susceptible to inbuilt age. Radiocarbon 56–1, 83–94.

DEE, M.W., WENGROW, D., SHORTLAND, A. J., STEVENSON, A., BROCK, F., and BRONK RAMSEY, C. 2014: Radiocarbon dating and the Naqada relative chronology. Journal of Archaeological Science 46, 319–23.

DEFORCE, K. and HANECA, K. 2011: Ashes to ashes; fuelwood selection in Roman cremation rituals in northern Gaul. Journal of Archaeological Science 39, 1338–48.

DIJKSTRA, M.F.P. 2011: Rondom de mondingen van Rijn & Maas: landschap en bewoning tussen de 3e en 9e eeuw in Zuid-Holland, in het bijzonder de Oude Rijnstreek (Ph.d. thesis, Universiteit van Amsterdam).

DIJKSTRA, M.F.P. and DE KONING, J. 2011: ‘All quiet on the western front’? The Western Netherlands and the ‘North Sea Culture’ in the Migration Period. In HINES, J. and IJSSENNAGGER, N. (eds.), Frisians and their North Sea Neighbours: from the Fifth Century to the Viking Age (Woodbridge), 53–74.

GENRICH, A. 1954: Formentreinisse und Stammesgruppen in Schleswig-Holstein nach geschlossenen Funden des 3. bis 6. Jahrhunderts (Neumünster).

GERRETS, D.A. and DE KONING, J. 1999: Settlement development on the Wijnaldum-Tjitsma terp. In BESTEMAN, J. C., BOS, J.M., GERRETS, D.A., HEIDINGA, H.A. and DE KONING, J. (eds.), The Excavations at Wijnaldum (Rotterdam, Reports on Frisia in Roman and Medieval Times I), 73–124.

GROENENDIJK, H.A. and KNOL, E. 2007: Marum-Oude Diep en Leyllens-Borgweg (Gr.). Aanzet tot nieuwe inzichten in grafbestel door 14C-dateringen. Paleo-aktueel 18, 100–6.

HAREMBERG, H., HOKLEHOYT, Y. and VINCE, A. 1994: Migration Period settlements and ‘Anglo-Saxon’ pottery from Flanders. Medieval Archaeology 38, 1–18.

HÄRKE, H. 2011: Anglo-Saxon immigration and ethnogenesis. Medieval Archaeology 55, 1–28.

HIJEMEKA, J. 2015: Nederzettingssporen op de kwelder Haak Noord, vindplaats 1: Marssum-It Aldlân Gemeente Menaldumadeel Archeologisch onderzoek: een opgraving (Weesp, RAAP-rapport 2997).

HILLS, C. and LUCY S. 2013: Spong Hill Part IX. Chronology and Synthesis (Cambridge).

JORDAN, D., HADDON-REEECE, D. and BAYLISS, A. 1994: Radiocarbon Dates from Samples Funded by English Heritage and Dated before 1981 (London).

KIELN, T.H. 1978: Anglosaxon Pottery (Aylesbury).

KNOL, E. 1993: De Noordnederlandse kustlanden in de vroege Middeleeuwen (Ph.D. thesis, Vrije Universiteit Amsterdam).

KNOL, E. 1995: Een nieuw ontdekt vroegmiddeleeuws grafveld: Ulrum-de Capel (Gr.). Paleo-aktueel 6, 112–14.

KNOL, E. 2008: Het Angelsaksische grafveld Beetgum-Besseburen. In HUISMAN, K., BEKKEMA, K., BOS, J.M., de JONG, H., KRAMER, E. and SALVERDA, R. (eds.), Diggelgoud. 25 jaar Arkeologisch Erfgoedonderzoek in Friesland (Leeuwarden), 148–57.

KNOL, E., PRUMMEL, W., UYTTERSCHAUT, H. T, HOOGLAND, M.L.P., CASPARIE, W.A., DE LANGEN, G.J., KRAMER, E. and SCHELVIS, J. 1997: The early medieval cemetery of Oosterbeintum (Friesland). Palaeohistoria 37/38 (1995–96), 245–416.

