Characterisation Studies of the Anglo-Saxon Pottery from Glebe Farm, Brough (GLF02)

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Archaeological investigations along the line of the A46 widening between Newark and Lincoln by Trent and Peak Archaeology Unit revealed evidence of early Anglo-Saxon (i.e. 5th to 7th-centur) domestic occupation. The pottery from this site was compared with that from other nearby sites, at Dunholme and Sleaford. This showed that whereas petrological examination indicated that the settlements were supplied with pottery from a number of sources, each with its own distinctive fabric recognisable in thin section and under x20 magnification using a binocular microscope, the chemical analyses showed that the pottery from each site was more similar to other samples from the same site than to material from other sites, irrespective of their fabric.

This result suggested either that chemical analysis of early Anglo-Saxon pottery (which was low-fired, heterogeneous and very porous) is so affected by burial conditions as to be extremely limited in its application, or that the evidence from thin section analysis has been misinterpreted, and that the pottery was all made with locally-available clays to which non-local sands have been added. Either or these two interpretations could be supported by the available evidence and whichever interpretation is correct there are serious implications for the study of this pottery.

The subsequent discovery of a second early Anglo-Saxon settlement at Brough (site code GLF02), very close to the first, was made during further fieldwork, by the City of Lincoln Archaeology Unit. A proposal was therefore made to select a series of samples from the Anglo-Saxon pottery from this site and to compare their petrology and chemical content with those from the first site.

Methodology

The Anglo-Saxon pottery from GLF02 was examined by Jane Young using a binocular microscope to record the principal inclusions (rock and mineral fragments over 0.1mm across). As a result of this study seven fabric groups were recognised (Table 1). In three cases there was sufficient internal variation within the group to warrant the sampling of two or more samples. In total twelve samples were taken and numbered V1991 to V2002.

Table 1

Cname	Ts Nos	Grand Total
CHARN	V1991, V1992, V2000	3
ESAXX	V2001	1
ESGS	V1993	1
FE	V1994	1
RQCL	V1997	1

SSTCL	V1995, V1996, V2002	3
SSTMG	V1998, V1999	2
Grand Total		12

The thin sections were produced at the Department of Earth Sciences, University of Manchester, by Steve Caldwell. They were stained using Dickson's method to distinguish ferroan calcite from non-ferroan calcite and dolomite. Each section was then examined using a petrological microscope and details of the principal inclusions recorded, together with the characteristics of the groundmass (i.e. clay minerals and other rock and mineral inclusions less than 0.1mm across).

Samples for chemical analysis were prepared by chopping off a lump of pottery from the sampled sherd and mechanically removing the surface layers and broken edges which might be contaminated through burial. The resulting sample, weighing c.1-2gm, was then crushed to a fine powder and submitted to the Department of Geology at Royal Holloway College, London, where they were analysed using Inductively-Coupled Plasma Spectroscopy under the supervision of Dr J N Walsh. A range of major, minor and trace elements were measured, as percent oxides for the major elements and parts per million for the remainder.

Petrological Analysis

The following inclusion types and traits were recorded in the thin sections:

- Sandstone of Millstone Grit type up to 1.5mm across. These inclusions are identified by the presence of overgrowth quartz grains and a kaolinitic cement. In one case the sandstone is micaceous (V1998). Although mainly present as the main inclusion type in a sample (when the fabric is classed as SSTMG), sparse fragments of this rock occur in three other samples.

- Biotite granite up to2.0mm across. These fragments are composed of feldspar and biotite with less quantities of quartz and accessory magnetite. The feldspar grains are either heavily altered or fresh and zoned. Individual grains range up to 1.0mm across. These fragments occur in moderate quantities in three samples (classed as CHARN). In most cases the fragments are angular but in some, especially those including altered feldspar, there is some evidence of rounding and staining, indicating the use of a detrital sand rather than crushed rock.

- Organic inclusions. These are either recognisable as thin elongated pores containing carbonised matter or as an elongated void surrounded by a carbon-enriched halo. There are sparse organic inclusions in all but three samples. Whether they are due to the deliberate inclusion of chaff or dung, or the use of an organic clay from, for example, a stream bed, is uncertain.

