Characterisation Studies of Anglo-Saxon and Medieval Pottery from Cambridgeshire: Early to Mid Anglo-Saxon Wares

Alan Vince

This paper is part of a series produced as part of the Cambridgeshire County Council synthesis of Anglo-Saxon and medieval pottery found in the county. Other papers have covered single wares, such as St Neot's type or Developed St Neot's type wares whose actual source is unknown or the products of a specific kiln and possible products of that kiln from consumer sites, as with Colne ware. However, in this case the scope is rather different, in that with the possible exception of sherds which might be Ipswich ware from Ipswich, none of the samples come from known production sites and most are from sources whose location is completely unknown. It is also uncertain if any of the samples come from the same production sites, nor even whether the concept of production and distribution from a limited number of sites supplying the whole of Cambridgeshire is an anachronism and we should instead be imagining more-or-less local production within communities.

Twenty-eight samples were submitted for study and these can be grouped into nine or ten groups based on the character of the principal inclusions (Table 1).

The Alan Vince Archaeology Consultancy, 25 West Parade, Lincoln, LN1 1NW
http://www.postex.demon.co.uk/index.html
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Table 1

TSNO	Group	Sitecode	Context	REFNO	cname	Action	locality	Description	subfabric
V4419	6	HINHH93	2672	231	ECHAF	TS;ICPS	Hinxton	Black bs with abundant grass/chaff temper	ASV ;ASV5
V4420	6	HINHH93	1438	232	ECHAF	TS;ICPS	Hinxton	Dk grey/brown bs with grass/chaff temper	ASV ;ASV5
V4421	10	HINHH93	2735	233	SST	TS;ICPS	Hinxton	Bs; mid-brown ext surface otherwise black; fine quartz and mica	ASQM ;ASQM
V4422	1	HINHH93	2673	234	CHARN	TS;ICPS	Hinxton	Abraded dark brown bs; cse quartz and v cse quartzite	ASQQT ;ASQM
V4423	9	HINHH93	1024	235	SSTMG	TS;ICPS	Hinxton	Black bs; cse quartz (poss. Quartzite rock)	ASQQT ;ASQ3
V4424	4	HINHH93	1276	236	FE	TS;ICPS	Hinxton	Dk brown bs; fine quartz and v cse brown Ironstone/slag frags	ASQR ;ASQ3
V4425	7	HINHH93	1440	237	IPS?	TS;ICPS	Hinxton	Dk grey bs with grooves/turning marks and fine mica, cse quartz	Ipswich ware? / ASQM ;ASQ20
V4426	8	HINHH93	2672	238	SST	TS;ICPS	Hinxton	Grey bs with brown ext surface; fine quartz and occasional cse limestone	ASQL ;ASQL
V4427	9	HINHH93	1288	239	SSTMG	TS;ICPS	Hinxton	Black slightly burnished bs; common cse ooliths/crushed ooliotic limestone and occasional v cse quarztite/rock frags	ASOQT ;ASQL
V4428	9	HINHH93	2673	240	SSTMG	TS;ICPS	Hinxton	Black bs with mid-brown ext surface; fine quartz and moderate cse ooliths and occasional cse quarztite/igneous rock frags	ASQOI ;ASQL
V4429	11	HINHH93	1246	241	MSAX SHELL	TS;ICPS	Hinxton	Mid grey bs with red-brown surfaces; common cse shell fragments	ASSH ;LSS5
V4430	5	HINHH93	2097	242		TS;ICPS	Hinxton	Grey bs with red-brown ext margin; abundant cse and v cse ooliths and limestone frags	ASOL ;ASL
V4431	5	HINHH93	2159	243	LIM	TS;ICPS	Hinxton	Base angle, dk grey with part mid-brown ext surface; common medium ooliths	ASO ;ASL3
V4432	3	WILHS96	606	244	IAFLINT	TS;ICPS	Willingham	Thick bs;ext buff surface otherwise dk grey; abundant cse and v cse flint	ASF ;Fabric A
V4433	11	WILHS96	527	245	RMAX	TS;ICPS	Willingham	Dk grey bs with red-brown int surface; abundant cse shell	ASSH ;Fabric A
V4434	2	WILHS96	2133	246	ESGS	TS;ICPS	Willingham	Black bs; common med quartz and occ cse chalk / limestone	ASQL ;Fabric C
V4435	1	WILHS96	2339	247	CHARN	TS;ICPS	Willingham	Thick black bs with dk brown ext surface; common cse/v cse igneous rock and occasional cse mica	ASIM ;Fabric C
V4436	1	WILHS96	2019	248	CHARN	TS;ICPS	Willingham	Blackbs , grey ext surface, common cse igneous rock and occasional mica	ASWIM ;Fabric D
V4437	2	WILHS96	2337	249	ESAXLOC	TS;ICPS	Willingham	Black burnished bs; abundant fine quartz and occasional chaff	ASQV ;Fabric D
V4438	7	WILHS96	2282	250	ESGS/IPS	TS;ICPS	Willingham	Thick grey bs with red-brown smoothed surface; common fine quartz	ASQ ;Fabric E
V4439	7	WILHS96	2023	251	ESGS/IPS	TS;ICPS	Willingham	Mid-brownbs in hard fabric with abundant medium quartz	ASQ ;Fabric E

V4440	1	WILHS96	2134	252	CHARN+OOL	TS;ICPS	Willingham	Brown bs with ext smoothing; common v cse igneous rock frag and occasional cse mica	ASIM ;Fabric G
V4441	1	peakirk R	u/s	253	CHARN+OOL	TS;ICPS	Peakirk	Black burnished bs; abundant igneous fragments, common ooliths,	ASIO ;-
V4442	1	peakirk R	u/s	254		TS;ICPS	Peakirk	Brown bs with grey ext surface; abundant igneous fragments, occasional ooliths,	ASIO ;-
V4443	1	HMF98	1258	255	CHARN	TS;ICPS	Fordham	Black bs with smoothed brown ext surface; common cse-very cse igneous rock and occasional cse mica	ASIM ;Fabric C
V4444	1	HMF98	1258	256	CHARN	TS;ICPS	Fordham	Grey bs with burnished dk grey ext surface; common cse-very cse igneous rock and common cse mica	ASIM ;Fabric C
V4445	1	HMF98	1258	257	CHARN	TS;ICPS	Fordham	Sherd for ICPS only (previously thin sectioned). Out-turned simple rim in dk grey fabric;abundant fine quartz, occasional v cse igneous rock and occasional cse mica	ASQIM ;Fabric C
V4446	1	HMF98	1258	258	CHARN+SST	TS;ICPS	Fordham	Sherd for ICPS only (previously thin sectioned). Slightly out-turned simple rim in v dark brown fabric; abundant fine quartz, occasional v cse igneous rock and rare cse mica	ASQ ;Fabric C

Thin Section Analysis

Although almost every thin section shows some unique characteristics, they can be grouped into nine groups based on the major inclusion types. However, these include one flint-tempered fabric which appears, to this author, to be of prehistoric date.

Group 1: Biotite Granite (plus/minus other inclusions)

Ten samples, from four localities (Fordham, Hinxton, Peakirk and Willingham), contain sparse to abundant fragments of "biotite granite" which is most likely in this area to be Mountsorrel Granodiorite. In most cases the sections also contain other inclusion types and it is very likely that the samples were made using local Cambridgeshire boulder clays rather than being imported from northeast Leicestershire (Williams and Vince 1997).

Description

The following inclusion types were noted:

- Biotite granite. Sparse to abundant angular fragments of a coarse-grained acid igneous rock containing feldspar, quartz, biotite, euhedral opaque grains and epidote. The fragments range up to 3.0mm across.
- Subangular quartz. Sparse to moderate grains, mainly c.0.2mm to 0.4mm. Several grains have one or two flat faces, indicating overgrowth.
- Well-rounded quartz. Absent to sparse grains mainly c.0.2mm to 0.4mm. These are probably of Triassic origin.
- Opaques. Absent to sparse rounded grains ranging from c.0.2mm to 0.5mm across.
- Calcareous sandstone. Two sections (V4422 and V4435) contained sparse rounded fragments of sandstone consisting of subangular quartz grains in a matrix of sparry ferroan calcite. In one case, V4435, the sandstone also includes rounded phosphate pellets which also contain subangular quartz grains.
- Oolitic limestone. Two sections definitely contain rounded fragments of oolitic limestone (V4435 and V4441) and one contains what might be heat-altered fragments (V4440). The ooliths themselves range from c.0.3mm to 0.6mm across consist of light brown micrite some of which surround sparry ferroan calcite or angular quartz cores. The pores between the ooliths are filled with sparry ferroan calcite.
- Foram-rich marl. A single rounded fragment c.1.0mm across of a marl containing several multi-chambered non-ferroan calcite microfossils in a matrix of variable clay and ferroan calcite was present in V4436.
- Well-rounded quartz with a low sphericity. Quartz grains of probable lower Cretaceous origin were noted in two sections: V4436 (rare) and V4441 (sparse).

- Organics. Sparse carbonised organic matter was present in two sections: V4446 and V4443.

