Characterisation of the Medieval Ceramic Building Material from Blue Bridge Lane, York

Alan Vince

Samples of the two most common fabrics found in the medieval ceramic building material at Blue Bridge Lane were submitted for thin section and chemical analysis. Some tiles of these fabrics were found with evidence for overfiring and these may have been produced alongside the late medieval pottery produced on the site, or they may have been utilised in the kiln structure but produced elsewhere.

Description

The two samples, both from flat roof tiles, were thin sectioned by Steve Caldwell at the Department of Earth Sciences, University of Manchester and stained using Dickson's method (Dickson 1965). A subsample of each tile was prepared for analysis by Peter Hill, who mechanically removed all the sample surfaces, both original and breaks, in order to minimise post-burial contamination. The resulting lumps were then crushed to a fine powder and submitted to Royal Holloway College London, where they were analysed under the supervision of Dr J N Walsh, Department of Geology, using Inductively-Coupled Plasma Spectroscopy (ICP-AES).

Petrological analysis

The two samples have different fabrics and are described separately.

Medieval Tile Fabric M15 (Sample V2491)

Description

The following inclusion types were noted in thin section:

- Angular quartz. Moderate monocrystalline grains up to 1.5mm across, usually with one or more flat faces, indicating overgrowth. No signs of the original grain boundaries. Also, no sign of iron or kaolinite cement, which are common in grains derived from Millstone Grit.
- Rhaxella chert. Sparse angular grains up to 1.5mm across including sponge spicules and quartz inclusions. The chert matrix usually has a brown colour. Similar but rounded grains occur in the groundmass (indicating a different depositional history).
- Fine-grained sandstone. Sparse angular fragments. up to1.5mm across. The rock is composed mainly of quartz grains which are overgrown, often including inclusion trails marking the original grain boundaries. Red iron-rich cement is present.

- Rounded opaques. Sparse rounded grains up to 1.0mm across.
- Rounded mudstone. Moderate rounded fragments up to 1.5mm across. They have few inclusions and are mainly a dark red colour although fragments with a lighter colour than the matrix are also present.
- Altered limestone. Sparse rounded grains up to 0.5mm across are represented by voids partially filled with secondary alteration products. No remains of the original structure survive.
- Angular flint. Sparse fragments up to 1.5mm across.
- Muscovite. Sparse laths up to 0.3mm long.

The groundmass (i.e. clay matrix and clasts less than 0.2mm across) consisted of isotropic baked clay minerals, abundant angular quartz up to 0.2mm long, rounded chert up to 0.2mm across and, probably, altered calcareous inclusions, whose former presence is indicated by the presence of voids up to 0.1mm across, some of which are surrounded by a reaction rim of slightly lighter-coloured clay.

Interpretation

This fabric can be paralleled at Beverley, where it was produced alongside a sand-tempered clay with a non-calcareous groundmass. The coarse inclusions reflect the northern catchment area of the local East Yorkshire fluvio-glacial sands: Middle Jurassic mudstones and sandstones; Upper Jurassic chert and Upper Cretaceous flint. The only common inclusion type which was not present in this section is erratic grains of fine-grained basic or, occasionally medium-grained acid igneous rock.

A local York-area origin can be discounted because of the fresh angular flint and Rhaxella chert, neither of which are commonly found in the local boulder clays or gravels. In addition, although the silty matrix might be matched in glacial/post-glacial lacustrine deposits in this case it is clear that the silt had originally had a calcareous component, whilst the reaction rims around the inclusions indicate that salt (sodium chloride) was present in the clay during firing. Such features might be present in Triassic mudstones, but despite being present at depth below the boulder clay at York these are not exposed locally, nor do they form a discernable element in the boulder clays.

