Characterisation Studies of Anglo-Saxon Pottery from *Lundenwic*: 1) Shell-tempered wares

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Background

The latest ceramic assemblages from the 7th to 9th-century settlement of Lundenwic typically contain sherds of Ipswich-type ware, which is the most common type used, followed by handmade shell-tempered wares and continental imports. In 1999 some of these shelly wares were included in a study of shell-tempered pottery from trading sites in the southeast of England, to test the possibility that they were of Frisian origin (Vince 1999).

The results of this study indicated that there was variation in the petrology and chemical composition of these wares. No examples of 7th to 9th-century shelly wares from the continent were included in that study but samples of shelly ware identified as medieval Flemish imports in Canterbury were included, together with a sample of a medieval shelly ware of local, Wealden, origin characterised by freshwater gastropods.

The results of this study were to show that the 'Flemish' shelly ware from Canterbury contains fragments of a shelly limestone. Two Mid Saxon samples had similar inclusions: AG486 and AG488,neither of which was from London. However, their chemical composition was more similar to the remaining Mid Saxon samples. The remaining shelly wares contain fragments of bivalve shell. These could be divided into those with mother of pearl-like (nacreous) structure and those composed of layers of calcite (here termed laminated bivalve shells). Further subdivisions were possible depending on the size and roundness of the fragments.

The latter shells are similar to those seen in early medieval (ie 11th to 12th-century) pottery in the London area. It is likely that in most cases these shells are not recent marine or freshwater mollusc shell but Tertiary fossils (Jenner & Vince 1991). Such fossils are naturally present in the Woolwich Beds, which outcrop in the Thames estuary on either side of the river (REF to geology memoir). Rounded fragments of this shell probably occur naturally in sands and gravels which pass over these outcrops.

In the current study, the thin-sections and chemical analyses from the 1999 study were first re-examined and compared with samples of medieval shell-tempered wares produced in the 12th and 13th centuries in the Thames valley (REF to SSW report). This showed that there was a similarity in the chemical composition of these medieval Thames valley shell-tempered wares and the majority of the mid Saxon samples, with the Canterbury 'Flemish' wares and the gastropod-tempered ware having distinctly different compositions (Fig 1). One of the mid Saxon shelly samples had a very different composition (AG484, Jubilee Hall) and when the thin-section of this sample was re-examined it was seen that the shell fragments were entirely nacreous in structure, and in some cases heavily rounded.

These characteristics are more similar to those of Late Saxon Shelly ware than of any of the other mid Saxon shelly wares (including northern and southern Maxey-type wares, produced in the east and southeast midlands respectively). Thus the Jubilee Hall sample is likely to either be an intrusive Late Saxon vessel, or a mid Saxon Oxfordshire import produced using the similar raw materials. Currently, however, it is thought that Oxfordshire was aceramic at this period.

Four other samples from the 1999 study have compositions which are different from those of the medieval Thames valley shell-tempered wares:

AG344 - Barking Abbey

AG481 – Sandtun, Kent

AG483 – Sandtun, Kent

AG488 – Sandtun, Kent

The thin-sections do not support the model of these four samples having a single source: AG344 and AG483 were tempered with laminated bivalve shell, AG481 was not thin-sectioned, and AG488 has shelly limestone temper. AG486, which also has this temper, has a chemical composition which places it in the Thames valley group.