The groundmass consists of optically anisotropic baked clay minerals, sparse angular quartz (more common in some sections than others) and sparse angular fragments of ferroan calcite. The latter were noted in all but one of the sections and do not appear to be of biological origin. However, they do appear to be an original constituent of the parent clay rather than post-burial filling of pores.

Interpretation

Despite the variation in inclusion types, the presence of the small ferroan calcite fragments in all but one of the sections suggests that these samples actually are a single group, made in one centre.

The parent clay appears to have contained very little quartz and has sparse ferroan calcite present. Ultimately, it is probably of Jurassic origin but possibly through the medium of redeposition in the Quaternary period.

The inclusions come from a variety of sources: Mountsorrel granodiorite from the Charnwood Forest; Rounded quartz of Triassic origin; oolitic limestone of middle Jurassic origin; calcareous sandstone, either of Upper Jurassic or Lower Cretaceous origin and rounded quartz of Lower Cretaceous origin. The most likely origin for this range of inclusions, assuming they all come from a single deposit, is a boulder clay derived partly from the midlands and partly from northeastern Lincolnshire. The lack of flint and chalk inclusions distinguishes this suite from those found in boulder clays in the Cambridge area, which are predominantly derived from the Chalk with sparse erratics from further afield (Worssam and Taylor 1969, 77-80 and 82-3). A source in northwest Cambridgeshire, in the Lower Nene valley, is probably the most likely.

Table 2

TSNO	saq	Trias q	opa	Ferroan specks	Calc sst	Oolitic lst	foram-rich marl	gsq	Org
V4422	M	S		S	S	N	N		
V4435	S		S	S	S + PHOSPHATE	S	N		
V4436	S			N	N	N	RARE	RARE	
V4440	S			S		HEAT ALTERED			
V4441	S		N	S		M		S	
V4442	A	S	S	N	N	S	N	S	N
V4443	S		S	S	N	N	N	N	S
V4444	M	S	S	S					
V4445	M	S		S					
V4446	A	S	S	S	N	N	N	N	S

Group 2: Calcareous Sandstone

Two samples of this group were present, V4434 and V4437. Both samples come from Willingham.

Description

The following inclusion types were noted:

- Calcareous sandstone. Moderate angular fragments of up to 1.0mm across containing subangular quartz grains up to 0.3mm across, sparse larger rounded grains up to 1.0mm across, rounded opaque grains up to 0.3mm across and rare non-ferroan calcite bivalve shell up to 1.0mm long. The groundmass consists of ferroan calcite.
- Organics. Sparse carbonised fragments up to 1.5mm long.
- Sandstone. A single rounded fragment 1.5mm long containing interlocking, overgrown quartz grains c.0.2mm across.
- Quartz. Moderate subangular grains similar in size and shape to those in the calcareous sandstone are present in V4437 whilst rounded grains of Lower Cretaceous character are present in V4434.
- Shell. Sparse bivalve shell fragments similar to those in the calcareous sandstone.
- Opaques. Sparse rounded grains similar to those in the calcareous sandstone.

The groundmass consists of optically anisotropic baked clay minerals, moderate angular quartz and moderate rounded opaque grains up to 0.1mm across.

Interpretation

The calcareous sandstone includes well-rounded grains with a low sphericity. These are typical of Lower Cretaceous sands and this suggests that this sandstone is a lower Cretaceous sandstone, such as the Spilsby Sandstone. Almost all the inclusions could have originated in such a sandstone and the rather silty groundmass also has lower Cretaceous parallels. Lower Cretaceous rocks outcrop to both the north and south of Cambridgeshire and as isolated inliers in the fens, as at Ely. However, the calcareous sandstone suggests a northern source, perhaps using boulder clay derived from the western side of the Lincolnshire Wolds.

Group 3: Flint

A single sample, V4432 from Willingham, containing abundant angular flint inclusions was submitted, from . However, such fabrics appear to be more common in the pre-Roman Iron Age than in the Anglo-Saxon period.

Description

The following inclusion types were noted:

- Flint. Abundant angular brown-stained fragments up to 2.0mm across. Some fragments show a dark brown cortex over a light brown or unstained interior.
- Quartz. Sparse rounded grains up to 1.0mm across.

The groundmass consists of isotropic baked clay minerals and sparse angular quartz grains up to 0.1mm across.

Interpretation

The brown-stained nature of the flint suggests that it did not come directly from an Upper Cretaceous chalk but from a later, Tertiary or Quaternary, deposit. The rounded quartz grains have a high sphericity and might be of Triassic origin. Such quartz has a very wide distribution in the midlands and East Anglia. The isotropic nature of the groundmass suggests that the sherd might have been burnt post-breakage as it is unusual for either prehistoric or early to mid Anglo-Saxon pottery to be fired at a temperature to alter the structure of the clay.

Group 4: Iron-rich Compounds

A single sample of this fabric, V4424 from Hinxton, was thin-sectioned.

Description

The following inclusion types were noted:

- Quartz. Sparse well-rounded and angular grains up to 0.4mm across. The angular grains sometimes have one or two flat faces and come from overgrown quartz grains.
- Concretionary clay. Moderate rounded dark brown fragments up to 2.0mm across. Some of these have an oolitic structure.
- Organics. Moderate carbonised fragments, from c.0.3mm long to 1.0mm long. Several similar voids are partially filled with ferroan calcite and might be the remains of ostracods.

The groundmass consists of highly birefringent clay minerals and sparse angular quartz up to 0.1mm across.

Interpretation

The iron-rich concretions probably formed in the parent clay. The ostracod shells, if such they were, would also be original constituents of the clay. Deliberate tempering therefore consists of sparse quartz sand, which might also be present through the contamination of a subsoil by overlying sand.

Group 5: Oolitic Limestone

Two samples of this fabric were sampled, V4430 and V4431, both from Hinxton.

Description

The following inclusions were noted in thin section:

- Oolitic limestone. Abundant subangular and rounded fragments up to 1.0mm across. The lithology of the rock is similar to that of the inclusions in the Biotite Granite fabric but in addition includes fragments of gastropod shell filled with sparry ferroan calcite and what may be non-ferroan calcite ammonite shell, also filled with ferroan calcite.
- Quartz. Sparse subangular and rounded grains up to 0.3mm across.

- Organics. Sparse carbonised inclusions up to 1.0mm long and 0.3mm wide.

Interpretation

The limestone is probably of Middle Jurassic origin whilst the quartz is too scarce for a consideration of its origins. Possibly both the limestone and quartz come from a gravel deposit, or weathered subsoil developed on an outcrop of oolitic limestone. However, given the presence of similar rock in the Biotite Granite fabric, the limestone may have been present in a boulder clay. The organic inclusions were probably deliberately added as temper.

Group 6: Organic temper

Two samples in which the predominant inclusions are burnt-out organics were examined in thin section. They have rather different groundmass textures with one, V4420, containing little or no quartz or other visible inclusions and the other, V4419, containing sparse quartz sand and having a silty groundmass. Both samples come from Hinxton.

Description

The following inclusions were noted in thin section:

- Organics. Abundant carbonised inclusions up to 3.0mm long and mostly c.0.1mm wide.
- Quartz. Sparse rounded grains up to 0.5mm across and subangular grains up to 0.3mm across. Some of the rounded grains have a low sphericity and are probably of Lower Cretaceous origin whilst the subangular grains appear to come from an overgrown sandstone.

The groundmass consists of optically anisotropic baked clay minerals with few visible inclusions (V4420) or with abundant angular quartz up to 0.1mm across and sparse muscovite laths up to 0.1mm long (V4419).

Interpretation

The two samples are very different in their range of inclusions and the texture of the groundmass. Sample V4420 is probably made from a Jurassic clay tempered with organic matter such as chaff whilst sample V4419 might be made from a Lower Cretaceous clay or from a Quaternary clay.

Group 7: Polished Rounded Quartz

Three samples contain a moderate rounded quartz sand in which the quartz grains are polished. This is a feature of sand derived from Lower Cretaceous strata but such grains occur in Quaternary deposits, notably in the sands in the Ipswich area used to temper some Ipswich-type ware. One of these samples comes from Hinxton (V4425) and the other two are from Willingham (V4438 and V4439).

Description

The following inclusion types were noted in thin section:

- Quartz. Moderate to abundant grains, the larger of which are well-rounded and of Lower Cretaceous character.
- Siltstone. A single subangular fragment 0.5mm across is present in V4438.
- Opaques. Sparse rounded grains up to 0.5mm across.
- Clay/iron pellets. Sparse rounded grains up to 0.5mm across, darker in colour than the groundmass but similar in texture.
- Ironstone. A single rounded fragment 1.0mm across was present in V4438. It contains well-sorted angular quartz grains c.0.2mm across in an opaque groundmass.

The groundmass consists of optically anisotropic baked clay, moderate angular quartz, sparse muscovite and sparse rounded dark brown grains up to 0.1mm across.

Interpretation

The slightly silty groundmass is similar to that found in Ipswich ware, where is it probably derived from one of the upper beds of the London Clay. However, none of the characteristics of this group in thin section is sufficient to positively identify Ipswich as a source and other potential sources of Lower Cretaceous quartz are available closer to Cambridge. .

