Characterisation studies of Iron Age pottery from the A1, Ferrybridge

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Ten samples of Iron Age pottery from the excavations on the A1 at Ferrybridge were submitted for thin section and chemical analyses. The fabrics were examined at x20 magnification and classed as shell-tempered, sandy, coarse sandstone, erratic rock and calcite-tempered wares. Following thin section analysis some of these broad groups could be subdivided (the shell-tempered and sand-tempered wares), giving seven fabric groups.

One of the sand-tempered fabrics and the calcite-tempered fabric were produced using the Speeton Clay which has a very narrow outcrop in the southeast corner of the Vale of Pickering. In all other cases, although the general nature of the raw materials used could be established there is no clear evidence for the precise source.

Table 1

TSNO	REFNO	Action	Context	Cname	Subfabric	Comments
V2481	77	TS;ICPS	2548	IASHELL	SAMPLE 1	Fabric 1
V2482	55	TS;ICPS	1750	IASHELL	SAMPLE 2	Fabric 1
V2483	69	TS;ICPS	2248	IASHELL	SAMPLE 3	Fabric 1
V2484		TS;ICPS	37	IASHELL	SAMPLE 4	Fabric 2
V2485		TS;ICPS	460	IASAND	SAMPLE 5	Fabric 3
V2486	3153	TS;ICPS	249	IASAND	SAMPLE 6	Fabric 4
V2487	007	TS;ICPS	779	IASST	SAMPLE 7	Fabric 5
V2488	33	TS;ICPS	1326	IAERR	SAMPLE 8	Fabric 6
V2489	149	TS;ICPS	3753	IACALC	SAMPLE 9	Fabric 7
V2490	2883	TS;ICPS	140	IACALC	SAMPLE 10	Fabric 7

Methodology

Thin sections were produced at the University of Manchester by Steve Caldwell and were stained using Dickson's method (Dickson 1965). Each section was systematically examined, listing each inclusion type present, its size range, sorting and any other relevant details.

The chemical analyses were carried out at Royal Holloway College, London, under the supervision of Dr J N Walsh. A range of elements were measured. Major elements were measured as percent oxides (Appendix 1) and minor and trace elements were measured in parts per million.

The quantity of silica present was estimated by subtracting the total measured oxides from 100%. The data were then normalised by division of each measured element value by that of Aluminium. At this stage, the data were then compared with those from other sampled wares using the Factor Analysis of Winstat ().

Shell-tempered wares

Fabric 1

Description

Three samples contained a temper consisting of bivalve shell and ferroan calcite cement fragments (Samples V2481 to V2483). The following inclusion types were noted in thin section:

- Shell fragments. Abundant fragments of bivalve shell, between c.0.2mm and c.0.5mm thick. The shells are composed of non-ferroan calcite and either have a prismatic structure or a nacreous structure, often with a thin, outer prismatic layer. Fungal borings, filled with non-ferroan calcite, are present in some shells. Most of the shells have no ornamentation and show little sign of curvature. Some have thin lines of opaque inclusions at right angles to the shell wall but do not appear to be punctate. Sparry ferroan calcite with crystals c.0.1mm across, often coats the shells, including broken edges. Some of the shell fragments are well-rounded but where coated in ferroan calcite cement the broken edges of the shell are unabraded.

- Rounded quartz. Sparse to moderate rounded quartz grains up to 0.5mm across. These grains are unstrained and monocrystalline. They have few visible inclusions.

- Calcite cement. In addition to the sparry calcite cement seen on the shell fragments, small fragments of similar cement occur separately. Larger, rounded fragments, with small unidentified inclusions (some voids, filled with clay) up to 1.0mm across were also present.

- Dark brown to opaque grains. Rounded and angular fragments of near-opaque material were present. The rounded grains were similar in size and shape to the iron-rich ooliths found in the Frodingham ironstone but none were noted in a calcareous matrix.

- Rounded chert. Sparse fragments up to 0.5mm across.

- Mudstone. Rounded fragments of mudstone with parallel bedding up to 1.0mm across. They are similar in colour and texture to the groundmass and could be relict clay pellets.

The groundmass consists of optically anisotropic baked clay minerals with no visible quartz or mica. At x100 magnification, sparse spherical dark brown grains less than 0.05mm across are discernable. These are probably of biological origin, either bacteria or faecal pellets.