KROL, T.N. 2006: Angelsaksisch aardewerk in Noord-Nederland. Nieuwe perspectieven op het Noordnederlandse kustgebied na het bewoningsdia in de vierde eeuw. De Vrije Fries 86, 9–32.

KROL, T.N., STRUCKMEYER, K. and NIEUWHOF, A. 2018: Pottery in Anglo-Saxon style from the northern Netherlands and north-western Germany: fabrics, regional and chronological patterns, and their implications. Archaeometry 60(4), 713–30.

KUIPER, A. 2018: Een nieuw kijk op het vroegmiddeleeuwse aardewerk van de Tuinswierde te Leens (Gr.). In NIEUWHOF, A., KNOL, E. and SCHOKKER, J. (eds.), Fragmenten uit de rijke wereld van de archeologie (Groningen, Jaarverslagen van de Vereeniging voor Terpenonderzoek 99), 131–45.

LANTING, J.N. 1977: Bewoningssporen uit de ijzertijd en de vroege middeleeuwen nabij Eursinge, gem. Ruinen. Nieuwe Drentse Volksalmanak 94, 213–49.

LANTING, J.N. and VAN DER PLICH, J., 2006: De 14C-chronologie van de Nederlandse pre- en protohistorie, V: midden en late ijzertijd. Palaeohistoria 47/48, 241–427.
LANTING, J.N. and VAN DER PLICHT, J. 2010: De 14C chronologie van de Nederlandse Pre- en Protohistorie VI: Romeinse tijd en Merovingische periode, deel A: historische bronnen en chronologische schema’s. Palaeohistoria 51/52, 27–168.

LANTING, J.N. and VAN DER PLICHT, J. 2012: De 14C-chronologie van de Nederlandse pre- en protohistorie VI: Romeinse tijd en Merovingische periode, deel B: aanvullingen, toelichtingen en 14C-dateringen. Palaeohistoria 53/54, 283–391.

LANTING, J.N., AERTS-BIJMA, A. and VAN DER PLICHT, J. 2001: Dating cremated bones. Radiocarbon 43, 249–54.

LUCY, S.J., TIPPER, J. and DICKENS, A. 2009: The Anglo-Saxon Settlement and Cemetery at Bloodmoor Hill, Carlton Colville, Suffolk (Cambridge, East Anglian Archaeology 131).

MCCORMAC, F. G., BAYLISS, A., BRONK RAMSEY, C., BUCK, C.E., CHENG, H., EDWARDS, R., HUGHEN, K.A., KAISER, K.F., KROMER, B., L., FRIEDRICH, M., GROOTES, P.M., GUILDERSON, T.P., HAFLIDASON, H., HADJAS, I., HEATON, T.J., HOFFMANN, T.A.S.M. (ed.), The Oxford Handbook of Archaeological Ceramic Analysis (Oxford), 181–99.

NICOLAY, J.A.W. 2005: Nieuwe bewoners van het terpengebied en hun rol bij de opkomst van het Fries koningschap. De Vrije Fries 85, 37–104.

NICOLAY, J.A.W. 2014: The Splendour of Power. Early Medieval Kingship and the Use of Gold and Silver in the Southern North Sea Area (5th to 7th Century AD) (Groningen, Groningen Archaeological Studies 28).

NIEUWHOF, A. 2006: De wierde Wierum (provincie Groningen). Een archeologisch steilkantonderzoek (Groningen).

NIEUWHOF, A. 2008: Het handgemaakte aardewerk, ijzertijd tot vroege middeleeuwen. In NICOLAY, J.A.W. (ed.), Opgravingen bij Midlaren: 5000 jaar wonen tussen Hondsrug en Hunzedal (Eelde, Groningen Archaeological Studies 7), 261–304.

