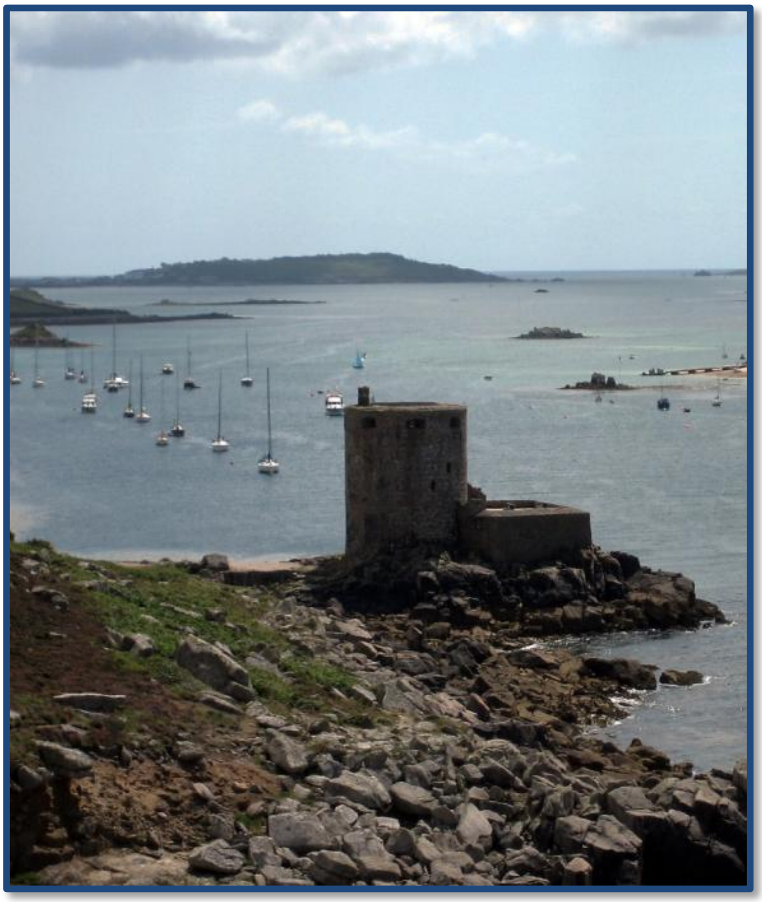
Tresco Channel

Isles of Scilly

Survey Project



Project Report 2011

ProMare & CISMAS

Acknowledgements

This project was undertaken jointly by the Cornwall and Isles of Scilly Maritime Archaeology Society (CISMAS) and ProMare. The project would not have been possible without funding generously provided by ProMare. The site was previously investigated by the charter boat skipper Dave McBride, who recovered a number of pottery fragments from Tresco Channel. The project has also received help from Ambient Pressure Diving, Tania Weller, Richard Larn and Sean Lewis. The pottery report was undertaken by John Allan, Duncan Brown and Michael J Hughes and appears in appendix I of this report. The Bone report was produced by Laura J Miller and is reproduced in appendix II.

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Contents

Project Summary

The existence of medieval pottery in Tresco Channel has been known for some time. In 2011 a local diver (Dave McBride) recovered a quantity of medieval pottery from around yacht moorings in the channel and brought it to the attention of CISMAS. This pottery was of French origin and initially dated to the fourteenth century. Later that year, CISMAS and Promare undertook a survey of the seabed in this area and recovered over 250 sherds of pottery. This again was mainly French (Saintonge), and after careful study was also dated largely to the late 13th / early 14th century. The pottery distribution was mapped and shows a distinct concentration around two of the mooring buoys.

It seems likely that this pottery is being removed from the seabed sediments by the action of the mooring chains scouring the surface of the seabed. The narrow date range, restricted origin and confined geographical location of this pottery suggest a single event leading to its deposition. The most likely event would seem to be a medieval shipwreck, but there are other possibilities.

Given the date assigned to the pottery recovered, any associated wreck material would be of great importance to our understanding of maritime Scilly, and any surviving hull structure would be of national importance given the scarcity of wrecks of this period in the UK.

In 2013 CISMAS will undertake small exploratory excavations in the areas scoured by the two mooring chains; this work has been commissioned by English Heritage. The aim is to establish the source of the pottery and to determine whether there is any surviving associated wreck structure.

Background

Location

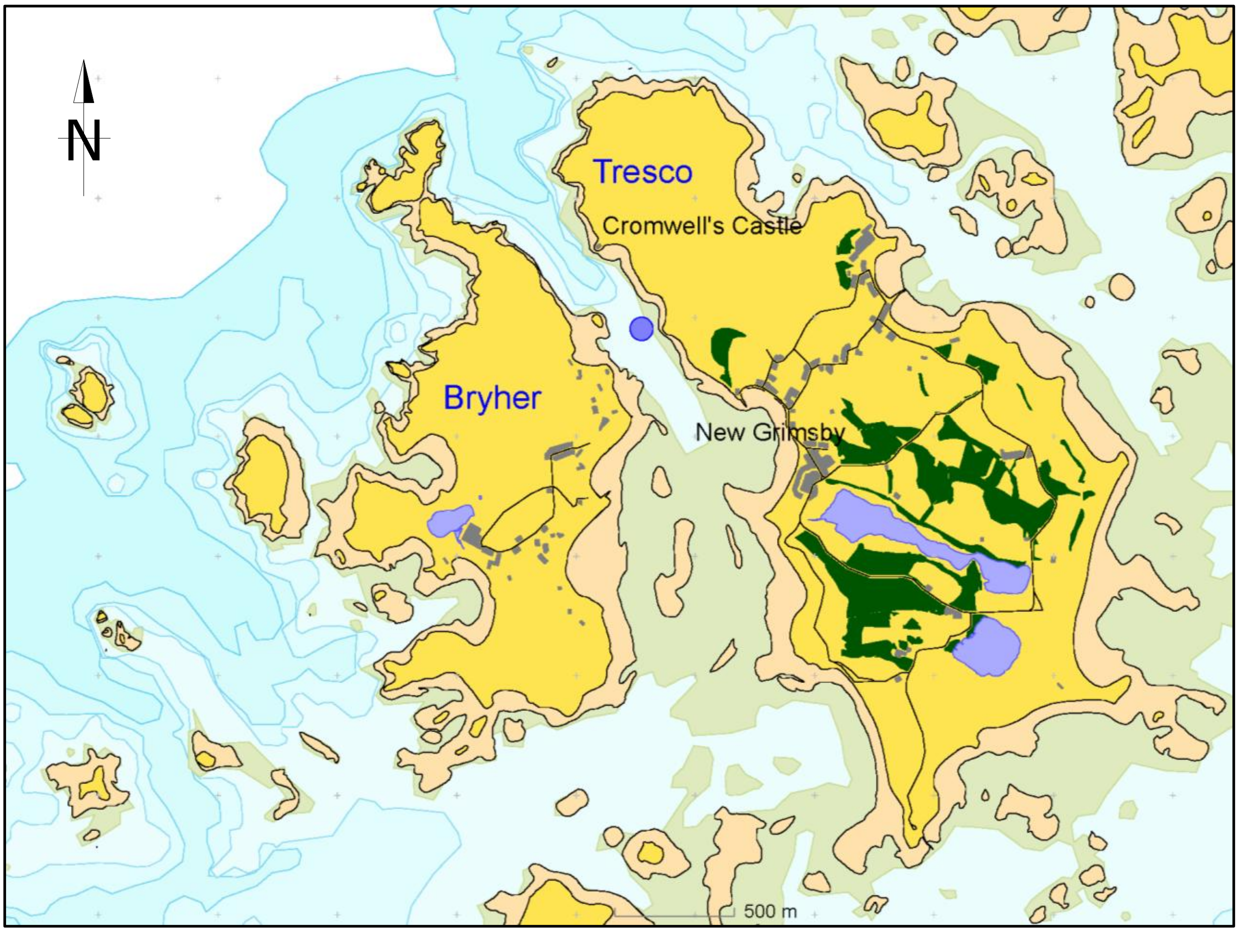


Fig 1.
The site is located in Tresco Channel, between the islands of Tresco and Bryher, on the Isles of Scilly. The site is shown by the blue circle.

The Site

Tresco Channel is a narrow stretch of water between the islands of Tresco and Bryher in the Isles of Scilly (fig. 1). There is a small harbour on the Tresco side of the channel, called New Grimsby, which lies close to the site (400m). The channel is defended by small coastal forts (on Tresco) of multiple periods, which lie approximately (350m) from the site. The earliest of these is a small blockhouse built in 1548-1554, which was replaced by Cromwell's Castle (see cover illustration) built in 1651 and enlarged in the mid-18th century. On slightly higher ground above Cromwell's Castle there is a ruined civil war artillery fort, King Charles's Castle, built in the mid-sixteenth century. All these defences were designed to protect the deep water approach to New Grimsby Harbour.

Fig 2.

Tresco Channel from the north; Cromwell's Castle is visible in the centre of the picture. The island of Tresco is on the left, and Bryher is on the right – photo Sarala Shama.

Shipping activity in medieval Scilly is mentioned by (Thomas, 1985, p.200) "Scattered references hint that, in the twelfth and thirteenth centuries, ships from many parts of Atlantic Europe called at Scilly. There are fragments of French polychrome pottery of the time from Samson, St. Helen's and Tean".

Local Context - St Nicholas Priory, Tresco

The Abbey Gardens on Tresco contain the ruins of a monastic settlement. This was the priory of St Nicholas, a cell of the Benedictine Abbey of Tavistock, in Devon.

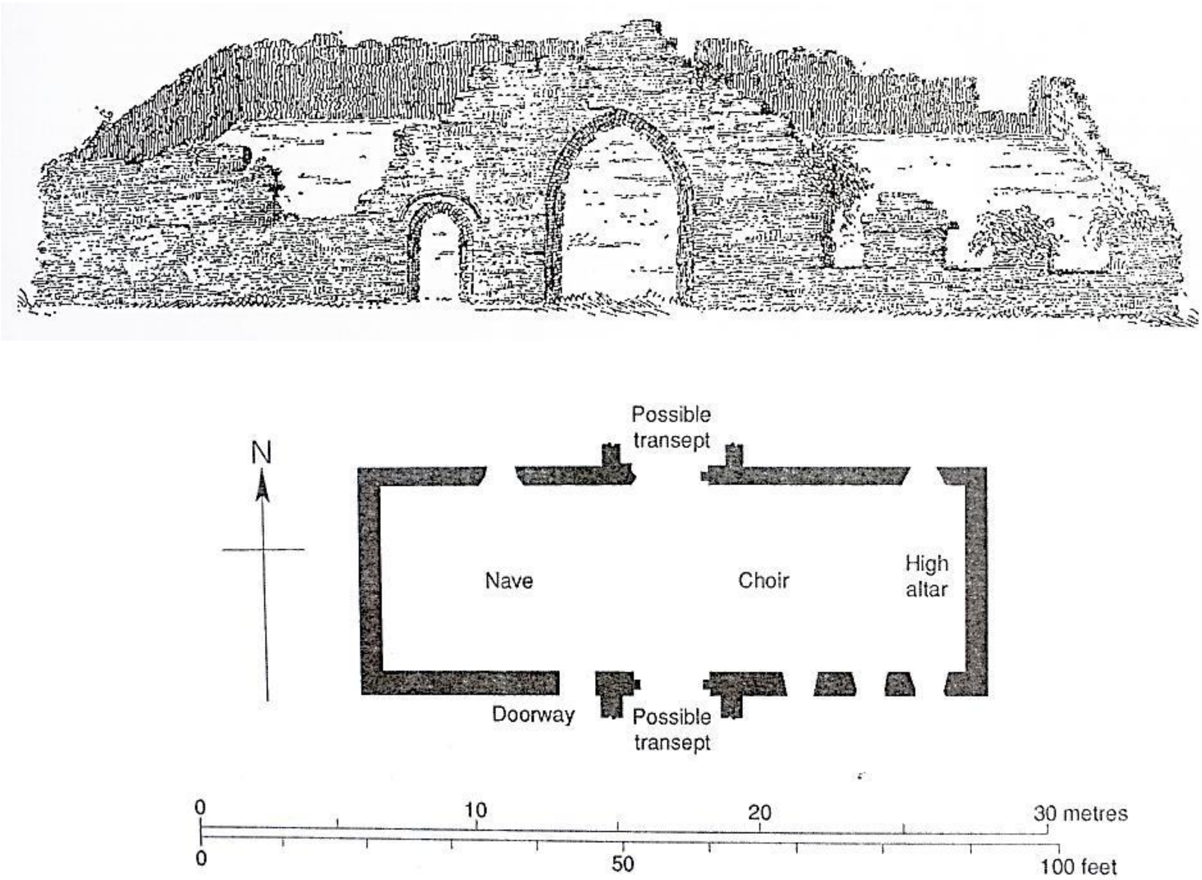


Fig. 3. The remains of the abbey church on Tresco recorded in 1756 by William Borlase.

In 1114 all the religious houses on Scilly came under the control of Tavistock Abbey, together with all wrecks except whole ships (Johns et al., 2004, p.75)(Bowley, 1968, p.39). St Nicholas' Priory was established on the island of Tresco. The priory was granted rights of wreck, a valuable and much wrangled-over asset which would only have any value if wreck was a reasonably common event. There is surprisingly little known about the abbey on Tresco; no record of its dissolution survives, and it may have already ceased to function by 1539 (Bowley, 1968, p.39).

There is some evidence that the abbey was involved with foreign trade. The 13th century *Orkneyinga Saga* tells how an early 12th century Viking, Svein Aseifarson, robbed a merchant ship belonging to the Monks of Scilly (Orme, 2010). This example of a monastic house engaging in shipping is by no means unique – another documented example is provided by Beaulieu Abbey in Hampshire, who owned their own ship *La Stelle* in 1269 (Ransley et al., 2011, p.247).

The abbey may well have had links with foreign trade, and further background research may yield useful information.

Pottery in Tresco Channel

The existence of medieval pottery in Tresco Channel has been known for some time. In 2001 Mac Mace, a mooring contractor in Scilly, informed one of the authors (Kevin Camidge) that green-glazed pottery was often found in Tresco Channel and was mostly French in origin. A dive at the time only revealed small, isolated fragments of green glazed pottery. The Archaeological Diving Unit (ADU) investigated the site in 2002 but they did not take the matter any further. The pottery is also mentioned in the Rapid Coastal Zone Assessment for the Isles of Scilly (Johns et al., 2004, p.123).

A significant quantity of French medieval pottery (mainly Saintonge) in material recovered from excavations undertaken as part of the electrification of Scilly is of interest, as this type of pottery is often seen as high status and the inhabitants of Scilly would seem unlikely owners of high status pottery (Ratcliffe, 1991). Saintonge is a small region on the French Atlantic seaboard, from whence pottery was widely exported in the medieval period, although this type is relatively rare on the Cornish mainland. This possibly betokens direct maritime trade between Scilly and France rather than transhipment via Cornwall, and is an important part of the maritime heritage of Scilly.

Pottery is one of the few trade items which survive well in archaeological contexts, and it is probable that it arrived as part of other, more perishable cargos. For instance in the mediaeval period wine is an important trade item, but other items such as pottery often accompanied it. (Ransley et al., 2011, p.273). Only small quantities of wine were produced in England and wine was imported, principally from Bordeaux. It was a high status commodity mainly consumed by the church and nobility. The measure of a ship's capacity was in fact derived from the number of standard Bordeaux wine tuns (c.252 gallons) which a ship could carry (Ransley et al., 2011).

Further evidence of trade links with France is exhibited by the presence of Caen Limestone reported in the fabric of the abbey church on Tresco and in the buildings on St Helens (Ratcliffe, 1991, p.93)

Previous Work

More recently, pottery has been recovered in considerable quantities (53 pieces in 2011) by David McBride, a local dive charter boat skipper. This has been recovered from a relatively small area (c. 15 m diameter circle) and appears to have been pulled from the seabed sediments by the action of a mooring chain. In June 2011, a concentration of animal bones was found about 20m from the concentration of pottery, and eight jaw bones, probably porcine, were recovered.

Fig 4. Some of the pottery collected by Dave McBride in 2011 (scale 10cm) – photo Dave McBride

John Allan has seen some of the pottery recovered by Dave McBride and reports that much of it is French (mainly Saintonge) dated to c.1300AD (John Allan pers.com.)

Fig 5
One of the jaw bones recovered by Dave McBride in 2011

Photo Dave McBride

Project Objectives

The primary objective is to search the seabed in the area around the recent pottery recovered by Dave McBride to determine its extent and distribution. By mapping the location of each piece of pottery, it should be possible to determine whether the pottery scatter has a focus or is randomly distributed. The pottery will be recovered so that the date range and origin can be determined. Any anchorage will accumulate detritus jettisoned from the vessels at anchor so a multi-period scatter of material can usually be expected. However, if there is a concentration of material from a single period or a small and well-defined location then an 'event', such as a wrecking, could be indicated. The concentration of Saintonge pottery recovered by Dave McBride and the significant quantities recovered from the electricity cable trenches in the 1980's may be indicative of either a wreck event or – perhaps - regular visits to Scilly by vessels trading with France.

Given the fourteenth-century date assigned to the pottery recovered by Dave McBride, any associated wreck material would be of great importance to our understanding of maritime Scilly, and any surviving hull structure would be of national importance given the scarcity of wrecks of this period in the UK.

Methods

The Searches

The site is overlaid by a line of yacht mooring buoys administered by the Tresco Estate. This is the reason the 2011 survey was undertaken in October when the moorings would be free of visiting yachts. The search started at the location discovered by Dave McBride and worked outwards until no more green-glazed pottery was found. Each search was centred on a shot line (or mooring buoy), the position of which was fixed using positions from a GPS receiver.

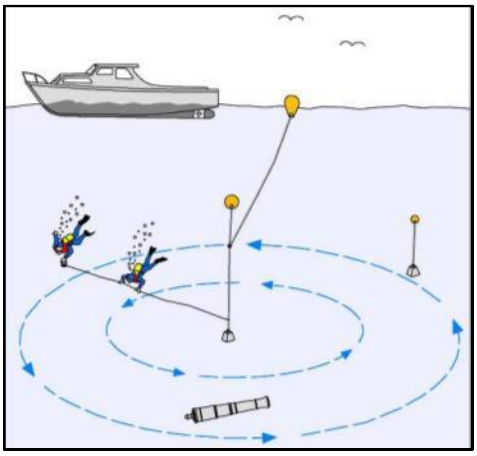


Fig 6
Diagram illustrating the circular search method used

Standard divers' surface marker buoy (SMB) reels were used as distance lines. These were marked at 1m intervals, as shown in fig. 7 below. The distance line was attached to the shot line 1m above the seabed, and a circular search was conducted by two divers. The divers were positioned along the distance line such that the innermost diver could clearly see the shot and the outermost diver. The spacing between divers varied depending on the visibility, but was usually two to three metres. Once a complete circle had been searched, the divers extended the distance line and continued with the next circle. A maximum search radius of 25m was used.