Medieval Tile Fabric M20 (Sample V2492)

Description

The following inclusion types are present in thin section:

- Angular quartz. Identical to that in M15.
- Rhaxella chert. Identical to that in M15.
- Fine-grained sandstone. Identical to that in M15.
- Rounded opaques. Identical to that in M15.
- Acid igneous rock. A single fragment of a medium-grained rock containing quartz, feldspar and biotite, 0.5mm long.
- Rounded mudstone. Moderate rounded fragments of varying texture. Some have a similar colour and lower silt content than the clay matrix whilst others have a higher silt content and others still have a higher iron content.
- Muscovite. Identical to that in M15.
- Rounded quartz. A single well-rounded grain 1.0mm across.

The groundmass consists of optically anisotropic baked clay minerals, sparse angular quartz, up to 0.05mm across, moderate muscovite up to 0.1mm long, rounded clay pellets, often with a darker red core but otherwise similar in colour and texture to the clay matrix.

Interpretation

The coarse inclusions in this fabric are almost identical to those in M15. No flint was noted but otherwise the range is very similar. The groundmass, however, is quite different, being not only non-calcareous but not containing much quartz silt. The similarity in colour and texture of the mudstone fragments and the clay pellets in the groundmass suggests that the parent clay is a weathered mudstone.

Such mudstones occur in the middle Jurassic of the North Yorkshire Moors and the Hambleton Hills as well as in the Coal Measures and were probably carried south by ice down both the Vale of York and east of the chalk in East Yorkshire. Rhaxella chert has not been reported in glacial deposits in the Vale of York, however, and the thin section suggests that this too is a Beverley product (albeit with less certainty than in the case of M15).

The groundmass of this fabric is similar to that of the Humberware produced on site but the coarse inclusions differ in their type, their size range and their sorting. It is therefore quite clear that this fabric was not tempered with the same sand as the Humberware and probably was made from a different parent clay, although this is not a conclusion that could be made from the thin section analysis.

Chemical analysis

A range of major elements were measured as percent oxides (Appendix 1) whilst a range of minor and trace elements were measured as parts per million (Appendix 2). Silica was not measured directly but was estimated by subtracting the total major element count from 100%. Fabric M15 contains 70% silica and Fabric M20 contains 64.7%.

In comparison with the Humberware produced on the site, both tile fabric samples contain less aluminium, titanium, lanthanum, neodymium and lead, M15 contains more sodium, potassium and yttrium, and less samarium, and M20 contains more magnesium, calcium, lithium and strontium, and less iron, vanadium, zirconium, europium, dysprosium, and ytterbium. These differences are not marked, but confirm that neither fabric was made from the same clay as the Humberware. Fig 1 shows the results of a factor analysis carried out on this dataset and demonstrates that in their chemical composition the two tile fabrics are as dissimilar to each other as they are to the Humberware, confirming that most of the measured chemical composition comes from the groundmass rather than the visible inclusions.