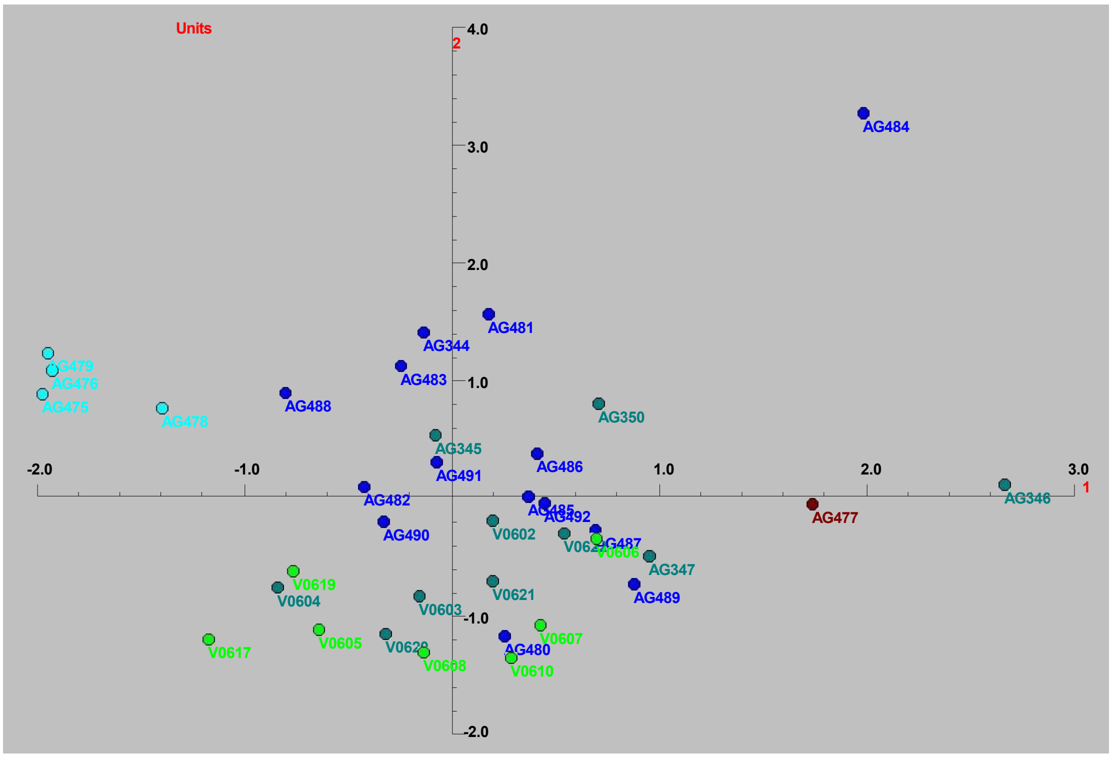

Figure 1

The separation seen in Fig 1 within the Thames valley group is mainly due to differences in silica content. This silica is both in the form of silt and sand.

Binocular microscope survey

In 2003 a survey was undertaken of all of the shell-tempered pottery from a range of excavations in the Lundenwic area. These showed that a modification of the fabric grouping adopted in 1999 was required. Sherds from 146 vessels were examined by the author and Jane Young and thirteen separate fabrics were identified (Table 1). Of these, only three were common and eight consisted of single examples. One of the latter is likely, in any case, to be a sherd of 11th to 12th-century pottery.

Table 1

Group	Description	BOB91	BRU92	dry90	jub85	rop95	SGA89	sot89	treas	Grand Total
A	A RQ SOME GSQ;S SHELL;POSSIBLY/PROBABLY EMSS		1							1
B	ABUNDANT BIVALVE, MOSTLY V SMALL;SOME NACREOUS>4.0MM					2				2
C	BIVALVE SHELL (MOSTLY NACREOUS BUT SOME LAMINATED OF VARYING SIZES);SHELLY LIMESTONE FRAGS		1						4	5
D	M UNID SOFT WHITE INCLUSIONS - ALTERED SHELL;LIMESTONE? PHOSPHATE?;SILTY MICACEOUS GROUNDMASS;S RQ			1						1
E	ROUNDED ORNAMENTED SHELL, BROWN IRON STAINING;FINE MATRIX	1								1
F	WOOLWICH BED CLAY?	7	5			3	8		1	24
G	WOOLWICH BED CLAY? OR ROUNDED ORNAMENTED SHELL;FINE MATRIX	1								1
H	WOOLWICH BEDS SHELL;SILTY MICACEOUS GROUNDMASS;A RQ	1				13				14
I	WOOLWICH BEDS SHELL;SILTY MICACEOUS GROUNDMASS;M RQ			1						1
J	WOOLWICH BEDS SHELL;SILTY MICACEOUS GROUNDMASS;S RQ	3	37	10	4	24	10	2	3	93
K	WOOLWICH BEDS SHELL;VERY SILTY MICACEOUS GROUNDMASS;S RQ					1				1
L	WOOLWICH BEDS SHELL? FRAGS OFTEN COATED WITH RED HAEMATITE;S R HAEMATITE GRAINS								1	1
M	SHELL SAND, GRAINS >2.0MM LARGEST ONES ROUNDED				1					1
	Grand Total	13	44	12	5	43	18	2	9	146

It is clear that the majority of sherds contain laminated bivalve shell, in some cases apparently completely unweathered (group F) but in most cases probably detrital (groups G to L). It is noteworthy that some sherds contain both nacreous and laminated bivalve shell (groups B and C). It is also noteworthy that there are differences in the inter-site distribution of these groups. In particular, the freshly dug Woolwich Beds fabric (group F) has a variable distribution, being much more common on two sites, BOP91 and SGA89, than on others. This may be due to differences in chronology, to the presence of smashed vessels across several contexts or to real differences in supply within the settlement.

Thin-section and chemical analysis

Twelve samples were chosen for further analysis (Table 2). Two further samples of group J were chosen, so as to provide, along with the 1999 samples, a representative sample for chemical analysis of the most common fabric. Five samples were then chosen of group F, mainly to test two alternative interpretations: firstly, that the two fabric groups were produced in different centres and secondly, that they were produced in a single area in which some clay was freshly dug from the Woolwich Beds but some was alluvial clay derived from those beds. Finally, five samples were taken from fabric groups which appear from visual analysis to be tempered with shell which does not come from the local Woolwich Beds. In two cases (groups B and C) the fabrics contain oyster-like shell. Such shells are never found in the Woolwich Beds but could be of recent origin, or of Jurassic age. Where, as in group C, these shells appear to be surrounded by a calcite matrix the Jurassic origin seems more likely. Group E, on the other hand, appears to have been tempered with a recent beach sand.

