Petrological Analysis of Ceramic Building Material from Ramsey Abbey, Cambridgeshire (RAS AB 98)

Alan Vince

Twelve samples of ceramic building material from Ramsey Abbey, Cambridgeshire, excavated by Cambridgeshire County Council, were submitted for analysis in order to provide an objective description of their petrological characteristics and to try and establish the source of the raw materials used in their manufacture (Table 1).

Petrological analysis

Fabric A (V2845)

One sample of Fabric A was submitted, a piece of flat roof tile. The tile has a light grey core and light brown margins and surfaces. At x20 magnification the fabric contains few large inclusions (lower cretaceous-derived polished quartz, sparse bivalve shell fragments and a single large angular black fragment, possibly fossil bone or clay/iron). Moulding sand on the base consists of abundant subangular quartz, mostly with a slight haematite coating, bivalve shell fragments, muscovite laths up to 0.2mm across, and sparse biotite.

In thin section the following inclusion types were noted:

- Quartz. Moderate angular quartz grains c.0.1mm to 0.2mm across. Sparse subangular and rounded grains up to 0.5mm across.
- Microfossils. Abundant ferroan calcite microfossils, consisting in the main of thin flat fragments some with a slight curvature, up to 1.0mm long. These are probably ostracods.
- Opaques. Sparse rounded fragments up to 0.5mm long.
- Voids. Sparse rounded and irregular voids. The rounded voids appear to have once held calcareous inclusions whilst the irregular ones appear to be pores.

The groundmass consists of optically anisotropic baked clay minerals, abundant dark brown/opaque grains, c.0.05mm across and ferroan calcite microfossils (probably broken pieces of the larger microfossils). Sparse quartz grains up to 0.05mm are also present.

Fabric AA (V2844)

One sample of Fabric AA was submitted, a fragment of flat roof tile. The tile has a light grey core and very pale brown margins and surfaces. At x20 magnification the fabric contains few large inclusions (two large fragments of oyster-like bivalve shell with a dark cement adhering

to the broken edges; lower cretaceous-derived polished quartz). Moulding sand on the base consists of subangular quartz grains, bivalve shell fragments, red iron ore, muscovite and biotite.

In thin section the following inclusion types were noted:

- Quartz. As Fabric A
- Microfossils. As Fabric A
- Opaques. As Fabric A.
- Voids. As in Fabric A except that some contain ferroan calcite, which might be secondary, or concretionary limestone, and some contain non-ferroan calcite, partially replaced around the edges by ferroan calcite.
- Clay Pellets. Sparse rounded clay pellets with similar characteristics to the groundmass, but containing no microfossils

The groundmass is as Fabric A.

Fabric A2

One sample of Fabric A2 was submitted, a fragment of flat roof tile. The tile has a light grey core and light brown margins and surfaces. At x20 magnification, the fabric contains few large inclusions (rounded calcareous grains which are possibly heat-altered bivalve shell; a large tabular fragment of chert). Moulding sand on the base consists of subangular quartz, muscovite, bivalve shell fragments, red iron ore which may be from the body, and biotite.

In thin section the following inclusion types were noted:

- Quartz. As Fabric A
- Microfossils. As Fabric A. Also, sparse rounded non-ferroan calcite microfossils.
- Opaques. As Fabric A.
- Voids. As Fabric AA.
- Clay Pellets. As Fabric AA.
- Altered glauconite? Sparse red fragments up to 0.3mm across. These may be altered glauconite or phosphate. The colour, however is different from the secondary brown-stained phosphate found in some of the pores.

The groundmass is as Fabric A.

Fabric B (V2839, V2848)

Two samples of Fabric B were submitted, both of which appear to be Romano-British bricks or tegula fragments. The tiles have a light grey core and red margins and surfaces. At x20 magnification, At x20 magnification the fabric contains few large inclusions but is variegated with lenses of lighter-firing clay. Moulding sand, present on the bases of the tiles and folded into the fabric of one sample, is a fine quartzose sand composed of subangular quartz grains up to 0.1mm across, rounded quartz grains, rounded black iron ore, muscovite and biotite laths. Shell is absent.