- Rounded and subangular quartzose sand up to 0.5mm across. These grains include well-rounded grains with a high sphericity, grains of a fine-grained sandstone (grainsize c.0.1-0.2mm) and grains of chert. This sand is found in all Trent Valley sandy wares but is also found in wares made in Lincoln (i.e. using Witham terrace sand) and in vessels produced on the dip slope of the Jurassic scarp. It is abundant in five samples and present in all but three (two SSTMG and one SSTCL).

- A single fragment of bone was present (sample V1991) and a single large clay pellet with dendritic iron staining (the same sample, V1991).
- Rounded opaque grains up to 0.3mm across were noted in five sections but it is almost impossible to separate these inclusions from the clay matrix when that matrix is black from unburnt carbon and they may well be more common.
- Fragments of a silica-cemented sandstone with grains up to 0.5mm across were noted in two samples (ESGS and SSTCL). These may be lower Cretaceous sandstone fragments.
- Fragments of subangular opaque inclusions (black in reflected light) up to 2.0mm across were abundant in one sample (FE, V1994) and sparse in two others (V1995 and V2001). These inclusions contain sparse rounded quartz grains and quartz silt of similar character to that in the remainder of the pot fabric and it is possible that these are fragments of iron pan rather than from a pre-Quaternary exposure such as the Northampton Ironstone (which outcrops along the Lincoln edge).
- Two samples contain voids which might have held limestone inclusions. Of these, V2002 may include a fragment of oolitic limestone (preserved as replacement clay in the void). The same sample produced a single void which from its shape may have held a bivalve shell fragment.
- The groundmass mostly contains little or no quartz and muscovite silt. In three samples, however, quartz and muscovite silt is moderately common (two CHARN and one FE).
- The clay matrix consists of anisotropic clay minerals in six samples, is black throughout in four samples due to carbon rather than reducing firing conditions and is black with oxidized, anisotropic clay at the margins in two samples. In one sample, there were streaks of a light-firing clay in the groundmass, together with laminated pellets of similar colour and texture (V2002).

Conventionally, the thin section data would be interpreted as follows:

1) Both Millstone Grit sandstone and biotite grantite can occur as erratic grains in fluvioglacial sands in Lincolnshire. However, they are not present in the Trent Valley sands, which are composed mainly of quartz, sandstone and chert derived from Triassic sandstones. Therefore, the samples classed as SSTMG and CHARN are tempered with sands which do not occur locally, within the central Trent valley, and the vessels were therefore made elsewhere. Sands composed of Millstone-grit sandstone and overgrown quartz grains outcrop in the Vale of York and some of the Anglo-Saxon vessels from that area do contain a high proportion of

muscovite, both as separate laths and as inclusions in the constituent sandstone. Sands composed mainly of biotite granite occur in the area to the south of the Charnwood outlier, which includes the Mountsorrel granodiorite. They are not found in the sands of the present river Soar or in terrace gravels in that area.

2) Sample V1993 contained polished rounded quartz grains which were not visible in thin section but were seen at x20 magnification. It also contained several fragments of a silica-cemented sandstone which is likely to be of lower Cretaceous origin. However, the remainder of the inclusions are rounded quartz sand of the same type as that found in the Trent valley. A source to the south of the Lincolnshire Wolds would explain both groups of inclusions.

3) Sample V2002 contains inclusions of Jurassic origin and is composed partly of light-firing clay which is likely in this case to have come from either the lower Estuarine Beds, which outcrop along the Lincoln Edge, or the Upper Estuarine Beds which outcrop on the dip slope of the limestone scarp. The presence of oolitic limestone and shell inclusions also suggest a source close to the Jurassic scarp whilst the presence of an erratic grain of biotite granite suggests a source to the east of the scarp.

4) The remaining four samples, classed visually as SSTCL, RQCL and FE, all contain moderate to abundant rounded quartz sand of the type found in the Trent and Witham valleys. However, the accessory rocks and minerals suggest that those classed as SSTCL were made to the east of the Jurassic scarp whilst the others may have been made in the Trent valley itself and are the only candidates for local production.