NIEUWHOF, A. 2011: Discontinuity in the Northern-Netherlands coastal area at the end of the Roman Period. In PANHUYSSEN, T.A.S.M. (ed.), Transformations in North-Western Europe (AD 300–1000). Proceedings of the 60th Sachsensymposion 19–23. September 2009, Maastricht (Hannover, Neue Studien zur Sachsenforschung 3), 55–66.

NIEUWHOF, A. 2013: Anglo-Saxon immigration or continuity? Ezinge and the coastal area of the northern Netherlands in the Migration Period. Journal of Archaeology in the Low Countries 5–1, 53–83.

NIEUWHOF, A. 2015: Eight Human Skulls in a Dung Heap and More: Ritual Practice in the Terp Region of the Northern Netherlands, 600 BC – AD 300 (Groningen, Groningen Archaeological Studies 29).

NÖSLER, D. 2017: Ein Jahrestausend in Scherben – Ein Beitrag zur Typochronologie frühgeschichtlicher Siedlungsware aus Loxstedt, Ldkr. Cuxhaven. Siedlungs- und Küstenforschung im südlichen Nordseekreisgebiet 40, 217–319.

OLSEN, L., HEINEMEIER, J., HURNSTRUP, K.M., BENNIKE, P. and THRANE, H. 2013: ‘Old wood’ effect in radiocarbon dating of prehistoric cremated bones? Journal of Archaeological Science 40, 30–4.

PLETTKARKE, A. 1921 (1920); Ursprung und Ausbreitung der Angeln und Sachsen: Beiträge zur Siedlungsarchäologie der Ingväonen: die Urnenfriedhöfe in Niedersachsen III (Hildesheim).

REIMER, P. J., BARD, E., BAYLISS, A., BRONK RAMSEY, C., BUCK, C.E., CHENG, H., EDWARDS, R. L., FRIEDRICH, M., GROOTES, P.M., GUILDERSON, T.P., HAFILDASON, H., HADJAS, I., HATTE, C., HEATON, T.J., HOFFMANN, D.L., HOOG, A.G., HUGHEN, K.A., KAISER, K.F., KROMER, B., MANNING, S.W., NIU, M., WEIMER, R.W., RICHARDS, D.A., SCOTT, E.M., SOUTHON, J.R., STAFF, R.A., TURNSEY, C.S.M. and VAN DER PLICHT, J. 2013: IntCal13 and Marine13 Radiocarbon Age Calibration Curves 0–50,000 Years cal BP. Radiocarbon 55(4), 1869–87.

SANTACREU, D.A., TRIAS, M.C., GARCÍA-ROSSELLÓ, J. 2016: Formal analysis and typological classification in the study of ancient pottery. In HUNT, A.M.W. (ed.), The Oxford Handbook of Archaeological Ceramic Analysis (Oxford), 181–99.

SCHMID, P. 1981: Some bowls from the excavations of the terp at Feddersen Wierde near Bremerhaven. In EVISON, V.I. (ed.), Angles, Saxons and Jutes: Essays Presented to J.N.L. Myres (Oxford), 39–58.

SCHMID, P. 2006: Die Keramikfunde der Grabung Feddersen Wierde (1. Jh. v. bis 5. Jh. n. Chr.) (Oldenburg; Feddersen Wierde 5; Probleme der Küstenforschung 29).

SCHÖN, M.D. 1988: Gräberfelder der Römischen Kaiserzeit und frühen Völkerwanderungszeit aus dem Zentralteil der Siedlungskammer von Flögeln, Landkreis Cuxhaven. Neue Ausgrabungen und Forschungen in Niedersachsen 18, 181–297.

SNOEK, C., BROCK, F. and SCHULTING, R.J. 2014: carbon exchanges between bone apatite and fuels during cremation: impact on radiocarbon dates. Radiocarbon 56, 591–602.