Table 2

Group	Subfabric	Action	Total
B	ABUNDANT BIVALVE, MOSTLY V SMALL;SOME OYSTER-LIKE >4.0MM	TS;ICPS	2
C	BIVALVE SHELL (MOSTLY NACREOUS BUT SOME LAMINATED OF VARYING SIZES);SHELLY LIMESTONE FRAGS	TS;ICPS	2
E	ROUNDED ORNAMENTED SHELL, BROWN IRON STAINING;FINE MATRIX	TS;ICPS	1
F	WOOLWICH BED CLAY?	TS;ICPS	5
J	WOOLWICH BEDS SHELL;SILTY MICACEOUS GROUNDMASS;S RQ	TS;ICPS	2
	Grand Total		12

Petrological analysis

Group B (V1705, V1706)

The thin sections reveal a fine textured shell sand composed mainly of thin-walled bivalve shells mainly up to 0.5mm long and rarely up to 3.0mm. Some of the shell fragments have ferroan calcite cement attached. The larger shell fragments included ornamented examples. Punctate brachiopod shell is common, with the holes often filled with ferroan calcite. Frafgments of echinoid shell are also present. The groundmass consists of anisotropic baked clay with rounded almost opaque brown grains, ostracod shell and forameniferae. There is no quartz silt present.

The fabric probably contains detrital fragments of a shelly limestone of Jurassic date but the clay itself is calcareous and comparable to many examples of Jurassic clay.

Group C (V1777, V1778)

The thin sections reveal a medium to coarse shell sand composed mainly of subangular fragments of shell (non-ferroan calcite) up to 3.0mm across. The shell fragments are in the main composed of thickwalled laminated bivalve shell with opaque specks, probably iron pyrites enclosed in the body of the shell. Thin-walled examples are also present. Fragments of a ferroan calcite/clay cement are present and vary in the relative proportion of the two. In one instance a shell fragment appears to have been totally replaced by sparry ferroan calcite. One fragment of a ferroan-calcite cemented rock containing abundant angular quartz grains up to 0.2mm across and a single shell fragment was noted.

The groundmass consists of anisotropic baked clay minerals with subangular opaque grains up to 0.3mm across and sparse to moderate angular and subangular quartz of fine sand grain. A single rounded pellet containing a much higher proportion of this sand was noted. The texture of this pellet is similar to that of brickearth.

Group E (V1707)

The thin section reveals moderate quantities of angular and rounded shell sand up to 3.0mm across. Most of the fragments are thick-walled laminated bivalve shell but thin-walled bivalve shell is also present. A few fragments of a shelly limestone with nacreous bivalve shell and a clay/ferroan calcite cement are present. No ornamented shell was noted in thin section. Angular almost opaque dark brown inclusions up to 1.0mm are present. The groundmass consists of anisotropic baked clay minerals and abundant dark brown inclusions, the smallest of which are rounded (faecal pellets?).

Group F (V1708, V1709, V1710, V1711, V1712)

The thin sections reveal moderate quantities of angular to rounded shell sand. The shell fragments range up to 4.0mm across and are mainly composed of thick-walled bivalve shell with opaque specks. Thin-walled bivalve shell, shelly limestone with a ferroan calcite/clay cement and a rock with angular quartz silt and shell fragments in a ferroan calcite cement were also present. There are variable quantities of angular quartz of fine sand grade present and some clay pellets containing higher quantities of such sand. A small number of pieces of ?fossil wood were noted.

The groundmass consists of anisotropic baked clay minerals and abundant dark brown, almost opaque grains and numerous small rounded ?faecal pellets specks of non-ferroan and ferroan calcite.

Group J (V1713, V1714)

One of the two thin-sections is identical to those of Group F. The other has the same range of calcareous inclusions (shelly limestone was noted but not the fine sandy limestone). However, it contains very little quartz of any size. The groundmass contains abundant dark brown, almost opaque grains, most of the smaller sizes, including ?faecal pellets.

Discussion

This second batch of thin sections suggests that Group B is quite clearly completely different from the remainder but that the remaining samples contain the same or similar shell sands and that these sands contain calcareous inclusions from three sources: fossil shell from a fossiliferous clay; a fossiliferous limestone with a ferroan calcite/clay matrix and a fossiliferous sandstone with a ferroan calcite cement. The presence of specks of ferroan calcite in the groundmass of some of these sections might suggest that the fossiliferous limestone might be present as bands or nodules within the parent clay, but the only nacreous shell noted was associated with ferroan calcite/clay cement and it is likely that the small ferroan calcite inclusions are detrital fragments of this limestone. It is difficult to support the division into Groups F and J on the basis of these sections and probable that the ornamented shell noted in Group E was a rare, recent shell in a sand composed mainly of reworked Tertiary fossils. Group C probably contains the same range of inclusions as Groups E, F and J but with higher quantities of the limestone and calcite-cemented sandstone inclusions.