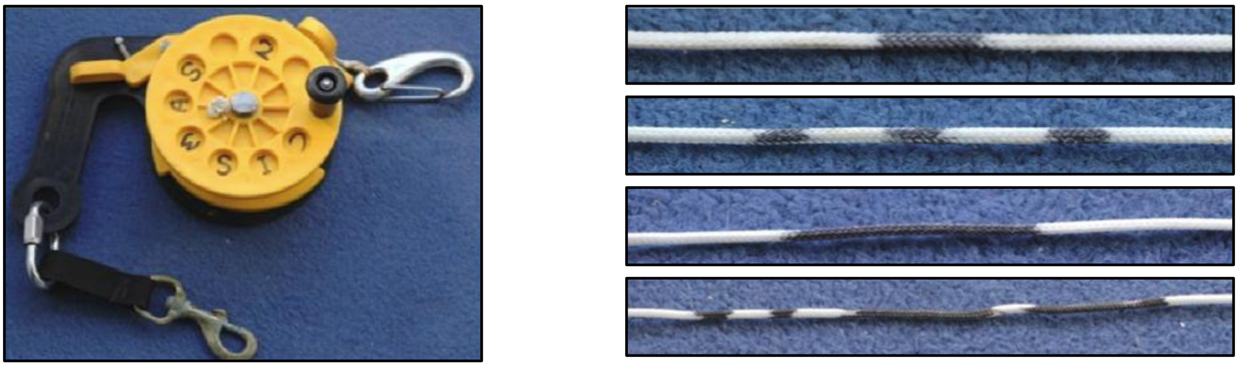
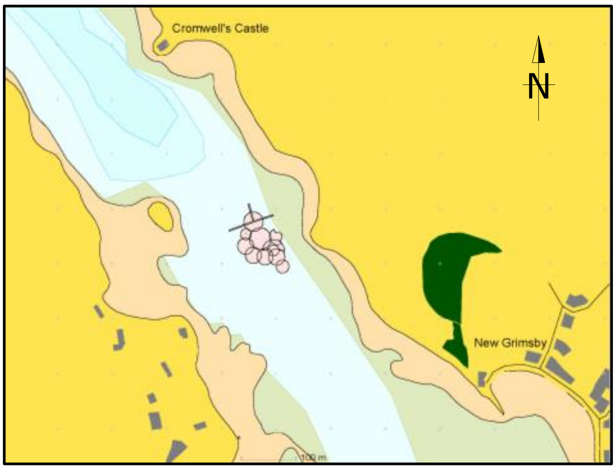


Fig 7. The SMB reel and markings (from the top down) 1m, 3m, 5m and 12m

When an artefact was located, the position was recorded by noting the distance to the shot (using the marked distance line) and the back bearing to the shot (using a diver's magnetic compass). This allowed the positions to be plotted using Site Recorder's radial positioning tool. This method of searching for and plotting artefacts was developed on previous CISMAS projects; a detailed description of the method is outlined in (Camidge et al., 2005) (Camidge & Randall, 2009)

Subsequent circular searches were carefully positioned to slightly overlap adjacent circles so that a complete coverage of the search area was obtained (fig 8).



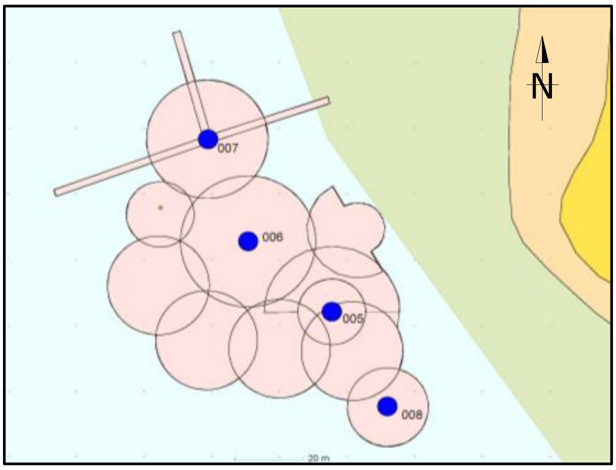


Fig 8 Left shows the position of the search areas, and right the layout of the circular searches. The yacht mooring buoys are shown as blue circles.

In total, eleven circular and three jack-stay searches were made, each search being given a unique number and plotted in Site Recorder. The total area searched was approximately 6000m^2.

Fig. 9 Divers conducting a circular search. Photos Sharon Austin

Survey Methodology

Primary positioning was done using a Garmin 76C WAAS-enabled handheld GPS receiver with an estimated precision of 4m (95%). All positions were given on the WGS84 datum with grid positions on UTM Zone 29.

Positioning of the circular searches was planned around the estimated positions for the mooring buoys and the area of seabed scoured by the mooring chains. The initial searches were done using the mooring blocks as the centre point while later searches were done using a shot line deployed from the surface at a pre-defined location.

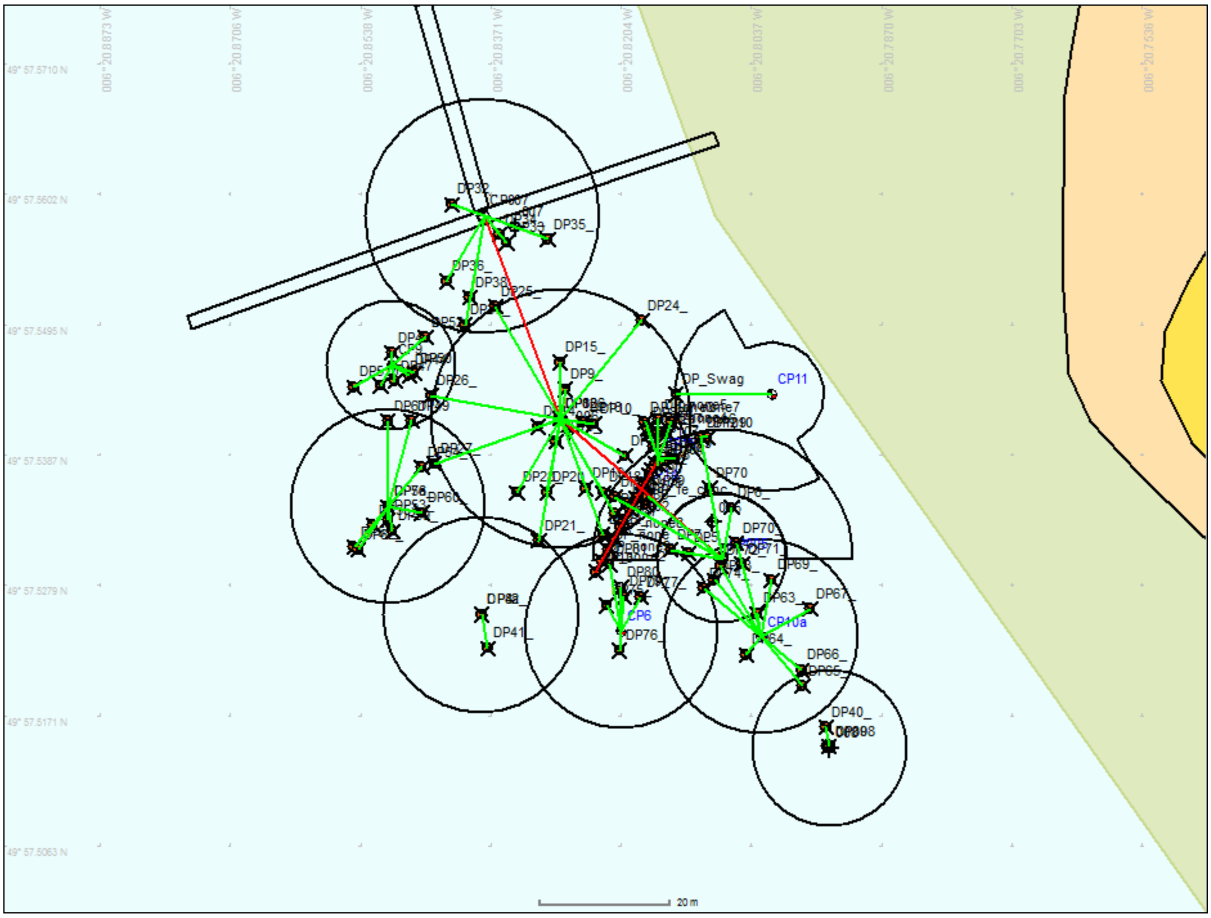


Fig 10. Survey methodology.

Artefacts were positioned using radial measurements back to a central shot line. The precision of a hand-held magnetic compass is in the order of 5° which equates to a position uncertainty of 1.8m at 20m. The estimated precision of absolute position for any artefact is better than 6m, but in tests the results were better as the same object could be positioned from two independent searches to within 2m.

Finds Handling

All finds were placed into pre-numbered minigrip bags on the seabed. Finds positioning was achieved by taking a distance and bearing to the centre of the circular search (mooring buoy or shot line). The centre of the search was established using a GPS receiver.

Pottery

The pottery was recovered to the surface. It was then photographed using a digital SLR camera (Nikon D70 with 60mm micro Nikkor lens). The pottery was desalinated in fresh running water for approximately four weeks until readings of the dissolved solids in the water showed no change over the fresh tap water used to wash it. The pottery was then marked and bagged. In total, 264 sherds of pottery were recovered.

Bone

The bone was recovered at the same time and in the same way as the pottery. At the surface the bone was photographed (separately to the pottery). The bone was reburied on site at the end of the project in a small hole c. 0.45m deep at position 690293.267E 5537442.734N. A total of 191 pieces of bone were recorded. Species identifications were made from the bone photographs and this faunal report is included in Appendix II below.

Results

Treasure Found (a bag of loot)

During one of the searches (TC11) a large sports bag was located on the seabed at 690288E 5537449N (UTM WGS84). The bag contained a number of bottles of alcohol, about £250 in cash and a charity collection box. This was handed over to the local police, who suspect that the money had been stolen from Bryher Church earlier in the summer. Richard Larn was a guest on the dive boat that day and subsequently informed the local press of the find. This resulted in several amusing stories in the national and local press – including the headline "*Loot-hunting divers stumble across real stolen treasure*" in the Western Morning News. As is often the case, archaeologists may be somewhat dismayed at the spin the press put on stories of their discoveries. *Loot-hunting* is perhaps a little pejorative, but *stumble across* is downright insulting when painstaking systematic searching was the means of discovery.

Fig 11.
The pictures which appeared in the Western Morning News and The Cornishman.

Above Lindsey Thomas with some of the alcohol; note Cromwell's Castle in the background.

Below left Richard Larn poses with the charity box while the finder, Peter Holt, looks on in the background.

Below Right PC Matt Collier with the bag of loot
Photo Peter Holt.
Photos Dave McBride

Distribution of the finds

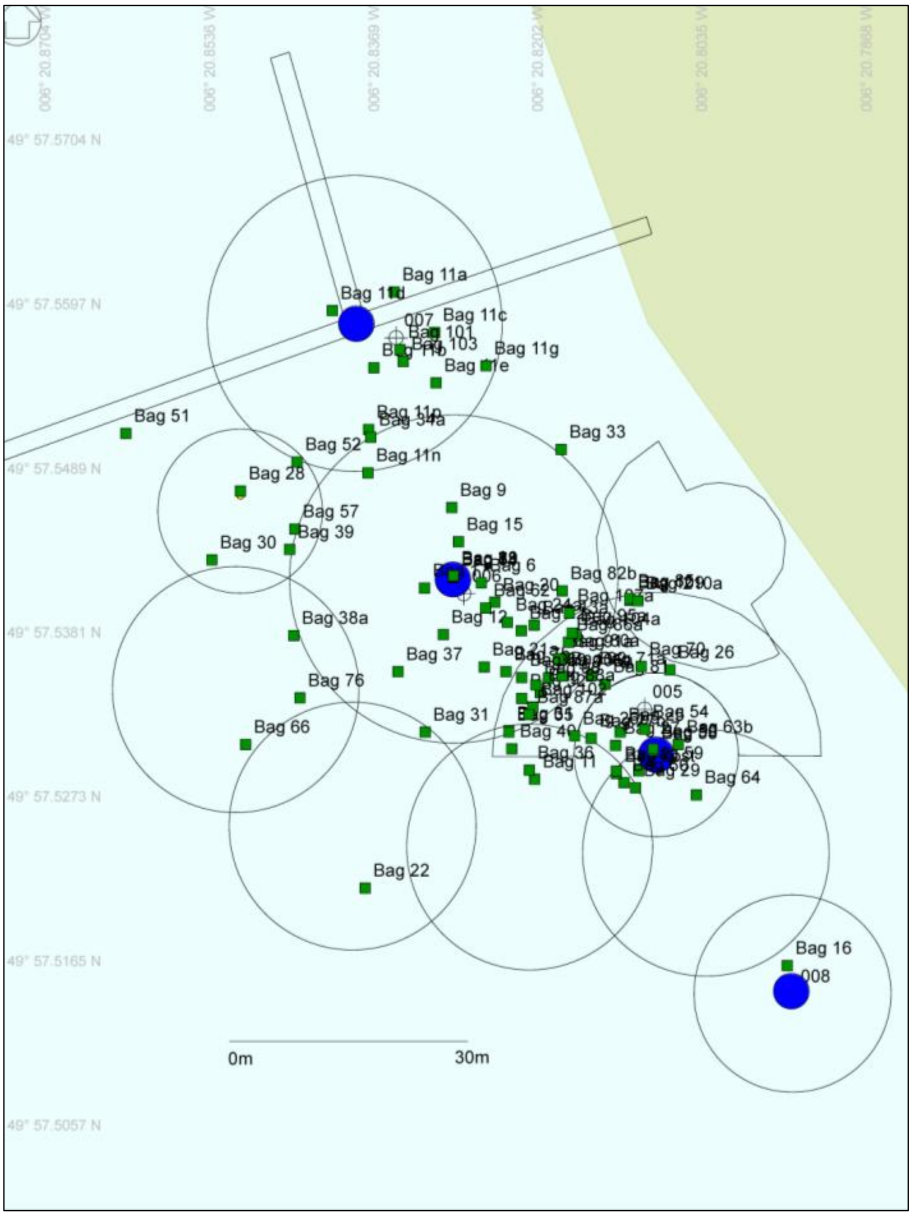


Fig 12. Distribution of the pottery. The mooring buoys are shown in blue.

The site is located within a line of mooring buoys which are evenly spaced at 33m intervals. The four mooring buoys shown above were positioned using a GPS receiver – their positions are as follows:

No	Position UTM (WGS84)
005	690295.484E 5537424.112N
006	690270.771E 5537445.489N
007	690258.909E 5537476.620N
008	690311.926E 5537395.295N

The moorings each consist of a stone mooring block c. 0.8m x 0.8m x 0.5m deep, partly submerged into the seabed sediment. A length of heavy chain approximately 3m long is attached to the mooring block, to which is fixed a length of rope tied to a mooring buoy at the surface. The mooring block is surrounded on the seabed by a shallow depression caused by the action of the heavy mooring chain being dragged around the block by the action of weather and boats on the mooring buoy. It is probably this scouring of the seabed by the mooring chain which has been responsible for exposing the pottery and bone from the seabed sediments. Four of the moorings are shown on the distribution plans (figs 12 & 13) as 005, 006, 007 and 008.

The pottery recovered by David McBride was all recovered from around two of the mooring buoys (shown as 005 and 006 on figs 12 &13). The precise location of recovery was not recorded but Mr McBride asserts that it all came from the area immediately around the mooring blocks.

The diver searches undertaken in this project located and recovered 264 sherds of pottery (fig 12) and 170 pieces of bone (fig 13). The distribution plan for the pottery demonstrates a concentration around the mooring blocks 005 and 006, the density of pottery becoming sparser the further from the mooring blocks you go. Interestingly the bone distribution (fig 13) is even more focused, clustered in a tight area between the two mooring blocks. It seems clear that the distribution of the recovered pottery indicates a single source for the majority of the pottery rather than a general scatter of debris in an anchorage.

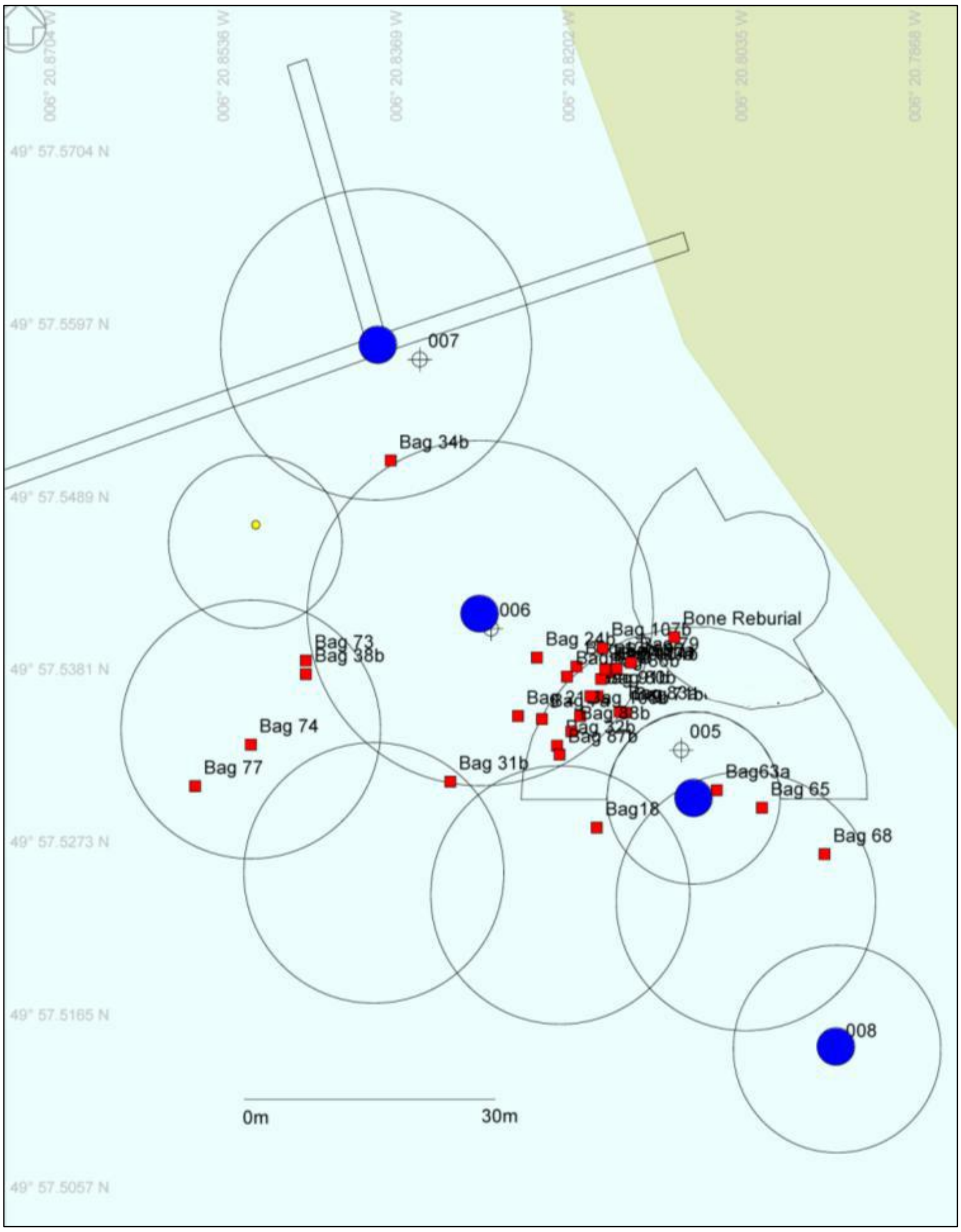


Fig 13.