Interpretation

Although it is possible that the shell and cement fragments are disaggregated limestone, the fact that the sparry cement usually forms a coating a single crystal thick suggests that it may represent a first generation of cement in a rock with a clay matrix. The cement may even be of biological origin, either deposited by worms or bryozoan colonies. The character of the groundmass suggests that it might have originated as a marine clay whilst the rounded quartz and chert sand is likely to be present as detrital sand. No quartz or chert grains were observed with a calcite cement coating and the size, shape and proportion of quartz to chert are similar to those found in the Trent valley, where they are derived from the weathering of Triassic sandstones.

Only two potential sources for this fabric exist: firstly, the limestone and cement inclusions might come from a shelly limestone of Permian date. Edwards and Trotter (1954) note that although most of the Permian limestones are dolomitic there are some which contain little or no Magnesium (Edwards & Trotter 1954, 62). The second possibility is that the shell, cement and clay are of Jurassic origin. The fine-textured groundmass, with its opaque bacterial/faecal pellets, is a common characteristic of Jurassic clays and the fabric has a similar appearance in thin section to that of mid Saxon and medieval shell-tempered wares produced in central and northern Lincolnshire, apparently exploiting clays and limestones of middle Jurassic date, including the Great Oolite formation (which in that area is not oolitic). The larger rounded opaque inclusions are, however, more characteristic of the lower Jurassic of northern Lincolnshire, occurring in clays throughout the formation, but being particularly common in the Frodingham ironstone.

No comparative chemical analyses have been taken of any Permian shell-tempered wares (if, indeed, such wares exist) but samples have been taken of three Jurassic shell-tempered wares: firstly, a late Iron Age/Early Roman wares with iron-rich ooliths (LOOL) thought to have been produced on the north bank of the Humber, where the river cuts through the chalk, exposing lower Jurassic clays and limestones; secondly, the mid Roman Dales Shelly ware (DWSH), for which multiple sources in the lower Trent valley, perhaps including the Rhaetic outcrop on the south bank of the Humber (Loughlin 1977), are likely; and thirdly, northern Maxey-type ware, produced in at least two centres situated on the east slope of the Jurassic scarp, between the Sleaford area in the south to the Brigg area in the north (MAX).

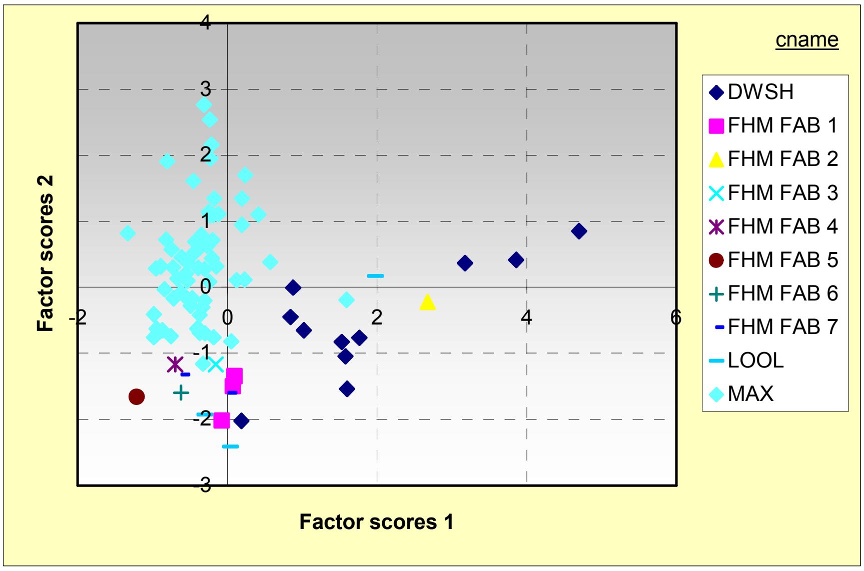

Figure 1

Fig 1 shows a plot of the two main factors found in a factor analysis of the Ferrybridge Iron Age data together with these comparative datasets. It shows that Fabric 1 has a similar composition to that of the LOOL samples, and one of the DWSH samples, but is clearly distinguished from the MAX wares.

