Characterisation of shell-tempered wares from Southeast England

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Background

As part of a wider study of cross-channel trade in the 7th to 9th centuries AD Lyn Blackmore and Nigel Macpherson-Grant selected sherds of shell-tempered pottery from mid-Saxon *emporia* sites at London and Sandtun and have submitted these for analysis. It has been suggested that a likely source for these wares would be Flanders and consequently samples of definite Flemish shell-tempered ware of 12th-century date and locally-produced shell-tempered pottery were also submitted for analysis.

Methodology

In total, eighteen samples were examined (App 1). The samples were thin-sectioned and the sections stained using Dickson's method (a mixture of Alizarin Red S and potassium ferricyanide, Dickson 1965). This method stains carbonates containing ferrous iron a pale to deep blue, depending on iron content, and distinguishes calcite (which is stained red with considerable reduction in relief) from dolomite, which is unaffected. For mid-Saxon and later shell-tempered wares in the east Midlands this method has proved extremely informative since it clearly distinguishes non-ferroan bivalve shell (and calcite fragments derived from these shells) from ferroan calcite cement, thus demonstrating that much of the shell-tempered pottery from Lincolnshire is actually tempered with a sand derived from decomposed shelly limestone. Dolomite, by contrast, has proved to be absent in Lincolnshire and south-east Midlands shell-tempered wares.

The thin-sections were then described using a semi-qualitative system after which sherds were grouped together into *petrofabrics* and a description based on all samples in the group was written.

Substantial (up to 5gm) sub-samples of the shell-tempered pottery submitted for analysis were then crushed and powdered, having mechanically removed the outer surface and broken edges of the sherd which are likely to have been most affected by post-burial leaching and deposition as a result of groundwater circulation. The resulting powders were then subjected to Inductively-Coupled Plasma Spectroscopy (ICPS) at Royal Holloway College, University of London, under the supervision of Dr N Walsh.

Petrological description

On the basis of thin-section analysis the eighteen samples were grouped into five groups. All but one contained abundant shell fragments in a clay matrix containing little quartz giving the sherds a soapy feel.

Group 1 (Samples AG476. AG478-9, AG485, AG490-2)

Seven sections are characterised by abundant fragments of bivalve shell, up to 2.0mm long. These fragments are composed of non-ferroan calcite and have a nacreous structure (oyster-like). Many of the fragments have surfaces and sometimes broken ends coated with a ferroan calcite cement.

Group 2 (Samples AG475, AG482, AG488-9)

Four sections are characterised by abundant fragments of bivalve shell of similar kind to those in Group 1 but often smaller fragments, with rounded outlines and some evidence for staining of the grains.

Group 3 (Samples AG481, AG483-4, AG486-7)

Five sections are characterised by abundant fragments of bivalve shell composed of non-ferroan calcite. In contrast to Groups 1 and 2 there is no ferroan calcite in these sections and the shell often shows parallel laminae rather than the sinuous layering seen in the Group 1 and 2 shells. Thin opaque lines sometimes mark the laminae. Such lines are thought in some cases to be the result of iron pyrites deposition on the surface of the living shell as a result of temporary anoxic conditions.

Group 4 (Sample AG477)

One section contained abundant fragments of thin-walled molluscan shell, mostly gastropods with some bivalve shell. The thin walls of these molluscs suggest that their habitat was a low energy body of water, such as a freshwater lake or delta.

Group 5 (Sample AG480)

One section contained abundant quartz sand (c.0.4mm across) with moderate altered glauconite grains. Some of the quartz grains show smooth rounded profiles, some coated with red iron ore. Iron also filled some veins or cracks in the grains. Both the quartz sand and glauconite are common characteristics in south-eastern English ceramics. Nevertheless, similar features have been noted in ceramics from the possible site of Quentovic in the Canche valley (pers comm M Worthington).

Chemical analysis

Nine major elements were recorded to 0.01%: Al2O3, Fe2O3, MgO, CaO, Na2O, K2O, TiO2, P2O5 and MnO (Appendix Two) and twenty trace elements were recorded as ppm: Ba, Co, Cr, Cu, Li, Nb, Ni, Sc, Sr, V, Y, Zn, Zr*, La, Ce, Nd, Sm, Eu, Dy and Yb. Several of these elements are likely to have been mobile in an archaeological context, notably calcium and phosphorus although there is relatively little evidence for phosphate concretion or leaching either in the hand-specimens or thin-sections.