Distribution of the bone. The mooring buoys are shown in blue.

The Pottery

A complete report of the pottery recovered is contained in appendix I. A total of 333 sherds of pottery were recovered, 264 in the course of this survey and 69 by David McBride. All of this pottery will be deposited in the Isles of Scilly museum on St Mary's. Apart from two or three 19th century sherds this collection of pottery is all medieval in date. The bulk of the pottery (60% of the sherds) is of the Saintonge type and dates to the late 13th/early 14th century. A smaller quantity of other French wares brings the total proportion of French ceramics to 73%. A much smaller number of sherds (14%) were of English origin, from the south-west and south-central regions of England. The balance of the pottery was unclassified and of indeterminate French or English origin (13%). One small group of pottery (16 sherds, less than 5% of the total) was Bristol ware dated to the late 12th century.

Pottery from Tresco Channel	
Pottery Type	**Sherds**
Saintonge	201
Other French	42
French or English	29
South west England	17
South central England	15
Bristol	16
Unclassified	13
TOTAL	333

The pottery was found clustered around two of the yacht mooring buoys (005 and 006 in fig 12), and the density of pottery finds decreased rapidly the further from these buoys the search progressed. This is the main reason that the source of this pottery is thought to be the action of the two mooring chains on the seabed sediments. These have visibly created a circular depression around the mooring buoys and it is easy to see how the action of these chains would disturb any ceramics buried in the seabed sediment in the region of these two mooring blocks. All the pottery recovered was contained within a circle of 65m radius centred on mooring buoy 006 (690270E 5537445N – UTM).

It must be remembered that this pottery was collected from the surface of the seabed, or embedded in mobile surface sediments. This is not stratified material and this part of Tresco Channel has probably been a mooring since at least the early medieval period. So pottery discarded from moored vessels could be expected on the seabed. However, it is remarkable that such a group of pottery, largely from a single source, has been found in such a small area of the seabed. The concentration of this pottery around a relatively small area of the seabed is also significant.

Finally, it is worth quoting the following two extracts from the pottery report (see appendix I). 'The concentration of sherds in a limited area, the almost complete absence (of) pottery dating after the 14th century and the consistency of dating of most of the material, suggests that the bulk of the collection represents a single event'. Also, 'The sample already recovered… amounts to the largest and most varied assemblage of medieval pottery ever recovered from a marine site in the UK'.

The Bone

In addition to the ceramics found on the seabed in Tresco Channel, a considerable quantity of animal bone was also encountered. A total of 204 fragments of bone were recorded on the site, 191 as part of this project and 13 fragments recovered by David McBride. The distribution of the bone recovered is shown in figure 13 above. The distribution of these bone fragments is similar to the pottery distribution (fig 12). The bone recovered in this survey (191 pieces), was recovered, photographed and reburied on site. Working from these photographs, Laura Miller has prepared a report on the bone which appears in appendix II of this report.

These bone fragments were found on the seabed or embedded in mobile surface sediments, so are not stratified. We have no way of knowing what period most of this material is from. However, at least some of the bone is of fairly recent origin, as clean cuts with marks consistent with band-saw cutting were noticed by Laura Miller (see appendix II). We have no idea how much (if any) of this bone is contemporary with the medieval pottery found in this survey. It should however be noted that the distribution of the bone is similar to that of the pottery (see figs 12 and 13) and is not just a random scatter across the seabed.

Of the 191 bone fragments recovered in this project the following identifications by animal class and species have been made:

Mammal	71.6%
Bird	0.4%
Fish	24%

Mammal bones recovered 2011		
Species	**Number**	**%**
Horse	1	1
Cattle	28	33
Pig	18	20
Sheep/goat	30	36
Rabbit	7	9

Table adapted from the bone report by Laura Miller reproduced in appendix II below.

For further details refer to the bone report in appendix II.

Conclusion

The distribution of the pottery and bone on the site suggests that these artefacts originate from a fairly well-defined location rather than from a scatter of material originating from an anchorage. It seems probable that, if this scatter was discarded material from a number of anchored vessels, the pottery would be spread over a wider area with a less well-defined focus. Furthermore 73% of the pottery found was French in origin, the majority of which (60% of the total) was from the Saintonge region. All but a tiny percentage of the pottery has been dated to the late 13th/early 14th century. The presence of English pottery of a similar date, amounting to 14% of the total, is of interest. The fact that this English pottery is from south-west and south-central England is probably also significant.

The large number of sherds originating from Saintonge in France leads to the speculation that these pots arrived here as part of the wine trade, the obvious candidate for such trade in Scilly being the nearby priory of St Nicholas on Tresco. This may even have been a trade undertaken by the priory on Tresco, as we know that the 'monks of Scilly' owned their own ship in the early 12th century (see page 10).

The obvious question to ask is how did such a closely dated group of pottery, much of it French, come to be located in such a tightly focused scatter in Tresco Channel? The spatial distribution and the fact that most of the pottery is of small temporal span tends to suggest a single event as the origin. Perhaps the most obvious such event is a medieval shipwreck, but other scenarios are possible. This could for instance represent a cargo (or part cargo) of pottery damaged in transit and jettisoned on the mooring in Tresco Channel. If this is the case then all that will remain is a large collection of medieval pottery buried in the seabed sediments. Another possibility is that a cargo of pottery was being lightered ashore when the lighter sank or capsized, in which case we have the possibility of a medieval lighter along with the pile of pottery.

The very small collection pottery from the Bristol area is probably of late 12th century date – about a century earlier than the rest of the pottery. This material is probably indicative of earlier shipping activity in Tresco channel. Again this is worthy of further investigation.

More work on the site is obviously necessary in order to establish exactly what (if anything) is buried on the site. Given the scarcity of English wrecks of this period the site is certainly worthy of further investigation. The most obvious course of action would be to excavate within the small areas being damaged by the mooring chains around buoys 005 and 006 – a course of action now planned to take place in September-October 2013.

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Appendix I – The Pottery Report

By John Allan, Duncan Brown and Michael J. Hughes

Introduction

Whilst diving in shallow waters beside Tresco Moorings, Isles of Scilly, in 2008, David McBride recovered a large sherd of medieval Saintonge pottery. Following its identification by one of the writers (JA), limited exploration in 2009–11 recovered 20 further fragments, some of them large and in fresh condition. The potentially high significance of these finds was highlighted in an assessment of the medieval and later pottery of Scilly, funded by English Heritage (Allan 2011). Since it seemed unlikely that large and delicate sherds of Saintonge pottery would survive unbroken for long in such a context, it appeared probable that some sherds had been newly disturbed. Promare funded a survey of the site in 2011, undertaken jointly by CISMAS and Promare, in which 264 sherds were plotted on the seabed and retrieved. A few additional pieces were collected subsequently, bringing the total sherd collection to 333 fragments.[1]

The site lies in the relatively sheltered waters of Tresco Channel, between the two largest islands of Scilly – Tresco and St Mary's. The modern moorings do not overlie a known historic harbour but this is one of the most sheltered anchorages on Scilly. The sherds were recovered from *c.* 7–8m of water. Modern sea levels are estimated to be *c.* 0.5m lower in Scilly than they were in the 13th and 14th centuries; at that time seawater at the site would thus have been *c*. 6.5–7.5m deep.

At least 145 different pots are represented. Fine white earthenwares from the Saintonge region of south-west France form the largest component of the group (60% of sherds, 50% of minimum number of vessels);[2] there are also vessels from Normandy and from a range of unlocated centres which probably lie in northern and western France. English sherds make up at least 14% of sherds. Ceramics from the Bristol area are prominent among this material, alongside finds from central southern England (possibly the Southampton area), and pottery from the coastal kilns of Cornwall or south Devon and from the Blackdown hills of Somerset and Devon. Most of the collection is datable to the period *c.* 1270–1300/1320, but a small element is almost certainly of earlier date – a point which will be discussed further below.

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[1] This represents the total at the end of summer 2012.

[2] Since it is almost impossible to distinguish individual vessels among a large body of Saintonge green-glazed or unglazed wares, the MNV for these wares will be appreciably lower than the true figure; therefore the sherd count is almost certainly the more accurate index.

Methodology

The assemblage was first sorted into fabric types and quantified by sherd count and minimum vessel count. Since an excellent range of the main types of medieval Saintonge pottery is represented in the collection, and little work has been undertaken hitherto to examine the chemistry of this major production centre, the opportunity was taken to undertake a pilot study of this class of material (ICPS below). Had resources been unlimited, we would have extended this study to the other fine whitewares in the group, and would have increased the range of comparative samples from other sites. Ideally, investigation of the collection would have been extended to tackle other classes of pottery, and petrological study would also have been undertaken. Further exploration of the site may follow this report; if it proceeds, fresh analytical work should accompany the publication of any new finds.

Catalogue

The numbers recorded in brackets after each entry are those of the site survey. Dispersed sherds from a single vessel will have more than one site code; those simply marked TC (Tresco Channel) were collected before the survey was carried out.

Saintonge white wares

1 Jug with beak spout and all-over (*alias* liquid or bright) green glaze, discoloured black. The glaze does not extend inside the spout, which is covered with external glaze, suggesting that it was brushed on rather than dipped. For the three standard vessel forms with this kind of narrow neck and pronounced shoulder, familiar on polychrome wares, see Chapelot 1983, 50, Fig. 5.2, redrawn here as Fig. 1, No. 1a. ICP sample 1.

This is the only Saintonge vessel in the group whose glaze has discoloured black. The reason is unknown but it may be noted that among the Saintonge wares from the celebrated Cuckoo Lane pit 14 group from Southampton, the polychrome wares have blackened in a similar manner, whilst the common green-glazed jugs were unaffected (Platt and Coleman-Smith 1975, Nos 1017–25). (TC).

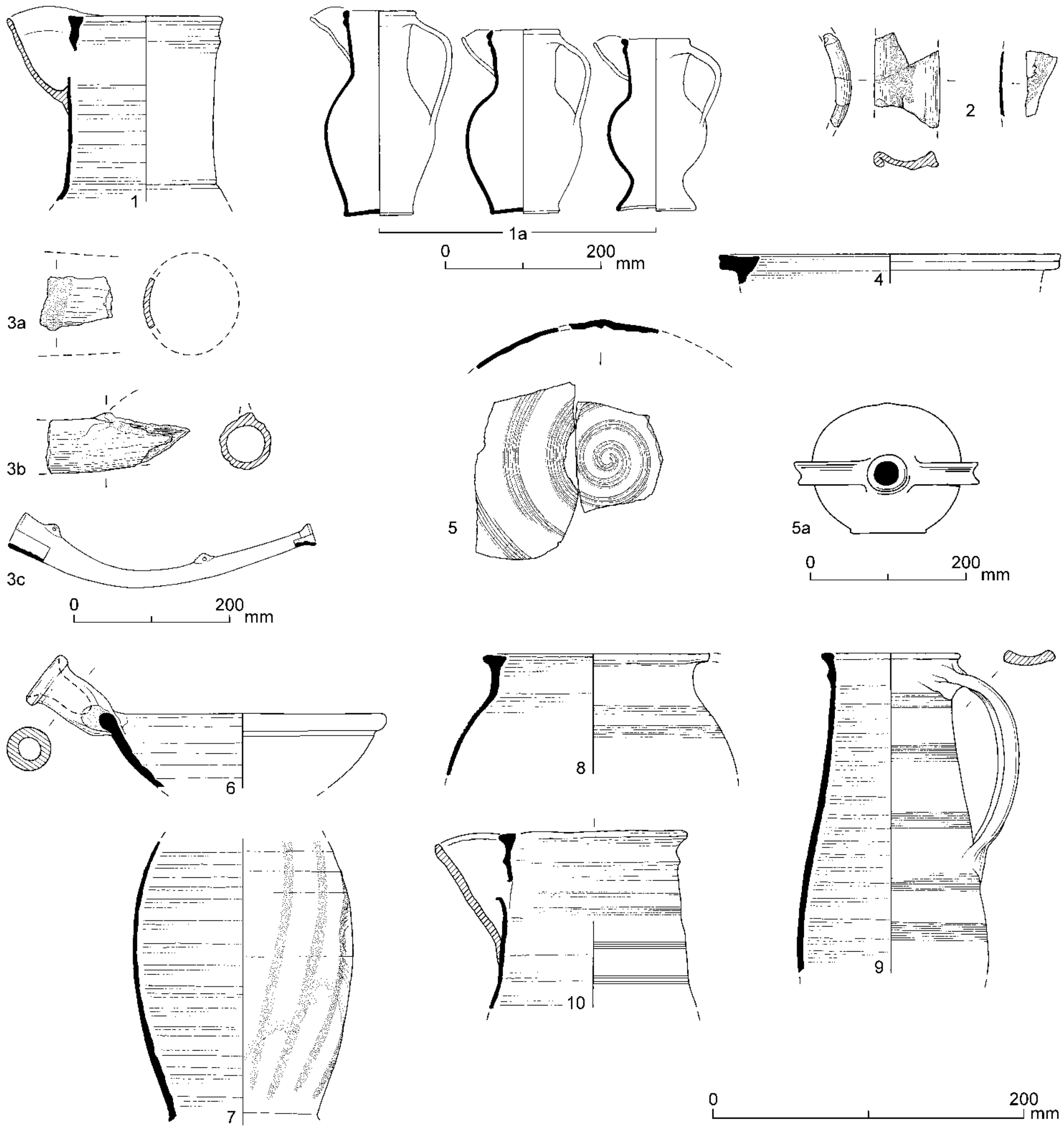

Fig 1 Saintonge pottery. Scale 1:4 except 1a, 3c and 5a 1:8.

2 Wheel-thrown handle and bodysherd, both with brushed dark brown slip under a clear glaze. A small area of one edge of the slip on the body has been scraped away, confirming that this was a sgraffito-decorated jug. For kiln wasters from Les Ouillières, La-Chapelle-des-Pots, and discussion of this scarce type, also known from Southampton, Canterbury, Exeter and St Peter Port, Guernsey, see Thomson and Brown 1991, 65–72. For Irish examples see McCutcheon 2006, 124–6. Complete examples have been recovered from tombs in Charente and Charente-Maritime (Cuisenier and Chapelot 1975, 62, Nos 170–1). ICP sample 2 (TC11:8, 62, 69).

3 Sherds of a horn, all burnished externally: one (3a) half-covered in clear liquid green glaze; a second (3b) of wider diameter, with the edge of a handle attachment and only spots of glaze.

Saintonge horns were uncommon exports: in her survey of the type Le Patourel (1992) recorded examples from only six sites in the British Isles (Le Patourel 1992, 159, 162–6). The Dublin finds have since been fully published by McCutcheon, who recognised at least five examples there (McCutcheon 2006, 120–1, which also details the Cork and Waterford examples), and further horn fragments are now known from Launceston Castle, Cornwall (Brown *et al.* 2006, 293, p83) and Port Cressa beach, St Mary's, Scilly (unpublished find, Isles of Scilly Museum).

All the Saintonge horn finds which are sufficiently preserved to show the body appear to have the long curving shape to Le Patourel's 'extended' form (Le Patourel 1992, 159, 162–6; form shown at 1:8 as Fig. 3c). ICP sample 3. (TC; TC11:32; TC11:88).

4 Rim of a mortar with quartz-tempered fabric and mottled green glaze on rim top.
For the type cf. examples from Southampton (Brown 2002, 61, Fig. 23, Nos 215–16) and Dublin (McCutcheon 2006, 125–9). ICP sample 4. (TC11:12).

5 Domed top of a costrel with combed spiral decoration, added after throwing, under a copper-mottled external green glaze. For a complete example of the type from Port Berteau, see Cuisenier and Chapelot 1975, 63, No. 174 ('forme … classique au Moyen Age en Saintonge', shown at 1:8 in Fig. 5a). ICP sample 5. (TC2; TC3; TC11:25).

6 Tubular handle and rim of a small pan, the fabric micaceous, the lower part of the bowl with copper-green glaze. Heavily burnt exterior, the sooting extending inside the bowl.

This is an uncommon form of medieval Saintonge import, but there are a few sherds of the type from Wood Quay, Dublin (McCutcheon 2006, 112–13, No. 19). ICP sample 6 (TC).

7 Jug with diagonal brushed brown clay stripes under a speckled copper-green glaze on middle and upper body. For complete examples of the type from Port Berteau see Cuisenier and Chapelot 1975, 59, Nos 157–8. ICP sample 7 (TC10; TC11:80).

Not drawn: sherds with narrow applied ridged strips of brown clay under a mottled green glaze.

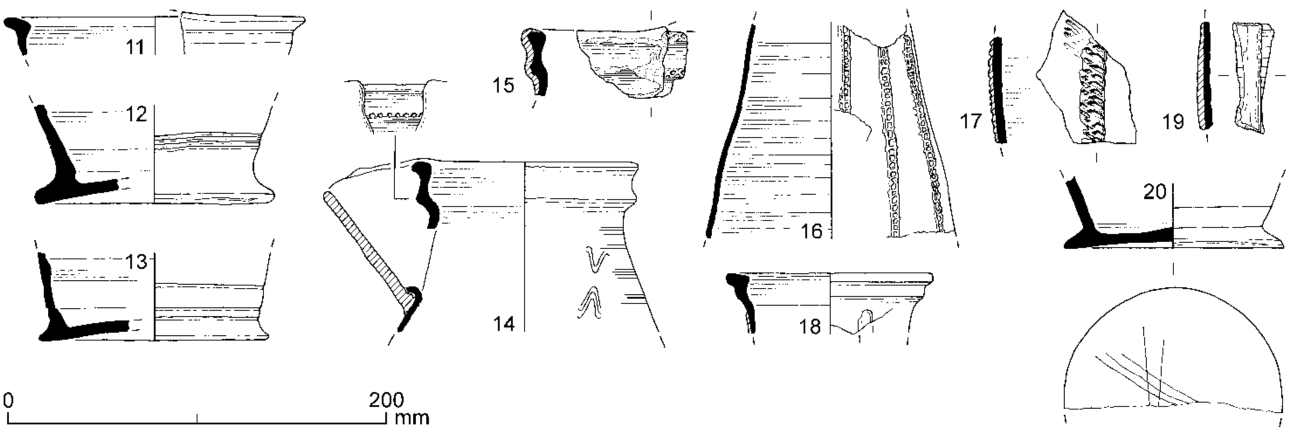

Fig 2 Saintonge pottery. Scale 1:4.