Combining the petrological and chemical data it is suggested that Fabric 1 might have been made on either side of the Humber estuary utilising an exposure of lower Jurassic clay with a temper derived in the main from lower Jurassic limestone.

Fabric 2

Description

Fabric 2 is distinguished from Fabric 1 by the character of its shell sand inclusions, of which echinoid spines and punctate brachiopod shell fragments are the most distinct visually. In thin section the following inclusions were noted:

- Bivalve shell. Abundant angular inclusions ranging up to 1.5mm long and between 0.1 and 0.3mm thick. Some have a nacreous structure but most have complex structures, consisting of two or more layers of prismatic non-ferroan calcite crystals, set diagonally to the shell surface. Some are clearly derived from a limestone and have a matrix consisting of non-ferroan calcite marl with ferroan calcite inclusions, probably comminuted echinoid shell fragments.

- Echinoid shell. Abundant angular fragments of echinoid shell ranging up to 1.0mm across. The shell consists of a ferroan calcite matrix with non-ferroan calcite filling of the pores.

- Echinoid spines. Moderate fragments of echinoid spine, with diameters up to 0.5mm and up to 1.0mm long. The spines are composed of non-ferroan calcite with clay or ferroan calcite filling of the pores.

- Very dark brown to opaque rounded grains. Abundant ellipsoidal grains up to 0.2mm across.

- Foraminifera. Moderate fragments with a non-ferroan calcite test and ferroan calcite filling. The foramenifera do not have any cement adhering to the exterior and thus were probably present in the parent clay.

- Punctate brachiopod shell. Sparse fragments up to 1.5mm long composed of non-ferroan calcite with dark brown clay filling of the pores.

- Marl pellets. Sparse rounded pellets of light brown non-ferroan micrite with a high clay content, up to 1.5mm across.

- Rounded quartz. Sparse to moderate rounded grains. Most are unstrained and monocrystalline but strained, polycrystalline grains are also present.

The groundmass consists of optically anisotropic baked clay minerals with moderate silt-sized inclusions of angular quartz, shell and ferroan calcite cement fragments, and dark brown to opaque rounded inclusions (probably of biological origin).

Interpretation

This distinctive fabric is identical to that of mid- to late-Roman Dales Shelly ware (1998, 157). The parent clay appears to be a Lower Jurassic clay, probably within the Hydraulic Limestone formation, which outcrops on both sides of the Humber (1980, 25-8).

Factor analysis of the chemical data indicates a similar composition for the Fabric 2 sample and Dales Shelly ware, and in particular with a fabric group characterised by its quartz silt content (Fabric S, the most common of the Dales Shelly ware fabrics). That this fabric was exploited in the late Iron Age/early Roman period is indicated through analysis of vessels from Elloughton, North Yorkshire, one of which can be grouped into this subfabric on the basis of thin section and chemical evidence.

Sand-tempered wares

Two distinct fabrics occur within the sand-tempered ware group.

Fabric 3

Description

This fabric contains abundant quartz and muscovite silt with sparse inclusions of rounded quartz and a shelly limestone, such as that seen in Fabric 1. The following inclusions were noted in thin section:

- Rounded quartz. Sparse grains, similar to those noted in Fabric 2.
- Ferroan calcite cement. Sparse subangular fragments of non-ferroan calcite, up to 1.0mm across.
- Bivalve shell. Sparse fragments of nacreous bivalve shell.
- Rounded dark brown/opaque grains. Sparse rounded grains similar to those in Fabric 2.
- Rounded siltstone. Sparse rounded siltstone or very fine sandstone with a moderate component of amorphous brown grains.
- Rounded chert. Sparse rounded grains of similar size and shape to the rounded quartz.

The groundmass consists of optically anisotropic baked clay minerals, abundant angular quartz silt up to 0.1mm across, moderate muscovite laths up to 0.2mm long and rounded dark brown/opaque grains up to 0.05mm across.

Interpretation

The limestone fragments, the siltstones and the rounded opaque grains are likely to be of Jurassic age whilst the rounded quartz and chert are likely to be derived from Triassic sediments. All are detrital grains and in combination indicate a source in north Lincolnshire or that part of the Humber valley north of the river, centred on North Cave. The silty groundmass might be due to the use of an estuarine silt or a Jurassic silty clay. Such clays occur in the Middle and Upper Lias, for example.