Discussion

The Petrological analysis suggests that the eighteen samples can be grouped into five petrological groups:

1 - shelly limestone

2 - shelly limestone as detrital grains

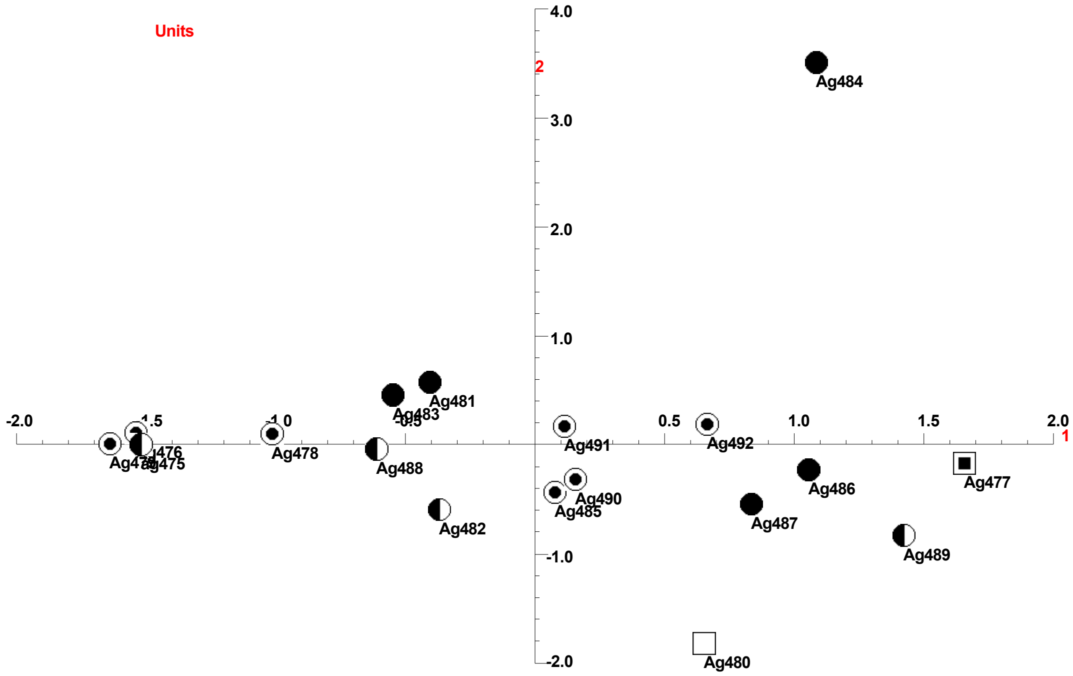
3 - bivalve shell

4 - freshwater gastropod shell

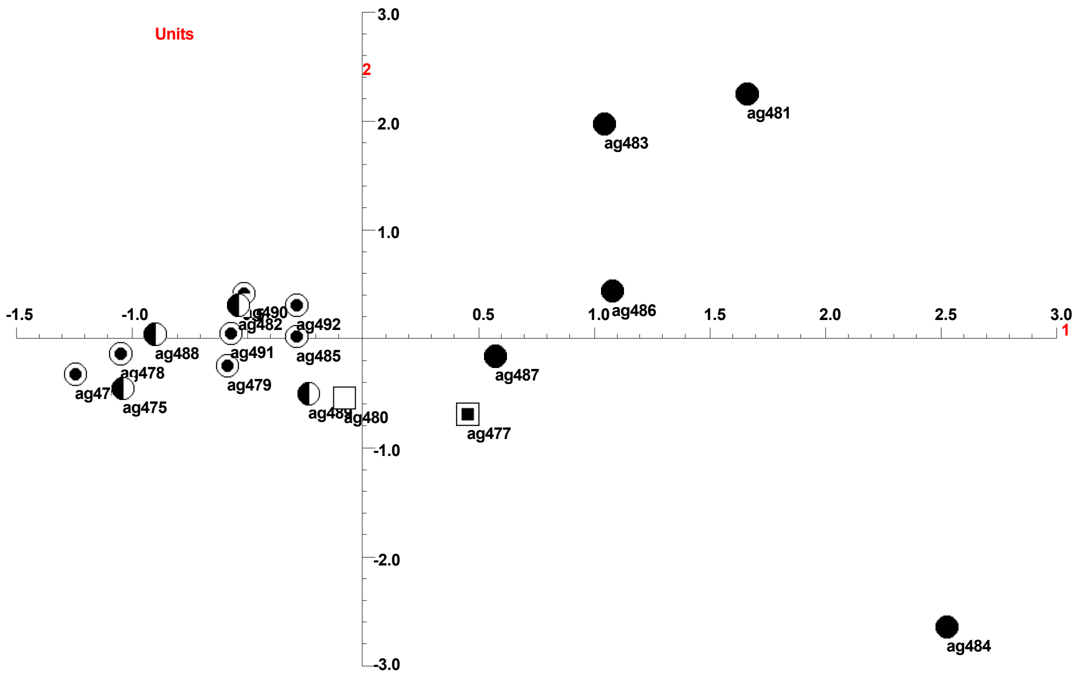
5 - No visible shell

Of these, Group 5 and 4 are clearly quite different from the majority and the sample of Group 4 was submitted merely to demonstrate this distinction. Groups 1 to 3, however, have a similar visual appearance and it is not clear how much reliance should be placed upon the differences between Groups 1 and 2, which contain shell which could be derived from the same source. Group 3, however, contains shell derived from a completely difference source - either added as recent shell sand or present as the result of fossilisation of a shell-rich clay. It has a similar appearance to a late 11th or 12th-century shelly ware from London, which it was suggested might have been made from Tertiary shelly clays, of which the prime candidate in the London area is the Woolwich Beds, which outcrops in north Kent from south-east London to Dartford.

The chemical data therefore was used to test the validity of the five petrological groups. Fig 1 shows the results of a Principal Components Analysis of the major elements. Here, Group 5 is clearly distinguished, primarily because of its low calcium content and low values of all measured elements (and thus by implication higher silica content). Also distinguished, however, is AG484, on the basis of a high Mn content (0.39% vs a range of 0.03 to 0.08% for the other samples). The remaining samples form a long cluster, with Ca-rich samples at one end and Ca-poor ones at the other. The four constituent petrofabric groups cannot be distinguished in this cluster, although the Group 4 sample is situated at the furthest limit of the Ca-rich end of the cluster(it has a Ca content of 19% compared with the maximum of 22%).