Chemical analysis

The data from this second batch of samples was studied using Principal Components Analysis (PCA) in a dataset which included the following groups:

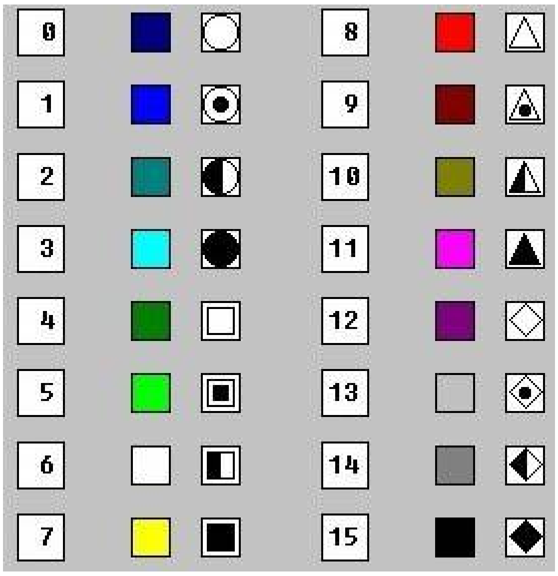

Figure 2 Key to PCA graphs

1. The medieval Canterbury 'Flemish shelly' ware samples
2. Mid Saxon shelly limestone-tempered wares from Sandtun
3. Northern Maxey-type ware (from a variety of findspots in Lincolnshire and York)
4. A group of Northern Maxey ware samples found during pipeline construction on the Isle of Axholme. Despite petrological evidence to suggest a northwest Lincolnshire source they have distinctive chemical composition, perhaps as a result of burial in anaerobic conditions.
5. Northern Maxey-type ware – Quarrington subfabric. Two samples with a distinctive fabric from Quarrington and probably made nearby
6. Southern Maxey-type ware. A putative example from a site at Quarrington, the most northerly findspot for this ware. Probably actually an aberrant Northern Maxey-type ware
7. Shell-tempered wares from Hartlepool, possibly of Anglian (mid Saxon) date and associated with the Mid Saxon monastery underlying the medieval town, but all from medieval contexts.
8. Fabric Group F
9. Fabric Group B
10. The Jubilee Hall vessel (AG484)
11. Fabric Group E
12. Fabric Group J

Group 1 the medieval Flemish shelly ware from Canterbury.

These samples form a discrete group. A plot of PC1 against PC2 shows an overlap with a Northern Maxey-type ware sample (AG329, from Holton-le-Clay in the Lincolnshire Wolds), but other plots show that this overlap is coincidental.

Group 2. Mid Saxon shelly-limestone tempered ware

These two samples do not form a separate group using PC1/PC2 but are clearly separated using PC3/PC4.

Group 3. Northern Maxey-type ware

Using PC1/PC2 the Northern Maxey-type wares form a large cluster with three outliers: AG329, described above, AG171 and AG148, both from Flixborough. This cluster can be seen in graphs of PC3/PC4 and PC5/PC6 but without these outliers. Although the samples come from eight separate findspots there is no evidence for a correlation of chemical composition and findspot.

Group 4. Northern Maxey-type ware from the Isle of Axholme

A group of 10 samples of Northern Maxey-type ware from the Isle of Axholme are an exception to the rule and form a distinct chemical cluster. In PC1/PC2 the two groups are close but in PC5/PC6 this group is clearly separated from Group 3. This is due to a range of elements but mainly Sr, normally closely correlated with CaO. Since the petrological analysis is quite clear that the vessels are tempered with a shelly limestone which does not outcrop in the Isle of Axholme but does outcrop in northwest Lincolnshire it is very likely that this group's chemical composition has been affected by burial in an anaerobic environment.

However, even when the analysis is re-run omitting the most mobile elements PC5/PC6 still separates these two Northern Maxey-type groups, in this case primarily through the Zirconium content. The absolute Zr content has the same range in the two samples and presumably, therefore the difference is in relative content. Table 3 shows the average values for the major elements and for Zr and Sr and those averages relative to Al2O3. The differences in NaO, CaO, MnO, Sr and P2O5 seem to be real and indicate both that there is more shell (CaO and Sr) in Group 4, more phosphate and less NaO. These differences are probably due to leaching of the Group 3 samples together with phosphate concretions on Group 4. Table 4, however, indicates just what variations can be found as a result of burial environment.

