PER DITLEF FREDRIKSEN, CHRISTIAN LØCHSEN RØDSRUD
AND FRANCESCO CARUSO

WHAT HAPPENED AT AUGLAND? A SOCIAL CHRONOLOGY FOR THE DEMISE OF A ROMAN IRON AGE CERAMIC WORKSHOP IN SOUTH NORWAY

Summary. *The unique ceramic production site at Augland in southernmost Norway thrived for more than 250 years until its demise in the troubled Migration Period. Contrary to previous opinions, we argue that production ended around AD 450–460 and not in the sixth century. Our approach, based on the craft practices, reveals that the introduction of a novel technology accelerated the process, fuelled by a regional power shift that severed once-resilient ties to south Scandinavia. This outcome is based on the analysis of Augland's terminal century: 1) re-analysis of radiocarbon data; 2) ceramic macroscopy; and 3) fine-sorting of pastes using handheld XRF data.*

INTRODUCTION

The demise of the previously thriving ceramic craft milieux in the western part of the Scandinavian Peninsula in the Migration Period (MP, AD 400–550) has intrigued generations of Iron Age archaeologists (Fredriksen *et al*. 2014; see Rødsrud 2012; 2016). High-quality potting seems to have gone from vibrant to virtually extinct in a few decades. Something happened to the artisans and their environment that caused production to rapidly dwindle and disappear. The most characteristic ceramic types of the MP continued to the mid-sixth century. The relatively swift demise of potting has therefore been related to the turmoil of the terminal MP, in recent discourse epitomized in the much-debated AD 536–540 'dust veil' and its climatic and socio-political aftermath. However, this event can only potentially explain the end of the minor level of production that still lingered towards the mid-sixth century. The following analysis shows that manufacture at the prolific workshop site at Augland in southernmost Norway came to an end 70–80 years prior to the dust veil. Resonating with recent studies that point to institutional changes in the foregoing fifth century as key to understanding craft developments (Kristoffersen and Magnus 2010; Rødsrud 2012; 2016; Fredriksen *et al*. 2014), our data underscore the need to fine-tune the spatiotemporal lens through which we view technological and social change.

The departure point for this analysis is the firmly established co-existence of two distinct ceramic production modes, or technical groups (*sensu* Roux 2017, 107), at Augland. The first

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consists of vessels made by coiling and culminated in the production of sophisticated black burnished wares (Bøe 1931). The second – producing a unique bucket-shape – were made using a markedly different plate/mould technique that, at least in its early phase, was easier to copy by non-specialists. The two modes had different geographical origins and historical trajectories (Kristoffersen and Magnus 2010; Fredriksen *et al*. 2014). While the first appeared at the transition to the Late Roman Iron Age (LRIA, AD 200–400) and seems to terminate by the turn to the sixth century, the latter emerged in the fourth century and continued until the end of the MP in the mid-sixth century. Significantly, only the demise of the later mode can be related to the 536–540 debate (Fredriksen *et al*. 2014, 132–4); further, the two modes belonged to overlapping but distinct exchange networks. While the first had its nodal points in the Agder region along the Skagerrak coastline in southernmost Norway, the latecomer was anchored in communities in the western region from Rogaland to Sogn along the North Sea coast (Fig. 1).

This article presents the analysis of ceramic and radiocarbon data from Augland in southernmost Norway, the largest known site for the production of the first and southern mode. The workshop was probably established just before or around AD 200 (Rolfsen 1980, 1992; Rødsrud 2016), and remained in continuous use for at least 250 years. Our chronological data clearly indicates that the second and western mode entered the Augland workshop in the mid-fourth century, and that manufacture at the site ceased around AD 450–460 or shortly thereafter. This means that the two modes co-existed for the workshop's last century. Accordingly, our aim is to develop a technological and social chronology of the terminal production phase at Augland. In seeking to understand what happened to the site's artisans and their technology, the key question for this study of the dynamics of decline and cessation of production, or *senescence* (cf. Hollenback and Schiffer 2010, 324), is to assess to what extent the western mode was involved in the passing of the southern. What specific changes to the learning network and apprenticeship can be detected at Augland in this final phase? We regard this encounter between the two modes as part of a wider shift of directionality – a change of flow of materials, ideas and practical knowledge – that had consequences for the role of making and using a certain array of vessels that were involved in regionally distinct practices of remembrance.

The co-existence of two production paths in a specific workshop offers a unique opportunity for a bottom-up perspective of technological change during the transition to the troubled Migration Period and its first five or six decades. The evidence will therefore be analysed at two scalar levels. The study of technological variation at the micro-level of the workshop, its artisans and the local milieu will be set against a regional and inter-regional synthesis. The working hypothesis is that the observed changes at Augland are symptoms of crisis and restructuring that represent a regional shift in power balance (cf. Pedersen and Widgren 2011, 61–2). More precisely, the terminal century at Augland seems to coincide with a gradual weakening of a trans-Skagerrak network characterized by intimate links between nodal points in southernmost Norway, such as Oddernes and Fjære (Fig. 1), and areas in Denmark. For Augland, the primary focus has been on northern Jutland, the most likely origin of the southern mode (Bøe 1931; Resi 1986; Rolfsen 1992; Rødsrud 2012; 2016). Our data from Augland suggests that its experts in the southern mode struggled with the novel western mode, and we present a socio-technological chronology for the workshop's final disappearance.

This study is designed to meet and deal with three challenges. Firstly, the lack of a report with comprehensive mapping of the original 1974–1975 excavations has hindered substantial work on Augland. Except for Hulthén's (1986) thorough petrographic analysis, only a few brief publications are available (Rolfsen 1980; 1992; Stylegar 1999; 2006). Consequently, a necessary

FIGURE 1
Map showing location of Augland and the wider region of this study. [Colour figure can be viewed at wileyonlinelibrary.com]

first stage for this study was to access archives in Oslo, Kristiansand and Trondheim.[1] Secondly, in order to establish the necessary chronological comprehension of the final century of the site, an adequate proportion of diagnostic samples from both production modes were selected. The western mode, better known as bucket-shaped pottery, is divided into Phases I–III (Fredriksen *et al*. 2014): it became clear at an early stage in the study that only material from Phase I and the transition to Phase II is found at Augland. Diagnostic samples of this mode could, therefore, provide a baseline for developing a relative chronology. In addition, the ceramic chronology was improved by obtaining new radiocarbon dates from organic residues and by recalibrating all original dates. Thirdly, limited funding did not allow for new petrographic and geochemical analyses necessary to add novel and statistically valid insights to Hulthén's (1986) work. Resources were rather used to gain a comprehensive overview of recipes at work in the final century, and the current knowledge base was widened by the statistical handling of portable XRF (pXRF) data. This allowed the analysis of 140–150 vessels (15–18% of the estimated total assemblage). Knowing that this economic challenge is far from unique for museums storing large quantities of undiagnostic ceramics, we seized the opportunity to develop a low-cost sorting method: an intermediary analytical stage that classifies wares and identifies promising sample groups for subsequent petrographic or geochemical study.