8-13 Jugs with combed horizontal grooves and copper-mottled glaze. 8. With single handle stub; area of spout absent (TC11:16). 9 Handle applied over combing; area of spout absent (TC). 10 Spout applied over combing of body (TC11:46). 11. Rim of a wide-mouthed jug (or bowl?) with handle attachment and traces of horizontal combing (TC11:27). 12–13 Bases of tall green-glazed jugs. A common type with many published examples, e.g. Cuisenier and Chapelot 1975, 59, Nos 155–6. ICP samples 8–9. (TC11:40; TC33).

14-15 Jugs with bands of horizontal rouletting and copper-green glaze. 14. One band of rouletting on rim (visible within the spout). Impressions of combed wavy decoration visible on the inner edge of the spout where it was pushed onto the body; the rest of this band wiped away upon application of rim. 15 Two bands of rouletting visible within the rim. ICP sample 10. (TC; TC11:2).

16-17 Jugs with applied vertical rouletted strips. 16 with rich copper-green glaze. 17 with rather blurred diamond rouletting, ICP sample 11. (TC; TC11:2).

18-19 Sherds from jugs with applied vertical thumbed strips and copper-mottled glazes. This type, which has a tall body and a spreading foot like Nos 12 and 20, is common in England, where it has generally been published as Saintonge ware (e.g. Platt and Coleman-Smith 1975, Nos 998–1000, etc; Brown 2002, Nos 196, 198). However, Chapelot did not accept this (Cuisenier and Chapelot 1975, 64), believing that it represents some other western French source. The question is addressed by Hughes below (Appendix 1), who shows that they display a chemistry typical of Saintonge products. ICP samples 12–13. (TC45; TC).

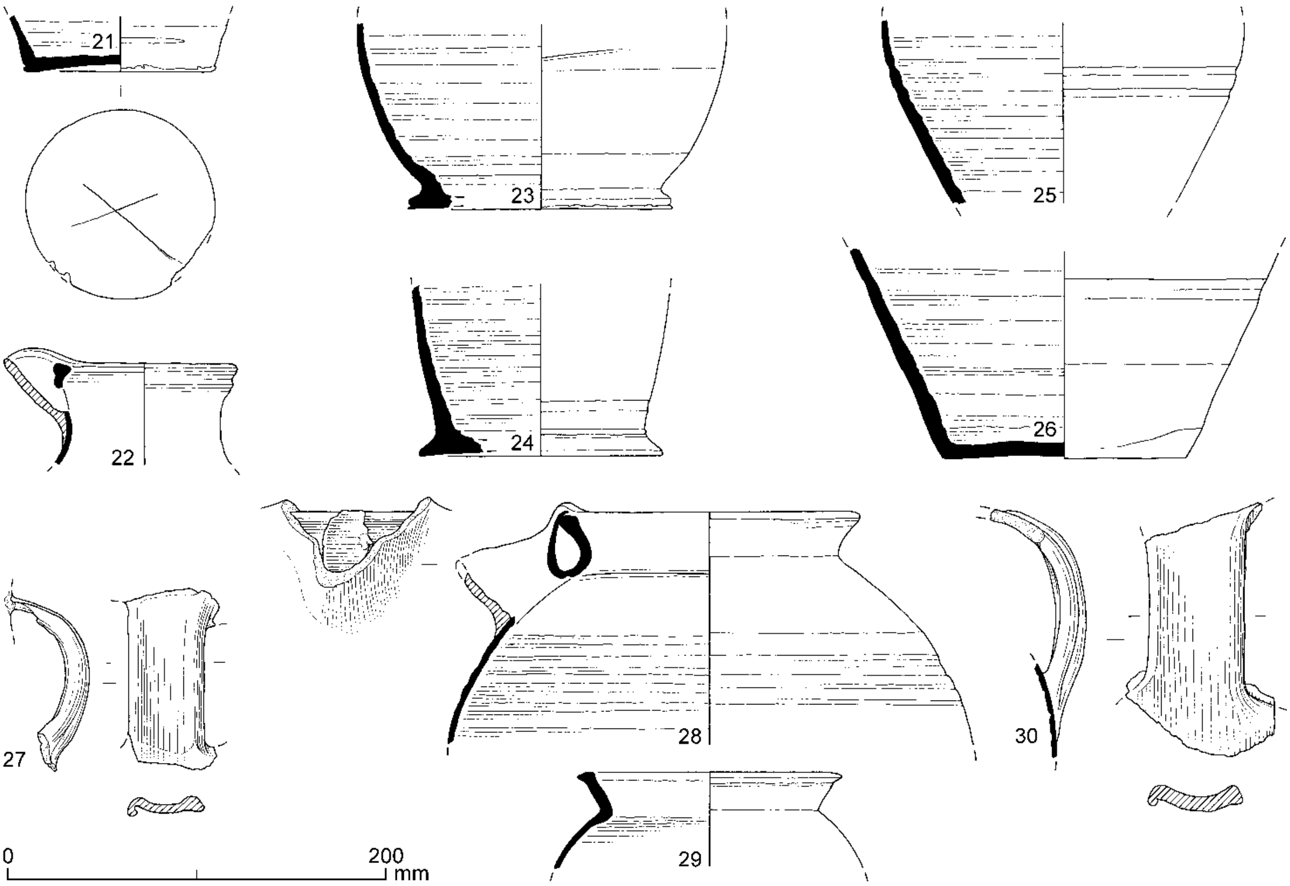

Fig 3 Saintonge pottery. Scale 1:4.

20-21 Bases of tall jugs with incised marks. 20 with glaze over most of exterior of base; mark scratched through glaze; 21 with a few glaze spots; uncertain whether marked before or after firing.

Incised marks of this type, some of which are scratched through the glaze, are a common feature of Saintonge jugs – e.g. from Dublin (McCutcheon 2006, 117–18: 40 examples from Wood Quay), Southampton (Platt and Coleman-Smith 1975, Nos 997–9, etc; Brown 2002, 59, Nos 202–8) and Hull (Watkins 1983, 252 mentions 41 examples). Simple crosses such as No. 21 are among the symbols known elsewhere (e.g. McCutcheon 2006, 117, Nos 14, 16). Their interpretation is uncertain. It has recently been proposed that they are owners' marks (*ibid.*, 114) but such graffiti are seen rarely on other types of pottery, and it is difficult to believe that owners in ports throughout the British Isles would regularly mark their Saintonge pots but not their equally elaborate wares from other sources. It seems more likely that they were added before the pots were sold – that they were merchant marks (as favoured e.g. by Watkins (1978; 1983, 252) and Brown (2002, 59)), or as batch marks or potters' identification marks as Dunning (1968, 46) first proposed. (TC11:10; TC11:80).

22-26 Plain jugs with copper-mottled green glaze. 22 With glaze below spout, patchy to one side. 23 Globular jug, ICP sample 14. 24 Tall jug, ICP sample 15. 25. Glazed throughout. 26 Most of lower body glazed. (TC11:8; TC 7; TC11:66; TC11:107; TC x3).

27 Green-glazed handle (TC11:26).

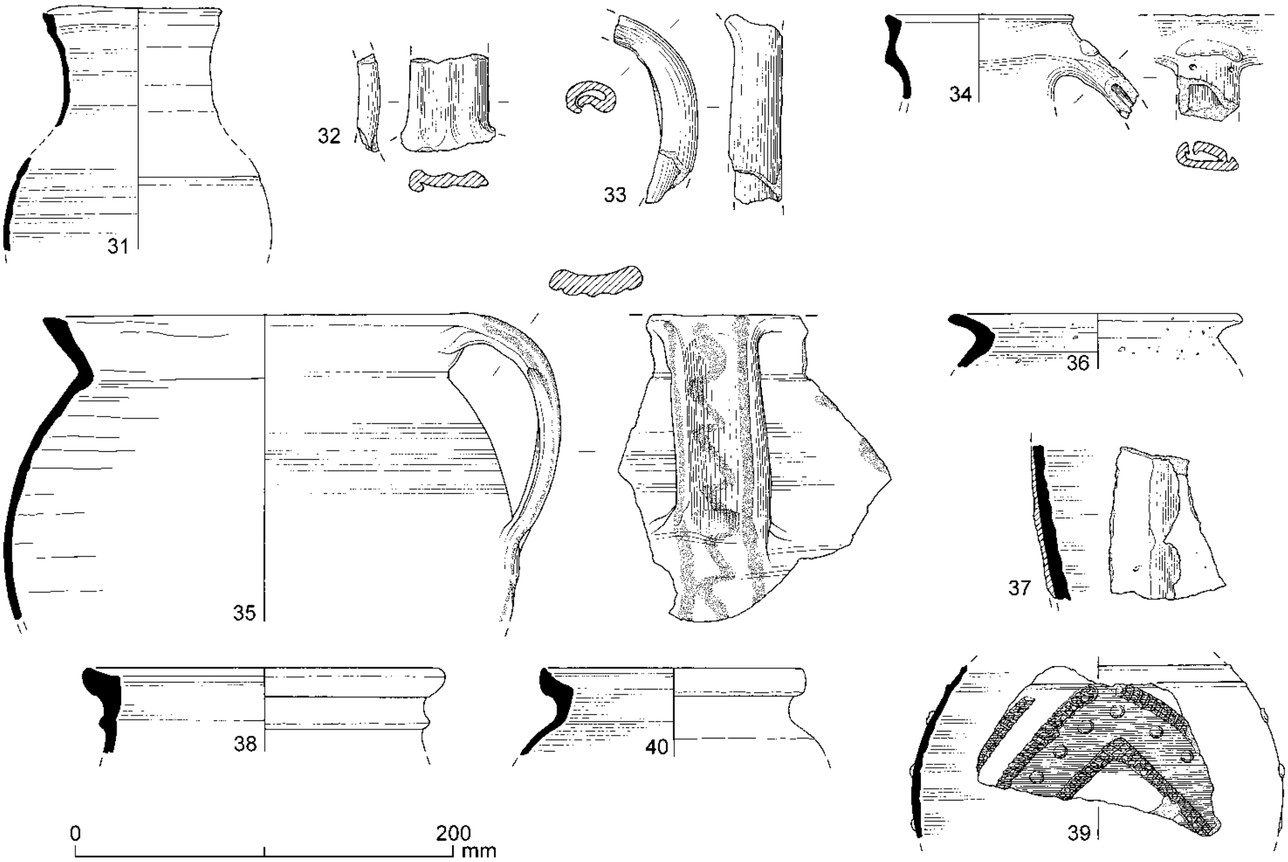

Fig 4 Pottery from the Saintonge, ?Western and Northern France. Scale 1:4.

28-31 Unglazed wares. 28 Probable *pégau*, the body with coarse quartz inclusions, the applied spout a segment cut from a wheel-thrown rim with thickened top edge; a hole has been roughly pushed through from within the vessel. (TC; TC11:17). 29-30 Rim and handle of similar vessels (TC 24; TC). 31 Jug with a little internal glaze speckling (TC11:107; TC).

Not drawn: Unglazed micaceous bodysherd, ICP sample 16.

32 Wheel-thrown jug handle, Saintonge pink ware. ICP sample 17 (TC17).

Western France?

33-34 Wheel-thrown hollow handles. 33 Very fine white fabric without visible inclusions, smudges of red slip, small patches of light green glaze. Perhaps western French? (TC11:13). 34 White ware with dull grey-green glaze (TC).

Northern France

35-39 Normandy gritty wares, the unglazed pale-firing cream or grey bodies with angular quartz temper. 35 Red-painted pitcher. 37 Tall vessel with applied strips. 38. Rim with red paint drip on top and light sooting on the projecting edge. 39. Jar rim, heavily sooted on the exterior and the lid seating of the interior (TC; TC11:21; TC11:2, 21, 27; TC; TC).

40 'Rouen jug' bodysherds. White ware, usual applied pellets and rouletted strips, but unusually the brown slip (some of which is much discoloured) covers both pellets and rouletting. The small vessel size and thin body are typical features of Developed Rouen ware as defined by Brown (2002, 23–4).

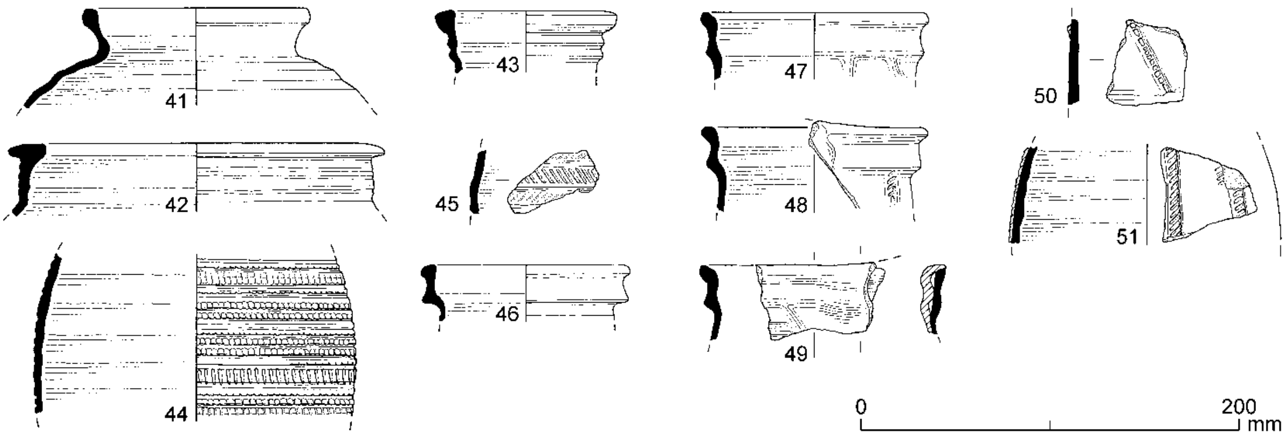

Fig 5 Pottery from Northern and ?Western France. Scale 1:4.

41-2 Hard-fired wheel-thrown sand-tempered greywares with blackened surfaces, probably Northern French. (TC11:7, 21).

43 Highly decorated jug rim in a very fine white fabric without visible inclusions. Rich copper-green glaze over the interior, spilling over the rim; the bottom edge of the exterior with brown slip. Probably from Normandy; reminiscent of an extraordinary vessel from Launceston Castle, Cornwall: Brown *et al.* 2006, 293, P81. (TC11:98).

Not drawn: Sherds of unglazed sand-tempered coarseware which appear to correspond to 'chocolate brown' ware as defined by Barton (1984). He suggested that this ware comes from Normandy.

France, origin uncertain

44-45 Jugs with pale-firing buff to light brown sand-tempered bodies, and elaborate rouletting. 44. With thick mid-green glaze containing black iron spots (TC). 45. With thin mid-green glaze (TC11:54).

46-51 Jugs providing a good visual match to Bristol Pottery Type 192 with characteristic fine cream or buff fabrics containing very fine quartz sand temper, collared rims, vertical and occasional curvilinear applied strips (the sides typically smoothed into the body, 48 and 50–1 with notch-rouletting) and the thick, rich dark green glaze, 48–9 with edges of applied spouts. A flat handle is also present.

The type has been identified at a number of ports in Britain and Ireland, the principal collections being in Dublin, Cork, Bristol, Exeter and Southampton ((McCutcheon 2006, 96; Ponsford 1991, 98–9; Allan 1984, 21, type (v)). McCutcheon (2006, 96) has pointed to the similarity of this ware to ceramics from Parthenay, Poitou-Charentes, western France, perhaps suggesting a source nearby, and raising the possibility that this type is a predecessor to the Saintonge pottery industry. Following chemical analysis, Vince (2006, 161) suggested that they may come from the Loire valley. Dating is considered in the general discussion.

However, one of the writers (DB) notes that these sherds, with their pale bodies, fine quartz sand tempering and rich glazes, are also similar to Southampton whitewares. This problem needs resolution by chemical analysis. (TC; TC11:69; TC11:27; TC11:27; TC11:29; TC11B).

England: South-West England

52-53 Granite-derived wares. 52 Base of a wheel-thrown jug, the red fabric with a scatter of prominent muscovite inclusions; patches of light green-brown glaze. Probably Cornish, since muscovite-rich wares are typical of E Cornwall, e.g. Lostwithiel kiln material. 53. Wheel-thrown rim. Unglazed light grey fabric with black and white mica plates and other inclusions typical of the potteries using sands derived from the granites of Devon and Cornwall. For discussion of the fabric type see Taylor and Allan 1998–9. (TC16; TC).

54 Upper Greensand-Derived ware from the Blackdown Hills, south Somerset/Devon. Thin, unglazed, hand-made vessel, the eroded mid-brown surfaces showing flint and other inclusions typical of the ware. The fabric is described in Allan *et al.* 2010. (TC11:11, 26, 28, 40, 202, 207).

Bristol area

55 Hand-made jug with low-fired fine sand-tempered fabric, bands of rather irregular rouletting, patchy mid-green glaze and light grey internal surface. Mike Ponsford has identified this as a product of kilns at Pill on the Bristol Avon. For the type, but with different rouletting, see Ponsford 1983, 220–1; 1991, 92, Fig. 4a, No. 1. (TC11:36).

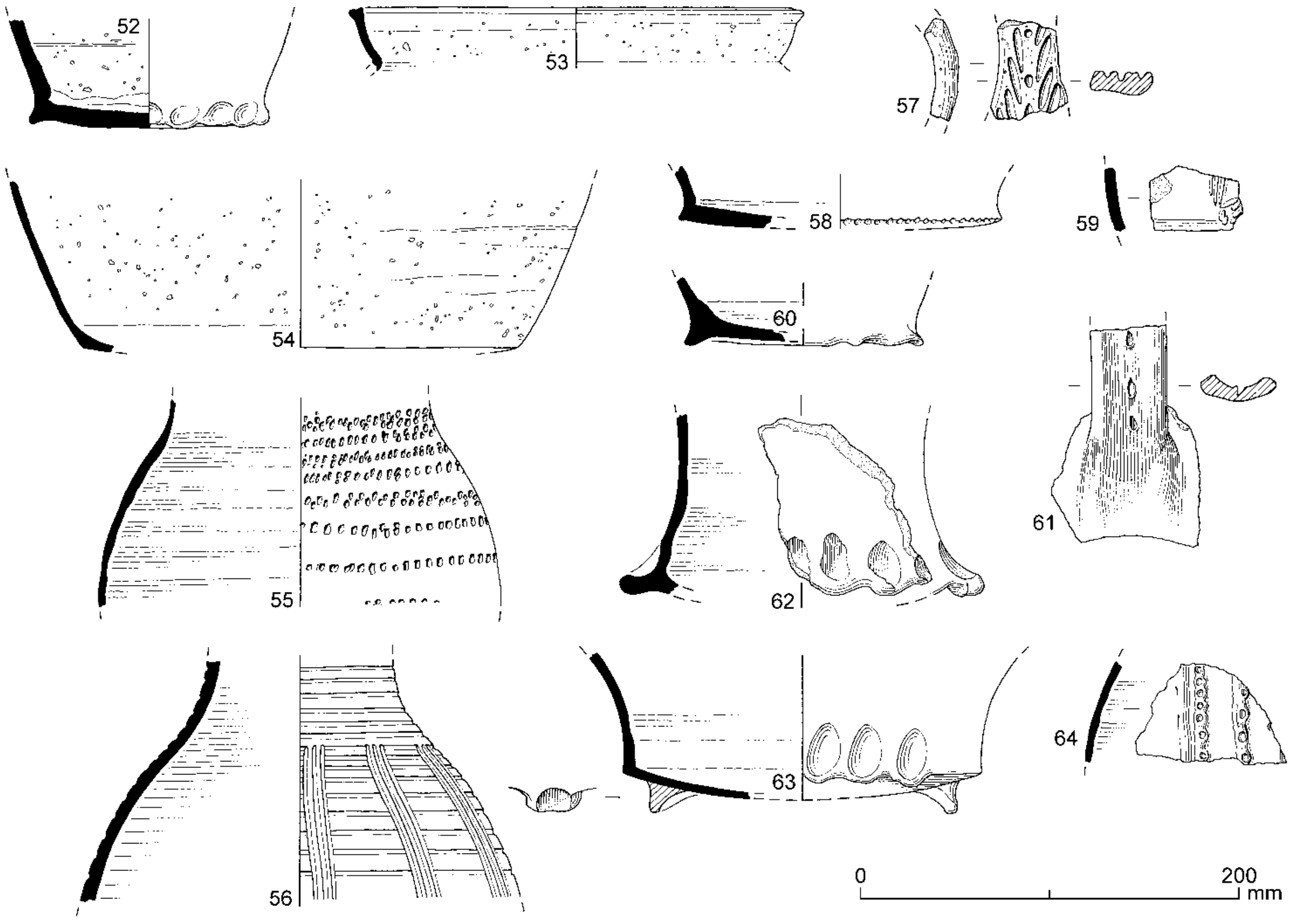

Fig 6 Pottery from South-West England, the Bristol area and ?Hampshire. Scale 1:4.