In thin section the following inclusion types were noted:

- Quartz. Moderate sub-rounded and rounded grains up to 0.5mm across. A few of the grains are polycrystalline and strained whilst the majority are unstrained and monocrystalline.

- Finegrained Sandstone. Sparse rounded fragments composed of angular quartz grains c.0.05mm to 0.1mm across.

- Clay Pellets. Sparse dark brown to black-stained rounded pellets up to 1.0mm across.

The groundmass is composed of variegated clays differing in colour, texture and their quartz sand content (indicating that the quartz sand was not added to a pre-existing parent clay). The different lenses of clay vary in the amount and size of quartz and muscovite present but all contain moderate to abundant quartz inclusions with sparse muscovite.

Fabric DR (V2849)

One sample of Fabric DR was submitted, a relief-decorated floor tile. The tile is unglazed buy has a dark brown surface which appears to be a slip. At x20 magnification the fabric contains few large inclusions (sparse voids of grass or straw leaves) but is variegated, consisting of a light pink calcareous clay with lenses of lighter-firing and red clay. Fragments of red tabular iron ore occur alongside the red clay. Moulding sand on the base consists of subangular quartz up to 0.2mm across, sparse rounded quartz grains, muscovite and biotite.

In thin section the following inclusions were noted:

- Quartz. As Fabric A but sparse.

- Microfossils. As Fabric A but represented by voids and ?phosphate replacement.

- Opaques. One large rounded fragment 6.0mm long. Others as Fabric A.

- Voids. As Fabric AA.
- Bivalve shell. Sparse fragments of non-ferroan nacreous shell up to 3.0mm across

The groundmass is similar to Fabric A but is variegated with streaks varying in colour.

Fabric DR2 (V2840)

One sample of Fabric DR2 was submitted, a flat roof tile fragment. At x20 magnification, the variegated calcareous fabric contains moderate, iron-stained quartz grains, including polished grains of lower Cretaceous origin up to 1.0mm across. Moulding sand on the base consists of similar quartz sand with red iron ore, white angular flint and sparse shell.

In thin section the following inclusion types were noted:

- Quartz. As Fabric A
- Microfossils. As Fabric A
- Chert. Sparse rounded fragments up to 1.5mm across.
- Opaques. Sparse rounded fragments up to 2.0mm across.
- Micrite. Rounded fragments of non-ferroan calcite, up to 1.0mm across, with traces of microfossils. Probably chalk.

The groundmass is as Fabric A.

Fabric DW (V2841)

One sample of Fabric DW was submitted, a flat roof tile with a round peg hole. At x20 magnification, the variegated calcareous clay contains few inclusions. There is no moulding sand.

In thin section the following inclusion types were noted:

- Quartz. Sparse angular fragments up to 0.2mm across and rare rounded grains up to 0.4mm across, some with iron-stained veins.
- Voids. Sparse sub-rounded voids up to 1.0mm across.
- Clay pellets. Sparse rounded fragments, similar to the groundmass but redder.

The groundmass consists of optically isotropic, variegated calcareous clays, varying in colour (iron content). Sparse angular quartz up to 0.1mm across is present.

Fabric E (V2843, V2846)

Two samples of Fabric E were submitted, both from flat roof tiles, one of which has a partial lead glaze. The fabric has a dark grey core with light brown margins and surfaces. At x20 magnification, the fabric contains abundant rounded quartz grains, up to 1.0mm across, some of which are of lower Cretaceous origin and haematite-coated; sparse angular white flint fragments and rounded bivalve shell fragments.

In thin section the following inclusion types were noted.