CURRENT KNOWLEDGE

The following review approaches Augland through two different scalar lenses. First, we present the archaeological material and its relation to the nearby Oddernes milieu. This local viewpoint allows an investigation of face-to face interaction between craftspeople, and of their interaction either within a local community or in a wider area belonging to the same community of knowledge (Knappett 2011, 61, 98). Secondly, the material from the Augland workshop site and its hinterland is related to the wider level of interaction within and between regions (cf. Knappett 2011, 124). Augland is here situated in the recently updated regional chronological framework.

The site and its ceramic technology

The Augland site is one of the very few known ceramic production locations (but see also Ballin-Smith 1997; Diinhoff 2005; Kjos 2008; Viken 2017) in coastal South Norway, although this region has a rich ceramic record from the period in question. The excavations at Augland in 1974–1975 uncovered *c*.55,000 fragments from an estimated 700–800 vessels of the southern mode, and an additional *c*.80–90 vessels of the western mode. The evidence includes clay 'beds' for preparing pastes (Fig. 2), the remains of several buildings, some 14 furnaces and a range of other structures, such as fireplaces, cooking pits, slag pits, waste pits, postholes and graves (Rolfsen 1980, 85–7; 1992; Rødsrud 2016). All the main stages in the ceramic *chaîne opératoire* have been documented at the site, starting with the extraction of locally abundant alluvial clays from the river

1 All publications and archival material are written in Norwegian or Swedish. Here we provide a comprehensive literature overview, to make the relevant discourse known outside Scandinavia.

FIGURE 2
Clay bed with prepared paste, as excavated at Augland. (Photo by Perry Rolfsen, Museum of Cultural History, University of Oslo).

valley and their mixing with granite tempers in the clay 'beds' on site (Hulthén 1986, 65, 77). These pastes matched the ceramic wares of the southern mode. The remains of a structure with 27 fireplaces and thousands of pot sherds was most likely the workshop building. A distinct pattern of internal postholes indicates a shelving system for drying. The furnaces were located next to the building, and considerable energy seems to have been invested in local charcoal production for fuel (Rolfsen 1980, 18–19).

Hulthén (1986, 65–73) classified the ceramic assemblage into five groups, based on materials, shaping techniques, surface treatment, decoration and firing method. Her Groups A–D correspond to the dominant southern mode, characterized by the use of local clays mixed with crushed granite. The grouping refers to differences in prepared paste types and their intended use, and Hulthén (1986, 77–8) narrowed the mode down to two main usages: i) a version of coiling called N technique was employed for the thin-walled black-burnished ware (Group A); and ii) a coarser variant (Group D). These pots were employed for the serving of food and drink (Fig. 3, vessel at left). The rougher pastes in Groups B and C are associated with a roughout/drawing technique. These were everyday wares for cooking and storage. The firing method is uniform for Groups A–D: a reduced atmosphere with a temperature range between 600 and 700° C (Hulthén 1986, 73–7).

Hulthén's Group E is significantly different and refers to bucket-shaped pottery of the western mode (Fig. 3, vessel at right). Materials seem to have been brought in from neighbouring areas to the north-west. Hulthén identified the use of sand, granite and talc as tempers, and found asbestos (e.g. chrysotile) in some samples. The average amount of tempering (above 50%) is significantly higher than for the southern mode. The resulting wares are more heat-resistant, leading Hulthén (1986, 79) to argue that the type had a different function. Experiments have demonstrated that such wares were made upside down on a wooden or ceramic mould. A thin rectangular plate

FIGURE 3
Example of pots of the southern mode (left) and the western mode (right), from the same grave in Hjelmeland, Rogaland (S10905). Note the use of carved stamps and steatite ware for the western bucket-shaped mode. (Photo by Terje Tveit, Museum of Archaeology, University of Stavanger).

was shaped around the mould, a circular bottom plate attached, and the pot was decorated while still mounted upside down (Kleppe and Simonsen 1983). Importantly, the technique allowed for relatively less energy to be spent on shaping and more attention to its creative decoration. This aspect becomes chronologically significant for understanding the transition to Phase II for the western mode (Fredriksen *et al*. 2014, 120), which coincides with the advent of period D2 of the MP around AD 450–460 (Kristoffersen and Magnus 2010). The production of high-quality vessels of the western mode in Phases II and III is defined by the use of specially carved stamps and a 'surface-covering expression' (Fredriksen 2006, 130, table 1). This 'expression' was intimately linked to metalworking milieux utilizing Salin's Style I animal art, and permeated by a rich mythological universe (Fredriksen *et al*. 2014, 123). Located in Rogaland and Sogn (Kristoffersen and Magnus 2015), the workshop milieux were closely connected to a novel leadership ideology underpinned by a specific material repertoire for commensality and feasting (Fredriksen 2006; Kristoffersen 2009; Rødsrud 2012).

