Characterisation studies of a whiteware stove tile from Croydon

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A fragment of green-glazed whiteware stove tile from Croydon was excavated by the Museum of London Archaeology Service. Visual examination suggested that the tile might not be made in the local Surrey/Hampshire border potteries and might instead have a continental source, perhaps Cologne. Further examination using a binocular microscope suggested the possibility of an English midlands source, although no similar tiles are known from the area. To test these possibilities, samples were analysed by thin section and chemical analysis. The sample was given the reference code V2219.

Petrological Analysis

The following inclusions were noted in thin section:

- Moderate subangular and rounded quartz grains up to 1.0mm across. Most of these grains are monocrystalline with straight extinction but some are strained and polycrystalline with some evidence for recrystallisation as a result of metamorphism whilst a few have a euhedral outline indicative of overgrowth.

- Moderate subangular white clay pellets up to 1.0mm across. These appear to be relict clay, having a similar colour and birefringence to the groundmass.

- Moderate rounded and subangular opaque and dark brown grains up to 1.5mm across.

- Moderate rounded and irregular patches of brown stained clay up to 0.3mm across, a few of which surround voids or form the core of white clay pellets.

- Sparse laths of muscovite up to 0.4mm long.

The groundmass consists of anisotropic white clay containing sparse quartz silt and muscovite laths.

The quartz sand in the sample can be distinguished from that found in Coarse Border Ware through its lower roundness and the lack of haematite coating and veins. It is, however, similar in character to the coarse quartz sand found in samples of wheelthrown greywares from production sites in north Middlesex (e.g. Pinner). Similar but finer textured quartz sands are found in samples of Roman pottery made in the Brockley Hill area.

There is, however, nothing visible in thin section which would necessarily indicate a local origin for the tile.

Chemical Analysis

A sample of the tile was prepared by Peter Hill by mechanically removing all surfaces and margins which might be contaminated and then crushing about 1-2gm of the core of the sample to a fine powder. This powder was submitted to Royal Holloway College, London, where the chemical composition was analysed using Inductively Coupled Plasma Spectroscopy (ICS-AES). A range of major elements were measured as percent oxides (App 1a) and a range of minor and trace elements were measured as parts per million (App 1b). The percentage of lead was measured and indicates contamination with lead glaze.

An estimate of the silica content, 66.4% was obtained by subtracting the sum of the major element oxides from 100%. The data were then normalised by dividing each measurement by that of Al203. This normalisation was carried out to counteract the dilution effect of added quartz sand.

The normalised data for the Croydon tile were compared with a range of whitewares of English and Rhenish origin:

- Midlands Whiteware from the late medieval kiln site at Sneyd Green, Staffordshire (MWWNS)
- Midlands Whiteware from a consumer site in Stafford (MWWSS)
- Verulamium Region Whiteware of Roman date from kiln sites at Brockley Hill and the City of London (VRW)
- Local Marbled ware of Roman data from a kiln site in the City of London (LOMA)
- Coarse Border Ware from a consumer site in the City of London (CBW)
- Kingston-type ware from a kiln site at Kingston-upon-Thames and waster dumps on the south bank of the Thames at Southwark (KING)
- Badorf-type ware from consumer sites at the city of Westminster and Flixborough, North Lincolnshire (BADO)
- Walberberg-type ware from consumer sites at the city of Westminster and Flixborough, North Lincolnshire (WALB)

Factor analysis of the major elements in these samples indicated only one significant factor with weightings dependent mainly upon the values for K2O, MgO, TiO2 and Na2O. A box and whisker plot of the factor scores (Fig 1) indicates that the Rhenish products (BADO and WALB) have higher scores whereas the remaining comparanda all have similar scores.