Factor analysis, however, indicates that the Fabric 3 sample differs from other samples of known or suspected to have been made from Jurassic clays. Fig 1 indicates a composition similar to both Northern Maxey ware and the Fabric 1 samples but a plot of the next two factors, F3 and F4, shows that the sample has a much higher F4 score. This is due, in the main, to a high Magnesium and Potassium content. The high Mg value might be due to contamination from the subsoil, which where filling pores in the thin sections can be seen to contain numerous dolomite rhombs.

However, samples of loom weights made from Humber estuary silt from Flixborough also have a higher Magnesium and Potassium content than the Jurassic shelly wares, but even these have much lower values than the Fabric 3 sample (Fig 2). In fact, samples with a similarly high relative Mg/K content are rare in the author's experience and those from the United Kingdom are normally of Permo-Triassic age, and in particular made from weathered

Mercian Mudstone (from throughout the outcrop from Staffordshire, Gloucestershire, Warwickshire to Devon).

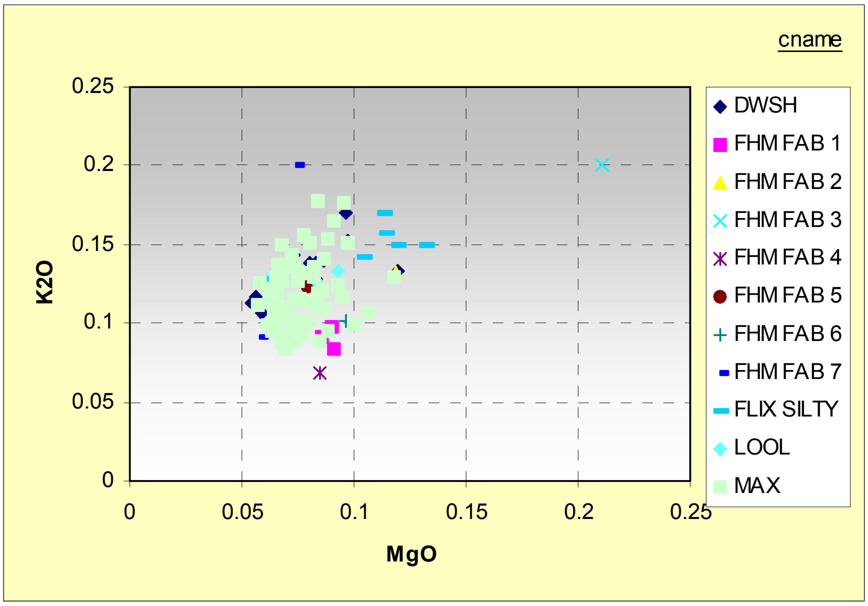

Figure 2

Fabric 4

The following inclusion types were noted in thin section:

- Angular and subangular quartz. Abundant grains up to 0.3mm across.
- Opaque grains and concretions. Moderate dark brown rounded grains up to 1.0mm across. Some of these have a concentric structure and are probably soil concretions.
- Muscovite. Sparse laths up to 0.3mm long.
- Chert. Sparse rounded fragments up to 0.5mm across.
- Altered feldspar. Sparse angular fragments up to 0.3mm across.

The groundmass is composed of optically anisotropic baked clay minerals, sparse angular quartz, feldspar (recognisable by their bladed shape) and muscovite up to 0.1mm long.

Interpretation

The thin section evidence does not clearly indicate the source of this clay. The texture, a fine sandy clay, is paralleled in some Quaternary deposits in the Vale of York (which are perhaps of lacustrine or fluvial origin) and the presence of feldspar laths in the groundmass is a feature of the Mercian Mudstone, where it is thought to indicate the arid conditions under which the clay was deposited. However, it is also a feature of silt of fluvioglacial origin, where mechanical erosion is much more prevalent than chemical erosion.