A PCA analysis of the trace elements, however, distinguishes Group 3 from Groups 1 and 2 (Fig 2). The Group 4 sample is placed at the extreme edge of the Group 1/2 cluster and the Group 5 sample is at the opposite edge of the same cluster. In all cases it is the first component which separates the samples; the Group 3 samples in fact span the entire range of component 2. The main element in component 2 is Zr, present in Zircon. This element was probably present as a minor component of the quartzose silt or fine sand in AG481 and AG483 and is much rarer in the remaining three Group 3 samples. It is interesting to note that the Flemish medieval sherds from Canterbury form a distinct cluster at one end of the Group 1/Group 2 cluster, indicating a slight chemical difference between these sherds and the mid-Saxon wares.



Conclusions

Ceramic petrology and chemical analysis between them indicate that the mid-Saxon shell-tempered pottery from London and Sandtun comes from at least two sources: the main group is tempered with nacreous bivalve molluscan shell derived from a shelly limestone. Petrologically, this pottery is identical to that identified as being Flemish medieval shell-tempered ware from Canterbury. Both this ware and the mid-Saxon finds include both Group 1 (larger, fresher shell fragments) and Group 2 (smaller, rounded, stained shell fragments) samples. Analysis of the ICPS trace element data, however, distinguishes the medieval and mid-Saxon samples.

The second source is unattributed although thin-section analysis of the 11th to 12th-century coarse wares from the City of London suggests that a comparable fabric, London EMSH, was obtained from the Woolwich Beds (Vince & Jenner 1991, 63-68). No doubt similar clays containing Tertiary littoral zone bivalve shells could be found on the continent but without comparanda it is impossible to locate the provenance further.