Table 3

Element	Average	relative to Al	average	relative to Al	Comment	ratio
Nd	29.24	2.817	14.87	1.652	lower	0.59
NaO	0.19	0.018	0.10	0.011	lower	0.61
Sm	4.95	0.477	3.12	0.347	lower	0.73
V	72.89	7.022	52.67	5.852	within 25%	0.83
K2O	1.24	0.119	0.91	0.101	within 25%	0.85
Ni	54.41	5.242	40.11	4.457	within 25%	0.85
Sc	10.07	0.970	8.22	0.913	within 25%	0.94
Fe2O3	5.41	0.521	4.48	0.498	within 25%	0.96
TiO	0.43	0.041	0.36	0.040	within 25%	0.97
Cr	64.70	6.233	54.33	6.037	within 25%	0.97
Cu	29.83	2.874	26.56	2.951	within 25%	1.03
Ce	64.18	6.183	60.00	6.667	within 25%	1.08
silica'	66.05	6.363	62.15	6.906	within 25%	1.09

Y	17.85	1.720	18.00	2.000	within 25%	1.16
Zr	58.00	5.588	59.22	6.580	within 25%	1.18
La	27.14	2.615	29.44	3.271	within 25%	1.25
Li	31.12	2.998	33.78	3.753	within 25%	1.25
MgO	0.74	0.071	0.83	0.092	higher	1.29
Yb	1.15	0.111	1.32	0.147	higher	1.32
Ba	497.91	47.968	577.33	64.148	higher	1.34
CaO	24.73	2.382	29.09	3.232	higher	1.36
MnO	0.09	0.009	0.12	0.013	higher	1.54
Dy	2.43	0.234	3.29	0.366	higher	1.56
Sr	423.37	40.787	666.33	74.037	higher	1.82
Eu	0.74	0.071	1.23	0.137	higher	1.92
P2O5	1.12	0.108	1.96	0.218	higher	2.02

Group 5 Northern Maxey-type ware – Quarrington variant

The two samples of MAXQ have a very similar chemical composition and consistently plot together in PCA graphs. In PC1/PC2 they are separate from the remaining Northern Maxey-type wares but in other plots they are included in that cluster.

Group 6. Southern Maxey-type ware

The single sample of this ware is not a typical piece but consistently plots on the fringe of the Northern Maxey group

Group 7. Hartlepool Shelly ware

The five samples of Hartlepool shelly ware have a similar chemical composition and can be separated from the remaining samples in the dataset using PC5/PC6. Using the restricted dataset created for comparing Groups 3 and 4 the group can clearly be separated using PC4 and PC5. This is due in the main to the Zr content.

Group 8. Fabric Group F (Woolwich Beds clay?)

Using PCA it is impossible to distinguish this group from Group 12 (Fabric J). This seems to confirm that the two fabrics are indeed ultimately derived from the same raw materials. The samples do not form tight clusters, however, and this may indicate that groups 8 and 12 were produced using several exposures of clay. However, there are insufficient samples present to test this.

Group 9. Fabric Group B.

The two samples have similar compositions and consistently plot near to each other in PCA. Using PC1/PC2 they plot on the edge of the Woolwich Beds-derived groups, 8 and 12 but could be considered to be part of that group. Using PC3/PC4 they plot on the boundary between Northern Maxey-type ware and the Woolwich Beds samples but using PC5/PC6 they form a separate cluster. This appears to be due to their rare earth contents, in particular Sm and Nd, followed by Eu, La, Dy and Ce. The samples have the highest Sm and Eu contents in the dataset.

Group 10. The Jubilee Hall vessel (AG484)

This sample appears to have a very different chemical composition from others in the dataset. The PCA emphasises the Y content (66ppm, twice that of the next highest measurement) but the sample also has the highest NaO2, MnO, Dy and Yb values in the dataset. Together with its petrological characteristics this evidence implies that the sample came from a different source from the other samples.

Group 11. Fabric Group E

In both PC1/PC2 and PC3/PC4 this sample plots alongside Groups 8 and 12 and probably, therefore, has a similar, local, origin. It has a higher iron content than any other sample in those groups and this is consistent with the iron panning visible around the rounded shell inclusions. Using the restricted dataset created to study the difference between Groups 3 and 4 this sample is separated from the remainder by PC6, to which Fe2O3 is the main contributor.

Group 12 Fabric Group J

Group 12 has already been considered alongside Group 8, which has a similar chemical composition. This evidence is taken to indicate that both groups were made from the same raw materials and by implication both could be of local origin.

Characterising the parent clay

Since the petrological analysis and visual study suggests that these shelly wares include examples where the shell was a deliberate addition, an attempt is made here to reconstruct the characteristics of the parent clay – minus the shell sand – of the five groups present in the Lundenwic shelly wares.

Firstly, the characteristics of the groundmass and any inclusions likely to have been in the parent clay were noted. Apart from Group B all the groups have a quartz-free clay matrix containing iron-rich faecal pellets and rare fossil wood. The quartzose inclusions are probably not present in the parent clay but represent varying degrees of admixture with brickearth. The grains have too coarse a grain size distribution for the parent clay to be a silty, micaceous, clay such as that outcropping in the upper London Clay. The quantity of faecal pellets and larger iron-rich nodules in these groups distinguishes them from the London Clay as found in the area around Lundenwic itself but is probably paralleled in the Woolwich Beds, the suggested source for some of the coarse shell-tempered vessels found in late Saxon and early Norman London. The Woolwich Beds outcrop mainly on the south side of the Thames from London eastwards along the north Kent coast. There is, however, a small outcrop east of London on the north side of the river.