56-60 Ham Green wares, all with usual light grey fabrics and dull mid to olive green glaze. 56 Hand-made pitcher with horizontal incised lines and vertical combing. 57 Heavily tempered handle. 58 Jug base with diamond rouletting. 59 Jug with portion of applied plastic decoration, perhaps a hand or foot. 60 Jug base. We are grateful to M. Ponsford for identifying Nos 56–7 and confirming the other identifications (TC11:54; TC11:27; TC11:34; TC; TC11:2; TC 85).

Hampshire and south-central England

61-63 South Hampshire redwares, with pale-firing sand-tempered bodies firing buff, pale orange or light grey, with speckled orange-green glazes. 61. Jug base. 62. Handle pushed through body. 63. With one of three or four groups of thumbing round the base and a pod foot (TC; TC11:69; TC).

Origin unknown

64 Fine sand-tempered buff fabric, applied strips with impressions of a blunt point, traces of glaze; possibly hand-made (TC11:104).

65 Not drawn: Unglazed redware tile with scatter of quart inclusions, perhaps a ridge tile. Medieval?

Discussion

This is clearly not a random collection of material of the sort commonly encountered in coastal waters. The sherds formed a distinct concentration within a restricted area, in shallow waters, with only two or three later pieces of pottery, all of the 19th century. The large number of pots present in this initial sample (at least 145) surely exceeds the requirements of a single ship's crew; this was cargo rather than working equipment in a ship. Before possible explanations of the find are explored, two aspects of the material need to be considered further: composition and date.

Table 1 Tabulation of sherds, minimum number of vessels and forms

Type	**No. sherds**	**Min. No. vessels**	**Forms**
Saintonge			
all-over-green	4	2	jug, horn
sgraffito	3	1	jug
with brown clay stripes	7	2	2 jugs
with horizontal combing	41	13+	costrel, 11 jugs
with vertical thumbed strips	2	1	jug
with rouletted strips	7	4	jugs
plain mottled green-glazed	72	*c.* 22	mortar, pan, *c.* 20 jugs
unglazed	63	*c.* 25	3 small jugs, 8 large jugs/*pégaux*
pink ware	2	2	jugs
Saintonge total	201	c. 72+	
Northern France			
Developed Rouen ware	2	1	jug
Normandy highly decorated	2	1	jug
Normandy gritty	10	6	jar
Normandy red-painted	1	1	pitcher
Plain greywares, poss. Normandy	11	7	jar
France, source uncertain			
Bristol Pottery Type 192	13	7	Jugs
Misc. white wares	3	3	1 jar, 2 jugs
French or English			
Fine sand-tempered buff wares	7	1	
Plain sand-tempered	22	11	As No. 43
South-West England			
Granite-derived, Lostwithiel-type	2	2	1 jug
Other granite-derived	7	5	
Upper Greensand-Derived	8	1	
Bristol area			
Pill	1	1	pitcher
Ham Green	15	9	6 jugs
South–central England			
Hampshire redwares	12	8	jugs
Limestone-tempered coarsewares	3	2	probably jars
Unclassified incl. greywares, scraps, etc	13	7	
Total of other wares	132	73	
SUM TOTAL	333	145+	

Composition

The find consists of a large quantity of pottery from the Saintonge, with a scatter of items from the Rouen area (No. 40), Normandy more generally (the Normandy Gritty and other plain wares), perhaps other parts of northern France and possibly western France (BPT 192). English sources are represented by material which is likely to have been shipped from Bristol and probably from Southampton, a Cornish port and perhaps a south Devon/Dorset/Somerset one such as Exeter, Lyme Regis or Bridgwater. There is nothing from London or further up the English coast. Although many of the pottery types represented are known to have been items of trade and therefore need not have been acquired in their home ports, it seems likely that several voyages are represented. In interpreting this pattern, comparison with other assemblages is instructive.

Firstly, if the Tresco Channel find represents a place where pottery was unloaded for use on the island (especially if it represented casual losses over a prolonged period rather than a single event), we might expect some correspondence between this material and pottery from habitation sites on Scilly. In fact there is little. Cornish wares are by far the most common component of the local medieval ceramics market, although Saintonge wares make quite a strong showing (*c.* 10% of sherds) and several of the types represented in the channel – Ham Green wares, Normandy Gritty wares and green-glazed wares, and odd sherds from Devon/Somerset – are also present on the islands (Allan 1991; 2011). We may note the absence from the group of some medieval types recorded on Scilly: Iberian pottery, notably red micaceous coarsewares (former 'Merida-type' wares), and pottery from the south Dorset coast around Poole.

Secondly, we may compare the assemblage with the one other find of pottery from a wreck site off British waters: the St Peter Port find (Thomson and Brown 1991). There are striking points in common between these two assemblages, which both consist principally of Saintonge wares: both include at least one example of Saintonge sgraffito ware, a horn, a costrel, a *pégau* and a mortar. The predominance of Saintonge finds suggests a probable connection to the wine trade, and the presence of pottery from Southampton and Bristol, major ports in the trade, is consistent with this interpretation.

Date

The most readily datable wares are the finest Saintonge vessels. The dating of sgraffito-decorated jugs such as No. 2 is discussed by Thomson and Brown (1991, 77); they probably belong to the period *c*. 1275–1300. The all-over-green-glazed wares such as jug No. 1 were certainly in circulation at the same time, but this type probably has a slightly longer life, coming into use at much the same time but probably extending up to the 1330s and possibly beyond (Allan 1983, 201). The other green-glazed and unglazed Saintonge wares were imported over a much longer period (broadly mid-13th- to early 15th-century), but the late 13th and early 14th centuries were also the highpoint in the trade of these types, and these all these plainer types have been found elsewhere in association with the finewares. They could easily have been lost at the same time. It is possible that the patchily-glazed Saintonge jugs are a little later in date, being typical of the 14th and early 15th centuries, but this is uncertain. A late13th/early 14th-century date would also be acceptable for most of the English wares, but they are not highly datable.

Some of the Bristol wares, however, belong to 12th-century types which are unlikely to have been in use a century later. Judging by their stratification in deposits dated by dendrochronology, the early Pill-type pitchers such as No. 55 were already in circulation by the 1120s; they are attested in the mid-12th century and are typical 12th-century types (Ponsford 1991, 94 and pers. comm. Jan. 2013). The roulette-decorated base and combed jug/pitcher body in Ham Green ware (nos 56, 58) are also late 12th- or early 13th-century types (*ibid*.); indeed in the entire component of Bristol wares is likely to be about a century earlier than the bulk of the collection (Ponsford, pers. comm.).

Some chemical and petrological analysis is needed to examine whether vessel Nos 46–51 do indeed match examples of BPT 192 from Bristol, Dublin and elsewhere, but if this is confirmed, they too appear to be earlier in date than the last quarter of the 13th century. This type was in use before 1182 at Bristol, where Ponsford regards it as a late 12th-century ware (Ponsford 1991, 84–5 and pers. comm. to JA, Jan. 2013). His conclusion is supported by evidence from Cork and other Irish sites (McCutcheon 2003, 209–10 and *in litt.* to JA, Feb. 2013). This type must have circulated in Ireland in the early 13th century, the date of the many finds from Wood Quay, Dublin,[3] but it fell out of use with the arrival of Saintonge jugs. Likewise at Exeter this type is stratified largely in contexts of the late 12th and early 13th century, most of the finds being in horizons which precede the arrival of Saintonge green-glazed jugs around the mid-13th century.[4] On present evidence from ports in the British Isles, it seems unlikely that it was still being imported in 1270–1330.

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[3] They form a major component of the Miscellaneous French wares tabulated by McCutcheon (2006, 150–4). These are common in the lowest levels inside the first waterfront, where Miscellaneous French wares form 14% of the total (*ibid.,* Fig. C1). The waterfront is dated by dendrochronology to *c.* AD 1200, and the deposits may be of the same date. This overall category of wares recurs in variable but generally smaller quantities throughout the later deposits (*ibid.,* Figs C2–9).

[4] This was the date first proposed by Gerald Dunning. For support for his conclusions see e.g. Vince 1985, 48–55.

Conclusion

Despite the concentration of material suggesting a single event, the Tresco Channel find appears to have two components. The earlier material, probably of late 12th-century date, forms a small fraction of the total, and is represented by sherds from Bristol and probably western France; it is also possible that some of the Normandy Gritty wares and perhaps other plain coarsewares (e.g. the Devon/Somerset vessel No. 54) are of the same date. They may represent the loss of part of a cargo of a vessel trading between western France and the Bristol area, or with ports around the Irish Sea where Bristol pottery was in everyday use – such as Cork, Dublin or the south Welsh ports.

The bulk of the collection, however, is attributable to the period 1270–1300/1330. It consists mainly of Saintonge wares, with a range of pottery from Normandy and smaller quantities from the southern coast of England, including Hampshire, where Southampton is by far the most likely point of departure. An obvious context is some form of connection to the wine trade from south-western France. Most of the unusual types of Saintonge pottery represented in the Scilly find are present at Southampton, but the distribution pattern of Saintonge horns suggests that their principal markets were in the Irish Sea ports and in South-West England (above, cat. entry 3). This may suggest that the cargo was destined for a western location, such as Bristol or an Irish port.

The concentration of sherds in a limited area, the almost complete absence pottery dating after the 14th century, and the consistency of dating of most of the material, suggest that the bulk of the collection represents a single event. The obvious explanation is that this is a shipwreck, but since no structural evidence for a ship has been found so far, and at this initial stage in the exploration a number of other possibilities deserve consideration. The sherds may represent a place where ceramics were lost as they unloaded from a seagoing ship into smaller boats which would take them to shore – an equivalent to the finds at Port Berteau on the River Charente, where there were repeated casualties as pottery was loaded onto boats for export abroad (Cuisenier and Chapelot 1975) – although the marked contrast between the overall makeup of the find and that of ceramics from the islands' landward sites may argue against this. Another possibility might be that they represent breakages discarded after a rough sea crossing. Future research may resolve these uncertainties. Whatever the precise explanation, however, this remains an exceptional find in British waters. The sample already recovered from initial investigations amounts to the largest and most varied assemblage of medieval pottery ever recovered from a marine site in UK waters. Given the sheltered and shallow location, it is very likely that further exploration would yield remarkable material under controlled conditions. The site deserves a high level of protection.

Plasma spectrometry analysis (ICPS) *By* Michael J. Hughes

Plasma spectrometry ICP analysis of pottery was applied to some finds of Saintonge ware from Tresco, to understand their chemical characteristics and consider their relevance to our understanding of the Saintonge industry.

Surprisingly few previous chemical analyses of Saintonge wares have been made: Deroeux *et al.* (1994) analysed French wares found at the Bryggen, Bergen, Norway, by X-Ray fluorescence for a few major elements. Alan Vince carried out the only other analyses by ICP, principally mottled green-glazed jugs and pégaux and a sgraffito-decorated jug from Boston, and from Wood Quay, Dublin (Vince 2006). He summarised the dating evidence of Saintonge wares and their relative occurrence on British sites and interpreted the previous XRF and his ICP analyses at the Caen 2009 conference (Vince 2011). His review of the XRF results identified small numbers of Saintonge wares (mottled, polychrome and unglazed) among the chemical groups which had been revealed by cluster analysis (Deroeux *et al.* 1994: groups 3 and 4) – a first indication that were at least two chemical profiles among Saintonge wares. Pauly (2010) has begun using scanning electron microscopy to examine mainly later Saintonge pottery to search for chemical signatures in the fabric by examining mineral grains.

Vince's significant finding, from both his ICP results and the Bryggen analyses, was to show that there were two chemical groups in Saintonge pottery characterised by high and low potassium and magnesium, and both chemical groups were present at all three sites. The mottled greens from Boston and Bergen (Vince 2011, 203) were high in potassium, together with a mortar and an unglazed painted sample from Dublin and unglazed samples from Bergen. On the other hand, the polychrome from Dublin and Bergen (SAIP), plus the all-over green, three unspecified and sgraffito from Dublin, and a sgraffito from Boston were all low in potassium. Vince (2011, 204) applied principal components analysis to the combined Bergen, Dublin, Boston and Ardglass data; in doing so he was aware of the caution required when statistically interpreting analysis data from two methods (XRF and ICP) by different laboratories. However the split into two major groups (characterised by high and low potassium and magnesium) was also reflected in other elements (*ibid*., Fig. 2). He also noted that the Bergen polychrome samples were chemically different from the rest of the samples on the third principal component (not plotted). This is consistent with our finding (see below) that there are consistent chemical differences between sites for Saintonge wares as well as the presence on each site of high and low potassium samples. A further principal components analysis by Vince (not plotted) used only ICP trace elements and revealed differences in the rare earth elements (Dublin samples were different to Boston and Ardglass – cf our Figure 7). All this suggests the chemical patterns of the fabric of Saintonge wares are far from being a simple uniform chemical pattern and suggest complex relationships associated with clays used by the potters and their choice of clay for particular wares. This is examined below in more detail in view of the results on the Tresco Saintonge wares. Seventeen representative sherds covering the range of Saintonge wares found at Tresco were selected for ICPS analysis (listed in Table 2).

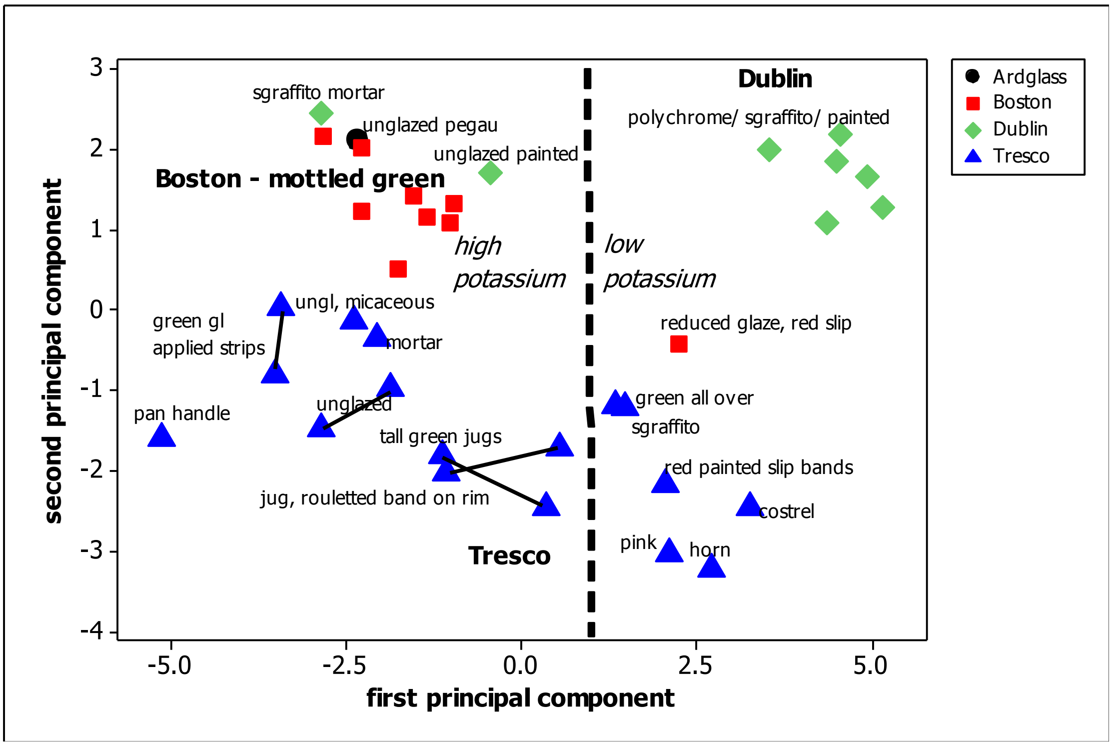

Fig 7 Principal Component Analysis of the ICPS results on Saintonge wares from Tresco, Boston, Dublin and Ardglass. The horizontal axis plots the first principal component (containing 40% of the variation in analysis of all the pottery), and the vertical the second principal component (a further 15%). The samples appear to fall groups by site, split also into high and low potassium and magnesium groups at the first three sites. It suggests each site received material from one kiln, which used two different clays for different wares (cf Table 3).

Powdered samples were obtained from each sherd by drilling into a broken edge with a 2 or 3 mm diameter tungsten carbide drill bit fitted into a hand-held electric drill. In addition, the samples sent for ICP analysis included several portions of a Certified Reference Material (NBS679 Brick Clay – produced by the US National Institute for Standards and Technology, Washington DC) spaced out in the analysis batch but without identification to the laboratory as such; these acted as analysis quality control samples. The analysis results on these control samples gave entirely satisfactory results. The powdered samples were analysed by the Department of Earth Sciences, Royal Holloway University of London (RHUL) using their standard techniques (Thompson and Walsh 1989; Potts 1987).