A sample of definitely local shell-tempered ware was clearly distinguishable from these two groups using petrological evidence and was also distinguishable (though with less certainly) using PCA of ICPS trace element analyses.

Finally, a mid-late Saxon imported vessel from Sandtun contained altered glauconite and quartz sand derived from a ferruginous sandstone, both features of south-east English and northern French ceramics but not of Rhenish pottery.

Bibliography

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Addendum (24/03/03)

As a consequence of further work carried out on Mid Saxon shell-tempered wares from London (Lundenwic), the thin-sections were re-examined. Some alteration to the original identifications was necessary. In particular, the identification of shelly limestone Groups 1 and 2 in some London sections is erroneous. The following alterations were made:

TSNO	Petrofabric	Revised 24/3/03
ag475	2	Shelly limestone
ag476	1	Shelly limestone
ag477	4	No change
ag478	1	Shelly limestone
ag479	1	Shelly limestone
ag480	5	No change
ag481	3	Not sectioned but chemical composition suggests Group 3
ag482	2	Woolwich Beds shell plus sparse rounded quartz
ag483	3	Woolwich Beds shell plus sparse rounded quartz in a silty matrix
ag484	3	Rounded nacreous bivalve shell. No ferroan calcite
ag485	1	Woolwich Beds shell plus sparse rounded quartz
ag486	3	Shelly limestone
ag487	3	Woolwich Beds shell plus sparse rounded quartz in a silty matrix
ag488	2	Shelly limestone
Ag489	2	Woolwich Beds shell plus sparse rounded quartz in a silty matrix
Ag490	1	Woolwich Beds shell plus

		sparse rounded quartz in a silty matrix
Ag491	1	Woolwich Beds shell plus sparse rounded quartz in a silty matrix plus some shelly limestone with ferroan calcite cement
Ag492	1	Woolwich Beds shell plus sparse rounded quartz in a silty matrix

In most cases this re-examination merely shifts a sample from one group to another, but in the case of one sample, AG484, it seems that a totally different fabric was present. This is reflected in its chemical composition, which seems to be due in the main to its MnO content.

In addition, a thin-section of a shell-tempered ware from Barking Abbey was re-examined and found to contain coarse Tertiary bivalve shell fragments with sparse rounded quartz inclusions, similar to the fabrics of AG482 and AG485.

Appendices

Appendix One

TSNO	Site	Sitecode	Sample Number	Petrofabric	Action
ag475	Canterbury	Twd96 (2867)	Fabric LS4	2	TS;ICPS
ag476	Canterbury	Twd96 (1052)	Fabric LS4	1	TS;ICPS
ag477	Canterbury	Twd96 (133)	Fabric EM2	5	TS;ICPS
ag478	Canterbury	Twd96 (3255)	S2a	1	TS;ICPS
ag479	Canterbury	Twd96 (1)	S2b-c	1	TS;ICPS
ag480	Sandtun	Hythe Museum Y384	S1	4	TS;ICPS
ag481	Sandtun	Sandtun S/GW	S3a	3	ICPS
ag482	Sandtun	Hythe Museum: Y834	S3b	2	TS;ICPS
ag483	Sandtun	WH97 A (1)	S3c	3	TS;ICPS
ag484	London	Jub85 III [1]	S3d	3	TS;ICPS
ag485	London	Rop95 [729]	S3e	1	TS;ICPS
ag486	Sandtun	Hythe Museum Y384	S4a	3	TS;ICPS
ag487	Sandtun	Hythe Museum: Y384	S4b	3	TS;ICPS
ag488	Sandtun	WH97 Tr C (25)	S4c	2	TS;ICPS
Ag489	London	Rop95 [508]	S4d	2	TS;ICPS
Ag490	London	Rop95 [524]	S4e	1	TS;ICPS
Ag491	London	Rop95 [669]	S5	1	TS;ICPS
Ag492	London	Rop95 [669]	S4f	1	TS;ICPS

Appendix Two (a)