Secondly, the chemical data for those elements not correlated with either CaO or P2O5, both of which are probably might be present in a shell temper or as post-burial filling of laminae and voids, were normalised by dividing their values by that of Al2O3.

For the Lundenwic finds alone a PCA analysis shows that the Group E, F, J samples cluster together (Fig 3) although the mean Factor 2 scores for Groups F and J differ (Fig 4). Groups B, C and M, however, are clearly made using clays with different compositions.

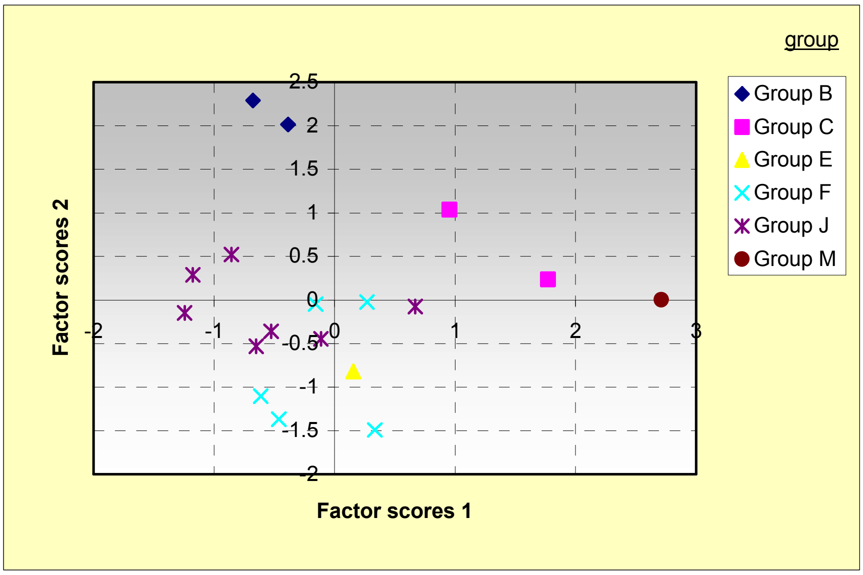

Figure 3

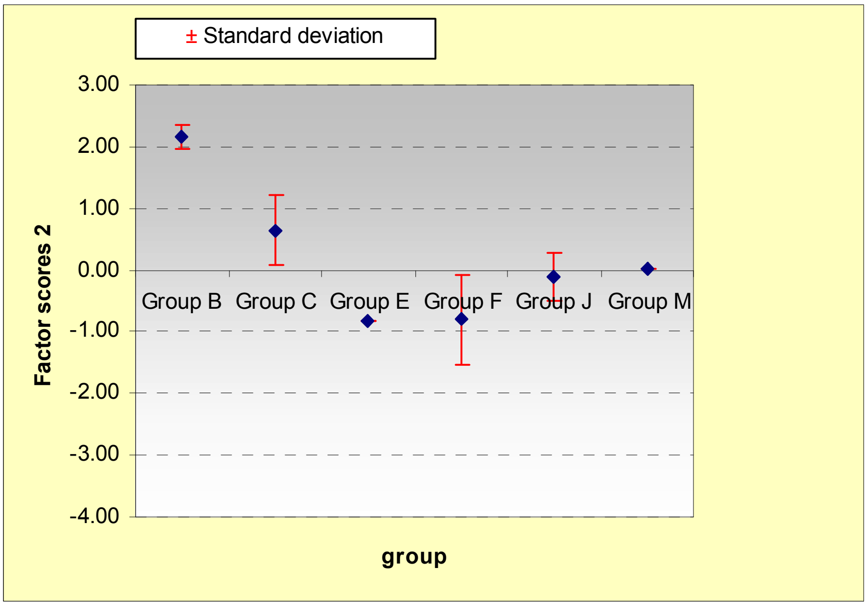

Figure 4

This analysis was then re-run using ICPS data collected by the author. Since there are over 2,500 records it was not possible to show this data visually and instead Cluster Analysis, using Ward's method, was employed. It was decided to separate the data into 100 clusters. The Lundenwic shelly wares fell into nine clusters. Most belong to cluster 41 (6 samples, followed by cluster 14 (3 samples). The remaining samples were grouped into 7 clusters, containing one or two Lundenwic shelly wares each (Table 4).