Table 2 Full list of ICPS (inductively coupled plasma spectrometry) analyses, and average of the high and low potassium and magnesium groups. All the elements are in parts per million, except the following in percent: aluminium (Al), calcium (Ca), iron (Fe), potassium (K), magnesium (Mg), and sodium (Na).

cat	ICP no.	Description	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5
1	1	bright green-glazed (all-over-green) jug	25.6	2.14	0.47	0.33	0.48	1.73	1.32	0.03
2	2	Sgraffito jug	23.0	1.50	0.45	0.43	0.40	1.54	1.18	0.03
3	3	horn	19.9	0.46	0.36	0.47	0.37	1.48	1.09	0.04
4	4	mortar	19.3	1.85	0.71	0.36	0.39	3.00	0.91	0.05
5	5	costrel	22.7	1.62	0.44	0.58	0.68	1.48	1.14	0.03
6	6	pan with tubular handle	20.3	3.66	0.79	0.43	1.07	2.97	0.82	0.05
7	7	jug with red-painted slip bands	23.0	2.15	0.36	0.39	0.42	1.63	1.15	0.03
12	8	base of tall green-glazed jug	24.6	0.96	0.68	0.36	0.53	2.68	1.04	0.03
13	9	base of tall green-glazed jug	23.4	1.56	0.66	0.39	0.75	2.94	1.17	0.05
15	10	jug with rouletted bands on rim	19.6	3.16	0.47	0.46	0.41	1.37	1.17	0.05
17	11	jug with rouletted bands on rim	22.1	0.80	0.61	0.41	0.40	2.38	1.00	0.03
18	12	green-glazed jug with applied vertical strips	21.8	1.73	0.75	0.41	0.68	3.23	1.07	0.06
19	13	green-glazed jug with applied vertical strips	21.2	2.09	0.93	0.39	0.47	3.09	1.03	0.07
20/21	14	unglazed ware	22.0	1.51	0.73	0.35	0.66	3.05	1.05	0.05
24	15	unglazed ware	21.7	1.35	0.74	0.35	0.75	3.21	1.07	0.05
	16	unglazed micaceous ware	19.2	1.35	0.61	0.39	0.33	2.70	0.91	0.05
32	17	Saintonge pink ware handle	19.5	2.51	0.41	0.35	0.95	1.36	1.17	0.05
	mean	low potassium group	22.3	1.73	0.42	0.42	0.55	1.54	1.18	0.03
	s.d.		2.3	0.73	0.05	0.09	0.23	0.13	0.08	0.01
	mean	high potassium group	21.4	1.82	0.70	0.39	0.58	2.78	1.02	0.05
	s.d.		1.7	0.87	0.12	0.04	0.22	0.53	0.11	0.01

cat	ICP no.	Description	MnO	Co	Cr	Cu	Li	Ni	Sc	Sr
1	1	bright green-glazed (all-over-green) jug	0.005	20.4	117	70.9	62.8	26.2	19.7	96
2	2	Sgraffito jug	0.008	19.0	103	26.4	57.1	23.3	18.2	94
3	3	horn	0.004	15.6	76	8.8	43.8	15.5	13.7	96
4	4	mortar	0.012	23.5	73	33.3	60.1	18.8	16.9	112
5	5	costrel	0.004	12.7	104	12.2	40.5	18.3	17.0	87
6	6	pan with tubular handle	0.017	23.3	63	18.5	79.7	28.9	14.5	87
7	7	jug with red-painted slip bands	0.005	22.5	94	6.7	47.9	20.1	16.9	102
12	8	base of tall green-glazed jug	0.007	30.0	84	18.8	47.5	18.5	18.7	101
13	9	base of tall green-glazed jug	0.009	20.6	86	21.5	53.0	17.5	19.6	113
15	10	jug with rouletted bands on rim	0.010	23.2	76	20.6	126.1	28.9	15.0	59
17	11	jug with rouletted bands on rim	0.006	26.5	72	66.0	45.3	17.2	16.6	96
18	12	green-glazed jug with applied vertical strips	0.013	22.7	85	33.5	64.6	28.5	18.6	107
19	13	green-glazed jug with applied vertical strips	0.019	22.4	86	31.6	73.5	36.3	18.9	107
20/21	14	unglazed ware	0.012	32.5	93	49.8	62.0	25.8	19.9	109
24	15	unglazed ware	0.010	24.5	88	28.0	62.5	21.9	18.4	106
	16	unglazed micaceous ware	0.009	18.0	96	19.1	56.1	19.6	17.2	93
32	17	Saintonge pink ware handle	0.007	14.3	77	5.9	39.2	19.3	17.8	78
	mean	low potassium group	0.005	17	95	22	49	20	17	92
	s.d.		0.002	4	16	25	10	4	2	8
	mean	high potassium group	0.011	24	82	31	66	24	18	99
	s.d.		0.004	4	10	15	22	6	2	15

cat	ICP no.	Description	Sr	V	Zn	Y	Ba	As	Rb	Zr*
1	1	bright green-glazed (all-over-green) jug	96	172	41	17.1	286	27.6	92.4	209
2	2	Sgraffito jug	94	147	40	16.5	258	17.7	84.8	201
3	3	horn	96	91	27	9.8	210	4.5	66.8	168
4	4	mortar	112	146	58	21.6	470	9.5	136.8	75
5	5	costrel	87	172	31	9.3	241	23.8	71.4	135
6	6	pan with tubular handle	87	92	113	29.5	594	18.2	164.3	250
7	7	jug with red-painted slip bands	102	128	31	12.0	242	27.1	78.2	136
12	8	base of tall green-glazed jug	101	135	45	14.5	440	3.7	138.0	116
13	9	base of tall green-glazed jug	113	169	46	24.9	476	7.4	150.0	96
15	10	jug with rouletted bands on rim	59	84	52	18.6	179	29.6	63.9	159
17	11	jug with rouletted bands on rim	96	113	38	12.8	387	6.8	125.0	110
18	12	green-glazed jug with applied vertical strips	107	159	83	51.4	529	8.0	152.7	99
19	13	green-glazed jug with applied vertical strips	107	153	97	38.4	515	13.9	147.6	85
20/21	14	unglazed ware	109	173	62	26.1	505	6.2	150.5	93
24	15	unglazed ware	106	161	64	34.5	515	5.2	149.6	87
	16	unglazed micaceous ware	93	154	59	38.1	487	9.8	135.2	121
32	17	Saintonge pink ware handle	78	124	27	8.9	207	68.9	65.2	151
	mean	low potassium group	92	139	33	12.3	241	28	76	167
	s.d.		8	31	6	3.7	30	22	11	32
	mean	high potassium group	99	140	65	28.2	463	11	138	117
	s.d.		15	30	23	11.6	108	7	27	50

cat	ICP no.	Description	Nb	Mo	Cd	Sb	Cs	Tl	Pb	Bi
1	1	bright green-glazed (all-over-green) jug	26.4	11.9	0.1	4.0	11.1	4.1	4872	0.3
2	2	Sgraffito jug	24.2	3.7	0.14	2.2	9.4	1.5	891	0.56
3	3	horn	20.6	3.0	0.12	1.8	7.6	1.0	411	0.47
4	4	mortar	19.1	3.0	0.12	1.8	10.9	1.4	369	0.51
5	5	costrel	24.8	4.7	0.07	1.9	8.5	0.9	131	0.49
6	6	pan with tubular handle	28.7	1.9	0.07	1.3	27.4	1.6	76	0.54
7	7	jug with red-painted slip bands	18.5	15.0	0.24	2.8	8.7	0.9	88	0.45
12	8	base of tall green-glazed jug	22.4	1.4	0.13	1.6	14.8	1.3	133	0.08
13	9	base of tall green-glazed jug	24.8	3.8	0.03	2.4	13.5	1.5	189	0.23
15	10	jug with rouletted bands on rim	21.1	12.1	0.14	2.6	16.6	0.8	334	0.18
17	11	jug with rouletted bands on rim	19.1	1.5	0.13	1.6	13.8	1.7	935	0.27
18	12	green-glazed jug with applied vertical strips	23.0	5.4	0.08	1.9	12.4	1.4	121	0.06
19	13	green-glazed jug with applied vertical strips	23.0	6.1	0.18	2.2	11.9	1.4	167	0.52
20/21	14	unglazed ware	23.6	2.5	0.07	2.8	12.8	1.7	558	0.37
24	15	unglazed ware	23.0	2.0	0.11	1.8	12.4	1.4	107	0.41
	16	unglazed micaceous ware	19.5	9.6	0.19	2.1	11.3	1.2	68	0.50
32	17	Saintonge pink ware handle	33.0	8.2	0.08	2.8	7.3	0.8	132	0.51
	mean	low potassium group	24.6	7.7	0.12	2.6	8.8	1.53	1087	0.466
	s.d.		5.0	4.9	0.06	0.8	1.4	1.3	1879	0.0841
	mean	high potassium group	22.5	4.5	0.11	2.0	14.3	1.41	278	0.3346
	s.d.		2.8	3.5	0.05	0.5	4.6	0.25	265	0.1781

cat	ICP no.	Description	Th	U	La	Ce	Pr	Nd	Sm	Eu
1	1	bright green-glazed (all-over-green) jug	20.1	5.9	50.7	88	9.9	39.5	6.7	1.2
2	2	Sgraffito jug	18.7	3.5	55.4	124	11.6	45.7	7.6	1.3
3	3	horn	13.8	2.8	31.1	55	6.2	23.6	3.7	0.6
4	4	mortar	14.6	2.7	60.4	111	12.9	52.8	9.4	1.9
5	5	costrel	17.3	2.5	32.7	56	6.3	24.3	3.8	0.6
6	6	pan with tubular handle	19.8	6.6	77.1	144	17.5	70.5	12.5	2.6
7	7	jug with red-painted slip bands	17.0	2.9	50.4	84	9.5	36.2	5.9	1.0
12	8	base of tall green-glazed jug	12.5	2.9	38.7	68	7.9	31.1	5.2	1.0
13	9	base of tall green-glazed jug	17.0	3.0	68.6	134	16.5	68.6	12.3	2.4
15	10	jug with rouletted bands on rim	16.3	3.5	51.8	104	11.3	45.5	8.0	1.5
17	11	jug with rouletted bands on rim	12.3	2.7	38.4	70	7.7	30.2	4.8	0.9
18	12	green-glazed jug with applied vertical strips	16.5	3.1	92.3	168	22.5	95.4	17.7	3.7
19	13	green-glazed jug with applied vertical strips	16.5	3.0	80.4	154	19.3	81.9	15.0	3.0
20/21	14	unglazed ware	16.6	3.0	72.8	141	16.3	67.2	12.0	2.3
24	15	unglazed ware	16.3	3.1	79.2	164	19.2	81.0	14.8	3.0
	16	unglazed micaceous ware	15.8	3.8	83.3	158	20.0	85.2	15.6	3.2
32	17	Saintonge pink ware handle	20.3	3.5	35.4	62	6.8	26.1	4.1	0.7
	mean	low potassium group	17.9	3.5	43	78	8.4	32.5	5.3	0.89
	s.d.		2.4	1.2	11	26	2.2	9.2	1.7	0.32
	mean	high potassium group	15.8	3.4	68	129	15.6	64.5	11.6	2.33
	s.d.		2.1	1.1	18	36	5.0	21.9	4.2	0.92

cat	ICP no.	Description	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
1	1	bright green-glazed (all-over-green) jug	4.7	0.8	3.6	0.6	2.1	0.3	2.0	0.3
2	2	Sgraffito jug	5.2	0.8	3.4	0.6	1.7	0.29	1.7	0.29
3	3	horn	2.6	0.4	2.0	0.4	1.0	0.18	1.2	0.20
4	4	mortar	6.8	1.1	4.5	0.9	2.1	0.34	2.0	0.29
5	5	costrel	2.6	0.4	2.0	0.3	0.9	0.16	1.0	0.16
6	6	pan with tubular handle	9.5	1.6	6.8	1.1	2.9	0.44	2.4	0.41
7	7	jug with red-painted slip bands	4.0	0.6	2.7	0.4	1.6	0.24	1.2	0.20
12	8	base of tall green-glazed jug	3.7	0.6	2.7	0.5	1.4	0.24	1.4	0.23
13	9	base of tall green-glazed jug	8.5	1.4	5.5	1.0	2.6	0.41	2.2	0.34
15	10	jug with rouletted bands on rim	5.8	1.0	3.8	0.7	1.9	0.31	1.7	0.28
17	11	jug with rouletted bands on rim	3.4	0.6	2.6	0.5	1.3	0.22	1.5	0.22
18	12	green-glazed jug with applied vertical strips	13.9	2.5	9.7	1.9	5.1	0.82	4.3	0.66
19	13	green-glazed jug with applied vertical strips	11.3	2.0	7.7	1.4	3.8	0.61	3.2	0.50
20/21	14	unglazed ware	8.5	1.4	5.4	1.0	2.6	0.40	2.2	0.33
24	15	unglazed ware	10.9	1.9	7.2	1.3	3.5	0.55	3.0	0.45
	16	unglazed micaceous ware	11.4	2.0	7.7	1.5	4.0	0.62	3.5	0.53
32	17	Saintonge pink ware handle	2.8	0.4	2.0	0.3	0.9	0.16	1.1	0.15
	mean	low potassium group	3.7	0.57	2.6	0.47	1.38	0.23	1.38	0.22
	s.d.		1.2	0.19	0.8	0.14	0.49	0.07	0.40	0.07
	mean	high potassium group	8.5	1.45	5.8	1.08	2.82	0.45	2.50	0.39
	s.d.		3.3	0.61	2.3	0.45	1.16	0.18	0.90	0.14

Key: Al2O3 aluminium; Fe2O3 iron; MgO magnesium; CaO calcium; Na2O sodium; K2O potassium; TiO2 titanium; P2O5 phosphorus; MnO manganese; Co cobalt; Cr chromium; Cu copper; Li lithium; Ni nickel; Sc scandium; Sr strontium; V vanadium; Zn zinc; Y yttrium; Ba barium; As arsenic; Rb rubidium; Zr* zirconium; Nb niobium; Mo molybdenum; Cd cadmium; Sb antimony; Cs caesium; Tl thallium; Pb lead; Bi bismuth; Th thorium; U ranium;

Rare earth elements: La lanthanum; Ce cerium; Pr praesodymium; Nd neodymium; Sm samarium; Eu europium; Gd gadolinium; Tb terbium;Dy dysprosium; Ho holmium; Er erbium; Tm thulium; Yb ytterbium; and Lu lutetium

The results from Al2O3 to MnO inclusive are given as the oxide, in weight percent; all the rest are given as the element, in parts per million. S.d. = one standard deviation about the mean.

Note: the zirconium results (Zr*) were not used in the statistical tests since the laboratory indicated possible incomplete dissolution of this element from the powder sample.

The chemical analysis technique used in this project on the fabric of pottery was inductively-coupled plasma spectrometry (ICPS) which gives a chemical fingerprint and thus information on its source, reflecting the clay from which it was made. Such analytical investigations show whether ceramics have the same fabric as each other – and are therefore made from the same clay source. The combined atomic emission and mass spectrometry versions of ICPS (ICP-AES plus ICP-MS) were used, which analyse for all the major elements in the ceramic including silicon, plus a large number of trace elements. Conclusions drawn from the use of numerous elements on each pottery sample are significantly more secure and considerably lessens the risk that pottery of different origins but made from clays of similar age and mineralogical make-up could be confused by chemical analysis. The results of the analyses are given in Table 2, for a total of 47 chemical elements.

Interpretation of the ICP analyses using Principal Components Analysis

Because ICPS analyses for many elements, detailed interpretation was carried out with Principal Components Analysis (PCA), a form of multivariate statistics which simultaneously considers the concentrations of many elements in each sample (Manly 2005; Afifi *et al.* 2012; Baxter 1994 and 2003; Shennan 1997; Orton and Hughes 2013, 175–83). The program MINITAB version 16 was used with the 'PCA' procedure (Ryan *et al*. 2005). As is common practice, logarithms were taken of all elements before subjecting the data to multivariate statistics. In addition, the log-centred ratio data treatment method (LCRD) was applied in a further stage. This is similar to scaling all elements to aluminium, as Vince (2011) applied to his Saintonge data, but has the advantage that the 'scaling' is based on a number of elements. It was successfully applied to interpreting analysis results on medieval tiles from Bordesley Abbey (Leese *et al.* 1989; Stopford *et al.* 1991), among others. It brings all concentration values, whether high or low, to approximately the same general level, while preserving inter-elemental ratios; it is similar to the technique used by Mommsen *et al.* (1988) for dealing with dilution. In the present case it enabled the underlying pattern of chemical differences between samples to emerge, free from the effects of variable proportions of tempering materials such quartz inclusions.

Principal components analysis (PCA) on all the samples analysed

The Tresco results were combined with all the previous known ICP analyses, i.e. those of Vince (2011), extracted from his online ICP database on the Archaeology Data Service website (Vince 2010): these included nine Boston sherds (V3162-70), eight from Dublin, Wood Quay (CMC3, 6-8 and 21–4: Vince 2006) and one Ardglass (V2347). In combining the data, some of the ICP elements determined in the Tresco samples by mass spectrometry had to be omitted from the comparison, since the earlier ICP analyses had used the atomic emission version alone. In addition, a number of rare earth elements were highly correlated and not used, omitting lanthanum, neodymium, europium, samarium and dysprosium. However, this still left 27 elements for the statistical tests, and of these twenty were selected: aluminium, iron, magnesium, calcium, sodium, potassium, titanium, manganese, lithium, nickel, scandium, vanadium, yttrium, zinc, chromium, cobalt, copper, strontium, cerium and ytterbium. In principal components, the elements which contribute towards the principal component scores (i.e. which determine the 'shape' of plots such as Figure 1) are those with the largest *spread* (standard deviation) among *all* the samples analysed. The resulting output from the program showed that the first principal component contained 40% of all the chemical variation between pottery samples in the whole dataset. The second component contained a further 15% and third 12%. Thus the first three principal components contain 67% of all the chemical variation in the samples, i.e. these three effectively summarise the chemical analysis results of all the samples.

The several principal component scores for each ceramic are a summary of the chemical analysis of its body fabric. Plots of the principal component scores are effectively chemical analysis 'maps' showing the relationship between the ceramics based on their chemical analysis alone, and ceramics made of the same clay will plot in the same part of the figure. In Figure 7, each item analysed has been shown by a symbol representing its find-site with identifier from Table 2. Patterns of similar chemistry are expected for sherds made in the same production and should emerge from such plots. It is hoped that sherds from different centres will plot separately from each other, indicating that the products have different compositions of the ceramic fabric. The first component was not associated 'total elements', as is commonly found without use of LCRD, confirming its effectiveness; instead, it was strongly associated (the 'loadings', in descending degree of strength) with higher concentrations of scandium, titanium, aluminium, chromium, and calcium and lower concentrations of magnesium, potassium, yttrium and rare earths towards positive values (i.e. sherds which plotted towards the right of Figure 7). The Dublin, Ardglass and Boston sherds appear above the Tresco sherds which spread across the lower part of the figure. The Tresco sherds were also divided (Tables 2 and 3) like the other sites into pottery with high (*c*. 3%) and low (1–2%) potassium concentrations, and on this figure the vertical dividing line separates the high and low potassium and magnesium sherds. The horizontal axis (the first principal component) contains by definition the most significant chemical differences between all the pots, and in this case this equates to the high/low potassium and magnesium groupings, but the loadings also show the higher potassium and magnesium is associated with rare earth elements, but with lower aluminium and clay-associated elements.

Table 3 Division of the Saintonge pottery from Tresco and other consumer sites into low and high potassium fabric groups.