Three of the elements measured by ICPS are atypical. Sodium is high (consistent with the observed feldspar silt), Vanadium and Potassium are low. Only 45 samples known to the author have similar characteristics and of these 16 are probably made from boulder clays or post-glacial deposits, mainly from the Vale of York, and the remainder are French whitewares, which have similar characteristics through the leaching of elements during tropical paleosol formation in the Tertiary period. Thus, the chemical composition suggests that the parent clay is a silty boulder clay or post-glacial lacustrine deposit. All of the observed inclusions could be derived from the mechanical weathering of lower Carboniferous sandstones and thus the source of the clay could either be in one of the dales draining the Pennines or in the Vale of York. The comparable chemical samples come from: Norton in the Tees valley; Piercebridge, Catterick, Otley, Scorton, and West Lilling in the Vale of York; and Whitby and Sewerby on the Yorkshire coast. Factor analysis of the data from these samples indicates that the Piercebridge and Catterick samples are least similar whilst the others form a group, in which the Fabric 4 sample is closest to Fabric 5 and then to the remaining boulder clay fabrics.

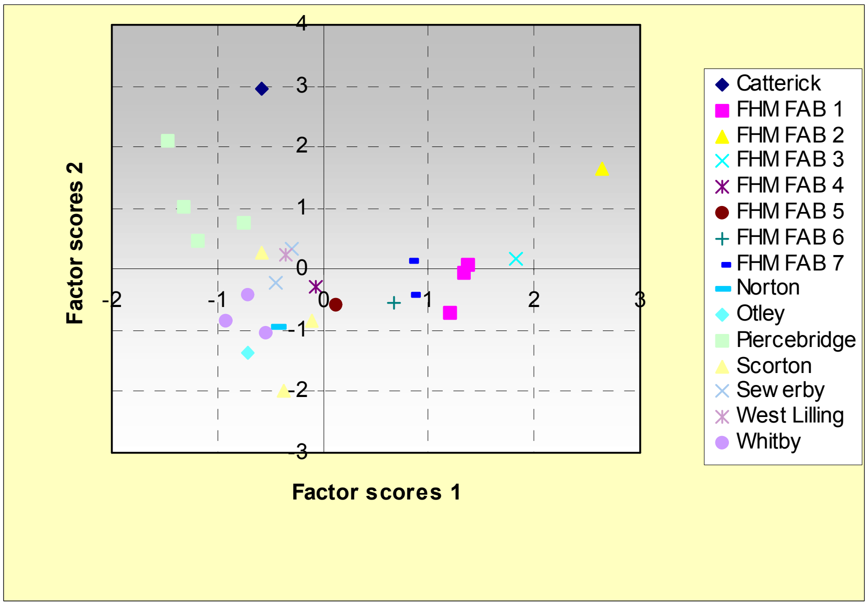

Figure 3

Sandstone-tempered wares

Fabric 5

The visual characteristics of this fabric are the presence of gravel-grade fragments of coarse-grained sandstone in a fine-textured groundmass. The following inclusion types were noted in thin section:

- Sandstone fragments. Abundant fragments of coarse-grained sandstone up to 2.0mm across. The rock has numerous pores, some filled with a kaolinitic clay and others empty. In both cases, the surrounding quartz grains have euhedral crystal faces, indicating overgrowth. Elsewhere, the quartz grains have sutured boundaries, through pressure solution, but are unstrained.
- Quartz grains. Abundant fragments similar to those seen in the sandstone, some of which have at least one euhedral face. In addition, some grains of sheared polycrystalline quartz, monocrystalline strained grains and recrystallised mosaic quartz are present. They are similar in size to the remainder.
- Altered feldspar. Sparse fragments of altered feldspar are present, up to 1.0mm across.
- Plagioclase feldspar. A single fragment of plagioclase feldspar, 0.5mm across, was noted.
- Rounded mudstone. Sparse fragments of a laminated mudstone, of similar colour and texture to the matrix, up to 1.0mm across.

The groundmass consists of optically anisotropic baked clay minerals with sparse muscovite and quartz inclusions.

Interpretation

This fabric is common in the Vale of York, in the Iron Age, and again in the very late Roman and Anglo-Saxon periods. It is probably made from a boulder clay but the inclusions are in the main probably added gravel temper.

The sandstone fragments are derived from the Millstone Grit. Several different facies occur within this outcrop, varying in grade and mineralogy (some are arkoses, with a high feldspar content, others contain significant amounts of muscovite), and detrital gravels in the Vale of York vary in the composition of the rocks present. The mudstone fragments may be of Coal Measures or Jurassic origin and if one were able to distinguish the two (which in this case is not possible) it might be possible to infer whether the parent clay came from the west or east side of the Vale of York.