Augland and its regional connectivity

Augland's connectivity via waterways is key to understanding its importance. The site is located only a few kilometres upriver from the elite milieu at Oddernes. While Augland's

TABLE 1
All available dates from the **Augland** project. Recalibrated using OxCal v. 4.3 (Bronk Ramsey 2009). Entries marked **Augland** are of organic residue from selected shards

Context	Dated material	Lab.-ID	Date BP	68.2% probability (1 sigma/standard deviation)	95.4% probability (2 sigma/standard deviation)
Augland, M/65/21, Lag 1	Charcoal	DF 681, T-1875	1920 ± 80 BP	17–15 BC (0.6%) **AD 1–175 (62.3%)** AD 192–212 (5.3%) AD 29–38 (2.6%)	148–144 BC (0.2%) **112 BC – AD 258 (93.5%)** AD 285–289 (0.2 %) AD 295–322 (1.6%)
Augland L 60, Grop 3 b	Charcoal	DF 681, T-1878	1890 ± 80 BP	**AD 50–228 (65.6%)** 20–12 BC (1.2%) **1 BC – AD 257 (62.9%)**	**52 BC – AD 333**
Augland M 60, Grop 6	Charcoal (alder)	DF 681, T-1930	1880 ± 120 BP	AD 297–321 (4.1%)	**168 BC – AD 399**
Augland I 50, Grop 2	Charcoal	DF 681, T-1877	1820 ± 80 BP	AD 87–106 (5%) **AD 121–259 (51.5%)** AD 282–323 (11.7%)	AD 27–40 (1.1%) **AD 48–390 (94.3 %)**
Augland J 45, Grop 1	Charcoal (oak & pine)	DF 757, T-2065	1810 ± 70 BP	**AD 127–260** (53.9%) AD 280–325 (14.3%)	**AD 67–385**
Augland L 50, Ildsted 1	Charcoal (hazel)	DF 757, T-2066	1790 ± 70 BP	**AD 135–261 (49.2%)** AD 278–327 (19%)	**AD 80–390**
Augland. M/65/21, Lag 2	Charcoal	DF 681, T-1876	1780 ± 80 BP	**AD 137–335**	**AD 69–415**
Augland L 60, Grop 3 a	Charcoal (alder & pine)	DF 681, T-1928	1780 ± 110 BP	**AD 129–381**	**AD 2–438 (91.1%)** AD 443–473 (1.4%) AD 486–535 (2.9%)
Augland I 60, Grop 4	Charcoal (oak)	DF 681, T-1933	1760 ± 90 BP	AD 143–155 (3.3%) AD 168–195 (7.4%) **AD 209–384 (57.5%)**	**AD 60–431 (93.3%)** AD 491–531 (2.1%)
Augland, G35 2/9b	Organic residue	Ua-52,718	1736 ± 26 BP	**AD 252–306 (45.1%)** AD 311–340 (23.1%)	**AD 243–381**
Augland, K40 Gr I	Organic residue	Ua-52,719	1715 ± 26 BP	AD 260–280 (18.1%) **AD 325–382 (50.1%)**	**AD 252–392**
Augland, N60 3/5	Organic residue	Ua-52,720	1693 ± 27 BP	AD 332–395	AD 257–298 (16.2%) **AD 320–410 (79.2%)**
Augland I 55, Grop 4	Charcoal (birch & pine)	DF 681, T-1931	1670 ± 90 BP	**AD 251–432 (58.2%)** AD 491–531 (10%)	**AD 138–565**
Augland G 55, Grop 4	Charcoal (oak)	DF 681, T-1929	1610 ± 90 BP	**AD 345–550**	**AD 241–630**
Augland, M/65/21, Grop 1	Charcoal	DF 681, T-1874	1610 ± 60 BP	**AD 395 (40.6%)** AD 484–536 (27.6%)	AD 261–279 (1.6%) **AD 326–587 (93.8 %)**
Augland N 75, Grop 2	Charcoal (oak)	DF 757, T-2064	1610 ± 60 BP	**AD 395–475 (40.6%)** AD 484–536 (27.6%)	AD 261–279 (1.6%) **AD 326–587 (93.8%)**
Augland P 55, Grop 1	Charcoal (oak)	DF 681, T-1932	1560 ± 90 BP	**AD 409–585**	AD 260–280 (1.5%) **AD 325–653 (93.9%)**

produce was widely distributed in southern Norway in the LRIA and MP (Rødsrud 2012; 2016), it should be observed that Oddernes is located at the point where exists the shortest sailing distance across the Skagerrak to Jutland (Fig. 1). Together with the elite milieu in Fjære in Aust-Agder (Skjelsvik 1961; Grieg 1990 [1939]; Larsen and Sollund 2002; Stylegar 2007, 82–99; Stålesen 2011; Kallhovd and Stylegar 2014), Oddernes was a northern nodal point in a trans-Skagerrak network that was sustained by a continuous exchange of material culture, social practices and ideology throughout most of the Roman Iron Age (Rolfsen 1976; 1992, 35–9; Bagøien 1978; 1980; Larsen 1990; Kallhovd 1991; Stylegar 2006, 208–13; 2007, 80–99; Sæther 2018). Relevantly, Hulthén (1986, 75) documented a direct link between samples from Augland and those from Fjære. The settlement pattern around Oddernes is different from its wider region, and very similar to the village organization typical of Jutland (Larsen 1990; Rolfsen 1992, 35–9; Stylegar 2006, 208–13; 2007, 80–99). Oddernes is the most likely 'point of arrival' for craft techniques and knowledge that crossed Skagerrak earlier in the RIA (Resi 1986, 51–3; Myhre 1987; Rundberget and Larsen 2014). The continuous trans-Skagerrak interaction sustained a sense of tradition throughout the LRIA and into the early part of the MP (Stylegar 2006, 211–13; Stålesen 2011), at which point it seemingly lost momentum and its connections faded.

Socio-political change and ceramic chronology

The fifth century saw a unique process of institutional and cosmological invention in Scandinavia (Hedeager 2011). The social development during the RIA had opened up increasing power struggles over landholdings, and this culminated in a period of upheaval in the decades leading up to AD 500. This represents a deep ideological change, where a number of new mental and social structures were created (Herschend 2009, 377–81). Social turbulence continued into the sixth century and was amplified by the 536–540 events (Price and Gräslund 2015). However, the high degree of regional variation (Moreland 2018 with references) underscores the importance of approaches that are sensitive to local context and topography for the modelling of macroscale social dynamics and political organization. And, as discussed elsewhere (Amundsen and Fredriksen 2014, 82–4; Fredriksen *et al.* 2014, 124), written sources can only be used retrospectively or by analogy for the area and the time period in question. For our case, seeking to understand the dynamics between craftspeople and their wider social surroundings in the two centuries leading up to the turbulent sixth century means that we need: a) an alternative to retrograde methods (see next section); and b) a regional ceramic sequencing that provides the necessary chronological control. Fortunately, the temporal resolution has improved significantly in the recent decade. Inventive typological work (Kristoffersen and Magnus 2010) has made it clear that the focus should be on social institutions in the fifth century when seeking to understand the demise of ceramic craftwork (Fredriksen *et al.* 2014).