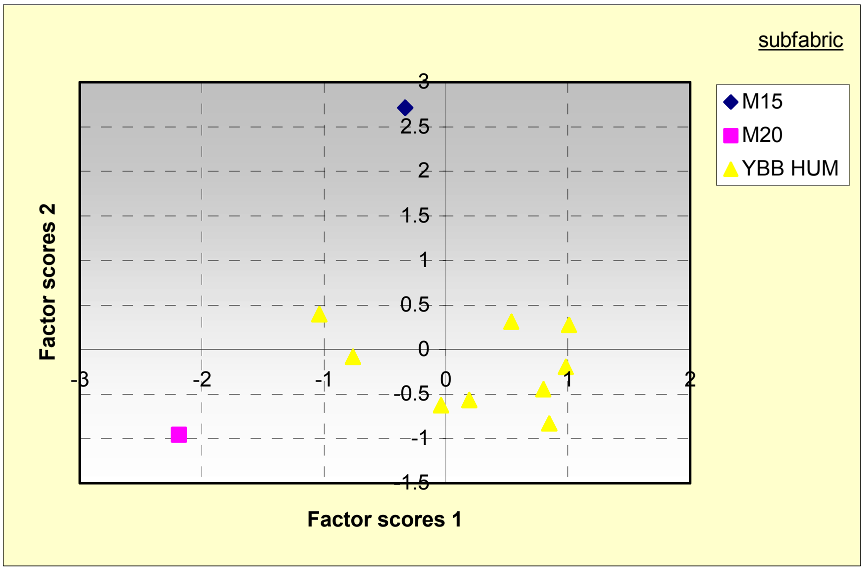

Figure 1

ICPS analyses are available for a group of flat tile wasters from Beverley and for a series of ceramic building material types and fabrics from Wawne, a rural settlement located just to the north of Beverley and almost certainly supplied with tile from the Beverley tilery.

Factor analysis of the two York samples together with this group shows that the York samples have similar compositions to Beverley products (Fig 2). Fabric M15 is similar to Wawne fabrics CBM2 (a micaceous, untempered fabric) and CBM3 (a micaceous sand-tempered fabric) whilst Fabric M20 lies midway between the Beverley waste samples and those from Wawne. From their petrological characteristics M15 would be classed as Wawne

CBM5 and M20 would be classed as Wawne CBM3. Unfortunately, no thin sections were made of the Beverley wasters but from their chemical similarity to Wawne CBM4 it is likely that they have a calcareous body, similar to that of M15.

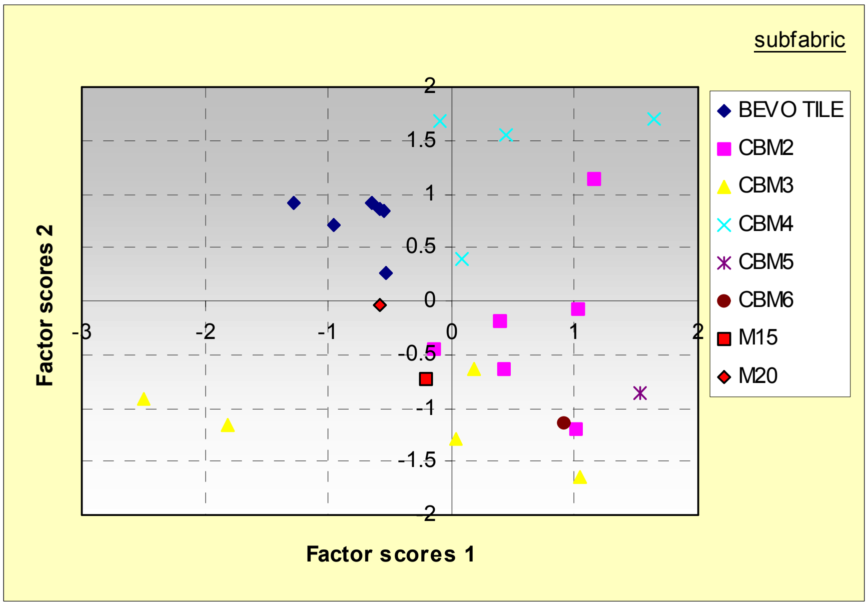

Figure 2

Despite the general similarity of the York and Beverley tiles in chemical content, there are some systematic differences (relative to aluminium, to minimise the effect of variable added sand temper):

- Both fabrics have a lower iron, titanium, chromium, scandium and vanadium content than the Beverley samples
- Both have a higher copper and cerium content
- M20 has a lower sodium and zirconium content
- M20 has a high lithium content

These differences are not great but bearing in mind that there are 22 Beverley tile samples they may well be significant. Fig 3 shows the result of a factor analysis carried out on just these discriminating elements (Fe_2O_3, Na_2O, TiO_2, Cr, Cu, Li, Sc, V, Zr and Ce). Three chemical composition groups can be seen in the East Yorkshire tiles: the Beverley tile wasters; Wawne CBM3 and Wawne CBM2/4. The York samples are distinguished by their high Factor 2 scores.