Factor analysis of the chemical data from samples of Anglo-Saxon coarse sandstone-sand tempered ware alongside the Ferrybridge samples shows that the Piercebridge and Catterick samples are distinguishable, as are those from Fishergate in York, Sancton and Whitby. No difference in chemical composition can be discerned between the Fabric 5 sample and those from site in the Tees Valley (Norton, Tollesby, and Redcar), on the Wolds or east Yorkshire claylands (Easington, Garton Slack, Hayton, Sewerby), the Vale of Pickering (West Heslerton), the eastern edge of the Vale of York, north of York (Scorton, Scrayingham, and West Lilling) and Otley. Fig 4 shows the location of these comparative samples. It should be noted that in the case of the Tees valley, Wolds and Humber claylands samples that they form only a small proportion of the contemporary pottery found. Thus, the data are consistent with an origin in the upper part of the Vale of York.

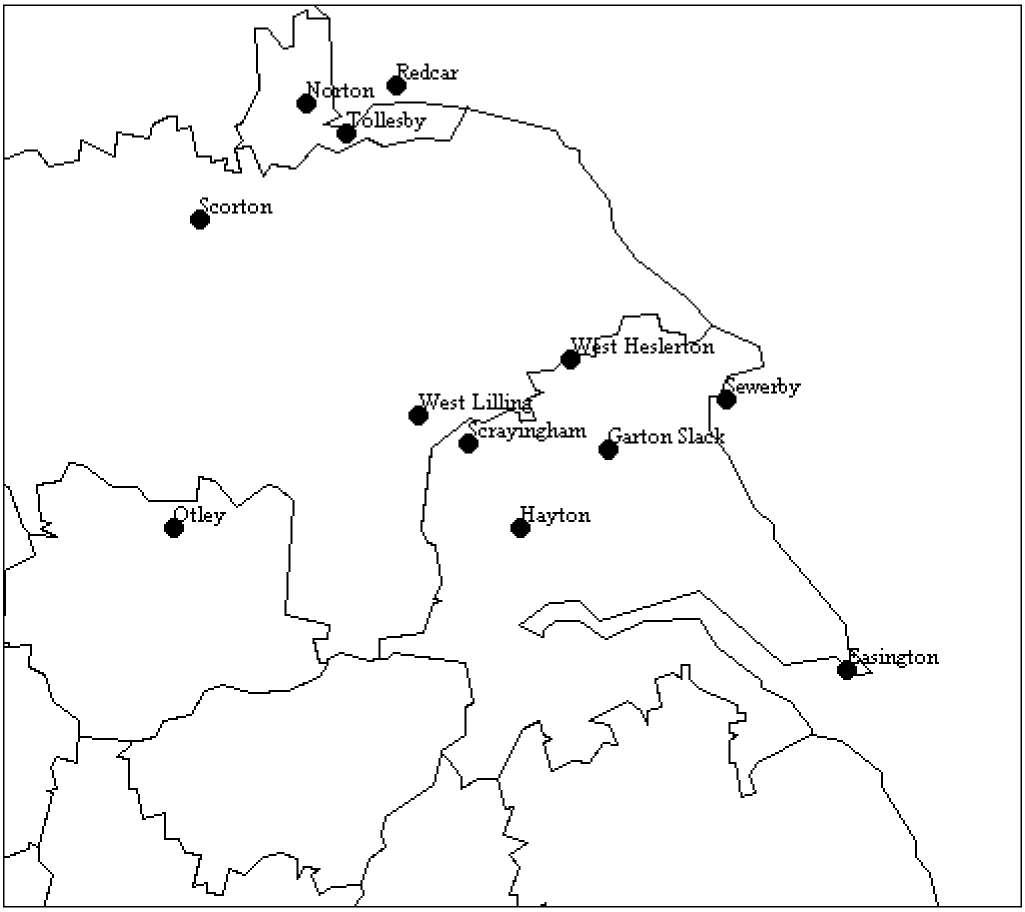

Figure 4

Erratic Rock-tempered wares

Erratic tempered wares of Iron Age date form a distinctive feature of the Iron Age pottery of northern Britain and are most common on sites in the Tees Valley, the Vale of Pickering, East Yorkshire and Lincolnshire east of the Wolds. This area coincides with the outcrop of boulder clay containing moderate quantities of igneous rocks (of various kinds), alongside sedimentary rock fragments of Carboniferous, Permo-Triassic, Jurassic and Cretaceous date, all of which are exposed along the eastern coast. Thin section analysis by Wardle, Swain, Freestone and others has indicated that the rock fragments are likely to have been deliberately added, by disaggregating a small number of erratic rocks, of types present in the local boulder clay. Although Fabric 6 is an example of this group it is by no means the most common fabric within it (which is tempered mainly with fine-grained basic igneous rock).