High potassium			**Low potassium**		
Cat.	ICP		Cat.	ICP	
4	4	mortar (copper gn.)	1	1	jug with beak spout (all over gn.)
6	6	tubular handle (copper gn.)	2	2	handle + bodysherd (dark br. slip, sgraffito)
12-13	8-9	jugs with combed horiz. grooves (mottled)	3	3	horn (liquid gn.)
15?	10	jugs with band of horiz. rouletting (copper gn.)	5	5	costrel (mottled)
17	11	jugs with applied vert. rouletted strips (copper gn.)	7	7	red painted slip bands
18-19	12-13	jugs with applied vert. thumbed strips (mottled)	32	17	jug handle (pink ware)
20 or 21	14	tall jugs with incised marks			
24	15	plain jugs (mottled)			
	16	ungl. micaceous body sherd			
Bergen		mottled gl. and ungl. sherds			polychrome
Boston		mottled gl.			red slip sgraffito
Dublin		mortar and an ungl. painted			polychrome; sgraffito; painted
Ardglass		pégau			
ICP calculation*: 48% quartz, 19% kaolinite, 26 % potash mica, 7% soda mica *representative sample					44% quartz, 36% kaolinite, 12 % potash mica, 7% soda mica

Figure 7 has a number of very significant features: firstly, all sites have pots in both high and low potassium groups, indicating the use of two clays. Thin sections on Saintonge wares show that the white body (from a kaolinite-rich clay) contained abundant fine quartz (less than 0.1 mm across) and a variable quantity of muscovite mica (Vince 2011, 198). Muscovite mica is a potassium aluminium silicate, while biotite mica is a magnesium aluminium silicate. It seems very probable that the differences in potassium and magnesium found in Saintonge wares reflect different proportions of muscovite mica in the clays (with a lesser amount of associated biotite mica).

Secondly, the horizontal spreads of pots from the three sites are significantly differentiated from each other in the vertical direction (second principal component): the Tresco sherds are differentiated from the Dublin and Boston groups by containing systematically more sodium, aluminium, and titanium, but less iron, manganese and copper. This second principal component describes secondary differences between the pots, and seems to represent different production centres for each of the three consumer site groups. It is proposed that we have three workshops represented by the pots from the three consumer sites, and at each workshop, two different clays were used for making different types of ware. This would account for both the vertical and horizontal associations between samples at each site. It is also important to notice the degree of homogeneity in chemical composition between sherds from the same site: the sherds found at each site show strong association with each other, indicating the same production centre, but with very little overlapping between sites, pointing to them being made at different production centres/kilns. A further possible explanation could arise if there were temporal differences between the

Tresco/Boston/Dublin assemblages, and the differences reflect the opening up of new areas of potting clay at successive periods. In that case many potters might have worked a good source together, then exhausted it and moved elsewhere. An important conclusion is the strong indication from the ICP results that all the Tresco finds are of a single production centre, which is consistent with them being from a single shipwreck.

In the past doubts have been expressed whether the jugs with applied vertical thumbed strips (cat. 18 and 19; ICP 12 and 13) were Saintonge products (e.g. Cuisenier and Chapelot 1975, 64; Chapelot 1983, 51–3) but they were entirely consistent chemically with other high potassium sherds from Tresco, confirming their identification as Saintonge ware rather than another western French source.

Discussion

There is an interesting breakdown of wares between the high and low potassium groups (Table 3). Also, even simple visual examination of the fabric shows in a crude way that the potters did prepare different clays for different jobs; coarse quartz inclusions are visible in the big *pégaux*, mortars, unglazed wares and some green-glazed jugs but this preparation was not used for the fine polychrome wares, sgraffito, etc. The ICP results showed that the heavier wares (jugs, mortars and *pégaux*) were made in the high potassium/magnesium group, i.e. with more mica inclusions, whereas the polychromes and more delicate items are made in the clay with less mica and more kaolinite (basically, the higher quality clay). The average analyses of the high and low potassium groups at Tresco are given in Table 3.

It is possible to calculate from the ICP major element results the approximate percentages of the mineral constituents of the two clay types (Table 3), a 'rational analysis': Worrall 1982, 46 shows a worked example from a very similar clay analysis for a ball clay. The proportions of kaolinite and mica switch almost exactly between the two clay types to half the percentages in the other clay. The presence of *c.* 25% mica in the high potassium/magnesium group and the lower percentage of kaolinite would significantly affect the physical properties of the clay. It is noteworthy that the percentages of 'free silica' (quartz) are approximately the same in both clays; most probably almost all fine quartz, though in the mortars it will include a proportion of coarse quartz grains.

A possible explanation of the two chemical groups within the Saintonge industry could relate to the geographical spread of Saintonge kilns. Barton (1963) excavated a dump of wasters at Les Oullières 1.5km north of the village of La Chapelle des Pots around which Saintonge wares were produced, and which lies 5km north-west of Saintes on the River Charente. French archaeologists have located numerous kilns of the 13th and 14th centuries around La Chapelle, which cluster in two groups: to the north (where Les Ouillières lies) and the west of the village (Chapelot 2011, 60, Fig. 6).

However a more convincing explanation comes from the geology of the Saintonge area. This area has extensive kaolin deposits, and Chapelot (2011, 72, citing Cartier and Cartier 1975) describes the occurrence of two superimposed deposits of clay of different periods on the plateau surrounding La Chapelle: the more recent Tertiary deposits include at its base seams of yellow and white clay, and overlies the decalcification zone of the upper Santonian Cretaceous deposits and their seams of clay.

It appears that both deposits were accessible and exploited by the potters of the region and available throughout the region at each kiln. The irregular thicknesses found (a few centimetres to 3–4 m thick – *ibid.,* 72) might prompt potters to move their operations around if clay was worked out at one location, resulting in the numerous known production sites scattered in the two areas. Chapelot *et al.* (2011, 72) give no mineralogical descriptions of the Tertiary and Santonian clays so it is not clear which is the higher-quality clay, low in potassium, and would require local sampling and analysis to confirm the present hypothesis.

In summary, we have evidence from the ICP analyses of the use of two different clay types for different wares among the Tresco finds, a pattern echoed by analyses of other consumer site material. From the geological evidence of two clay types present at each production site, it appears that each kiln had available (and used) two clays for different wares, and that the products of different kilns had slightly different but detectable differences in clay chemistry. We should also bear in mind the possibility that the differences between sites represent temporal differences between the assemblages. Further analytical and archaeological work would be required to indicate the most probable explanation. Differences have been previously found between the products of different kilns at major production centres in Europe: for example London delftwares (Hughes 2008); Antwerp tin-glazed wares (Hughes and Gaimster 1999); and Seville tin-glazed ceramics (Kingsley *et al.* 2012). It is unlikely that the material from Tresco, for example, came from two different kilns some distance apart, since the high and low potassium group material at the site has the same underlying chemical 'signature' (denoted by their horizontal spread across Fig. 7), but differentiated from other consumer sites (the vertical dimension of Fig. 7).

In the wider picture, it appears that Tresco, Boston, and Dublin received Saintonge material from three kilns respectively, which can be distinguished from each other chemically. We cannot as yet tie down which particular kilns were involved, but we hope to analyse further material from other important consumer sites in the UK and from the source area; so far no-one has analysed any Saintonge pottery from the production sites themselves.

Acknowledgements

We are grateful to David McBride and Richard Larn for drawing the find to our attention, and for submitting the sherds which they recovered for study and for helpful correspondence about the find. We also wish to thank Kevin Camidge, who undertook the site survey in 2011, and Peter Holt and Ayse Atauz of Promare, who funded and supported our programme of analysis. In studying the collection we were grateful to Mike Ponsford, whose deep knowledge of the pottery of the Bristol area was especially valuable, and to Clare McCutcheon, who discussed with us the dating and interpretation of related evidence from Irish sites.

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Appendix II – Bone Report by **Laura J. Miller**

Background to Analysis and Methodology

This collection of animal bones was recovered during the 2011 survey project in the Tresco Channel off the coast of Tresco Island in the Isles of Scilly, U.K., a project completed by Promare & CISMAS. Faunal remains were collected during radial searches along a line of modern mooring buoys in the channel and bones were recovered from the surface of the sand or buried very shallowly and exposed through hand fanning. No screening of sediments was conducted during the survey, limiting the recovery of smaller faunal elements and species. After the survey and photo-documentation, the faunal sample was reburied.

All faunal analysis and taxonomic identifications were completed remotely by the author in 2012, using pictures of the bones taken by the survey team in 2011. Without physical examination of the faunal sample, identifications were limited to the pictorial data record. In many cases, only one photo was available for each bag of bones collected, showing a single view of all bone elements in the bag. Lacking multi-dimensional views of many of the elements limited the potential for species identification based on morphological criteria. Therefore, identifications are conservative, focusing first on Class (Mammalia-mammals, Aves-birds, Actinopterygii-fish etc.) and then animal size category. If photos limited the assessment of bone morphology and taxonomic identification to the species level, then at least general animal size group identifications were made (large, medium, and small mammals). A significant portion of the sample, however, remains unidentifiable.

Basic quantification of the sample includes first order data only, including NISP counts (Number of Identified Specimens) and percentage values to evaluate species abundances. No attempt was made to calculate an MNI (Minimum Number of Individuals) for the sample. As an unscreened seabed surface collection with obvious modern bone refuse intrusion, and many bones assigned only to general size categories, this type of analysis is inappropriate as it goes beyond the limits of the available data.

Element identifications were completed when possible, but sometimes had to be limited to the general morphological category of bone fragment (longbone, flatbone, irregular, cranial, dental) represented. Unidentifiable fragments (either elements, species, size category, or class) were designated as such to avoid misidentification errors. For bone elements where species identifications could be made, age data were recorded using standard faunal methods including dental eruption/wear patterns and epiphyseal fusion of longbones (Hillson 2005; Payne 1973; Schmid 1972; Silver 1970). Fragmentation pattern data were recorded including the part of element present and how much (a percentage) of the complete element was represented, as well as side information to understand body part frequencies. No morphometric or weight/mass data were collected. Condition of the bones (such as weathering, staining, surface erosion, and other natural taphonomic processes affecting the sample) was recorded.

Sample Size, Bone Counts, and Species Identified

A total of 91 bags of artifacts were collected from the seafloor during the Tresco Channel survey and the bones were removed for further analysis. Out of this collection, 45 bags (49.5% of the bags) contained bone fragments. A total of 191 bone fragments were processed in this analysis (Number of Identified Specimens or NISP raw count = 191). On average, each bag contained about four bone fragments (minimum: 1, maximum: 37). A few bags with a high number of fragments were dominated by small fish bones. These bags of fish bones may represent a spatial concentration of a deadfall fish, or may reflect differential collection practices by the survey team. Further analysis of the fish bones may be undertaken by a zooarchaeologist specializing in fish identification.

In addition, a separate sample of bones (N=13) was donated to the project by another researcher (Dave McBride) who collected them during earlier work at the site. These bones are discussed separately at the end of the report.

Sorting the primary Tresco Survey sample into animal classes (Figure B.1) shows that Class Mammalia (mammals, N=137), Class Aves (bird, N=1), and Class Actinopterygii (boney fish, N=46) are represented. Bird and fish bones make up a quarter of the sample, 0.4% and 24.0% respectively, and are outside the expertise of the author so no further analysis was completed for these bones. The majority of the sample or 71.6% (N=137) are mammal bones, predominantly domestic mammals. The mammal bones (Total N=137) were sorted into size categories (N=118) and then species (N=84).

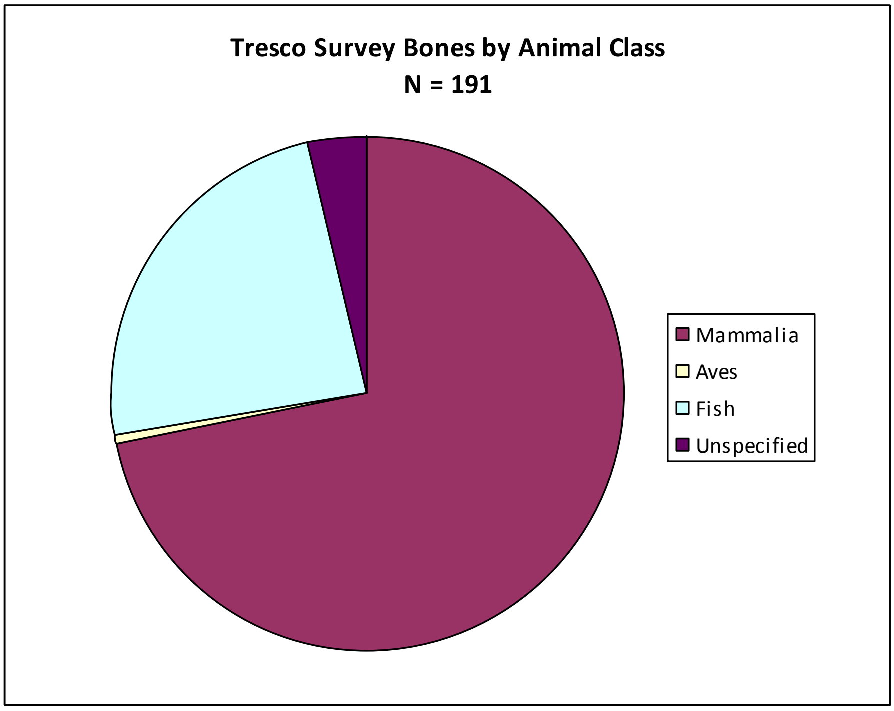

Figure B.1. Tresco Survey bones sorted by animal class.

Figure B.2. Typical bag of animal bones from Tresco Survey (Bag 107).

A total of 118 mammal fragments could be identified to a mammal size class and/or species (Figure B.3). *Bos* sp. (domestic cattle) and *Equus* sp. (domestic horse) bones are included in the Large Mammal category, *Sus* sp. (domestic pigs) and *Ovicaprids* (domestic sheep and goats) are Medium Mammals, and *Lepus* sp. (rabbit) is a Small Mammal. The combined categories Medium/Large Mammal include unidentifiable fragments that are likely either cattle or pigs, while the Small/Medium Mammal category includes unidentifiable fragments from what may be small sheep or goats or other small mammals. The combined categories prevent misaggregation of the less identifiable fragments with the element identifications made to the species level. The distribution by size categories reflects the dominance of domestic bovids (cattle, sheep, goats) and suids (pigs) in this assemblage.

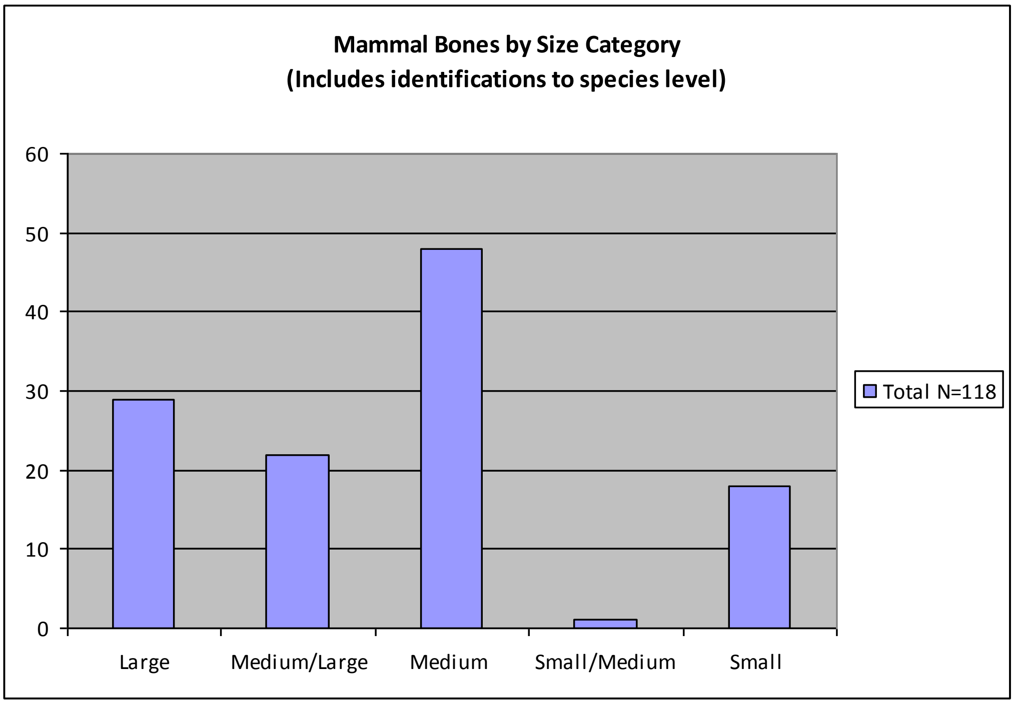

Figure B.3. Tresco Survey Mammal Bones sorted by size category.

A total of 84 mammal bone fragments could be identified to the species level. Large mammal species identified include *Equus* sp. (horse, N=1), and *Bos* sp. (cattle, N=28); medium mammals include *Sus* sp. (pig, N=18), and *Ovicaprids* (sheep or goats, N=28); small mammals include *Lepus* sp. (rabbit, N=7) (Table 1, Figures B.4 and B.5).

Table 1. Tresco Survey Mammal Species	N = 84 (%)
Equus sp. (horse)	1 (1%)
Bos sp. (cattle)	28 (33%)
Sus sp. (pig)	18 (20%)
Ovicaprids (sheep/goat)	30 (36%)
Lepus sp. (rabbit)	7 (9%)

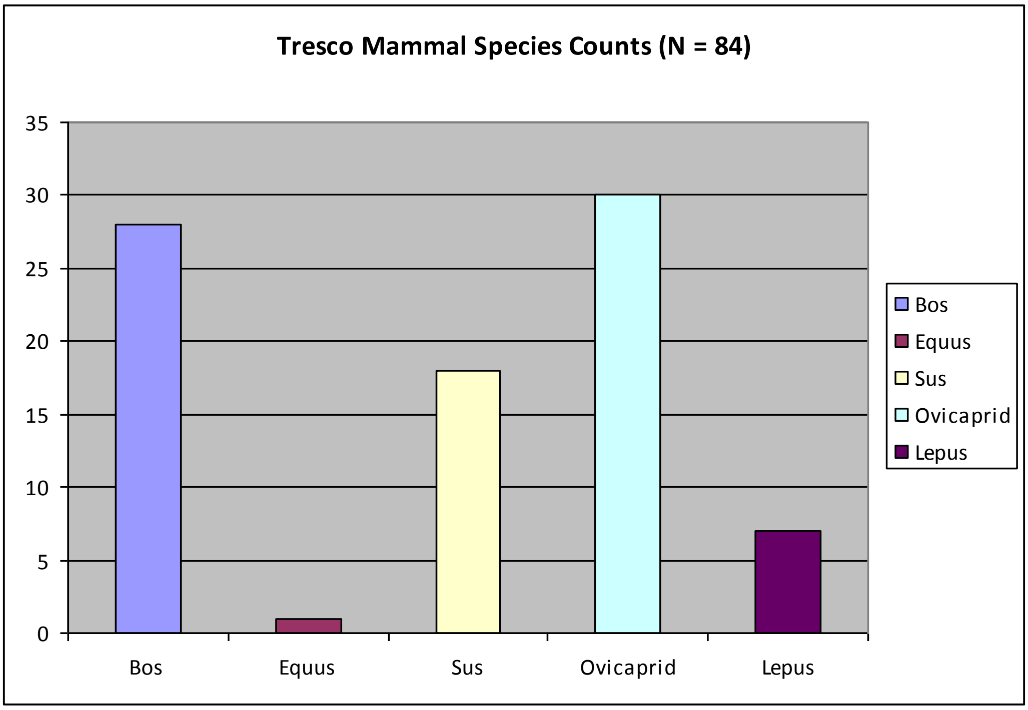

Figure B.4. Tresco Mammal Species Counts.