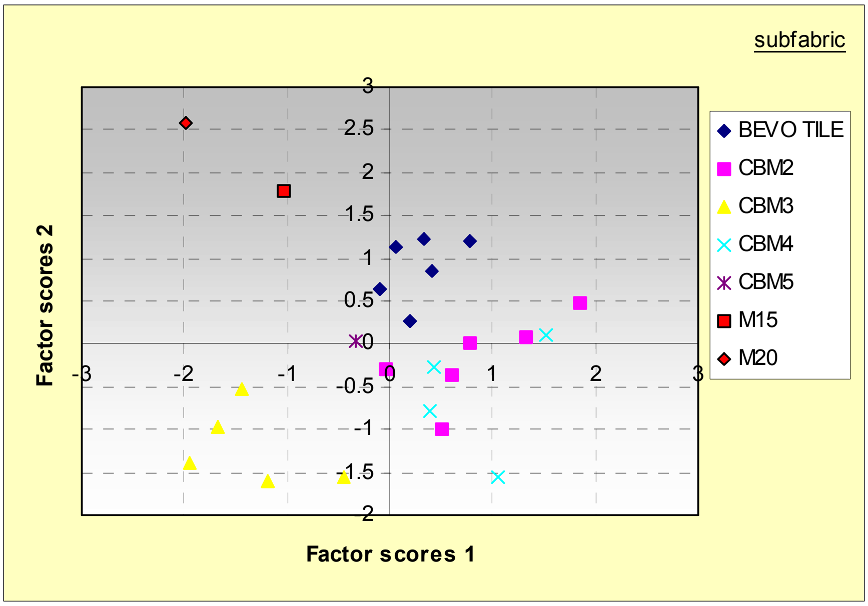

Figure 3

Discussion and conclusions

The thin section and chemical evidence are in agreement in showing that both of the York tile fabrics submitted for analysis are likely to be Beverley products, and certainly different in fabric from that used for the Humberware vessels made at Blue Bridge Lane. The differences between the two fabrics appears to be due to two distinct clays, as at Beverley (sometimes, confusingly, mixed together). The first is a boulder clay, derived ultimately from middle Jurassic mudstones, whilst the second is a calcareous silt, which from its inferred brine content we can identify as a Humber estuarine silt of recent date. Both of these two clays could be used separately or together and both could either be used untempered or with added sand.

It is clear, therefore, that the overfired tile from Blue Bridge Lane was overfired through use in the structure of the Humberware kiln rather than being a product of that kiln.

There is documentary evidence for the importation of tile from Beverley, for example for the Bedern Hall in 1238-9 (1952, 36-7), but Ian Betts concluded from his study of the medieval tile from York that most was of local manufacture (Betts 1991, 50) whilst there is also documentary evidence in the later medieval period for the importation of tile from Cawood. Wasters of flat roof tiles have recently been recovered from Cawood and have a calcareous silty groundmass, similar to M15 (Vince 2004) and it would be useful to analyse a sample of this waste in order to confirm that it cannot be the source of the York M15 fabric.

Appendices

Appendix 1

TSNO	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO
V2491	17.02	5.78	1.65	1.12	0.42	2.9	0.66	0.15	0.089
V2492	18.54	6.1	2.58	3.73	0.36	2.92	0.69	0.26	0.098

Appendix 2

TSNO	Ba	Cr	Cu	Li	Ni	Sc	Sr	V	Y	Zr*	La	Ce	Nd	Sm	Eu	Dy	Yb	Pb	Zn	Co
V2491	512	93	31	102	52	14	118	92	24	60	43	89	44.556	7.122	1.2532	4.4	2.3	79.172	92	19
V2492	470	100	33	133	55	15	182	83	21	47	48	94	48.88	8.49	1.234	4	2.3	75.044	96	18

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