Group 8: Polished Rounded Quartz and Opaques

A single sample from Hinxton, V4426, contains similar polished quartz to that in the polished rounded quartz fabric but in addition contains moderate rounded opaque grains.

Description

The following inclusion types were noted:

- Quartz. Abundant well-rounded grains c.0.2mm to 0.5mm across.
- Opaques. Moderate well-rounded grains c.0.2mm to 0.4mm across.
- Sandstone. Sparse fragments of fine-grained sandstone up to 0.5mm across. The sandstone contains interlocking, overgrown quartz grains c.0.2mm to 0.3mm across, some of which show a brown stain around the original rounded grain boundaries.
- Ironstone. Sparse fragments of opaque rock up to 1.0mm across containing angular quartz grains up to 0.2mm across.
- Organics. Sparse carbonised fragments up to 1.5mm long and c.0.1mm wide.
- Microcline feldspar. Rare well-rounded grains up to 0.3mm across.
- Mudstone. Rare rounded fragment c.0.5mm across, of similar colour but finer texture to the groundmass.
- Limestone. Rare subangular fragment of non-ferroan micrite with traces of structure, possibly chalk or possibly calcareous algae.
- Flint. Rare subangular brown-stained flint up to 0.5mm across.

- Siltstone. Rare subangular fragment 0.4mm across.

The groundmass consists of dark brown optically anisotropic baked clay and sparse angular quartz grains up to 0.1mm across.

Interpretation

The rounded quartz and opaques sand is reminiscent of fabrics from the Cambridgeshire/Norfolk border (e.g. Pott Row Grimston and Blackborough End) and a lower Cretaceous origin is fairly certain.

Group 9: Sandstone (Lower Carboniferous plus/minus other inclusions)

Three samples from Hinxton (V4423, V4427 and V4428) contain fragments of coarse-grained sandstone of Carboniferous age, together with other inclusions. Two are very similar and the third, V4423, contains no definite oolitic limestone and a few rounded quartz grains which may be of Lower Cretaceous origin.

Description

The following inclusion types were noted in thin section:

- Quartz. Abundant subangular grains ranging from c.0.2mm to 1.0mm across.
- Sandstone. Sparse fragments of sandstone of two types. The first is coarse-grained, with grains up to 1.5mm across and the second is fine-grained, with grains ranging from c.0.2mm to 0.4mm across. The first consists of interlocking overgrown grains with some dark brown clay minerals infilling the remaining pores. The second also contains interlocking overgrown grains but the original rounded grains are sometimes revealed by brown staining.
- Oolitic limestone. Sparse rounded fragments consisting of non-ferroan calcite micrite ooliths, bivalve shell fragments and angular quartz grains in a matrix of sparry calcite, mostly ferroan but including some areas of non-ferroan calcite. A possible ammonite infilled with non-ferroan calcite was noted.

The groundmass consists of optically anisotropic baked clay and sparse angular quartz up to 0.1mm across.

Interpretation

The range of inclusions suggests that the inclusions are of glacial origin. The coarse-grained sandstone is of Carboniferous origin but occurs widely and glacial deposits, both along the east coast, where it probably comes from northeast England, and inland, where it probably derives from the Pennines. The finer-grained sandstone might have several origins, for example Jurassic sandstones from the North Yorkshire Moors or more local sources whilst the oolitic limestone is probably relatively local and of Middle Jurassic age. The presence of Lower Cretaceous-derived quartz in one section suggests that the parent sand came from an area south of the Spilsby Sandstone outcrop, given the choices of a northern or (north)western origin for the sand. Whether the inclusions were present in a boulder clay or added as temper is not clear whilst the absence of ferroan calcite specks in the groundmass may distinguish this group from the Biotite Granite fabric group.

Group 10: Micaceous Sandstone-tempered

One sample from Hinxton (V4421) contains fragments of an unidentified micaceous sandstone.

Description

The following inclusion types were noted:

- Sandstone. Moderate subangular fragments of a sandstone containing abundant quartz, sparse muscovite laths and sparse plagioclase feldspar.
- Quartz. Abundant subangular quartz grains ranging from c.0.2mm to 0.5mm across.

The groundmass consists of very dark brown optically anisotropic baked clay minerals, sparse angular quartz up to 0.1mm across and sparse muscovite laths up to 0.1mm across.

Interpretation

The source of this micaceous sandstone is not known, but might be of Coal Measures or Jurassic age. In either case, if the fabric was made locally then the inclusions are likely to have been present as a consequence of glacial action.

Group 11: Shell

Two samples contained abundant shell fragments. One of these, V4429 from Hinxton, contains shell with a laminar structure, similar to those found in Tertiary clays in south-east England and Flanders whilst the other, V4433, is probably Southern Maxey Ware.

Description

The following inclusions were noted in sample V4429:

- Bivalve shell. Abundant ferroan calcite shell fragments up to 1.5mm long, some with fresh angular breaks and others with rounded edges. The shell has a strong red stain and is laminated.
- Quartz.
- Opaques.

The groundmass consists of optically anisotropic baked clay minerals, moderare rounded dark brown to opaque grains up to 0.1mm across and sparse angular quartz grains up to 0.1mm across.

Interpretation

Sample V4429 contains shell from thick-walled bivalves of the type which lived in the tidal zone. In eastern England, they might be of Tertiary or later date. The quartz grains include grains of Lower Cretaceous date and the groundmass could be of Jurassic or lower Cretaceous origin. All these feature are consistent with a local origin, perhaps in the eastern part of the county. However, the similarity of the shell sand to that found in southeast English and Flemish shelly wares of 8th to 10th-century date suggests that a more distant source should also be considered.

Chemical analysis

Samples of each vessel were prepared for chemical analysis by making an off-cut, mechanically removing all surfaces, to a depth of c.1.0mm or to beyond any visual sign of staining if possible and then crushed to a fine powder. The powders were submitted to Royal Holloway College, London, Department of Geology where Inductively-Coupled Plasma Spectroscopy was carried out under the supervision of Dr J N Walsh. A series of major elements was measured in parts per million (App 1). A series of minor and trace elements were measured as parts per million (App 2). An estimate of the silica context was obtained by subtraction of the measured oxides from 100% and the data were normalised to Aluminium before examination using the Factor Analysis program in WinSTAT for Excel (2002).

Biotite Granite (plus/minus other inclusions)

The ICPS date for the ten samples from Cambridgeshire with Biotite Granite inclusions (as listed in Table 1) were compared with those for similar fabrics from sites in the East Midlands and northern England. All have similar chemical compositions. Factor analysis revealed five factors and a plot of the first two (Fig 1) separates samples from County Durham, East Yorkshire and South Yorkshire from the remainder whilst showing that the F1 and F2 scores for the Cambridgeshire samples overlap with all the other data. The F3 and F4 scores separate the Nottinghamshire data from the remainder (Fig 2).
Repeating this analysis without the distinguished counties allows Staffordshire and North Yorkshire to be separated and repeating a third time allows north Lincolnshire and Cleveland samples to be excluded.
This leaves the Cambridgeshire samples, three from Lincolnshire (Tallington, Kirkby la Thorpe and West Deeping), one from Oxfordshire (Benson) and one from the City of London. A plot of the F1 against F2 scores for this final analysis, grouped by site, indicates that the four Fordham samples and the three Willingham samples can be distinguished (Fig 3). The most likely explanation of the patterning found here is that the Biotite Granite-tempered samples from Cambridgeshire and the remaining comparanda were produced from boulder clay which included material from the Charnwood inlier. Whether there was a single source for these samples or a series of sources exploiting similar boulder clay cannot be definitely determined, but the difference between the Fordham and Willingham samples suggests several sources. The presence of outliers in Lincolnshire, Oxfordshire and London is probably due to the movement of vessels from Cambridgeshire (or East Anglia, where similar fabrics occur but have not been analysed using ICPS). Given that both London and Benson are on the Thames, one possible route

would be from and East Anglian port, such as Ipswich, around the coast and up the Thames.