- Quartz. Abundant rounded fragments up to 1.0mm across, including well-rounded, spherical grains (of Permo-Triassic origin).
- Chert. Sparse rounded fragments up to 1.0mm across.
- Flint. Sparse angular and subangular fragments up to 1.0mm long.
- Bivalve shell. Sparse rounded fragments of nacreous bivalve shell up to 1.0mm long.
- Opaques. Sparse rounded, heat-altered grains up to 1.0mm across.
- Baryte. A single possible identification of a banded fragment 1.0mm long.

The groundmass consists of optically isotropic variegated lenses and streaks of baked clay minerals with sparse angular quartz. Some of the clay lenses are light-coloured and possibly once calcareous.

Fabric F(V2842)

A single sample of Fabric F was submitted, a flat roof tile fragment. At x20 magnification, the fabric contains few large inclusions and has abundant iron-stained subangular quartz and unstained bivalve shell fragments up to 0.2mm and sparse muscovite and biotite laths of similar size.

In thin section the following inclusion types were noted:

- Quartz. As Fabric A but slightly more common.
- Microfossils. As Fabric A but also sparse non-ferroan echinoid spines and circular microfossils c.0.15mm across.
- Altered Glauconite. As Fabric A2. Some are brown rather than red and more definitely altered glauconite.
- Clay Pellets. As Fabric AA

- Bivalve shell. Some nacreous shell fragments up to 1.0mm long. In addition, probably some voids once contained bivalve shell, also up to 1.0mm long.

The groundmass is similar to Fabric A

Fabric G (V2850)

A single fragment of Fabric G was submitted, a flat roof tile fragment. At x20 magnification, the variegated, calcareous clay contains few inclusions (angular red clay/iron ore fragments up to 0.5mm across and voids whose original contents are unknown).

In thin section the following inclusion types were noted:

- Quartz. Rare rounded quartz up to 0.3mm across.

- Voids. Sparse voids, up to 1.0mm across.

The groundmass consists of optically isotropic variegated lenses and streaks of baked clay minerals, abundant quartz up to 0.05mm and sparse muscovite and biotite laths up to 0.1mm long. Some of the lenses are formed of light-firing heat-altered calcareous clay.

Discussion

Ignoring those inclusions which may have been deliberately added as tempering, the fabrics can be grouped into three:

1. Fabric B. Non-calcareous, few inclusions visible to the naked eye. Quartz and muscovite silt present in the groundmass.

2. Fabrics A, AA, A2, DR, DR2 and F. Calcareous body in which the calcareous matter is probably formed from microfossils, with abundant ostracod? or thin-walled bivalve shell sand. In some cases the shell has been altered, either before or after burial. The groundmass also contains variable amounts of dark brown/opaque iron, either of bacterial or faecal origin. Such matter is a distinctive feature of some Jurassic clays but cannot be tied down to a specific strata or period within the Jurassic.

3. Fabrics E, DW and G. Calcareous body with no fossils visible. In this case the calcareous matter in the groundmass is much more abundant and finer-textured. Similar clays were used to make Cambridgeshire yellow bricks in the 19th century (for example, a sample from Cambridge collected by David Hall and thin-sectioned by the author). Similar clay was also collected by David Hall from a clay pit at Ely, apparently exploiting Kimmeridge Clay.

It is likely that groups 2 and 3 were both produced from Jurassic clays, either the Oxford Clay or the Kimmeridge clay. It is likely that the most common group, Group 2, was actually produced at Ramsey, since it includes the decorated floor tile sample thought on other grounds to be made at Ramsey. Group 2 is perhaps more likely to have been imported to Ramsey from south Cambridgeshire, but a more local source cannot be discounted without sampling of the local clay sources.

The group 1 clay contains no distinctive features to indicate its likely origin and it may well not be locally produced.