Fabric 6

The following inclusion types were noted in thin section:

- Angular sandstone fragments. Fragments of quartz and quartz arenite with very sharp edges, up to 2.0mm long. At x100 magnification numerous incipient cracks can be seen in the crystals. These do not seem to be signs of cleavage since the crystals are all of quartz, but seem instead to be possible evidence for thermal shock, such as might occur if the rock was heated and quickly cooled by quenching. The fragments include strained and sheared polycrystalline grains but are mainly unstrained, with few inclusions. It is not clear whether the parent rock was an orthoquartzite (such as the Millstone Grit) or a metaquartzite.

The groundmass is composed of optically anisotropic baked clay minerals, sparse angular quartz, feldspar (recognisable by their bladed shape) and muscovite up to 0.1mm long.

Interpretation

The groundmass is very similar to that of Fabric 4, and it may well be that both were produced from the same parent clay.

A small number of samples with erratic rock temper have been analysed by ICPS, although most of these are probably self-tempered, through the use of boulder clay "as dug". In general these have similar compositions to the three Ferrybridge boulder clay fabrics (Fabrics 4, 5, and 6). Only samples from Barton upon Humber, which were presumably made using boulder clay from the Lindsey Marshes outcrop, can be distinguished, and even then one of the five samples matches the composition of the remainder, which are mainly from sites in East Yorkshire (Easington, Elmswell, Sancton, and Sewerby) with a few from sites further west and north (Binchester, Scorton and West Heslerton).

Calcite-tempered wares

Calcite-tempered wares have a long history of use in northern Britain, perhaps being present in the Bronze Age in the Vale of Pickering (C Haughton, pers comm) and certainly being present in the Iron Age, for example at Staple Howe (Freestone and Humphrey 1992). Thin section analysis indicates that there are two distinct groundmass types present (glauconitic and non-glauconitic) but that both contain identical calcite inclusions, formed from the crushing of vein calcite, eroded from the chalk on the southern side of the Vale of Pickering.

Fabric 7

The following inclusion types were noted in thin section:

- Calcite. Abundant sparry calcite up to 3.0mm across. In a few cases, the edge of the vein is present, preserving the chalk country rock. Although both calcite and chalk are composed of non-ferroan calcite the stain is taken up much more strongly by the chalk.
- Altered glauconite. Abundant grains of altered glauconite, up to 0.5mm across. Some show the “squashed pea” outline which is typical of glauconite and which indicates that the grains are authigenic. In some cases, the grains have been altered to a near-opaque dark brown mineral whereas in others they are translucent but light brown rather than their original green in colour.
- Subangular quartz. Sparse subangular grains up to 0.3mm across. Most of these are unstrained, monocrystalline grains with few inclusions.
- Microcline feldspar. A single subangular fragment, 0.3mm across.
- Light-firing clay. A single pellet of light brown-firing, highly birefringent clay 0.5mm across was noted, together with a lens of similar colour and texture.
- Muscovite. Sparse laths up to 0.3mm long.

The groundmass consists of dark brown optically anisotropic baked clay minerals, with sparse quartz grains up to 0.05mm across and muscovite laths up to 0.1mm long.

Interpretation

The two samples of Fabric 7 are both clearly made from a glauconitic clay. The only outcrop of such a clay known in Yorkshire is the Speeton Clay, which outcrops as a narrow band along the southern edge of the Vale of Pickering, from Knapton in the west to Folkton in the east, and then forms a larger outcrop to the south of Filey. Furthermore, faulting, producing the veins in which the calcite was deposited, only occurs in the Yorkshire chalk along this northern edge of the Wolds and in the extreme southern tip, where lower Cretaceous strata are absent and the chalk sits unconformably on upper Jurassic rocks.