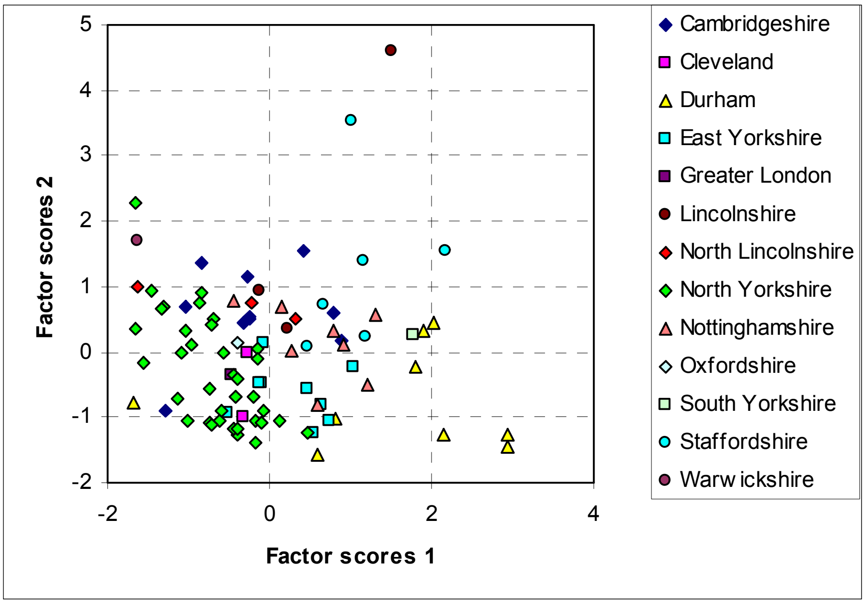

Figure 1

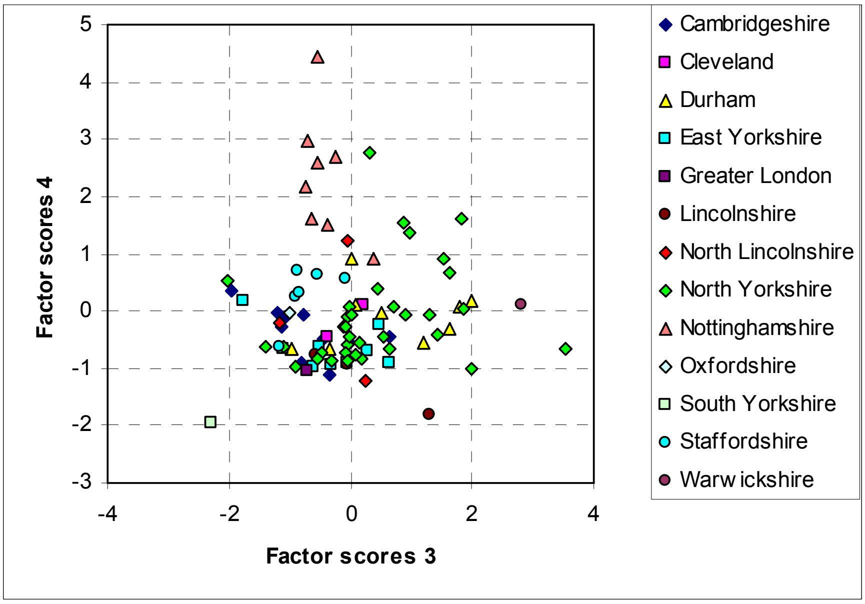

Figure 2

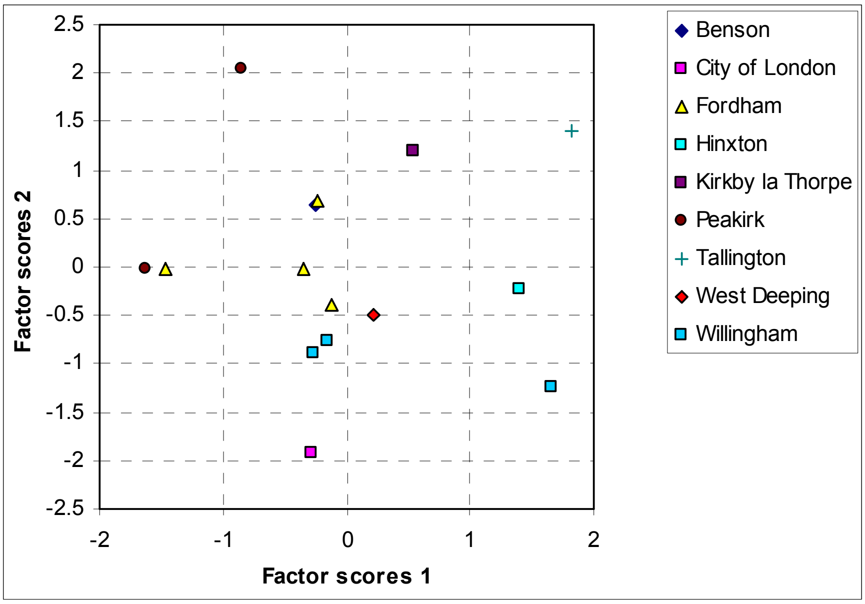

Figure 3

Calcareous Sandstone

The two samples with calcareous sandstone temper were identified in thin section as probably containing Spilsby Sandstone. Fragments of this rock are common in boulder clays in the Lincolnshire central clay vale and as isolated inliers, partially buried by fenland deposits, further south.

The ICPS data were compared with a series of samples which share similar quartz inclusions, some of which also have calcareous-cemented sandstone fragments and some of which do not. These samples are of both Iron Age and early to mid Anglo-Saxon age.

Factor analysis revealed six factors. The first two separate samples from Nottinghamshire and North Lincolnshire but show that the remainder are similar. The third and fourth factor scores separate the two Cambridgeshire samples and two of the Lincolnshire samples (and the north Lincolnshire sample, previously distinguished from the Cambridgeshire samples). These two comparative samples are from Dunholme and Barnetby-le-Wold. Finally, the fifth and sixth factors distinguish the Cambridgeshire samples from all the comparanda (Fig 4). This analysis suggests that there are chemical differences between the two Cambridgeshire samples and those from sites further north and probably this favours the interpretation of the Cambridgeshire vessels as being locally-made from clays derived from the region to the north of the county.

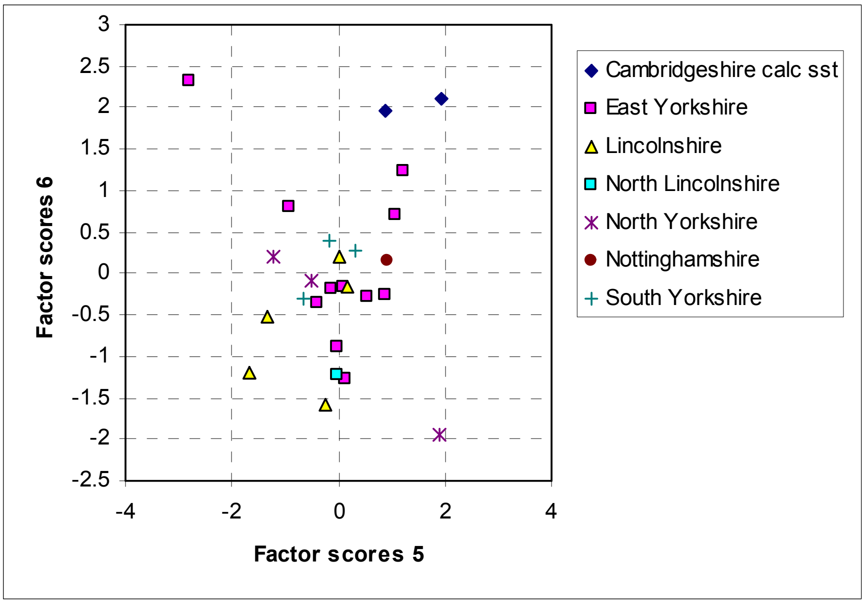

Figure 4

Flint

The thin section analysis of this sample suggests an origin in East Anglia, the south-east Midlands or the Thames basin. The fine texture of the clay groundmass is not typical of either East Anglia or the Thames basin (the exceptions either having shell inclusions or fire to an off-white colour). Inclusionless or near-inclusionless clays occur in the Triassic and Jurassic deposits of the midlands, and in Quaternary clays derived from them.

The ICPS data for the Cambridgeshire sample was compared with prehistoric flint-tempered ware analyses from sites in East Yorkshire, Buckinghamshire, Hampshire, Leicestershire and Lincolnshire. Factor analysis found six factors and combinations of these could separate all of the samples by county, indicating local production (e.g. Fig 5, a plot of F3 against F4 scores). No comparative data for the likely source area of this sample is yet available to the author.

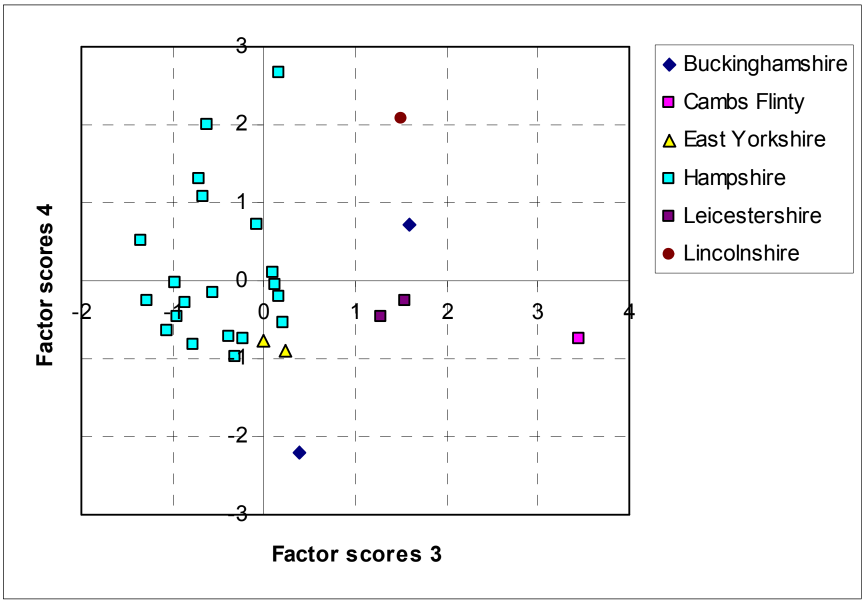

Figure 5

Iron-rich Compounds

The characteristics of the single example of this fabric in thin section do not suggest a particular source for the fabric. However, the low quantity of quartz in the groundmass is suggestive of a Jurassic origin for the clay, as is the hint that ostracods might have been present and the high birefringence of the clay.