Table 4

cluster	Group B	Group C	Group E	Group F	Group J	Group M	Grand Total
41				1	5		6

14				2	1		3
55	2						2
66				2			2
18					1		1
26						1	1
44		1					1
47			1				1
79		1					1
Grand Total	2	2	1	5	7	1	18

The samples clustered with Group B include only 7 samples from the Greater London area, one chaff-tempered and the remainder white-firing sandy wares (one of which was identified as a Mid Saxon import and the others are Roman Verulamium Region Whiteware. The remaining 22 matches are with vessels from a wide variety of localities and fabrics in midland and northern England. This seems to confirm that Group B is not a local product. The samples clustered with the Group E vessel are mainly from Lincolnshire and Cambridgeshire containing lower Cretaceous inclusions. The inclusion of the Group E sample in this cluster may be fortuitous.

The two Group C vessels were placed in different clusters. Cluster 44 contains mainly samples made from Thames valley brickearth whereas Cluster 79 groups together samples with haematite inclusions and it is probably these inclusions in the Treasury sample which mask any other signature.

Groups F and J samples were assigned to four clusters and in two cases samples from both fabric groups were assigned to the same cluster. This confirms the suggestion that they were made from the same parent clay. The largest of these clusters, 14, includes a large number of the non-shelly Lundenwic samples together with Romano-British wares produced in the City of London and medieval wheelthrown greywares from kilnsites at Arkley, the Fleet valley in the City of London, Elstree, Kingston-upon-Thames and Pinner. This strongly suggests the use of the London Clay. Cluster 41, by contrast, includes relatively few Greater London samples, and those that are included point east of London (an medieval Essex shelly ware, a chaff-tempered sherd from Barking Abbey as well as a mid Saxon shelly ware sample from the same site. The majority of the samples in this cluster, however, are from Kent. They include two of the Sandtun shelly wares but also 3 samples of medieval pegtile made at Tyler Hill and 10 samples of medieval Sgraffito-decorated floor tiles made at Clowes Wood, near Tyler Hill, and found at Canterbury and Faversham. Whilst these samples are also dominated by those made from London Clay the range of sites from which they come suggest a source to the east of London, presumably reflecting both the survival of higher beds of the clay as one heads east and also changes in the depositional character of those clays.

Finally, Group M is placed in cluster 26 which contains six other samples with little obvious connection except for high iron contents.

Conclusions

The majority of the shell-tempered wares from Lundenwic were probably tempered with Tertiary fossil shell and made from a Tertiary clay. It is extremely likely that the shell came from the Woolwich Beds and was either used fresh or was obtained from a detrital shelly sand. Some of the samples show a close similarity with the London Clay but probably with a contribution coming from superficial brickearths or sands. These vessels were divided into two groups by eye, Group F and Group J but this division does not seem to be clear-cut and in any case is cut across by the chemical data.

Shelly wares from some other English sources were compared and in most cases could be clearly distinguished from the Lundenwic samples. The only close comparisons were with shelly wares from Sandtun and Barking Abbey, although since both of these sites lie close to outcrops of the Woolwich Beds it is not possible to say whether they all come from a single production centre or simply utilised the same clay.

No samples of shelly ware from sites of comparable date on the European mainland were included in this study but such material is known to occur at Ribe, Quentovic (Visimarest) and Dorestadt. Potential 'Frisian' shelly wares from the mid Saxon trading settlement outside of York (Fishergate) have been shown to be of Lincolnshire origin, Northern Maxey-type ware, whilst shelly wares from sites in Hartlepool, which was occupied in the mid Saxon period by an Anglian monastery, are clearly separated from the southern finds and in all probability are contemporary with the high medieval pottery with which they were found.

Four groups of shelly ware were distinguished from the majority through binocular microscope study. Of these, one, Group E, appears to have been made from a parent clay indistinguishable from the main group although its shell inclusions suggest the use of recent marine shell. Group B contains a fine textured shell sand which includes microfossils and punctate brachiopods which suggest that it may be an example of Southern Maxey-type ware, found on sites from central and Southern Lincolnshire in the north to Buckinghamshire in the south. The two samples may well come from one decorated, handled, vessel.

Group C contains a mixture of Tertiary bivalve shell as found in Groups F and J together with fragments of a shelly limestone and possibly also brickearth. This limestone has not been identified.

Finally, Group M is clearly differentiated from the remaining samples, both in the character of its shell inclusions and in the chemical composition of the clay matrix but no source can be yet suggested.