Table 2

TSNO	Cname	sstmg	biotite granite	organics	rq	r chert	r fine sst	bone	fe-stained clay	silt	r opaque >0.3	musc >0.1	matrix	silica cemented sst	sa fe with quartz silt and saq	burnt out r lst	laminated clay	shell voids	comments
V1991	CHARN	m	m	s	s	none	none	s	s	s	s	s	anis	none	none	none	none	none	charn+sstmg
V1992	CHARN	none	m	s	s	none	none	none	none	m	none	s	black	none	none	none	none	none	charn
V1993	ESGS	none	none	s	a	none	none	none	none	none	none	none	black with anis borders	s	none	none	none	none	esgs but with triassic sand
V1994	FE	s	none	none	m	none	none	none	none	m	none	s	anis	none	a	none	none	none	northampton sands or pan?
V1995	SSTCL	none	none	none	a	s	s	none	none	s	none	s	anis	none	s	none	none	none	Trent valley sand
V1996	SSTCL	s	none	s	a	s	s	none	none	s	none	s	black	s	none	none	none	none	Trent valley sand
V1997	RQCL	none	none	s	a	s	s	none	none	s	s	s	anis	none	none	s	none	none	Trent valley sand;what is identity of lst?
V1998	SSTMG	a inc musc >0.2mm	none	s	none	none	none	none	none	s	s	m >0.2mm	anis	none	none	none	none	none	micaceous sstmg
V1999	SSTMG	a	none	none	none	none	none	none	none	s	s	s	anis	none	none	none	none	none	sstmg
V2000	CHARN	none	m	s	a	s	s	none	none	m	s	s >0.3mm	black	none	none	none	none	none	charn+rq

TSNO	Cname	sstmg	biotite granite	organics	rq	r chert	r fine sst	bone	fe-stained clay	silt	r opaque >0.3	musc >0.1	matrix	silica cemented sst	sa fe with quartz silt and saq	burnt out r lst	laminated clay	shell voids	comments
V2001	ESAXX	a	none	s	s	none	none	none	none	s	none	s	black	none	s	none	none	none	sstmg
V2002	SSTCL	none	s	s	none	none	none	none	none	s	none	s	black with anis borders	none	none	s; possible oolitic lst	m light-firing	s	laminae of white-firing clay;Jurassic clay and detrital sand inc Jurassic rocks

Chemical Analysis

The data from the ICPS analyses were firstly transformed by normalising all the values to that of Al2O3, to counter the effect of dilution caused by the variable amount of silica (which was not measured) present in the samples.

The dataset was then analysed using factor analysis to discover which elements were most variable in their distribution and their cross-correlations. Fig 1 shows the contribution of the measured elements to the variation in the dataset for the two principal factors, F1 and F2. It can be seen that the main cause of variation in F1 is TiO2, which is mainly present in oxides such as rutile which is a common detrital mineral. It is not particularly mobile and is unlikely to be affected by leaching, encrustation or other post-burial processes. However, there is no strong correlation between fabric group or supposed source and TiO2 content.

Factor 2 is mainly governed by three elements, Co, Fe2O3 and MnO. All three are mobile elements and are likely to be affected by iron pan concretion and staining, although undoubtedly where large iron-rich inclusions are present their composition will outweigh any post-burial effect. Naturally enough, these three elements are most common in the FE sample followed by sample V1995, in which large iron-rich pellets were noted. Otherwise, these elements occur randomly in the samples, with no correlation with visual fabric group or supposed source.