For the study of the terminal century, the presence of diagnostic western mode (bucket-shaped) sherds provides a temporal baseline. The bucket-shaped vessel sequence consists of Phases I–III (Fredriksen *et al.* 2014). Phase I is especially relevant for Augland. Extending to the mid-fifth century, this phase is quite uniform for south-west Norway. The production did not require special knowledge. Accordingly, no specific area of origin is identified, although Rogaland is the only region where production centres have been located throughout the entire sequence (Kristoffersen and Magnus 2010, 119). Previous work found that Phase I has an early and a late stage. Early western mode vessels clearly resemble the southern mode specimens, sharing the characteristic light coloured, dry and sandy fabrics (Shetelig 1905; Bøe 1931; Engevik 2008; Kristoffersen and Magnus 2010; Rødsrud 2012). Late Phase I is characterized by diagnostic elements that signal the transition to Phase II (two of them being identified at Augland): pastes with high contents of steatite and asbestos (see Engevik 2008, 130–2, 148) and the surface-covering decorative expression discussed earlier. These were core elements for the western mode after Phase I (Kristoffersen and Magnus 2010, 121). However, as we shall see, it seems that Augland was not part of this development.

APPROACH

The integration of the ceramic technology at Augland into a socio-political synthesis requires a bottom-up approach that is sensitive to the dynamics between the two modes in the terminal phase. Our relational approach (Duistermaat 2017, 125; see also Budden and Sofaer 2009) focuses on variations in learning frameworks, in differences in skills, gestures and knowledge. Differences in *chaînes opératoires* (Wallaert-Pêtre 2001; Roux 2017) at the micro-level have implications for long-term change in ceramic sequences (Crown 2014, 75). The changes may be related to wider socio-political aspects, including the makers' social identity and how their produce was associated with the consumers' collective memory: such can help explain the demise of ceramic crafts at Augland.

The individual artisan is best understood when they are placed within a community and a lineage of practitioners. The *community of practice* concept describes a group with a shared history of learning and engaged in a joint enterprise (Wenger 1998; Crown 2014, cf. Lave and Wenger 1991). Learning takes place in the arenas where identities are made and shaped, so that apprentices learn specific ways of doing things that convey belonging and difference (Crown 2014, 76). The *recipes* of a specific community of practice are defined as clear and repeated patterns common to potters with a shared understanding of the 'rules' for making a specific repertoire of socially acceptable vessel types (Budden and Sofaer 2009, 209). Knowledge transfer through apprenticeship involves acquisition of embodied knowledge (Wallaert 2012, 23–5; Wendrich 2012, 4–5). Changes to techniques may therefore be intimately tied to the craftsperson's identity (Budden and Sofaer 2009, 209).

Comparative ethnographic work has shown that shaping techniques are key to understanding changes in the recipes of communities of practice (Gosselain 2008; 2011). Shaping requires the learning of rhythmic motions over extended time periods, and their successful mastering results in a new status of independence as a craftsperson. Shaping, therefore, relates to group identity more often than other *chaîne opératoire* stages. However, while usually a resilient and stabilizing factor, the shaping stage may also create conditions for sudden changes (Gosselain 2011, 214–21). When such shifts actually occur, key factors to consider are: relocation of craftspeople; new producers coming in and causing changes to social identity; and new connections between communities of practice with different learning frameworks (Roddick and Hastorf 2010, 164–7 with references).

The memories of how to assemble materials and make things are distributed within the community of practice (Fowler 2017, 96). Changes to ceramic recipes may therefore be related to new ways of performing and making among the group of practicing artisans and their wider social context. The recipes for making specific forms of material culture were deeply tied to the identity of craftspeople as makers of *social memory*. Ceramic practices cite earlier customs and events, and a recurrent citation of the past is fundamental to the ongoing process of remembrance, of making and remaking memory (Lucas 2012, 195–201).

For the case of Augland, the meeting between the southern and earlier mode and the western latecomer may be described one between two forms of learning networks (see Miller 2013, 229–33, fig. 11.1) where strategies are – consciously or unconsciously – structured to develop either *closed* or *open* abilities (Wallaert-Pêtre 2001, 482–5). The southern mode peaked in quality with the black burnished vessels, which emerged slightly earlier in the LRIA than the bucket-shaped ones (Stout 1986). While locally produced and co-existing with the western mode, the black ware was clearly a continuation of previous types present in the southern mode and remained largely standardized and unchanged. On the other hand, the bucket-shaped ware was characterized by experimentation and continuous development, gaining momentum around the transition to Phase II (Fredriksen *et al*. 2014, 123). A relatively closed learning network is one characterized by behaviours leading to a strict and faithful reproduction of style, while a more open network has an adaptability to unknown situations and a tendency for trial-and-error learning (Wallaert-Pêtre 2001, 482). Phase I of the western mode is characterized by a 'flat' structure without discernible nodal points for learning. Consequently, our hypothesis is that the introduction of bucket-shaped pottery at Augland represents the arrival of an open and easy-to-copy work mode at an existing workshop milieu that faithfully reproduced the types of the southern mode, which carried specific references to social memory.

The two modes' different roles in practices of remembrance can be further accentuated by observing the ceramic manufacture within a more general pattern that also includes consumption. The use of ceramics in graves carries different ideological connotations. The southern black ware is associated with sets of tableware for the serving of food and drink throughout its entire existence (Rødsrud 2012, 50, 214–17). The western bucket-shaped pot, however, was most likely invented as a cooking vessel (Kleppe and Simonsen 1983). Only subsequently, in Phases II and III, did its primary use shift to serving food and drink. Moreover, it may have been that only one bucket-shaped pot accompanied each buried individual during the MP in West Norway (Magnus 1984, 142); this distinct one-to-one relationship has led to the argument that the type became an ontological metaphor, with the pot becoming intimately linked to the identity of the deceased (Fredriksen 2006, 132–4).

