Characterisation Studies of Clay from Ramsey Abbey, Ramsey, Cambridgeshire

Alan Vince

Samples of the various ceramic building material fabrics used at Ramsey Abbey were thin sectioned and analysed by the author in 2005. These included samples of floor tiles made on the site and a number of fabrics whose similarities suggested that they were made from the same basic parent clay. It was recommended that samples of local clay were sought out and compared with these fabrics in order to establish which clay was being used and its outcrop. As part of this process, a sample of clay from the site was submitted for study.

The clay is blue-grey in colour with black mottling and moderate decayed roots. Mixed with this clay is a light brown, very sandy clay. A subsample of the clay was made into a briquette, with the minimum of working to preserve the original texture, and fired at c.1000 degrees C by Andrew Macdonald. The fired clay has a variable dark red colour (Munsell 2.5YR 3/6) with black mottling.

Thin Section Analysis

Description

The two clays present in the sample are clearly distinguishable in thin section, although there are quartzose grains which derived from the sandy clay scattered throughout the finer clay. Nevertheless, it is possible to reliably describe each clay separately.

The following inclusion types were present in the blue-grey clay:

- Clay pellets. Sparse rounded pellets, mainly c.0.5mm to 1.5mm across. The pellets have a similar groundmass to the rest of the clay but are mottled black.
- Voids. Sparse rounded voids, some elongated ovals in outline and others more spherical. These voids sometimes contain a lining of clay, similar in colour and texture to the groundmass.

The groundmass consists of partially isotropic, partially anisotropic baked clay minerals, moderate angular quartz, up to 0.05mm across and sparse muscovite laths, up to 0.05mm long.

The following inclusions were present in the sandy clay:

- Quartz. Abundant rounded grains, with several having a high sphericity, up to 0.5mm across.

- Chert. Moderate rounded grains, varying in texture and colour but all coarser than flint. Some have a high sphericity.
- Flint. Sparse subangular fragments up to 0.5mm across.
- Sandstone. Sparse rounded fine-grained sandstone fragments up to 0.5mm across with grains up to 0.2mm across and a colourless or brown-stained silicious matrix.

The clay groundmass between the quartzose inclusions is similar in colour and texture to that of the fired blue-grey clay.

Interpretation

It is likely that the blue-grey clay is, ultimately, of Jurassic origin, based on the low silt content. It may be that it had been redeposited by glacial action but there is no evidence to support this in the sample itself. The voids present in thin section can be equated with the decayed organic matter in the unfired clay and are probably rootlets rather than organic matter present in the clay from the Jurassic period, although Jurassic clays do often have a high organic content. The quartzose sand contains grains derived from Triassic sands and the Upper Cretaceous chalk and is presumably a Quaternary cover sand. Such sands occur widely in the east Midlands, and all contain mostly Triassic material.

The thin section analysis of the Ramsey Abbey ceramic building materials revealed three distinct clay types had been employed:

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.

Of these, Group 1, which was used only in the Roman period, is the most similar but contains more silt in the groundmass that the Ramsey clay. However, the quartz sand found sparsely in this fabric is similar to that in the clay sample, and black-stained clay pellets are present, as in the Ramsey clay. Groups 2 and 3 are clearly different from the clay sample in that they contain either bioclastic inclusions (Group 2) or authigenic calcareous inclusions (Group 3).

Chemical analysis

A sample of the clay was ground to a fine powder, having ensured that no contamination was present (other than the sandy clay). It was submitted to Royal Holloway College, London, Department of Geology, where Dr J N Walsh analysed its chemical composition using Inductively-Coupled Plasma Spectroscopy. The Ramsey Abbey tiles were not themselves studied using this method, which was carried out mainly for the future benefit of having this data. However, the data were compared with a range of wares from the East Midlands whose source and parent clay are known, with greater or lesser degrees or certainty.

This data was analysed using the Winstat for Excel Factor Analysis add-in ({Fitch 2001 #44933}). Since some of the fabrics are calcareous and some are not, this analysis was carried out firstly including the values for Calcium and Strontium and then excluding them.

In both analyses, the Ramsey clay was more similar to samples of clay and ceramics made from Upper Jurassic age than to others. Furthermore, in both analyses the Ramsey clay is most similar to samples of shell-tempered ware, from the Haddon kiln and from neighbouring sites analysed for comparison (Figs 1 and 2). The two factors which most differentiate the Ramsey clay from the other samples are F1 and F4. Using a combination of these two factors, it is possible to distinguish the Ramsey clay from all the others (Fig 3).