Appendices

Appendix 1a: ICPS analyses for major elements (percent oxides)

TSNO	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO
V1709	18.693058	7.8898	1.4214	8.2915	0.4326	3.09	0.8343	0.2884	0.05253
V1708	17.260843	7.7456	1.2772	9.2185	0.2369	2.8634	0.7004	1.1536	0.06798
V1705	14.661638	5.9637	0.9991	18.2928	0.3399	2.163	0.7004	0.7313	0.07725
V1706	14.025098	5.9328	0.9991	18.5503	0.3399	2.0909	0.6592	0.9373	0.09579
AG492	14.8	6.63	1.03	15.9	0.25	2.25	1.05	0.62	0.07
AG491	13.22	5.41	1.26	14.95	0.39	2.36	0.71	0.5	0.08
AG490	13.15	4.99	1.27	12.91	0.39	2.34	0.81	0.41	0.05
AG489	15.77	5.7	1.4	7.3	0.33	2.64	0.82	0.35	0.04
AG485	13.78	4.94	1.32	14.88	0.28	2.31	0.68	0.29	0.03
V1778	9.13	5.65	0.55	21.77	0.095	1.2	0.65	1.88	0.169
V1777	7.09	9.29	0.52	20.5	0.114	1.12	0.37	2.99	0.132
AG484	14.31	5.89	1.21	16.16	0.62	2.87	0.6	1.43	0.39
V1713	11.88208	4.3363	0.9064	14.0698	0.1648	1.8437	0.6283	0.515	0.0309
V1707	13.282468	8.7138	0.9373	16.171	0.309	2.2042	0.6077	1.0609	0.09167
V1712	16.051417	6.8186	1.0815	10.1249	0.1545	2.1424	0.927	0.4326	0.06798
V1714	13.738655	9.7026	0.8652	15.2852	0.309	2.1527	0.7828	2.781	0.1442
V1710	12.953589	6.695	0.8755	14.3891	0.2575	2.06	0.927	2.1527	0.09167
V1711	13.696219	6.3139	1.03	16.4285	0.412	2.4411	0.927	0.9476	0.06077

Appendix 1b: ICPS analyses for minor and trace elements (ppm)

TSNO	Ba	Cr	Cu	Li	Ni	Sc	Sr	V	Y	Zr*	La	Ce	Nd	Sm	Eu	Dy	Yb	Pb	Zn	Co
V1709	384.19	106.09	30.9	38.11	49.44	18.54	367.71	135.96	22.66	66.95	37.08	65.92	38.2439	5.94104	1.25351	3.605	2.369	29.51568	117.42	17.51
V1708	550.02	94.76	42.23	31.93	51.5	16.48	470.71	124.63	18.54	61.8	32.96	56.65	33.98382	5.35188	1.15772	3.193	2.266	22.84128	112.27	15.45
V1705	316.21	81.37	32.96	33.99	45.32	12.36	408.91	97.85	25.75	57.68	48.41	97.85	50.63686	11.06426	1.864815	5.459	2.472	32.87348	2239.22	16.48
V1706	333.72	81.37	29.87	28.84	47.38	13.39	402.73	96.82	26.78	53.56	46.35	101.97	48.8941	11.17344	1.96936	5.665	2.472	28.05308	167.89	15.45
AG492	360	92	47	34	55	17	477	145	23	90	30	66	36	6.7	1.1	3.1	1.5		113	20
AG491	334	89	35	41	49	15	579	129	24	71	33	61	32	5.9	1	2.9	1.6		100	19
AG490	365	85	32	39	38	15	600	134	17	67	35	61	32	5.6	1	2.4	1.1		98	17
AG489	358	107	24	47	47	17	359	158	26	78	49	81	42	7.5	1.3	3.5	1.8		98	17
AG485	354	89	32	47	49	15	670	138	26	79	39	75	41	7.6	1.3	3.6	1.9		115	21
V1778	859	57	35	30	37	11	617	93	23	75	28	44	30.832	5.805	1.4045	4.8	2.2	16.04	135	16
V1777	1526	51	19	23	42	7	731	94	17	59	21	37	22.748	4.013	1.0497	3.2	1.8	22.02	134	17
AG484	734	101	25	51	108	15	392	128	66	53	45	70	44	8.4	1.4	6	3		166	33
V1713	302.82	70.04	32.96	27.81	42.23	12.36	401.7	88.58	23.69	57.68	25.75	48.41	27.88416	5.20974	1.122185	3.914	2.266	16.6448	109.18	11.33
V1707	381.1	84.46	27.81	28.84	50.47	12.36	521.18	95.79	19.57	48.41	29.87	56.65	31.27286	4.84924	1.10931	3.399	1.854	21.50228	108.15	18.54
V1712	407.88	96.82	64.89	30.9	90.64	17.51	256.47	133.9	24.72	78.28	28.84	51.5	31.07922	5.43428	1.20407	4.223	2.678	20.43932	219.39	19.57
V1714	435.69	79.31	47.38	21.63	45.32	15.45	648.9	123.6	30.9	63.86	33.99	60.77	36.88842	6.81448	1.57487	5.253	2.987	21.2798	172.01	15.45
V1710	518.09	77.25	51.5	22.66	47.38	15.45	479.98	136.99	27.81	75.19	30.9	59.74	33.4029	6.901	1.41625	4.635	2.575	21.06144	125.66	18.54
V1711	361.53	76.22	51.5	25.75	40.17	15.45	487.19	126.69	25.75	65.92	32.96	60.77	34.95202	6.46222	1.435305	4.223	2.266	18.34224	112.27	16.48