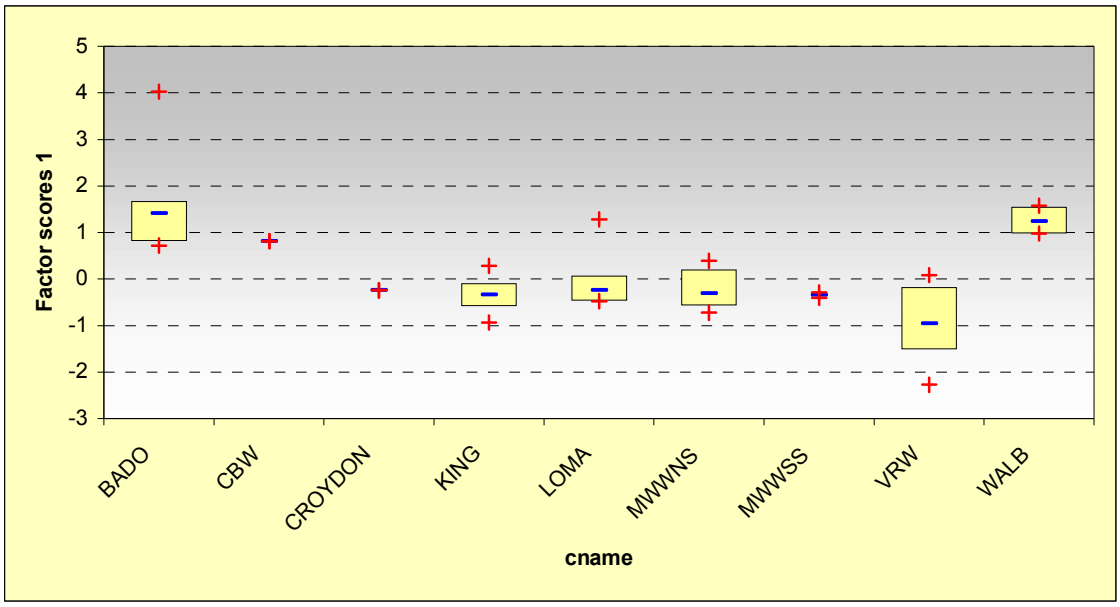

Figure 1

A second factor analysis was then carried out using the minor elements. This indicated differences between the Staffordshire whitewares (MWWNS and MWWSS) as well as the Rhenish wares and the remainder, including the Croydon tile. The principal factor, F1, is mainly determined by high values for a range of rare earth elements, which are exceptionally high in a small number of VRW samples from Brockley Hill. This probably masks other patterning in the dataset and merely shows that the Croydon tile is similar to the remaining samples (Fig 2). Factor 2, however, is mainly influenced by high weightings for Vanadium and Nickel and, to a lesser extent, Scandium and Zirconium.

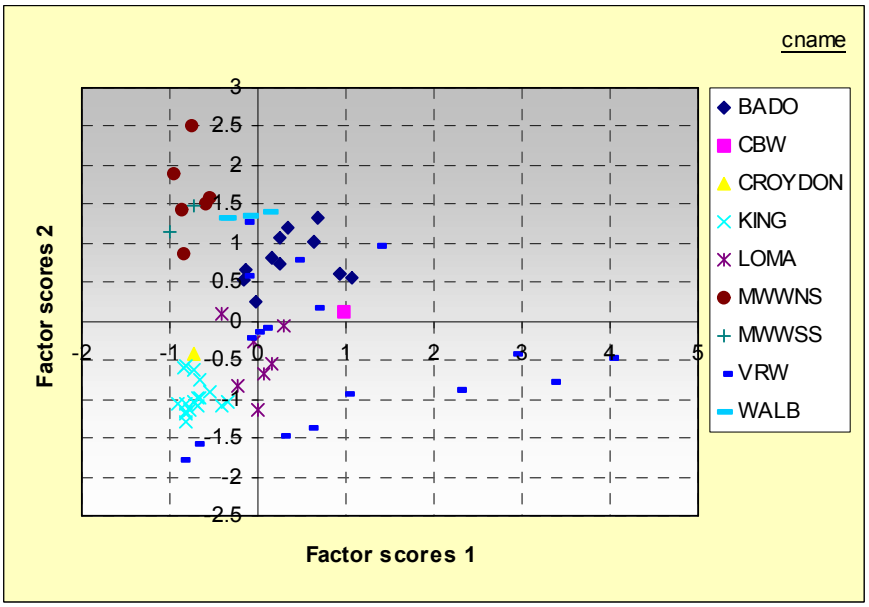

Figure 2

Setting aside the Rhenish and Staffordshire samples, this leaves two groups: Surrey whitewares made from Bagshot Beds clay and the Roman VRW/LOMA samples made using Reading Beds clay. The Croydon sample differs from these two groups in its Lithium/Aluminium ratio (higher), its Zirconium ratio (lower) and its Lanthanum ratio (lower).

In conclusion, therefore, the Croydon stove tile has a chemical composition which distinguishes it from all the comparative material. The principal differences are found in the

K2O, MgO, TiO2, Na20, V, Ni, Li, Zr and La values. A factor analysis of just these elements (Fig 3) found three factors. A plot of F1 against F2 (Fig 3) indicates that the Croydon sample can be distinguished from the Staffordshire, Rhenish and Bagshot Beds samples and is most similar to the Reading Beds samples whereas a plot of F2 against F3 (Fig 4) separates the Croydon sample from all the remainder.