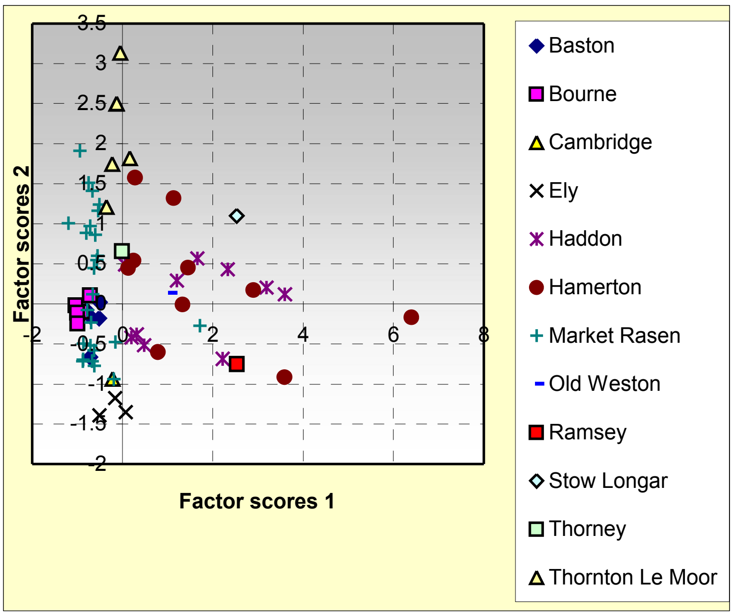

Figure 1

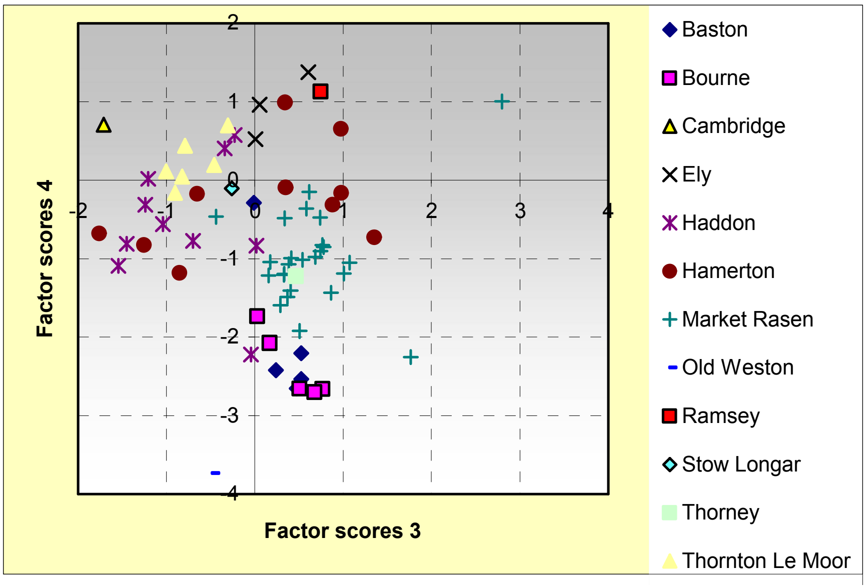

Figure 2

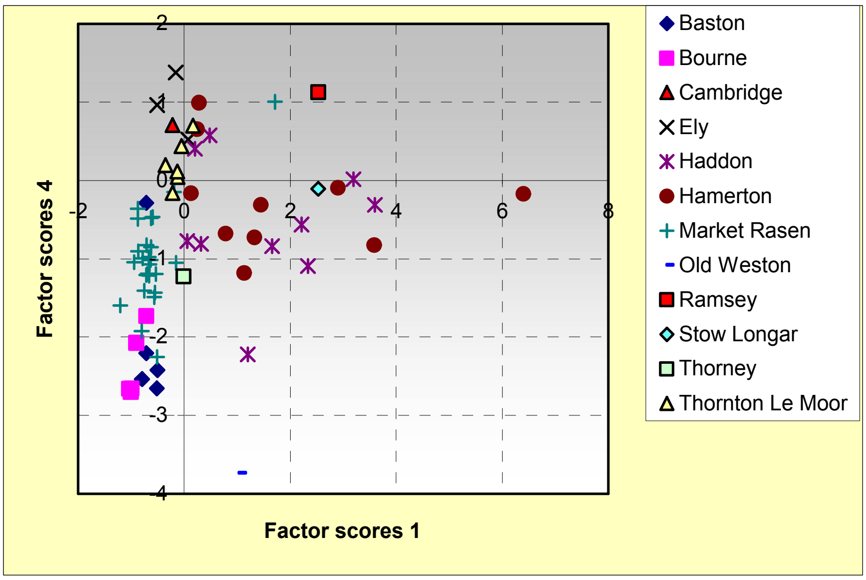

Figure 3

It is difficult to tell, without considerable work, whether the distinguishing features of the Ramsey clay lie in the clay or the sand but the majority of the sand consists of quartz and cherts which should play little part in the chemical composition, except to depress the frequencies of all other elements. Fig 4 shows the weightings given to each element included in the factor analysis and from this diagram we can see that the Ramsey clay could be distinguished by low Titanium values, high Magnesium and Potassium values or generally depressed values for all the rare earth elements and metals. However, a visual study of the raw data (normalised to Aluminium, to take account of the dilution effect of silica) reveals no obvious reason for the placing of the Ramsey sample in Fig 3 and it must therefore be due to a number of factors, some positive and some negative. Fig 5 shows two such factors: a low

Zirconium content and a moderately high Yttrium content (similar to that of the other Rare Earth Elements).