The ICPS data were compared with those from a series of Cambridgeshire ceramics made from Jurassic clays: St Neots-type ware; Developed St Neots-type ware; Earith Roman shelly ware. These indicate that there are substantially higher quantities of Manganese, Barium, Scandium, Dysprosium and Zinc in sample V4424. Of these, the Manganese is presumably present in the concretionary pellets, which may therefore not be iron-rich but manganese-rich. The remaining elements might be present in inclusions or the clay fraction.

In comparison with the other early to mid Anglo-Saxon samples, this sample has high iron, manganese, barium, yttrium, neodymium, samarium, europium, dysprosium, ytterbium and zinc. Therefore, several elements are enriched in this sample, compared to the other early to mid Anglo-Saxon samples, but are present in comparable frequencies in Cambridgeshire Jurassic clays.

The data were then compared with all ICPS analyses for ceramics from Cambridgeshire and the manganese, barium and zinc values were found to be higher than all the comparanda.

The ICPS analysis at present cannot be used to determine the source of this fabric but does has some distinctive characteristics.

Oolitic Limestone

The thin sections of this fabric suggest the presence of an oolitic limestone-derived sand or possibly a boulder clay, since similar limestone fragments were noted in some of the biotite granite-tempered samples. The ICPS data were therefore compared with those from the biotite granite-tempered fabric; shelly limestone-tempered ware from Lyveden (where oolith-rich sand is used to temper the glazed ware); Bourne wares and Baston wares.

The samples were also compared with the entire database of Cambridgeshire ceramic analyses and found to compare best with samples of Colne ware and Hunts Fen Sandy Ware, which were therefore also added to the detailed analysis which was then repeated. Factor analysis revealed five factors and a plot of F1 against F2 (Fig 6) distinguishes the Baston samples (lower F2 scores) and the Biotite Granite samples (higher F2 scores). A plot of F3 against F4 scores (Fig 7) distinguishes the Bourne and Stanley/Lyveden shelly wares. This leaves the Colne wasters and the Hunts Fen Sandy ware samples as the closest comparanda.

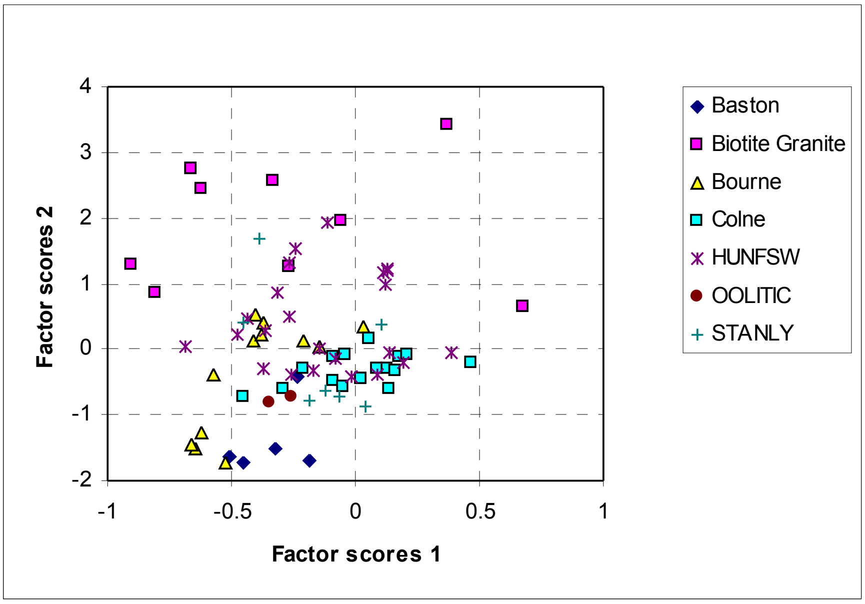

Figure 6

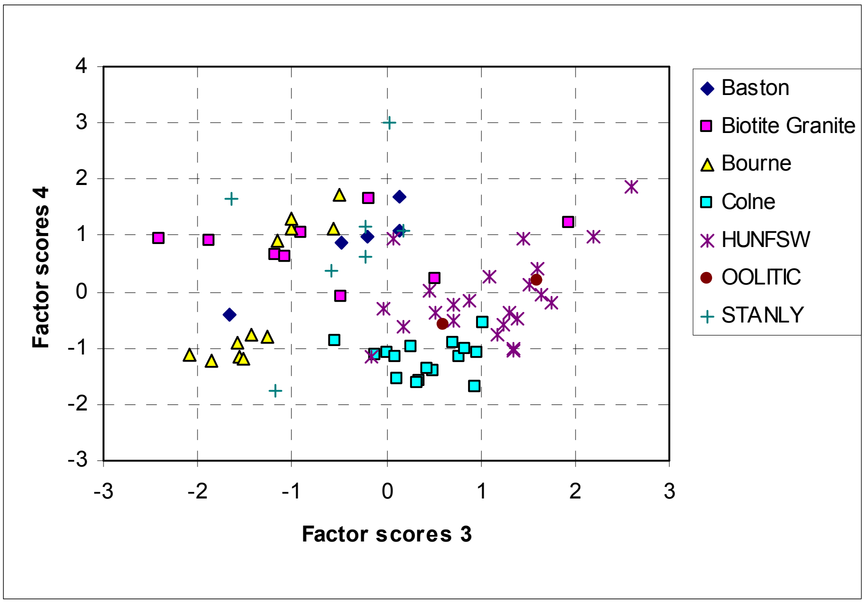

Figure 7

The F5 score separates the Colne and Hunts Fen Sandy ware samples and places the two oolitic samples with the latter (Fig 8).

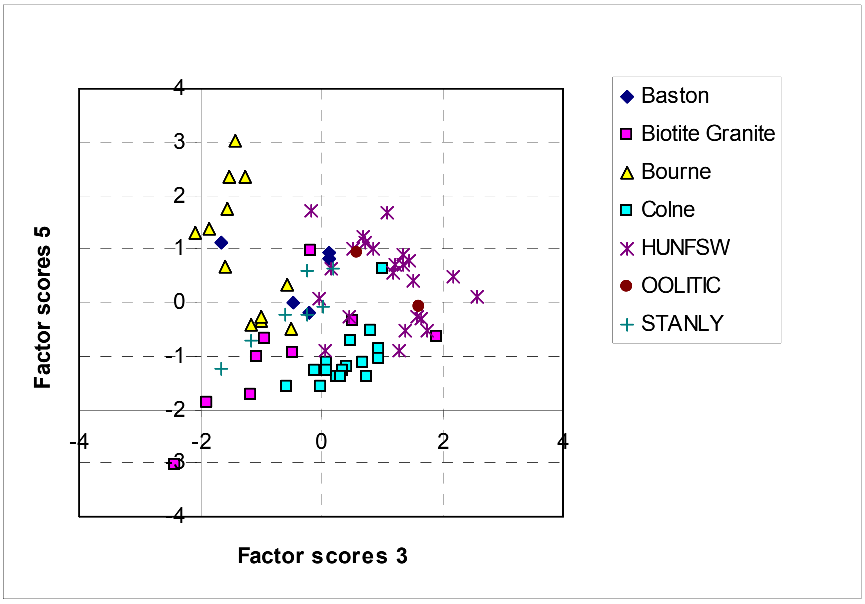

Figure 8

The ICPS data therefore suggest a source in the Hunts Fen area (samples of this ware came from Huntingdon, Ramsey and Bury but no production site is known). This proposed source area is about 25 miles northwest of Hinxton.

Organic temper

The two organic-tempered samples have differences in thin section which suggest that they were made from different raw materials – a Jurassic clay in one case and a lower Cretaceous or younger clay in the other.

The sample with the fine groundmass was compared with other Cambridgeshire ceramics with similar groundmass and was found to be similar in composition to several groups – principally medieval Ely wares and Hunts Fen Sandy ware. Other samples made from petrologically similar clays could be distinguished. These were mainly Bourne/Baston types and Iron Age, Roman, Late Saxon and medieval shelly wares, most of which appear to have been made using Middle Jurassic clays.

The silty sample was compared with a few samples of ceramics made from Quaternary fenland silt and some micaceous silty wares, probably made in Essex.

Factor analysis of the ICPS data from these samples found five factors and a plot of the F1 against the F2 scores (Fig 9) shows that the organic silty sample (ECHAF in Fig 9) is close in composition to two other early to mid Anglo-Saxon samples, V4434 and V4438, both of which contain inclusions of lower Cretaceous origin (Calcareous sandstone and polished quartz respectively). A plot of F3 against F4 scores distinguishes the organic silty sample from these two, placing it with the micaceous silty wares of probable Essex origin. A factor analysis of the ICPS data solely from Cambridgeshire ceramics containing Lower Cretaceous-derived sand distinguishes the organic silty sample and combining these two results suggests that the sample cannot be precisely matched with other Cambridgeshire ceramics, which might support a non-local origin.