METHODS AND MATERIALS

Our approach to the recipes and transmissions of communities of practice consists of an overarching framework: within this are integrated different methods generating three datasets. The temporal resolution for the western mode provides a reliable chronological frame for the terminal century, which enables us to trace technological changes and relate them to the wider socio-political context.

Macroscopic analysis

The macroscopic analysis was conducted in two stages. The first was a survey of the entire ceramic assemblage, selecting samples that were clearly marked with a reference to the spatial distribution grid from the 1974–1975 excavations.[2] The analytical procedure followed the approach outlined by the Prehistoric Ceramic Research Group (2010), and the set of variables there proposed, customized according to the typological framework by Kristoffersen and Magnus (2010). The typological selection was approached as a dialectic feedback between the individual vessel sherd and previously defined types. This resulted in a broad classification of the material into four ware types: black burnished wares (So), tablewares (Bo), bucket-shaped pottery (Sp), and miscellaneous cooking wares (M).[3]

Secondly, given our focus on the dynamics after the introduction of the western mode until the end of production at Augland, samples that could be related to the fourth and fifth centuries were selected for further visual analysis and pXRF analysis (see below). The selection was supported by established criteria for the relative quality of paste recipes for the western mode (Fredriksen *et al*. 2014, 126–7): surface treatment (decoration, burnishing, slip colour), ware type (ware colour, mineral inclusions, grain size) and ware thickness. The sample size is estimated to represent 140–150 different vessels (15–18% of the grand total). This sampling strategy secured a full overview of the range of western mode recipes at Augland, and serves as a reliable basis for a comprehensive analysis of links between the western and the southern modes in the terminal century.

A high proportion of non-decorated sherds that could be reliably related to either of the two modes were selected for sampling, in order to: a) test the groups identified by macroscopy against the results generated from the pXRF data (see below) and, on this basis, b) evaluate to what extent pXRF data provide the same categorizations and whether it brought novel information that is of classificatory significance. This procedure may pave the way for future studies that increase the percentage of non-diagnostic ceramic material available for inclusion.

Analysis of p-XRF data

Following the approach described by Goren *et al*. (2011) for the use of pXRF with Silicon Drift Detectors (SDD) for Non-Destructive Testing (NDT), the third dataset was generated by pXRF analysis of the samples previously selected for the macroscopic study. The pXRF apparatus used was a Thermo Scientific Niton XL3t-900, equipped with an anode able to reach 50 kV and 200 µA, a Geometrically Optimized Large area Drift Detector (GOLDD), 80 MHz real-time digital signal processing, and dual embedded processes for computation and data storage. We employed the proprietary 'mining' testing mode Cu/Zn. The apparatus uses a filter for each of the four irradiation settings (namely, for main, low, high and light ranges of elements). The apparatus is capable of detecting up to 50 elements through the mining mode (Goren *et al*. 2011, 688). Applying this mode, the instrument was set to the irradiation times of 30 seconds for each of the four filters, with the measurement unit set to ppm. Acknowledging the limitations of pXRF without any additional sample treatment (Hunt and Speakman 2014), correct quantitative results can be obtained only for homogeneous samples with no layering. Therefore, to average out a possible varying internal

2 All sample IDs in this study refer to the excavation's original coordinate system, and may therefore be spatially plotted if and/or when the report should appear.

3 The codes refer to standard terms in Norwegian ceramic nomenclature: *sortglittede kar* (So) for black ware, *bordkar* (Bo) for serving vessels, *spannformede leirkar* (Sp) for bucket-shaped vessels, in addition to the generic category *diverse kar for matlaging og forråd* (M) for miscellaneous cooking/storage vessels.

structure, a large sample area was analysed and repeated measurements performed at different positions to test for non-homogeneities. Importantly, a non-flat structured surface can be tolerated with the geometry of our instrument (Goren *et al*. 2011, 688).

Each sample sherd was tested on at least four locations. The quantitative handling of the data included several stages. First, the measurements taken from each sample were compiled on an Excel spreadsheet. To obtain the elemental composition, the content value of each element for each sample was obtained by averaging the measurements on the single locations. Deviant values were discarded according to the ISO-recommended Grubbs' test with $P = 0.05$. The readings were deleted when they did not contain results for aluminium (Al), phosphorus (P) and sulfur (S).

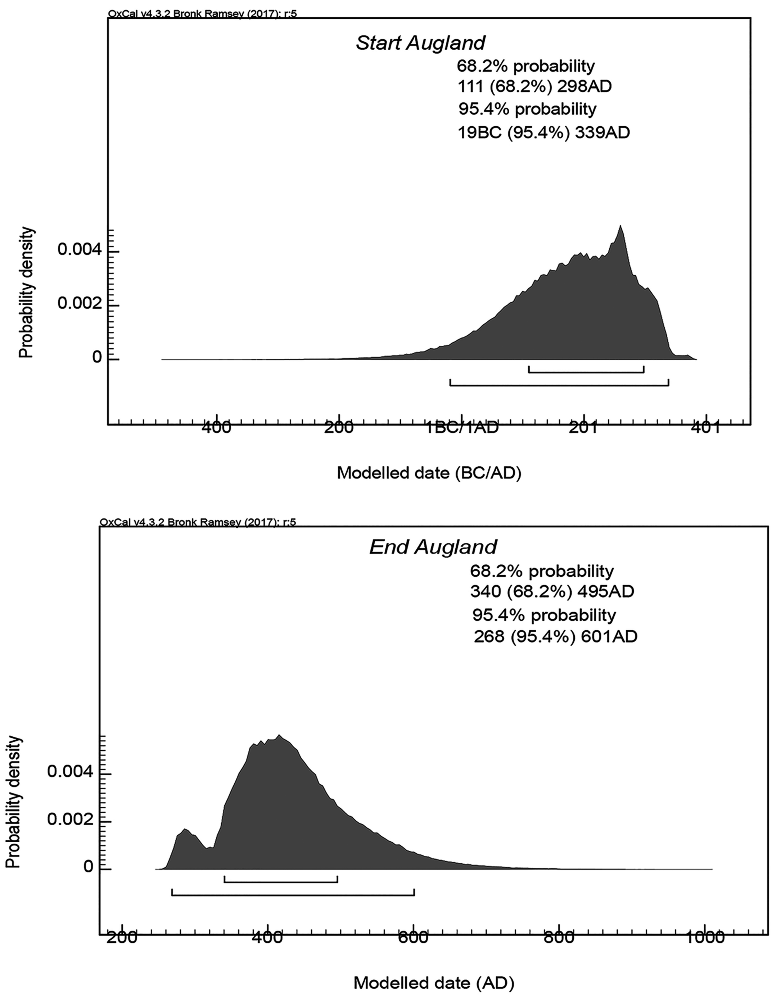

FIGURE 4
Bayesian model showing start and end phases at Augland, using Trapezium priors (Lee and Bronk Ramsey 2012).