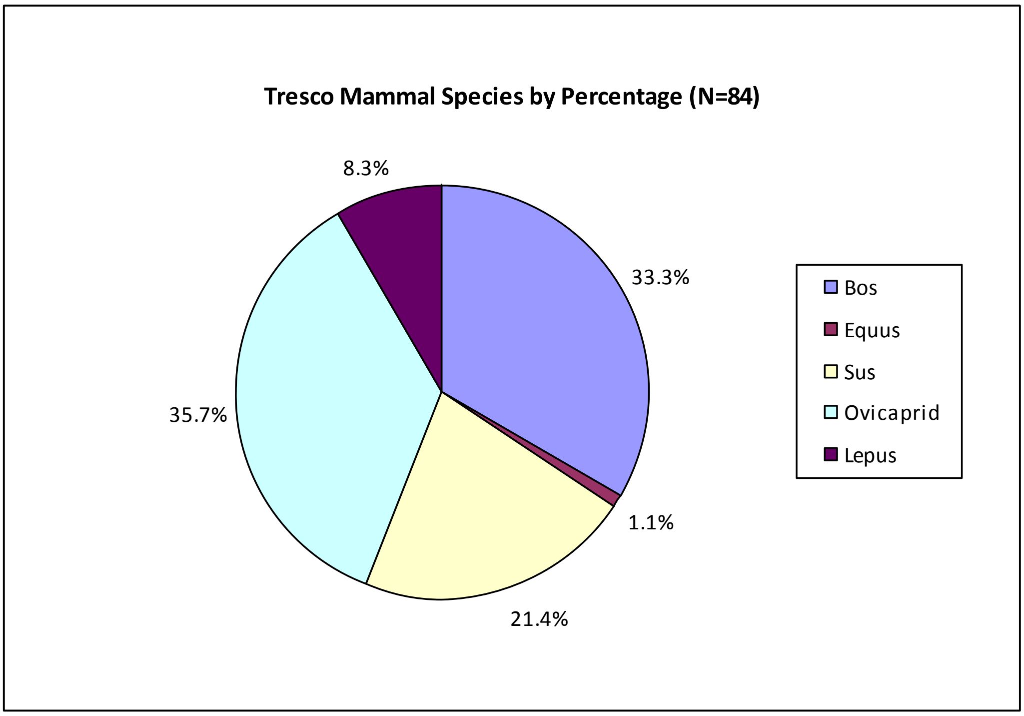

Figure B.5. Tresco Mammal Species by Percentage.

Domestic cattle, sheep, goats, and pigs are recognized cornerstones of the modern English diet, and they were important components of the Medieval diet in the late 13th Century, the time period for the associated ceramic assemblages (Saintonge, Bristol, Southampton) recovered in the survey.

However, in Medieval diets pigs were the preferred meat animal while sheep and goats were important for their dairy products. Cattle, being more expensive to raise, were consumed primarily by elite members of Medieval society (Adamson 2004; Armitage 2004; Woolgar 2006). The presence of so many cattle bones in this sample may represent a significant intrusion of modern bone refuse in the sample (see below).

Also of interest is the presence of rabbit bones (*Lepus* sp., N=7) in the sample which included mandibular and appendicular skeletal elements from several individuals. Rabbit was considered a delicacy in England before the 13th Century. After this time, in the south of England, rabbits were raised for meat and fur, especially by monastic communities as a food source during Lent, as the young rabbits were equated with fish for doctrinal dietary restrictions during this month (Johnston 2011). Ceramic evidence from the Tresco site suggests economic links with the wine trade, and interactions with monastic communities involved in the wine trade (and rabbit husbandry) may be further supported through this bone evidence. However, the modern dietary contribution of rabbits can not be discounted either and the rabbit bones in this sample may be a modern intrusion.

Condition of the Bones and Taphonomic Processes

Working with enlarged photos, the external condition of the faunal sample was evaluated to assess taphonomic processes affecting the sample. Detailed microscopic examination of the bones' taphonomic signatures could not be completed. Preservation of bones is affected by the pH of water and burial sediments, temperature, the level of other organic/inorganic action in the burial environment, and other natural or cultural taphonomic processes (Lyman 1994). Many bones in the sample display evidence of weathering and staining from burial sediments, erosion of cortical epiphyseal surfaces (possibly due to rolling in sand from wave/current action), and pitting from sea creature colonization and infiltration. Specimens without any of these taphonomic signatures made modern food refuse clearly identifiable (Figure B.6). Several obvious modern and recently deposited bone fragments were recorded. They are bright white in color and fresh in appearance, exhibit no surface weathering or cracking, no intrusion by sea creatures, and have sharp, straight-edge bandsaw cutmarks on them. Indeed, the seabed surface location of all the bones and their spatial association with the modern mooring buoys (around which modern food refuse accumulates, *ie*. lazy modern sailors tossing trash overboard), suggest the more weathered bones in the sample, though obviously older in depositional age, also could be relatively recent in origin compared to the associated ceramic artifacts.

Figure B.6. Modern bone refuse (Bag 33). Note the bright surface color and straight-edge cut across the shaft of this sub-adult unfused tibia.

Many bones (N=28) have dark black/brown staining of the cortical surfaces. Dental fragments and teeth within mandibles and maxillae have dark reddish brown staining on the enamel surface (Figure B.7). The dark stains develop as the bone and tooth fragments absorb minerals and chemicals in burial sediments and sea water. Other staining may be a result of other activities such as infiltration, colonization, and consumption by sea creatures. These stained bones have been underwater for longer periods of time, although exactly how long is uncertain.

Some of the larger, more complete longbone fragments (N=9) display evidence of erosion around their epiphyses or articular ends. Although bone epiphyses often display similar damage related to meat consumption created during butchery and cooking or post-depositional damage created by carnivore action/gnawing, many of the bone epiphyses are worn smooth, possibly from rolling in sand on the sea bed through wave or current action (Figure B.8). Fracturing of the elements also may be due to the active seabed environment (Lyman 1994, Haglund and Sorg 2001). In addition, some of the bones (N=3) have a pitted surface and have been infiltrated/colonized by sea organisms (sea worms, barnacles, etc.), consuming both the organic and inorganic portions of the bones.

Figure B.7. Staining of the enamel surface and infiltration by sea organisms are present on this pig mandible (Bag 20).

Figure B.8. Note smoothing and erosion to the surfaces at the ends of these two metapodials (Bag 4).

Skeletal Elements, Body Part Abundances, and Age Patterns

Besides recording taxonomic abundances in the sample, skeletal elements were examined to identify body part frequencies and age patterns that might provide more information about how this faunal collection was created. This analysis is important for separating natural taphonomic processes affecting the sample from signatures of deliberate cultural activity like cooking, butchery, food preservation (salt curing of meat in barrels for sea transport), and disposal (food refuse – modern or ancient) that may have contributed to the creation of this faunal sample. Identified skeletal elements were tabulated by species and according to the animal body part from which they originate, separating the animal into four sections of head, axial elements, forelimb/hindlimb, and hoof. For example, cranial elements, mandibles, and teeth are from the head of the animal, longbones like the humerus or femur are from the forelimb and hindlimb respectively, ribs and vertebrae are axial elements, while metapodials and phalanges are from the distal limb or hoof of the animal. These groups seek to distinguish major meat-bearing elements or "prime parts" of the carcass from skeletal elements with less meat value, such as the head and hooves. Without much associated meat, the head and hooves are portions of the carcass often discarded during the initial butchery process. Discarded elsewhere, these elements may not reach the primary food consumption, disposal, or deposition locations (a shipwreck event) which are being investigated through the archaeological record.

As illustrated in Figures B.9-B.11, meat-bearing elements of the forelimb, hindlimb, and axial elements dominate the samples from both cattle (*Bos*) and pigs (*Sus*), with very few head or hoof elements represented. There is a more equal distribution of skeletal elements between meat and non-meat bearing skeletal parts for the sheep/goats (Ovicaprid) in this sample.

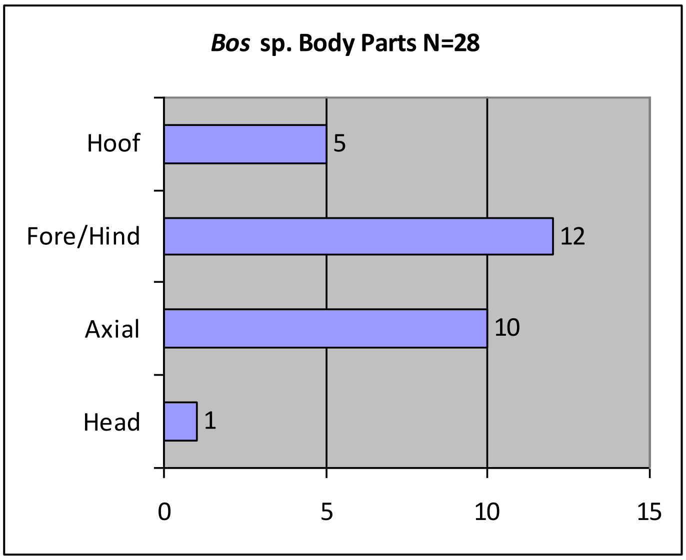

Figure B.9. Body parts represented for cattle (Bos sp.).

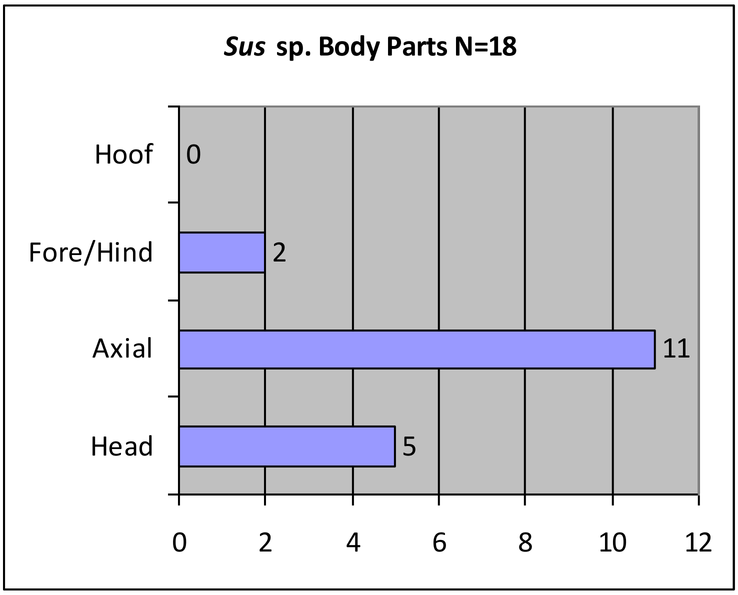

Figure B.10. Body parts represented for pigs (Sus sp.).

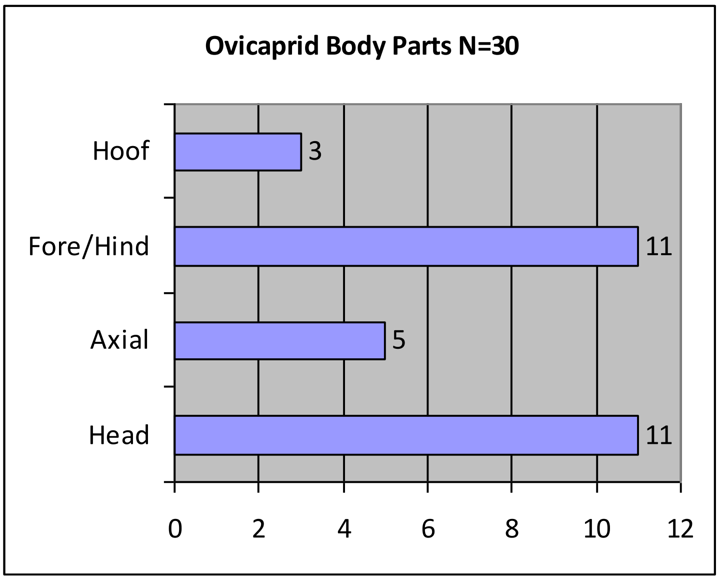

Figure B.11. Body parts represented for sheep/goats (Ovicaprids).

However, there were several mandibles and many individual, loose Ovicaprid teeth recovered in the survey. Without being able to reconstruct tooth rows in the mandibles or check for adjacent wear facets, it is impossible to say whether these teeth represent separate individuals or are from a few animals. Post-depositional fragmentation and dispersal may be skewing patterns, making Ovicaprid head or cranial elements seem over-represented in the sample. However, they also could represent a difference in shipboard provisioning patterns (see below).

The body part patterns observed indicate that prime, meat-bearing parts of mammals contributed significantly to the bones recovered at the Tresco site, suggesting it is food refuse and does not originate from some other bone processing activity (butchery, tool making). The presence of so many cranial elements may indicate the proximity of a primary butchery/slaughter location or disposal area. However, this pattern could be a product of differential preservation of the denser dental elements in the seabed environment. Although the body-part data cannot tell us whether these bones are modern or ancient food refuse, body part distributions are consistent with medieval food traditions.

These patterns can be compared to what is known about medieval sea-faring practices and meat preservation and provisioning techniques. For example, medieval ship provisioning included large sides of beef or pork that were salt-cured then cut into chunks and stored in barrels for the journey. Limbs were kept whole as smoked haunches for preservation and transport in sea vessels. Unlike larger mammals, it was not uncommon for small and hardier live sheep and especially goats to be kept on board a ship during voyages, providing milk products for the crew and meat when needed (Adamson 2004; Armitage 2004; Clutton-Brock 1979; L'Hour & Migaud 1990). This practice of keeping live animals aboard may explain the presence of the high numbers of Ovicaprid cranial elements found at the site.

However, when discussing the body part patterns and medieval shipboard provisioning patterns, it also must be remembered that none of the sediments during the survey project were screened. All bones recovered were either visible on the surface of the seabed or were exposed through hand fanning. In no way should this sample be considered a complete picture of medieval (or modern) foodways. An unscreened faunal sample is biased toward the recovery of large bones, easily recognizable skeletal elements, and larger species. Small skeletal elements and small animal species may be underrepresented or missed entirely. The seabed environment and local conditions in the active sea channel also may be affecting preservation and recovery in ways not fully understood at this time. Modern boat traffic and boat anchors around the mooring buoys may be disturbing the burial environment, leading to fragmentation and dispersal of an ancient faunal sample.

Although it was hoped that epiphyseal fusion and dental eruption/wear patterns could be used to construct age profiles for the sample, only a few skeletal elements of each species were complete enough to evaluate for their age status. Lacking abundant data to construct age profiles, however, it is noted that both adult and juvenile individuals are represented for the mammal species (*Bos, Sus, Ovicaprid*) identified in the sample.

Interestingly, the obvious modern bone intrusions in the sample are primarily sub-adults, reflecting modern husbandry practices that slaughter animals immediately after reaching maximum body size or when the animal achieves optimal meat weight. Slaughter is prior to skeletal maturation as profits decline from the expense of continuing to feed an animal once it has achieved its maximum body size.

Additional Faunal Sample

Besides the bones collected during the Tresco Channel Survey Project, the director of the Tresco Survey team was presented with a collection of bones recovered during an earlier project in the same survey area by researcher Dave McBride. There were 13 bones in this collection (Figure B.12, Table 2).

Table 2. Additional Faunal Sample Species	**N = 13**
Bos sp.	7
Sus sp.	5
Ovicaprid	1

Figure B.12. Additional bones turned over to project by Dave McBride.

This sample includes the same domestic mammal species that dominate the Tresco Survey sample discussed above, cattle, pigs, sheep and goats. Longbone (tibia, femur, metatarsal) and mandibular/dental skeletal elements dominate. Like the other sample, weathering patterns suggest some of the bones are of very recent origin, without sediment staining, while other elements exhibit stains and cracking to surfaces suggesting they have been in the burial environment for longer time periods. These bone fragments are relatively large, intact and easily recognizable skeletal elements (mandibles, teeth, longbones). No small, miscellaneous bone fragments were included, suggesting that it may have been selectively collected. Small bone fragments may not have been retained or not recognized. No information about the precise recovery location or recovery methods is known for this sample. Because of the contextual uncertainties, these elements were not included in the Tresco Survey faunal statistics. However, based on the species and elements represented and their condition, the turned-over sample conforms to the general patterns observed for the Tresco Survey faunal sample. It is food refuse/butchery refuse, dominated by domestic meat animals.

Summary

Although only limited faunal analysis has been completed, the bones recovered from the Tresco Channel site are consistent with a 13th century Medieval Period food refuse assemblage. The sample contains mostly domestic mammals (cattle, sheep/goat, and pigs). A few rabbit bones were identified, possibly suggesting links with local monastic communities. There are significant numbers of fish bones as well. The presence of fish bones on a sea-going vessel is understandable, as sailors could supplement their shipboard diet with fresh-caught fish.

Unfortunately, taphonomic signatures observed for some of the bones indicate that there are definite modern bone refuse intrusions at the site. The extent of this intrusion is poorly understood at this time but could be significant. Unburied or shallowly buried bone will not survive long on the seabed floor and this is precisely the context in which these bones were found. The spatial proximity of recovered bone to the modern mooring buoys suggests that much of the sample has the potential to be modern or historic trash deposits from periods later than the 13th century.

In addition, other lines of evidence point to historic intrusions at the site. Allan and Brown, the authors of the ceramic analysis report for the Tresco Channel Survey, documented the presence of a small number of 19th century pottery fragments. This suggests there could be historic faunal remains present as well. However, the authors also identified patterns in the ceramic assemblage that point to the site's 13th century origins. Besides documenting a ceramic assemblage that overwhelmingly dates to the late 13th/early 14th centuries, they describe large pieces of delicate Saintonge ceramics having a "fresh" appearance, hypothesizing that the fragments recently were uncovered by a local disturbance of the burial sediments around the 13th century "event", possibly a shipwreck. Likewise, previously buried archaeological bone also may have been disturbed and disbursed in the areas adjacent to the modern mooring buoys. The temporal status of the faunal sample remains uncertain unless further excavation is completed at the site and chronometric dating of bone samples can be completed. However, based on the diversity in taphonomic signatures, elements represented, and the species identified (i.e. faunal patterns consistent with Medieval food refuse), and the faunal sample's spatial association with datable artifacts, at least some portion of the faunal sample is likely contemporaneous with a 13th century event.

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