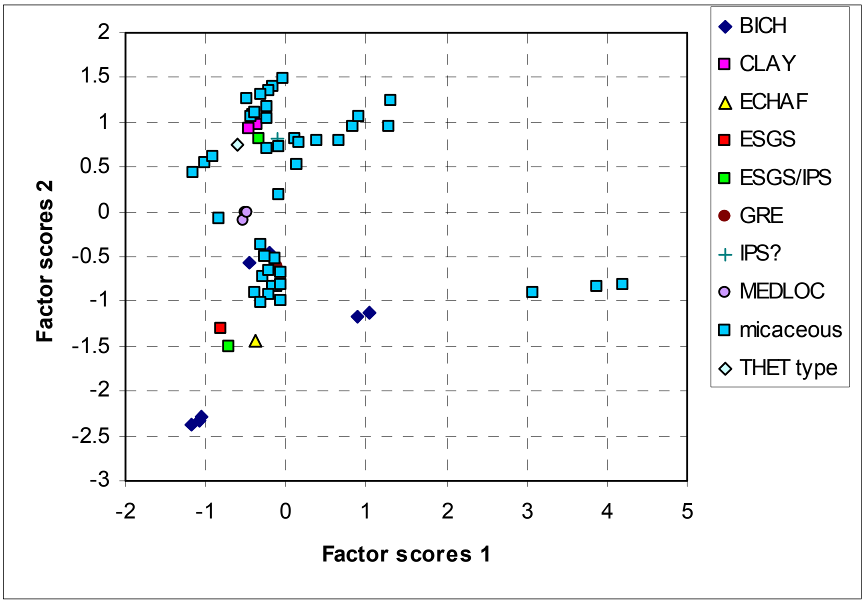

Figure 9

Polished Rounded Quartz and Polished Rounded Quartz and Opaques

The three samples containing a polished rounded quartz sand, V4425, V4438 and V4439, and the sample containing a similar sand together with abundant opaque inclusions were compared with data from other Cambridgeshire wares containing inclusions of Lower Cretaceous origin (the Calcareous sandstone-tempered samples and three samples of medieval date from Ely made from a glauconitic clay with polished quartz sand, ELY).

Factor analysis of this data found four factors. The Ely data could be distinguished from the remainder by its F1 and F3 scores. Two of the samples with polished quartz sand were similar in composition to each other but the third, V4439, was different. Combining the results from all four factors it is possible to distinguish all four groups (and the sub-group formed by V4439) indicating probably difference sources for all the groups but giving no guidance as to their sources.

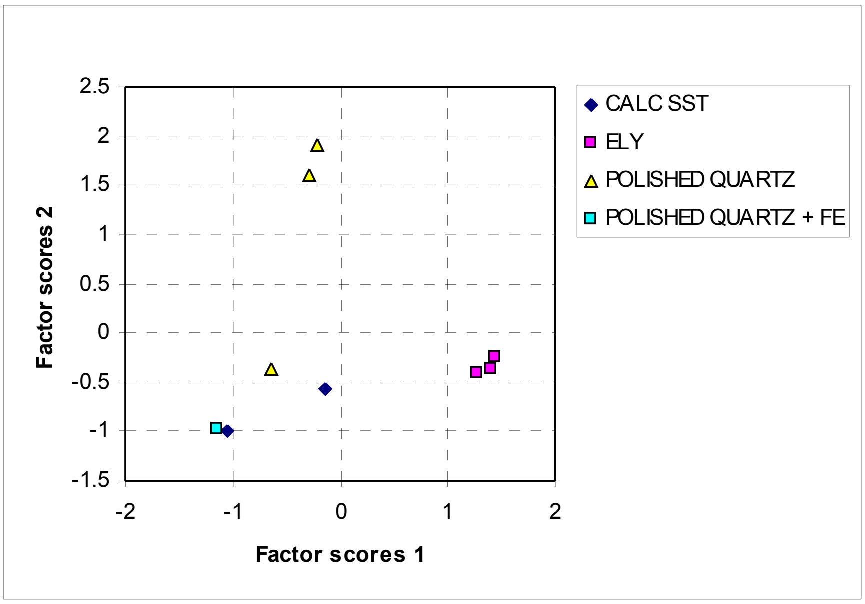

Figure 10

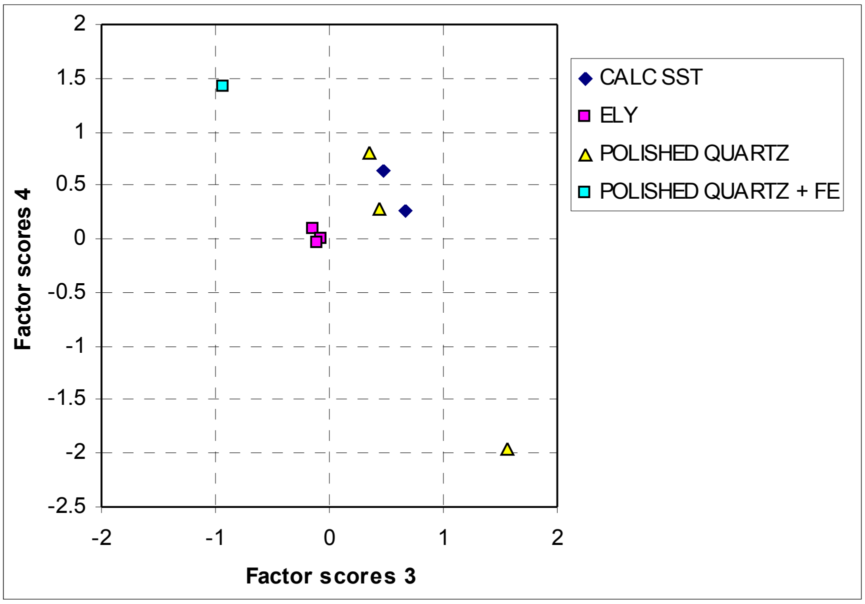

Figure 11

Finally, the data were compared with that from a series of samples of Grimston Thetford-type ware from consumer sites in eastern and northern England. All the Cambridgeshire samples. Samples V4425 and V4438 have higher F2 scores than the Grimston Thetford-type samples (Fig 12) and one of the calcareous sandstone-tempered samples and the sample with the polished quartz sand and opaque inclusions is also distinguishable using a combination of F1 and F2 scores. V4439 and the Ely samples, however, match some of the Grimston Thetford-type ware samples. The F3 and F4 scores distinguish V4439 and one of the Calcareous sandstone-tempered samples (Fig 13). None of the early to mid Anglo-Saxon samples, therefore, appear to have been made in the Grimston area despite the general similarity of their fabrics.

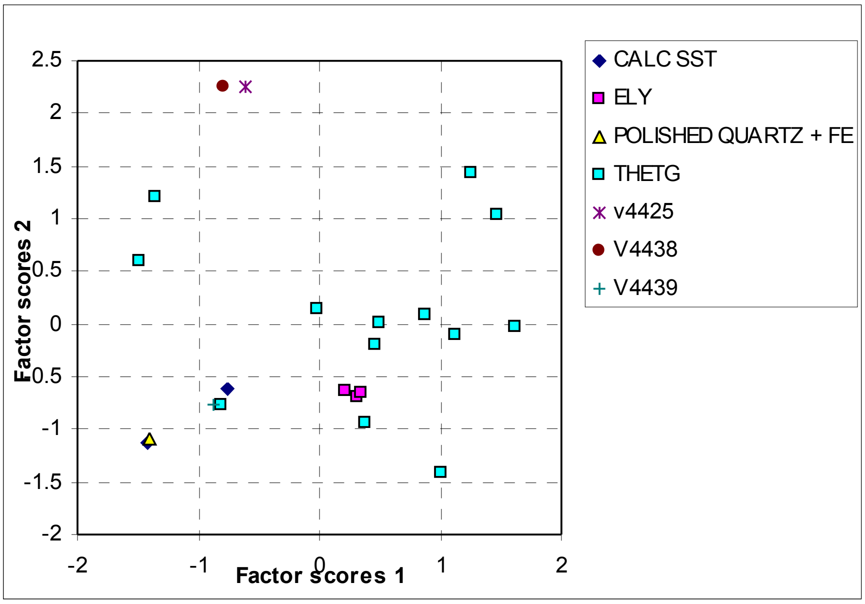

Figure 12

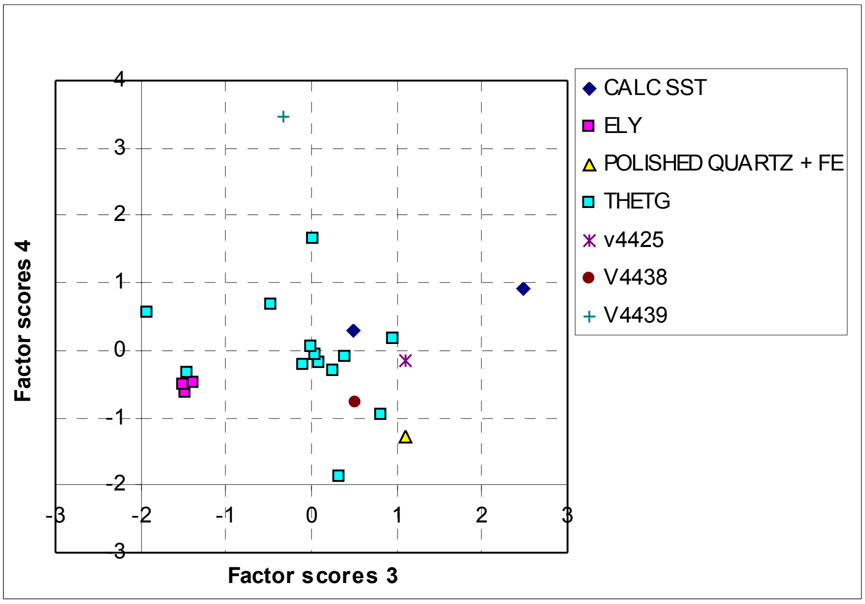

Figure 13

Sandstone (Lower Carboniferous plus/minus other inclusions)

The thin sections of the three samples with Lower Carboniferous sandstone inclusions are interpreted as being made from a boulder clay derived from the midlands and should therefore be similar to those containing Biotite Granite inclusions.