The deliberately added inclusions consist of several different quartzose sands, distinguished both by their size ranges and the accessory minerals present. Two main groups are present, however: a rounded quartz sand, varying in grain size, and included well-rounded, almost spherical quartz grains, fine-grained sandstones and rounded chert. These characteristics indicate a Permo-Triassic origin for the sand but sands of this type are so widespread throughout the east Midlands and East Anglia that they are of no use in characterisation in this case. This sand occurs in Fabrics B and E. The second main group consists of the fine angular quartz sand noted in Fabrics A, A2, DR, D2 and F. This may be naturally present in the Group A clay or may be added through contamination by the moulding sand.

The sand in Fabric DR2 includes rounded fragments of micrite, almost certainly chalk. These do not survive long in river sands and if these fragments were of riverine origin then they would indicate a source close to the chalk outcrop. However, chalky boulder clay also contains rounded chalk fragments and this is probably the immediate source of the Fabric DR2 micrite. Angular flint is also normally indicative of an origin close to the chalk, since detrital flint is brittle and is quite quickly rounded in detrital sands. The only fabric to contain flint is Fabric E but here the fragments have undergone some rounding (but not a large amount). Flint too occurs in Chalky boulder clay although in the case of Fabric E no micrite or rounded voids which might once have contained it were noted in either section.

Water-polished, well-rounded quartz grains are diagnostic of the Lower Cretaceous but these occur widely as detrital grains and are not a good indicator of source (except that they do not occur in sands from rivers whose catchment occurs only Jurassic and earlier strata). They occur widely in the fens as a result of fluvio-glacial transport from their outcrop on the west side of the Lincolnshire Wolds. Such grains are easier to identify in the hand specimen than in thin section and were noted in Fabrics A, AA, DR2 and E. This is consistent with the suggested origins of these fabrics.

The shell fragments visible to the naked eye are mostly nacreous bivalve shell, almost certainly naturally present in the clay (since it would serve no purpose to add them in such sparse quantities). They support the Jurassic origin of the parent clays in the fabrics in which

they occur (Fabrics A, AA, A2, DR, E and F).It should be noted that these macroscopic shell inclusions occur in both Group 2 and 3 fabrics.

It would be possible to pursue the source of these Ramsey tile fabrics in two ways: firstly, to obtain samples of clays in the Ramsey area and to make briquettes, fire them and make thin sections of the fired briquettes and, secondly, to obtain chemical analyses of the Ramsey fabric samples, using Inductively Coupled Plasma Spectroscopy. This would provide a means to test the suggested fabric groups postulated here and would allow the Ramsey tiles to be compared with the Ely and Cambridge samples mentioned above.

Table 1

TSNO	Context	REFNO	Action	class	Cname	Subfabric	Form	Part	Description
V2839	1244		TS	POTTERY	RTIL?	FABRIC B	BRICK / TEG	BS	
V2840	1000		TS	POTTERY	MTIL	FABRIC DR2	FLAT	BS	
V2841	1005		TS	POTTERY	MTIL	FABRIC DW	FLAT	BS	ROUND PEG HOLE
V2842	1000		TS	POTTERY	MTIL	FABRIC F	FLAT	BS	
V2843	1304		TS	POTTERY	MTIL	FABRIC E	FLAT	BS	ROUND PEG HOLE
V2844	1331		TS	POTTERY	MTIL	FABRIC AA	FLAT	BS	
V2845	1288		TS	POTTERY	MTIL	FABRIC A	FLAT	BS	
V2846	1323		TS	POTTERY	MTIL	FABRIC E	FLAT	BS	PARTIAL PLAIN GL
V2847	1331		TS	POTTERY	MTIL	FABRIC A2	FLAT	BS	
V2848	1299		TS	POTTERY	RTIL?	FABRIC B	BRICK	BS	
V2849	1356	SF49	TS	POTTERY	MTIL	FABRIC DR	FLOOR	BS	RELIEF DECORATED
V2850	1005		TS	POTTERY	MTIL	FABRIC G	FLAT	BS	SQUARE PEG HOLE