SOULAT, J., BOQUET-LIÉNARD, A., SAVARY, X. and HINCKER, V. 2012: Hand-made pottery along the Channel coast and parallels with the Scheldt valley. Colloquium of ACE, Bruxelles, Relicta 2012, 215–24.
STILKE, H. 2001: Grauware des 8. bis 11. Jahrhunderts. In LÜDTKE, H. and SCHIETZEL, S. (eds.), Handbuch zur mittelalterlichen Keramik in Nordeuropa (Neumünster, Schriften des Archäologischen Landesmuseums 6), 23–82.

TAAYKE, E. 1996: Die einheimische Keramik der nördlichen Niederlande, 600 v. Chr. bis 300 n. Chr. (Ph.D. thesis, Rijksuniversiteit Groningen).

TAAYKE, E. 2000: Onder Franken en Saksen. Friesland in de laat-Romeinse tijd. De Vrije Fries 80, 9–28.

TAAYKE, E. forthcoming: Handmade pottery of the Migration Period and the Merovingian Period. In NIEUWHOF, A. de KONING, J., de LANGEN, G. and TAAYKE, E. (eds.), The Excavations at Wijnaldum II. Handmade and Wheelmade Pottery.

TISCHLER, F. 1956: Der Stand der Sachsenforschung, archäologisch gesehen. Berichte der Römisch-Germanischen Kommission 35, 21–215.

TUIN, B.P. 2008: Graven aan de Rand, Onderzoek van de akkers grenzend aan de Bloemert. In NICOLAY, J.A.W. (ed.), Opgravingen bij Midlaren: 5000 jaar wonen tussen Hondsrug en Hunzedal (Groningen, Groningen Archaeological Studies 7), 521–44.

VAN ES, W.A., 1967–68: Een Angelsaksische urn uit Helpman. Groningse Volksalmanak 1967-68, 224–9.

VAN ES, W.A. 1964: Het rijengrafveld van Wageningen. Palaeohistoria 10, 181–316.

VAN ES, W.A. 1967: Wijster: a Native Village beyond the Imperial Frontier 150–425 A.D. (Groningen, Palaeohistoria 11).

VAN ES, W.A. 1979: Odoorn: frühmittelalterliche Siedlung; das Fundmaterial der Grabung 1966. Palaeohistoria 21, 205–25.

VAN DER SANDEN, W.A.B. 1993: Een vroeg-middeleeuwse keienvloer in Balloo. Nieuwe Drentse Volksalmanak 110, 97–101.

VAN STRYDONCK, M., BOUDIN, M. and DE MULDER, G. 2010: The carbon origin of structural carbonate in bone apatite of cremated bones. Radiocarbon 52, 578–86.

VERHOEVEN, A.A.A. 1998: Middeleeuws gebruiksaardewerk in Nederland (8ste – 13de eeuw) (Amsterdam, Amsterdam Archaeological Studies 3).

VAN VILSTEREN, V.T. 1993: Een vroeg-middeleeuws grafveld in Tynaarlo. Nieuwe Drentse Volksalmanak 110, 87–96.

WAASDORP, J.A. and EIMERMANN, E. 2008: Solleveld. Een opgraving naar een Merovingisch grafveld aan de rand van Den Haag (Den Haag, Haagse Oudheidkundige Publicaties 10).

WATERBOLK, H.T. 1973: Odoorn im frühen Mittelalter. In Hoobericht der Grabung 1966. Neue Ausgrabungen und Forschungen in Niedersachsen 8, 25–89.

WATERBOLK, H.T. and LANTING, J.N. 2002, Odoorn. Reallexikon der Germanischen Altertumskunde 21, 562–72.

WENGROW, D., DEE, M., FOSTER, S., STEVENSON, A., and BRONK RAMSEY, C. 2014: Cultural convergence in the Neolithic of the Nile Valley: a prehistoric perspective on Egypt’s place in Africa. Antiquity 88, 95–111.

WHITTAKER, J.C., CAULKINS, D., and KAMP, K.A. 1998: Evaluating consistency in typology and classification. Journal of Archaeological Method and Theory 5(2), 129–64.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Data S1 Supporting information