The ICPS data for these three samples was therefore compared with the other early to mid Anglo-Saxon samples, grouped into biotite granite and other groups. Five factors were found and the first and fifth factors do not distinguish the three groups whilst the second separates one of the “other” samples, masking any differences between the remaining samples. The F3 and F4 scores, however, partially separate the samples with biotite granite inclusions and place these three samples with the “other” group (Fig 14). This separation, however, is based mainly on the magnesium, potassium and sodium values and is probably therefore solely a result of the composition of the granitic inclusions themselves.

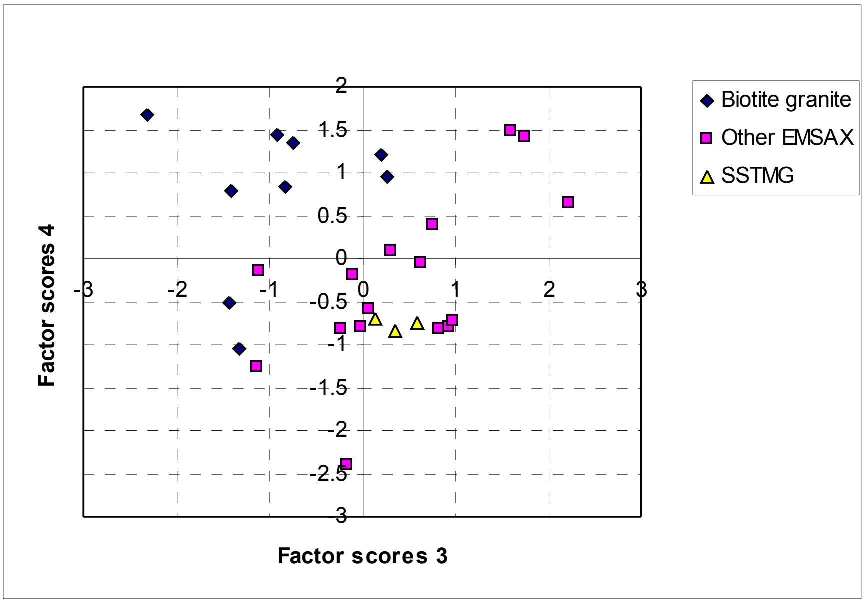

Figure 14

The ICPS data for these three Cambridgeshire samples was also compared with that for samples of similar appearance in thin section from sites throughout the country, mainly northern England. No clear patterning was found in the data but the second and fourth factors show most grouping (Fig 15). Even here, the Cambridgeshire samples are shown to be similar to those from Nottinghamshire (Brough, in the Trent valley), and East Yorkshire (Sancton). The ICPS data therefore allow either a local Cambridgeshire source or perhaps one in Yorkshire with pottery travelling down the Trent valley.

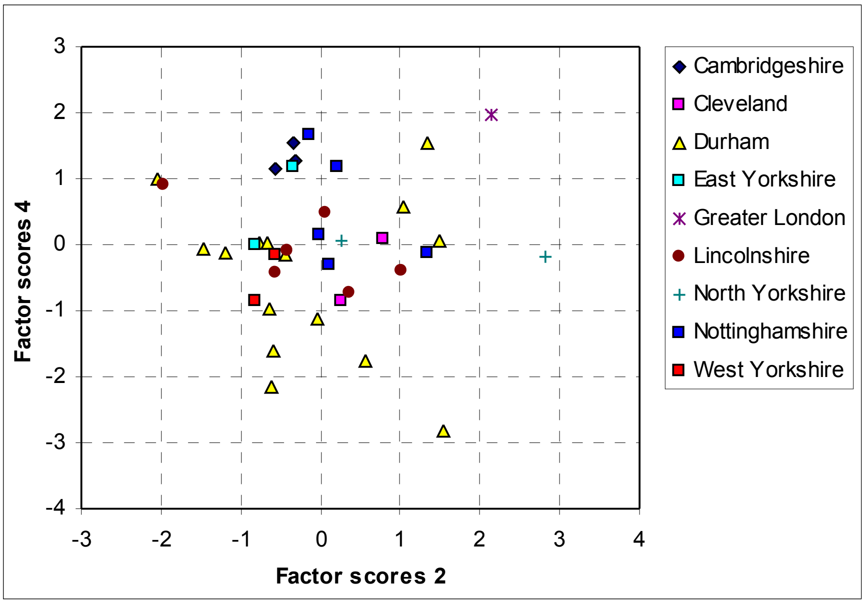

Figure 15

Micaceous Sandstone-tempered

The thin section of this sample indicated that it contained moderate fragments of an unidentified micaceous sandstone. Factor analysis of the ICPS data shows that the sample is most similar to the three samples with Lower Carboniferous sandstone inclusions, which may point to a Carboniferous origin for the sandstone (the other option, if a local product, being a Jurassic sandstone).

Shell

The thin sections indicate that the two shell-tempered samples have different characteristics and that one is similar to wares from the southeast of England (and Flanders) whilst the other is probably an example of Southern Maxey-type ware, which is found from southern Lincolnshire to Buckinghamshire and dates to the mid Saxon period. The Cambridgeshire samples were therefore compared with samples of mid Saxon and later shell-tempered ware from southeastern England and Flanders and with samples of Southern Maxey ware from Lincolnshire.

Factor analysis of the ICPS data for the Tertiary shell-tempered wares shows that the Hinxton sample has a similar composition to those from sites such Lundenwic (City of Westminster) and Sandtun (West Hythe) and to later (10th to 12th-century) shell-tempered wares from southern Flanders. The latter is found in post-conquest contexts at sites such as Dover. Therefore, a southeastern English or Flemish origin is possible for this sample.

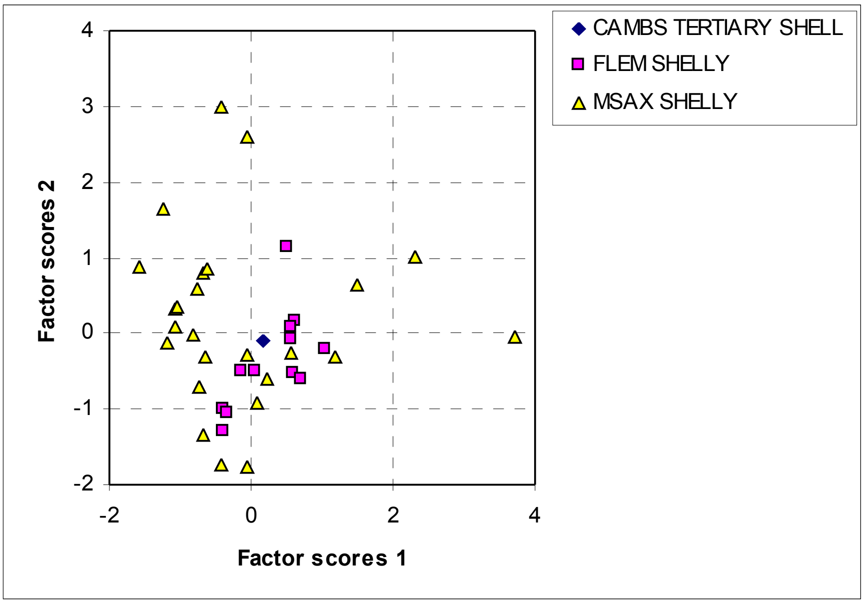

Figure 16

Factor analysis of the Southern Maxey-type ware samples revealed five factors and a plot of the F1 against F2 scores (Fig 17) found that the Willingham sample fell within the range of the Lincolnshire samples, albeit being peripheral. A plot of the F3 against F4 scores partially separates the Gosberton and Willingham samples from the Fishtoft and Quarrington ones and this supports the model of multiple production centres, with the Cambridgeshire sample coming from the same source as that supplying Gosberton. However, the two sites are over 50 miles apart and further sampling might produce evidence for further centres.