Subsequently, two approaches to the data analysis were investigated: multivariate analysis with Principal Component Analysis (PCA) and the visualization of the contents of potassium (K) and titanium (Ti) for each sample. PCA was carried out using the 'prcomp' command of R 3.4.2 (R Core Team 2017). RStudio 1.1.383 was used as Graphical User Interface (RStudio Team 2016). For PCA, three matrix datasets were tried: a) the whole dataset composed of the averages of the content given by pXRF for 12 elements [nickel (Ni), iron (Fe), manganese (Mn), chromium (Cr), Ti, calcium (Ca), K, silicon (Si), magnesium (Mg), Al, P and S]; b) a sub-dataset composed of the averages of the content given by pXRF for nine elements (Fe, Mn, Ti, Ca, K, Si, Mg, Al, S), as described by Hunt and Speakman (2014); and c) a sub-dataset composed of the averages of the content given by pXRF for four elements (Ti, K, Si, Al), as described by Goren *et al*. (2011), being the results of the contents for rubidium (Rb), zirconium (Zr) and niobium (Nb) available only for a subset of the whole results. The PCA carried out with the different matrix datasets (a-c) reproduced the pattern given by the plotting of the K and Ti contents to such an extent that only this, for the sake of simplicity, will be illustrated in the following discussion.

RESULTS

Dating the end of the Augland workshop

We recovered the results from 14 samples analysed in 1975. In addition, samples of organic residue from three sherds of different types were radiocarbon dated (marked *Augland* in Table 1). The samples were recalibrated using OxCal v. 4.3 (Bronk Ramsey 2009). The dates range from 168 BC to AD 653 (2 sigma), but the level of activity at the site clearly peaked in the third and fourth centuries AD.

In addition, Bayesian statistics was applied to identify the most likely start and end phases for the activity at Augland, using 'trapezium' priors (Lee and Bronk Ramsey 2012), a model that allows for gradual changes/transitions. The Bayesian model shows that the start-up of production lies between 19 BC and AD 339 (2 sigma), most likely AD 111–298 (1 sigma). The end phase at Augland lies between AD 268–601 (2 sigma), most probably AD 340–495 (1 sigma) (Fig. 4). The model indicates a marked decline in activity at Augland in the second half of the fifth century, and this observation is corroborated by the macroscopic study. Typologically speaking, there are few indications of ceramic production after *c*.AD 450–460 (Kristoffersen and Magnus 2010). This transition broadly coincides with the transition to Phase II, for bucket-shaped potting in south-western Norway (Fredriksen *et al*. 2014).[4]

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[4] The relative dating of metal artefacts recovered at Augland offers additional chronological support. Bronze smiths worked alongside the potters, and four copper-alloy fibulas – a cruciform brooch and three small-long brooches – help define the end-phase at Augland. The cruciform brooch is of Reichstein's (1975, 36, pl. 32) type Eine, dated to the first half of the fifth century. The small-long brooches are more difficult to date, as no clear sequence has been established (Rogers 2007, 118–19; Røstad 2016, 272 with further references). Shetelig (1911, 61–8) placed the type mainly in the late MP, but two of the three have divided/undivided lozenge-shaped feet (*takfot* and *planfot*) that seem to mirror the larger silver-foil/relief (cross-headed) brooches (Hansen 1970, 65–6, figs. 61–2, Sjøvold 1993, 16–17, Group A, types 11 and 12). This indicates that the two brooches date to AD 350–450. Consequently, metal production at Augland probably ended not long after AD 450 and before 500. This resonates well with the radiocarbon probability curves of the end-phase (Table 1 and Fig. 4) indicating that activity declined rapidly after AD 450.

A three-stage sequence for Augland's terminal phase

Relating the K-Ti plot of the pXRF data (Fig. 5) to the macroscopic observations, the material may be organized into four main clusters: a 'Main recipe' cluster for the southern mode (Fig. 6), and Clusters 1–3 including samples of the western mode (Table 2). The Main cluster consists of samples of all three southern ware types: So, Bo and M. The cluster includes virtually all So samples, the majority of the Bo samples (seven exceptions) and almost all M samples (three exceptions). Typologically speaking, the Main cluster is temporally heterogeneous and includes samples that could span the Augland workshop's entire life time of over 250 years.

The macroscopic observations show that Cluster 1 (Fig. 7) consists of light-coloured sandy wares. The Sp sample is of the earliest known Phase I variant, and groups with one Bo and two M samples. While small, the cluster is distinct and supports a link between the earliest examples of the western mode and food preparation practices.

Cluster 2 is more heterogeneous. This comprises all four ware groups and contains several examples of intimate crossovers between the western and the southern mode (Table 3). The proximity of some Sp and Bo samples is especially striking: in at least two instances, Sp and Bo vessels may well come from the same prepared batch of clay. Following Hulthén's (1986) observations of shaping techniques, this means that there is a relative closeness between recipes made using the simpler roughout/drawing technique (Bo and M) without black-burnishing and the plate/mould technique (Sp), whereas there is relatively more distance between plate/mould potting and the black-burnished wares made using N technique coiling. From a technological and chronological perspective, Cluster 2 may be identified as a transitional group where mixing and hybridization occurred.