Chemical analyses of calcite tempered wares from sites in the Vale of Pickering and in the southern tip of the Wolds have been analysed using ICPS. Fig 5 shows a plot of the two main factor scores for these samples (which were analysed excluding elements likely to be introduced alongside the calcite). It indicates that the fabric of Roman calcite tempered ware is identical to that of a companion ware which appears to be “untempered calcite-tempered ware” (BLSF) and of three samples from a site at Elloughton in the Humber valley, south of the Wolds. The two Ferrybridge samples plot within the same part of the graph. By contrast, early Anglo-Saxon calcite-tempered vessels have a much broader composition (ESAX) as a result of the addition of local wind-blown sand, which has a high erratic rock content.

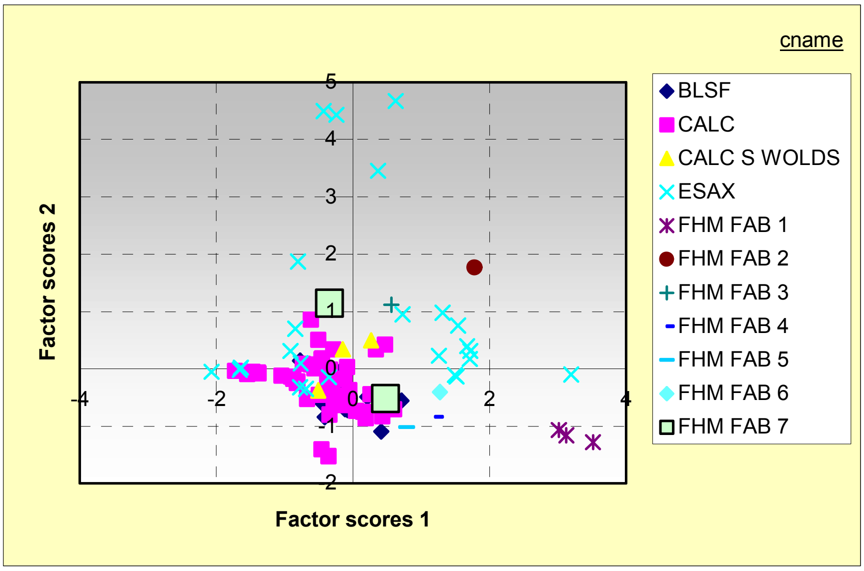

Figure 5

Of particular interest in the Ferrybridge thin sections is the light-firing clay pellet and lens. These are probably derived from the light-firing Jurassic clays employed in the Crambeck industry and the presence of the lens indicates that the clay entered the calcite-tempered ware fabric in a plastic state, not as a detrital mudstone grain. If the two Ferrybridge samples were actually of Romano-British date then this might be explicable in terms of the carriage of glauconitic clay to a production site where both calcite-tempered and white-firing wares were being produced. If, however, the samples are indeed of Iron Age date then one has to look for a geological explanation for their presence.

Conclusions

This study is based on a total sample of ten sherds, selected to reflect the visual variation in fabric. In two cases, Fabrics 1 and 7, two or more samples have the same fabric characteristics but in the remainder the analysis is based on a single sample and further samples ought to be obtained to confirm the conclusions arrived at here.

Of these, the most interesting is that at least six of the ten samples can be shown to be regional imports; from the Humber estuary or north Lincolnshire in the case of Fabrics 1 and 2 and from the Vale of Pickering in the case of fabric 7. Of the remaining fabrics, three (Fabrics 4, 5 and 6) appear to be produced from boulder clay obtained from within the Vale of York, probably to the north of York. These fabrics are the best candidates for local production, although it is by no means proven and samples of clay or definitely local ceramics (such as daub) are needed to take this matter further. The final fabric, Fabric 3, cannot yet be provenanced, although it contains a distinctive rock and mineral suite and has a distinctive chemical signature. Here, certainly, further samples might help.

An aspect of the Iron Age archaeology of the Ferrybridge site is the presence of a chariot burial, a type normally restricted to East Yorkshire and the Wolds. Fabrics 1 and 2 originated in an area where such burials are not known. Fabric 6 might come from each Yorkshire, although the petrological and chemical analyses indicate that it is more likely to be made along with Fabrics 4 and 5 in the Vale of York, but Fabric 7, the calcite-tempered ware, was certainly made in an area in which square barrow burial, sometimes with chariots, was practiced.

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