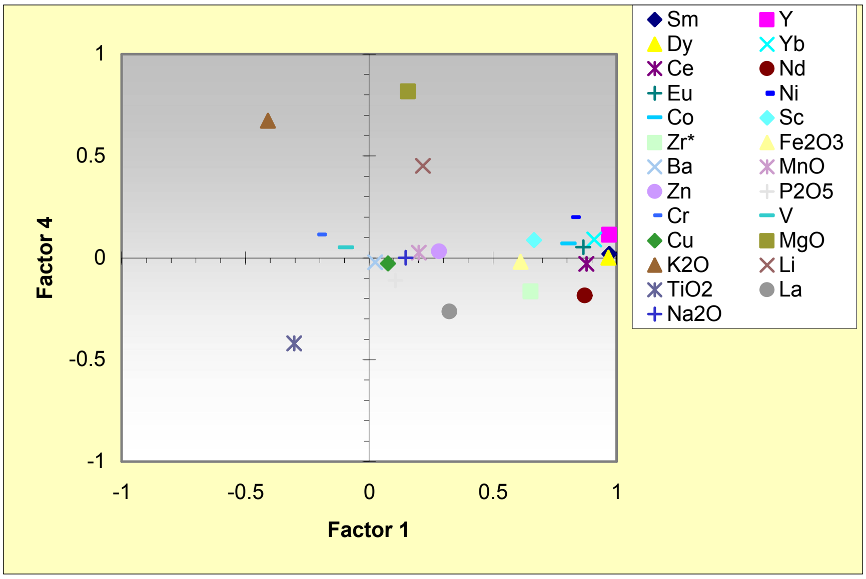

Figure 4

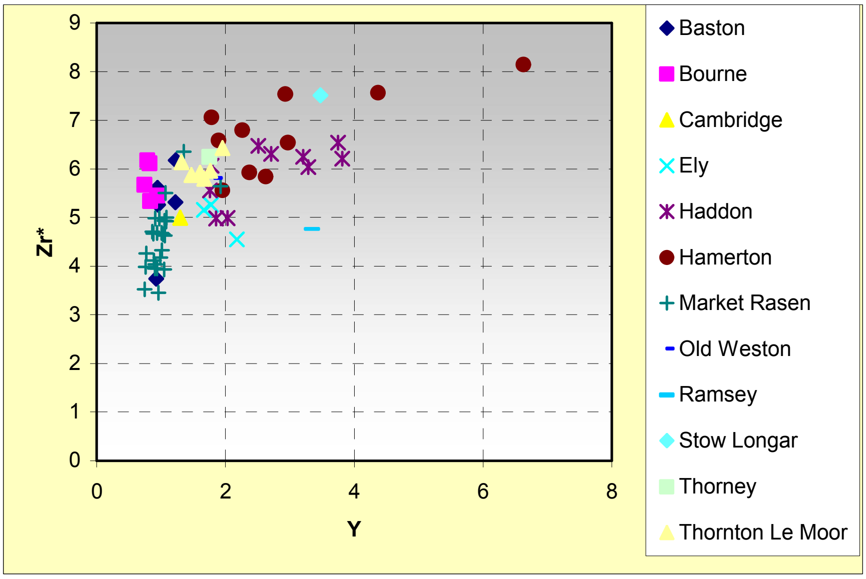

Figure 5

Conclusions

The Ramsey Abbey clay sample is composed of a mixture of Upper Jurassic non-calcareous clay and a Quaternary sand. It cannot have been the source for any of the medieval tiles used at the site, even those which were produced on site. It is, however, similar to the fabric of the Roman tiles found on the site, although these have a higher silt content than the clay sample.

Chemical analysis shows that it should be possible to distinguish ceramics made from this clay from others made from other outcrops of Upper Jurassic clay and suggests that in future characterisation studies of Cambridgeshire ceramics both thin section and chemical analyses should be employed.

Table 1. ICPS data for major elements, measured as percent oxides

TSNO	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO
V3079	13.0465	7.1586	0.9797	0.679	0.2425	2.5123	0.5238	0.2522	0.06111

Table 2. ICPS data for minor and trace elements, measured as ppm

TSNO	Ba	Cr	Cu	Li	Ni	Sc	Sr	V	Y	Zr*	La	Ce	Nd	Sm	Eu	Dy	Yb	Pb	Zn	Co
V3079	295	89	29	71	76	14	76	125	44	62	42	102	46	10	2	7	4	69	127	25