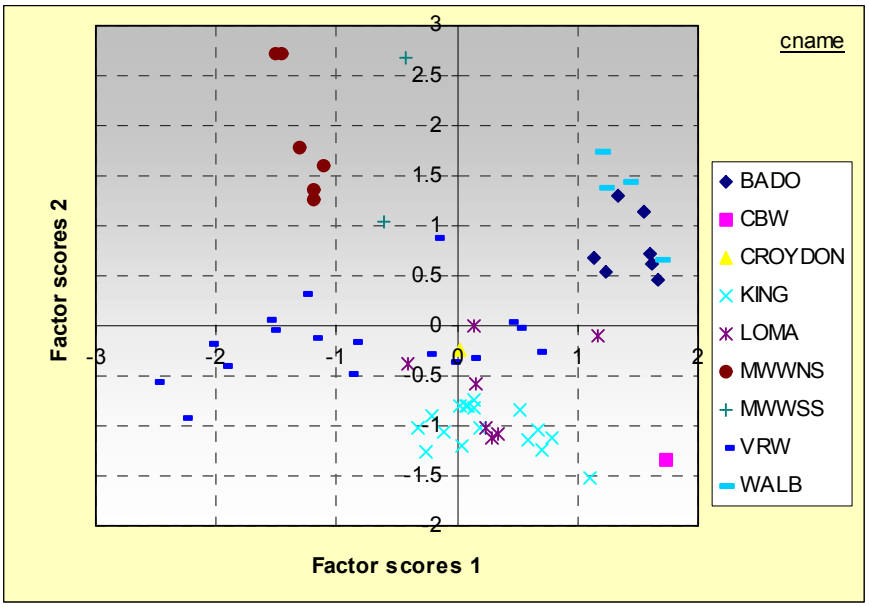

Figure 3

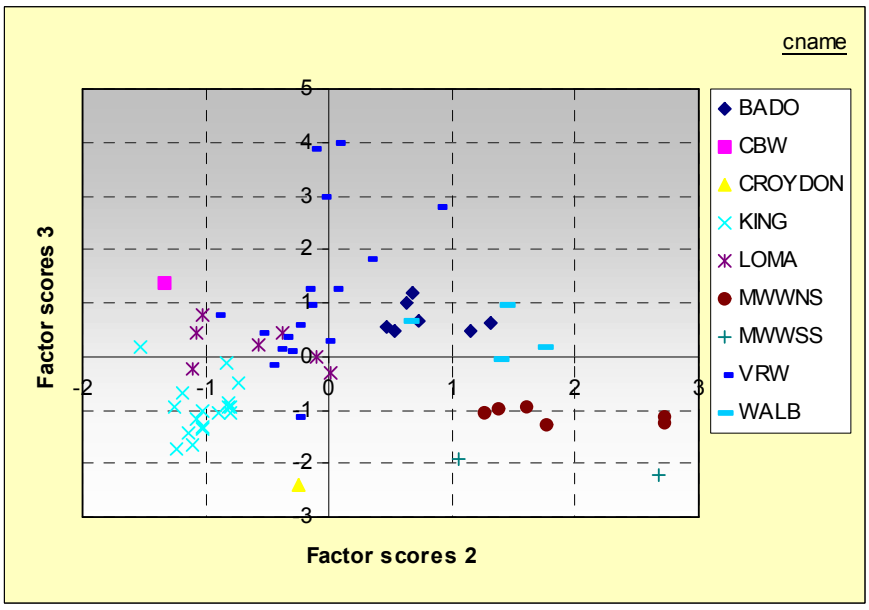

Figure 4

Conclusions

The petrological analysis confirms that the rounded quartz gravel found in the fabric is not similar in detail from that used in the Surrey/Hampshire border (in Coarse Border Ware, CBW, Pearce & Vince {Pearce & Vince 1988 #22183}). The inclusionless groundmass, however, is similar to that found in Thames basin whitewares, including CBW but also wares

made from exposures of Reading Beds clay which outcrop to the north of London. The character of the quartz sand in thin section is similar to that of the pre-Anglian plateau gravels which outcrop in that area. However, chemical analysis indicates that there are several differences in detail between the chemical composition of this tile and that of samples of whiteware made from the Reading Beds. These differences do not appear to be so great that they discount a Reading Beds source whereas it is quite clear that in chemical composition there are large differences between the Croydon tile and samples of midlands whiteware and Rhenish whitewares (albeit of mid Saxon date). Thus we can conclude that the Croydon tile is probably not a product of the middle Rhine, nor from the Staffordshire medieval whiteware industries, nor from the Surrey/Hampshire border. Tentatively, it is suggested that it could have been made using an outcrop of Reading Beds clay and pre-Anglian plateau gravel temper, both of which outcrop to the north of London. Reading Beds clay does outcrop in Surrey, and Berkshire, but it is thought that the clay in those areas contains more silt and fine quartz sand (as, for example, in the Cheam whiteware industry). Therefore, there are three possibilities: a continental origin somewhere other than the middle Rhine valley, a Middlesex/Hertfordshire origin or perhaps a central London origin using raw materials imported from the Middlesex/Hertfordshire area.

Appendix 1a. ICP-AES results for major elements (percent oxides)

TSNO	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO
V2219	23.74	5.25	0.74	0.31	0.18	2.22	0.91	0.15	0.025

Appendix 1b. ICP-AES results for minor and trace elements (ppm)

TSNO	Ba	Cr	Cu	Li	Ni	Sc	Sr	V	Y	Zr*	La	Ce	Nd	Sm	Eu	Dy	Yb	Pb	Zn	Co
V2219	344	115	70	146	34	17	56	99	21	56	29	62	30.362	4.85	1.2	3.3	2.1	1594.66	67	13