TSNO	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO
Ag476	10.09	3.84	1	21.74	0.26	1.97	0.38	0.51	0.07
Ag477	15.29	6.67	1.79	8.09	0.6	2.48	0.73	0.41	0.04
Ag478	11.53	4.86	1.09	22.22	0.27	2.27	0.46	0.32	0.04
Ag479	9.88	4.1	0.9	21.99	0.21	2.01	0.37	0.53	0.05
Ag480	15.08	3.29	0.87	2.2	0.26	2.22	0.83	0.28	0.02
Ag481	13.06	4.99	0.95	16.76	0.29	1.78	0.6	1.03	0.07
Ag482	12.82	4.97	1.23	14.61	0.25	1.94	0.67	0.28	0.03
Ag483	12.77	4.81	0.91	17.26	0.28	1.78	0.59	1.03	0.05
Ag484	14.31	5.89	1.21	16.16	0.62	2.87	0.6	1.43	0.39
Ag485	13.78	4.94	1.32	14.88	0.28	2.31	0.68	0.29	0.03
Ag486	15.32	5.77	1.42	6.77	0.23	2.27	0.63	1.06	0.04
Ag487	14.68	5.56	1.45	7.26	0.28	2.11	0.75	0.77	0.04
Ag488	12.65	4.77	1.1	17.62	0.26	2.05	0.48	0.38	0.06
Ag489	15.77	5.7	1.4	7.3	0.33	2.64	0.82	0.35	0.04
Ag490	13.15	4.99	1.27	12.91	0.39	2.34	0.81	0.41	0.05
Ag491	13.22	5.41	1.26	14.95	0.39	2.36	0.71	0.5	0.08
Ag492	14.8	6.63	1.03	15.9	0.25	2.25	1.05	0.62	0.07
Mean	13.42	5.12	1.18	14.03	0.32	2.21	0.65	0.6	0.06

Appendix Two (b)

TSNO	Ba	Co	Cr	Cu	Li	Nb	Ni	Sc	Sr	V	Y	Zn	Zr*	La	Ce	Nd	Sm	Eu	Dy	Yb
ag476	292	17	73	15	35	7	40	10	370	76	18	76	52	22	39	21	4.1	0.7	2.2	1.2
ag477	416	24	109	34	53	13	69	17	355	157	34	111	77	47	90	49	8.9	1.6	5.1	2.4
ag478	315	16	89	24	46	9	44	11	346	83	19	76	55	24	43	23	4.3	0.7	2.4	1.3
ag479	457	17	75	16	38	7	45	10	345	75	18	94	46	22	39	21	4.1	0.6	2.2	1.1
ag480	403	11	101	33	46	16	56	15	162	107	20	92	61	50	97	47	8.5	1.4	3.1	1.5
ag481	651	34	83	41	73	16	96	13	661	119	20	123	89	35	103	33	5.9	1	2.8	1.5
ag482	343	21	84	30	49	11	49	14	678	123	20	91	82	31	62	33	5.8	1	2.8	1.6
ag483	601	21	82	35	85	16	83	13	640	115	22	119	86	31	73	33	5.8	0.9	2.8	1.4
ag484	734	33	101	25	51	12	108	15	392	128	66	166	53	45	70	44	8.4	1.4	6	3
ag485	354	21	89	32	47	12	49	15	670	138	26	115	79	39	75	41	7.6	1.3	3.6	1.9
ag486	582	17	102	18	91	23	73	14	236	121	22	131	85	43	81	36	6.5	1.1	2.8	1.6
ag487	496	18	98	25	72	14	50	17	357	141	27	117	82	45	75	40	7.1	1.3	3.6	2
ag488	297	21	82	16	64	20	54	12	331	94	20	87	74	31	71	30	5.4	0.8	2.7	1.4
ag489	358	17	107	24	47	15	47	17	359	158	26	98	78	49	81	42	7.5	1.3	3.5	1.8
ag490	365	17	85	32	39	13	38	15	600	134	17	98	67	35	61	32	5.6	1	2.4	1.1
ag491	334	19	89	35	41	12	49	15	579	129	24	100	71	33	61	32	5.9	1	2.9	1.6
ag492	360	20	92	47	34	14	55	17	477	145	23	113	90	30	66	36	6.7	1.1	3.1	1.5
Mean																				