Cluster 3 is the clearest category in the entire assemblage (Fig. 8). Comprising four Sp and one Bo sample, it is characterized by its relative low K and Ti content values. Moreover, the visual

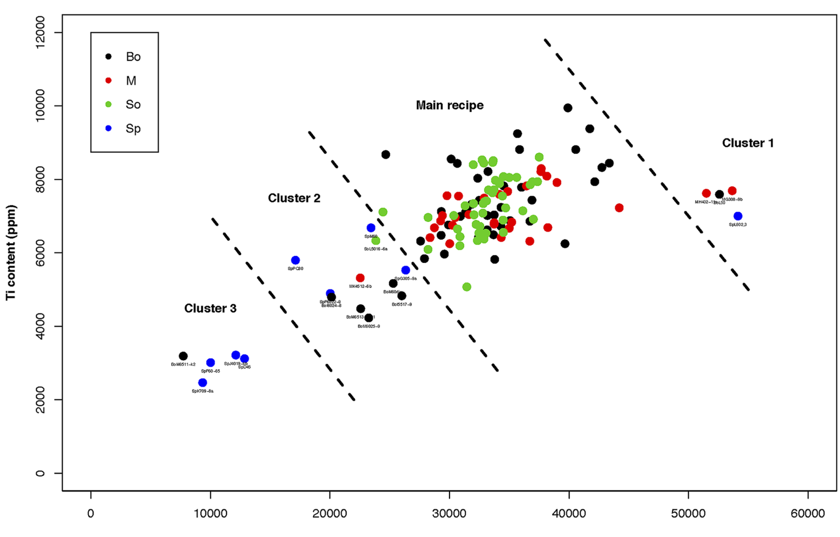

FIGURE 5
K-Ti plot of the Augland pXRF data. Stippled lines indicate grouping into Main recipe and Clusters 1–3.

FIGURE 6
Example of vessel made using the Main recipe of the southern mode. Partly refitted from sherds from Augland. (Photo by Ove Holst, Museum of Cultural History, University of Oslo).

TABLE 2
List of types in this study, their relationship to Hulthén's classification and the sherd thickness range for each type

Type code	Vessel type	Hulthén's (1986) Group	Shaping technique	Sherd thickness
So	Black-burnished	A	N technique coiling	3–8 mm
Bo	Other serving vessels	D	Roughout and drawing from lump	4–12 mm
M	Cooking vessels, miscellaneous	B, C	Roughout and drawing from lump	4–13 mm
Sp	Bucket-shaped	E	Plate/mould technique	3–8 mm

analysis confirmed this cluster as distinct: all four Sp samples had visible inclusions of steatite or soapstone. The Bo sample (M65) was observed as atypical for the southern mode and, although a significantly thicker ware, could be from the same batch as two of the bucket-shaped samples (Sp K70 and Sp J40). The macroscopic studies also revealed that the majority of Bo sherds with steatite temper belong to the group of tableware referred to by Bøe (1931, 156–64) as 'the little cooking pot'. This indicates that the earliest experimentation with steatite within the western mode was primarily connected with these cooking vessels. This again corresponds well with the argument that the invention of the bucket-shaped pot was related to changes in culinary practice (Kleppe and Simonsen 1983). Typologically, the Sp samples have elements of the Phase I–II transition. Two Phase II features are present: steatite tempering and traces of specially carved stamps that indicate a surface-covering decorative expression (samples Sp 45 and Sp F60-65). Also, all Sp samples adhere to the formal <4 mm-ware definition for high-quality bucket-shaped vessel recipes

FIGURE 7
Example of Cluster 1. (Photo by Christian Rødsrud). [Colour figure can be viewed at wileyonlinelibrary.com]

(Fredriksen *et al*. 2014), belonging to Phases II and III. Thus, Cluster 3 can be dated between AD 400 and AD 450–460, or slightly later. Most likely, vessels related to this cluster were among the last to be made at Augland.

The studied samples from Augland form a relative sequence of three stages, which can be correlated with the regional chronology for the western mode in the fourth and fifth centuries AD (Table 3). Cluster 1 is the earliest and Cluster 3 the latest phase, while Cluster 2 forms an intermediate stage with crossover examples. This middle phase is characterized by experimentation, before the use of steatite and asbestos becomes typical for bucket-shaped vessels (Engevik 2008; Kristoffersen and Magnus 2010; Rødsrud 2012; 2016; Fredriksen *et al*. 2014; Kristoffersen and Magnus 2015). Corroborating the general observation that the use areas for the bucket-shaped pot altered during Phase I (see above), the changes at Augland clearly indicate a drift from a concern for cooking vessels in the early Cluster 1 to having more in common with table wares in Clusters 2 and 3.

Importantly, while the identification of Clusters 1 and 3 finds support in previous typological observations, Cluster 2 has not been recognized until our study. This further emphasizes the value of a method that combines the use of pXRF as a sorting tool with more conventional visual analysis.

TABLE 3

Clusters 1–3 as a relative chronology for the terminal century at Augland. Definitions and main characteristics of recipes, and identified matches of samples most likely belonging to same paste batch

Cluster/Recipe	Stage in Phase I	Recipe definition	Characteristics	ID of likely same-batch examples (ware thickness)
1	Early	Light-coloured, sandy, dry, fine-ground, local materials	Recipe adopted from roughout technique types (Bo, M)	Sp L60, Bo L50, M G30 (5 mm)
2	Middle	Darker, more heterogenous, sand, glimmer, some imported steatite but mostly local materials	Transitional recipes merging with roughout technique types (Bo, M) and the N technique type (So)	Sp F60, Bo I60 (5 mm) Bo M60, M K45 (11 mm) Sp G30, Bo I55 (7 mm) Sp M60, So L50 (5 mm)
3	Late	Darker colour, high steatite and asbestos content (<50%), mostly imported materials	Distinct pastes with early Phase II characteristics, clearly separate from N technique (So), a few Bo examples of paste use	Sp F60, Sp D45 (3 mm) same ware as Bo M65 (10 mm)

FIGURE 8
Example of Cluster 3. Sherd of southern mode vessel with high steatite content. (Photo by Christian Rødsrud). [Colour figure can be viewed at wileyonlinelibrary.com]

A SOCIAL CHRONOLOGY FOR THE TERMINAL CENTURY

From the perspective of interaction between communities of practice, the western mode seems to have originated in an environment with relatively open capacities and characteristics. The seemingly swift spread across a wide area of a technique that was fairly easy to copy indicates a relatively 'flat' learning network. When entering Augland in the mid-fourth century AD, this mode encountered a more traditional, hierarchically organized and thus more closed mode. At Augland, we see an intimate interaction between the two first Phase I stages of the western mode, represented by Clusters 1 and 2, and the southern mode. These two stages are characterized by the use of overlapping and even identical recipes. In the first stage this was primarily for cooking pots, in the second the focus had shifted to serving vessels. Significantly, it is only for Cluster 3 that we see a clear divide between the western and the southern mode, in our case characterized by the inclusion of steatite. This situation may be interpreted as indicating a higher degree of cementation of the two modes, whereby the western has adopted more of the practices of closed learning networks. Such a cementation resonates well with the regional status assigned to the western mode, as characterized by the formation of distinct workshop milieux producing the high-quality wares in Phases II and III (Fredriksen *et al*. 2014, 123). However, as we have seen, this inclination for the Augland workshop to produce high-quality western wares did not make it to a fully developed Phase II.