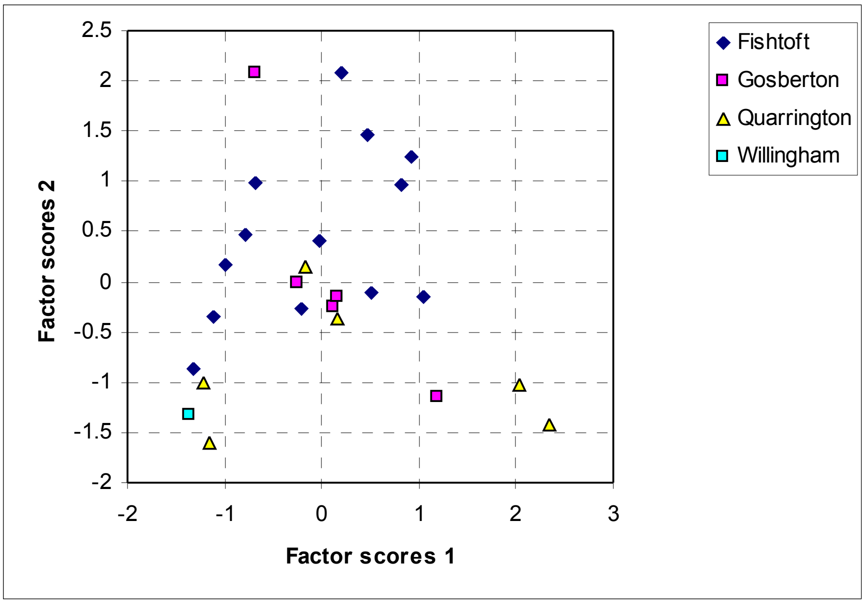

Figure 17

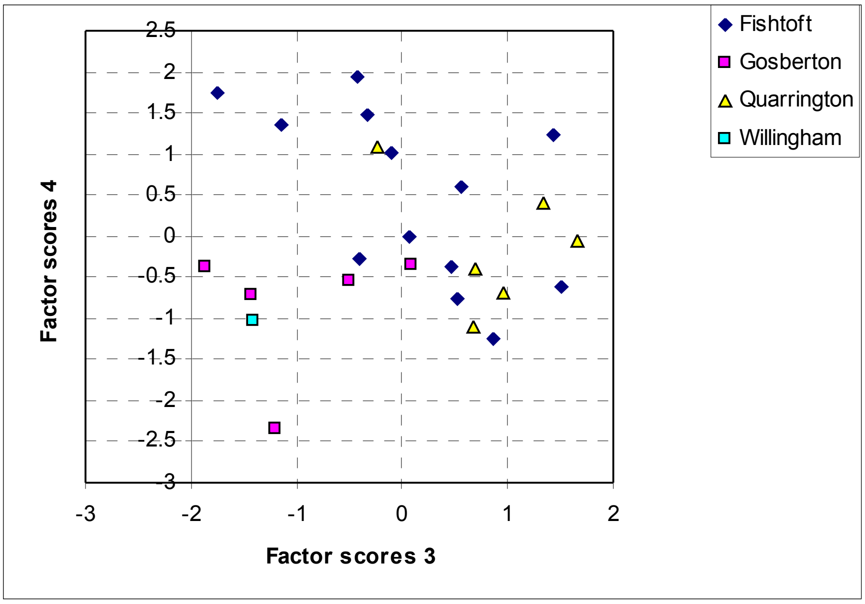

Figure 18

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Appendix 1

TSNO	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO
V4419	15.55	4.93	0.78	2.91	0.25	1.12	0.61	1.73	0.012
V4420	18.84	8.53	1.41	2.96	0.16	2.84	0.77	1.42	0.109
V4421	14.67	4.00	0.74	1.43	0.24	2.19	0.56	0.45	0.031
V4422	13.58	3.61	0.86	2.47	0.46	1.94	0.59	0.74	0.020
V4423	15.41	4.55	0.84	1.93	0.21	2.26	0.60	0.64	0.016
V4424	16.22	11.53	1.69	2.93	0.33	1.93	0.56	1.51	0.825
V4425	13.95	6.38	1.53	1.36	0.37	2.34	0.87	0.60	0.045
V4426	15.71	7.02	0.93	3.00	0.22	1.71	0.64	1.19	0.026
V4427	16.95	4.78	0.99	4.97	0.24	2.06	0.67	0.69	0.038
V4428	13.18	4.23	0.73	6.10	0.23	1.76	0.53	0.72	0.025
V4429	13.61	6.52	1.20	12.12	0.17	1.72	0.87	0.38	0.060
V4430	14.70	4.54	0.98	16.75	0.17	1.53	0.56	1.35	0.025
V4431	13.24	3.91	0.91	15.50	0.22	1.49	0.51	0.93	0.021
V4432	13.93	6.99	0.90	2.40	0.17	1.94	0.42	2.49	0.146
V4433	13.08	4.80	0.70	19.45	0.17	1.59	0.54	2.00	0.024
V4434	13.55	8.04	1.12	9.81	0.16	1.90	0.45	1.20	0.126
V4435	15.28	5.14	1.44	6.25	0.83	3.26	0.56	1.11	0.090
V4436	14.21	4.32	1.32	2.98	0.85	3.38	0.58	1.05	0.092
V4437	14.30	7.08	1.18	7.95	0.21	2.30	0.61	1.10	0.056
V4438	13.41	6.12	1.37	1.38	0.51	2.42	0.80	0.70	0.032
V4439	13.08	5.62	0.91	4.18	0.19	2.61	0.47	2.38	0.126

V4440	15.59	5.18	1.48	6.34	0.89	3.05	0.60	0.91	0.098
V4441	16.06	4.64	0.91	4.72	0.46	2.15	0.51	0.59	0.023
V4442	14.32	4.67	0.64	1.75	0.37	1.61	0.69	1.07	0.016
V4443	16.25	5.93	1.28	3.53	0.53	3.03	0.64	0.69	0.043
V4444	16.36	5.22	1.17	5.38	0.97	2.91	0.64	0.68	0.055
V4445	16.05	5.51	1.33	5.75	0.74	2.85	0.65	0.56	0.056
V4446	12.24	5.99	1.00	2.41	0.50	2.22	0.49	0.41	0.051

Appendix 2

TSNO	Ba	Cr	Cu	Li	Ni	Sc	Sr	V	Y	Zr*	La	Ce	Nd	Sm	Eu	Dy	Yb	Pb	Zn	Co
V4419	611	116	51	61	56	16	234	124	28	79	43	81	45	9	2	5	3	20	151	10
V4420	1,023	122	38	57	78	19	182	151	36	86	51	86	54	11	2	6	3	29	148	25
V4421	527	90	25	60	43	14	134	150	12	54	30	52	30	5	1	2	2	17	63	12
V4422	683	85	31	40	40	13	164	116	30	74	41	83	43	9	2	5	3	26	121	11
V4423	585	99	29	64	44	16	149	160	11	62	30	53	30	4	1	2	2	23	62	12
V4424	1,538	110	41	83	69	19	191	149	45	69	46	78	54	12	2	12	4	29	267	21
V4425	541	119	31	45	46	16	120	148	28	81	41	66	43	8	2	5	3	20	88	18
V4426	529	104	30	79	62	17	199	180	20	83	35	70	36	6	1	3	3	26	96	16
V4427	624	104	32	81	58	18	168	178	19	99	37	81	38	7	1	4	3	26	86	17
V4428	404	85	22	58	43	13	206	133	14	59	28	54	28	5	1	2	2	21	64	12
V4429	483	73	46	40	43	17	383	131	27	98	33	65	35	6	1	4	3	16	84	19
V4430	569	85	28	65	50	15	268	191	19	76	29	59	30	6	1	3	3	20	81	12
V4431	414	88	27	63	45	15	261	146	14	66	29	53	29	4	1	2	2	16	65	10

V4432	354	92	24	91	69	14	251	127	17	58	30	54	31	5	1	3	2	14	130	15
V4433	216	81	24	37	28	11	548	93	20	92	33	66	34	7	1	4	2	17	75	10
V4434	391	96	27	89	80	13	262	142	18	76	30	63	32	5	1	4	3	16	109	14
V4435	437	92	21	55	49	13	263	132	21	67	30	51	31	5	1	3	2	18	93	14
V4436	396	73	20	55	50	12	201	82	28	79	39	81	41	7	1	5	3	26	78	18
V4437	266	112	26	96	136	15	239	142	21	82	38	81	39	6	1	4	2	18	97	20
V4438	368	113	34	36	42	15	154	143	25	75	38	62	39	7	1	4	2	20	79	17
V4439	612	83	15	83	55	13	362	83	20	64	32	62	33	6	1	4	2	18	123	13
V4440	448	92	23	49	46	14	243	137	22	75	32	56	33	5	1	4	2	20	97	14
V4441	293	73	21	27	25	12	189	94	14	69	24	29	25	3	1	2	2	12	47	8
V4442	396	97	20	30	24	13	147	109	16	84	30	46	31	4	1	3	2	16	89	10
V4443	598	113	23	58	63	14	174	177	15	73	31	55	31	5	1	2	2	21	107	19
V4444	625	89	24	83	71	14	240	121	23	87	36	72	37	7	1	4	3	17	78	19
V4445	492	91	27	99	83	15	266	125	22	95	38	86	39	6	1	4	2	22	76	21
V4446	426	70	21	45	51	11	108	154	19	73	30	51	31	5	1	3	2	16	87	16