Significantly, the current evidence does not support the idea that expert practioners of the external western mode were the primary cause for the demise of the southern mode learning network. Rather, the disjuncture seems to have developed from within, to become obvious only several decades after the initial introduction of the bucket-shaped pot. The main reason for this line of argument is that the earliest versions of the type were fairly easy to copy, even for non-specialists. It is hard to envision the making of these simple, cylindrical vessels on a mould (represented by Clusters 1 and 2) as very challenging for the skilled potters at Augland. However, the production of the thin (<4 mm) high-quality wares in Cluster 3 would be more demanding, requiring significantly more skills and experience. The cementation of the two modes in this final stage seems to reflect a clear divide of craftspeople specialized in different shaping techniques. The expression of difference in technique is linked to the making and remaking of the self, and changes of technique may, therefore, be intimately tied to the craftsperson's identity (Budden and Sofaer 2009, 209). In our case, we may relate this identity to being a maker of ceramic vessels with specific connotations to social memory.

Viewing the terminal century at Augland against a geographically wider and temporally deeper frame, the workshop's 'frozen' potting practices indicate that the southern mode had a significant role connected to past practices and events, within a tightknit network that stretched south across the Skagerrak strait. However, this fabric begun to fray and diminish between AD 400 and 450–460; there are few traces of activity at Augland in the following decades. The most likely explanation is that the Oddernes and Fjære milieux (the northernmost nodal points in this network) remained somewhat alien, outside and but loosely connected to their surrounding environment. They found a marker for their regional identity and collective commemoration in the performance of specific crafts that had a distinctive heritage and were anchored in remembrance of a past in Jutland across the Skagerrak. The demise of the southern mode is largely concurrent with a societal change in the organization of the household (Fredriksen *et al*. 2014, 132–3). This severed the ties to the previously dominant ideology of commensality, in which this mode was deeply embedded (Fredriksen 2006; Rødsrud 2012; 2016).

The final Cluster 3 at Augland can be related to the momentum gained by the regionally developed western mode, when craftspeople began exploring minerals with improved pyrotechnological benefits and a characteristic metallic look (namely, steatite). The evidence indicates that the end of manufacture at Augland coincides with the transition to Phase II in the bucket-shaped potting. This way of manufacture was embedded in a new elite ideology and regional identity. The new elite milieux along the North Sea coastline found a material expression in metalworking and the use of Style I animal art. The primary producers of this artwork were workshops located within the axis of magnate farms on Jæren. Interestingly, the falling away of ceramic production at Augland matches a lack of prestige finds of gold in the region (Reiersen 2017, 317–18, fig. 318, 311). This impoverishment indicates that extant nodal points along the southern Skagerrak coast were struggling to cope with the new western magnates, and perhaps those on Jæren in particular.

CONCLUDING REMARKS

The available evidence we have worked on relates to a shift in power and influence during the first five or six decades of the fifth century AD at Augland. The changes we see in the directionality of the networks can be described as a decline in the role of Augland's dominant southern mode as a carrier of social memory. The ties across the Skagerrak seem to have been severed and eventually faded away. This erosion of connectivity occurred within the time span of one or two generations, and can be seen in connection with our identified Cluster 3. The decline in exchange of materials, objects and ideas, and the failure to maintain the sphere of interaction across the Skagerrak (that included the continual transmission of craft knowledge) may well explain the demise of ceramic manufacture at Augland. The relatively frozen and closed ways of potting became brittle, and were eventually shattered by a more dynamic and open production mode. The western mode eventually gained ground because it was a regionally distinct invention that used a wider range of locally available minerals, and therefore more readily associated with regional differences on notions of heritage and identity. From a social memory perspective, the produce coming from Augland was and continued to be a foreign import that eventually ended up deprived of its local base.

Viewing the demise of Augland within the wider Scandinavian context, the southern mode seems to have been anchored in an older form of regional elite that lost its foothold during the early decades of the MP. As Frands Herschend writes, during the fifth century 'an old economically dominant aristocracy is replaced by a new one', and this new aristocracy is inspired by 'the notion of geographical network dominance rather than the realm' (2009, 380–1). As a northern nodal point in a trans-Skagerrak network, the Oddernes milieu may have experienced the same form of stagnation as their counterparts in south Scandinavia. The power struggles that characterized the RIA did not end well for Oddernes and Augland. The new elite milieux along the North Sea coastline, on the other hand, heralded the new form of leadership ideology, and this ideology was expressed in new forms of artwork.

Our synthesis resulted from a contextually sensitive archaeological analysis, informed by an ethnographic approach to craft learning and transmission. The identified recipe clusters provide a firm basis for a three-stage relative chronology for the workshop's final century of ceramic manufacture. This chronology offers a novel departure point for future engagement with the Augland material and the site's connections to other regions in Scandinavia and beyond. Given the fragmented state of the site documentation, this study would not have been possible without developing a low-cost quantitative analysis for a statistically significant proportion of the ceramic assemblage. We needed such an intermediary stage that was able to sort and group large amounts of material, and so facilitate the future selection of samples for petrographic or geochemical study. This pXRF tool offers an approach for other research scenarios facing similar challenges.

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(PDF) Department of Archaeology, Conservation and History
University of Oslo
NORWAY
E-mail: p.d.fredriksen@iakh.uio.no

(CLR) Department of Archaeology, Museum of Cultural History
University of Oslo
NORWAY

(FC) Department of Art Technology
Swiss Institute for Art Research
Zurich
SWITZERLAND

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