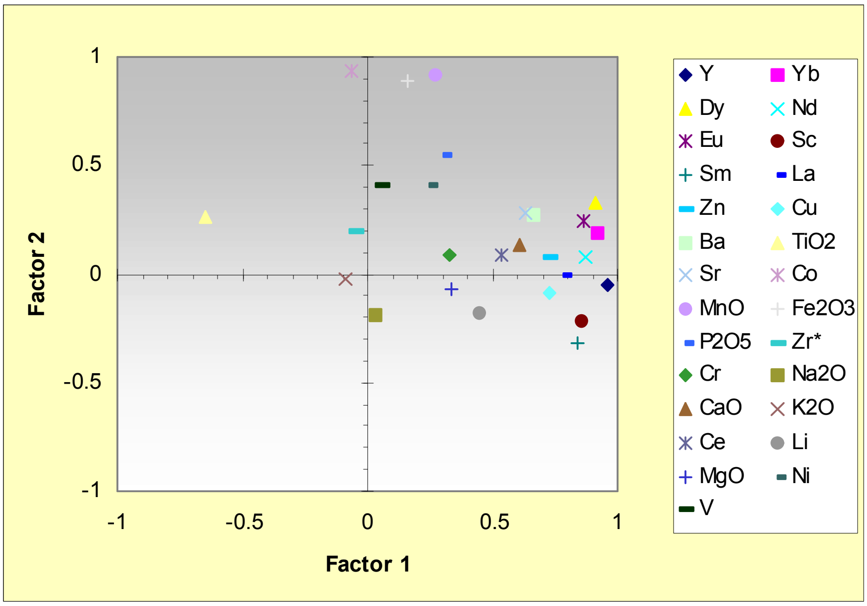

Figure 1

The remaining elements mostly either provide no contribution to the two main factors or combine to give a high F1 score. They include elements which are probably present in inclusions, such as Zr (zircon), K2O (micas), CaO (limestone and shell) and Na2O (feldspars) and those which are mostly bound to clay minerals. By and large the elements which are most likely to occur in large inclusions are distributed as one might predict from the petrological analysis:

- Na2O is most common in two of the CHARN samples

- K2O is most common in two of the samples containing Millstone Grit sandstone
- Zr is least common in the samples containing abundant Millstone Grit sandstone sand

However, no clear division of the data is possible on the basis of these analyses.

The elements which are likely to be present in the clay matrix fall into two groups: metals (V, Ni, Cr, Zn, Cu and Sc) and Rare Earth elements (Yb, Y, Dy, Eu, Ce, La and Nd). Their distribution shows little correlation with visual fabric group nor with the petrological analysis. A factor analysis of these elements shows that all the samples have similar compositions except for V2002, which thin section showed contained significant amounts of light-firing clay (Fig 2, arrowed).

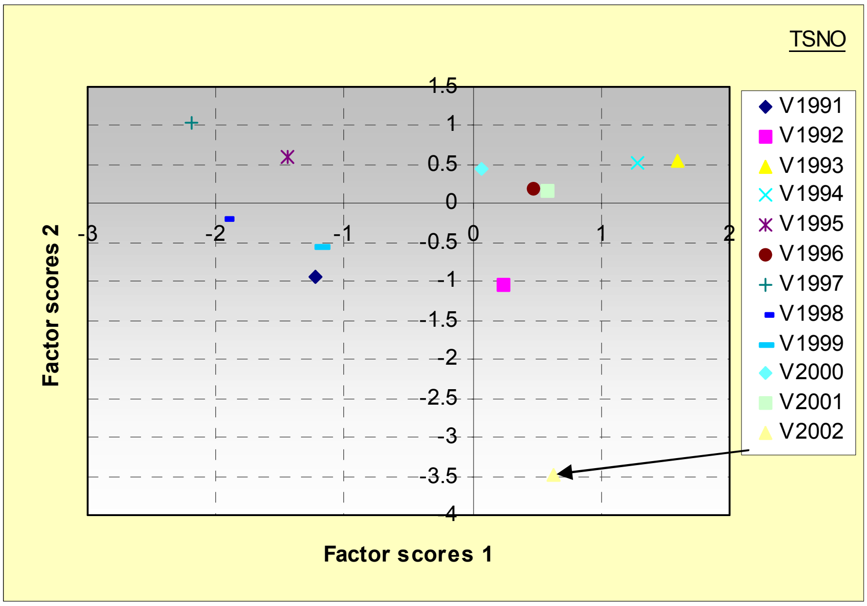

Figure 2

Thus, taking the analyses from the glf02 site on their own, the chemical data can be mainly explained by reference to the petrological data and with the exception of V2002 shows no significant differences in the chemical composition of the clay itself.

The GLF02 data were then compared with other chemical data collected from samples of Roman, Anglo-Saxon or medieval date from sites in Lincolnshire. Omitting all elements which are present mainly in inclusions or through post-burial alteration, the remaining data were analysed using factor analysis (Fig 3).

This showed that in the main all the data cluster together, indicating that there is no distinctive signature for the clays used at Torksey, Market Rasen or for the sites in the northeast of Lincolnshire supplying Barton-upon-Humber. However, for three sites the chemical data indicate a different composition. These are the two Brough Anglo-Saxon sites (GFB and GLF02) and an Anglo-Saxon site at Dunholme (SLD01). In all three cases some of the samples have similar compositions to the remaining Lincolnshire samples but a number have higher Factor 1 scores. The two Brough sites have similar F1 and F2 scores and therefore plot close together but the Dunholme samples have higher F1 and negative F2 scores.

Similar results are found if the two next factors, F3 and F4, are examined, except that both Barton-upon-Humber and Flixborough are also separated from the remainder, indicating minor but systematic differences in composition in some of the samples from these sites too (Fig 4).

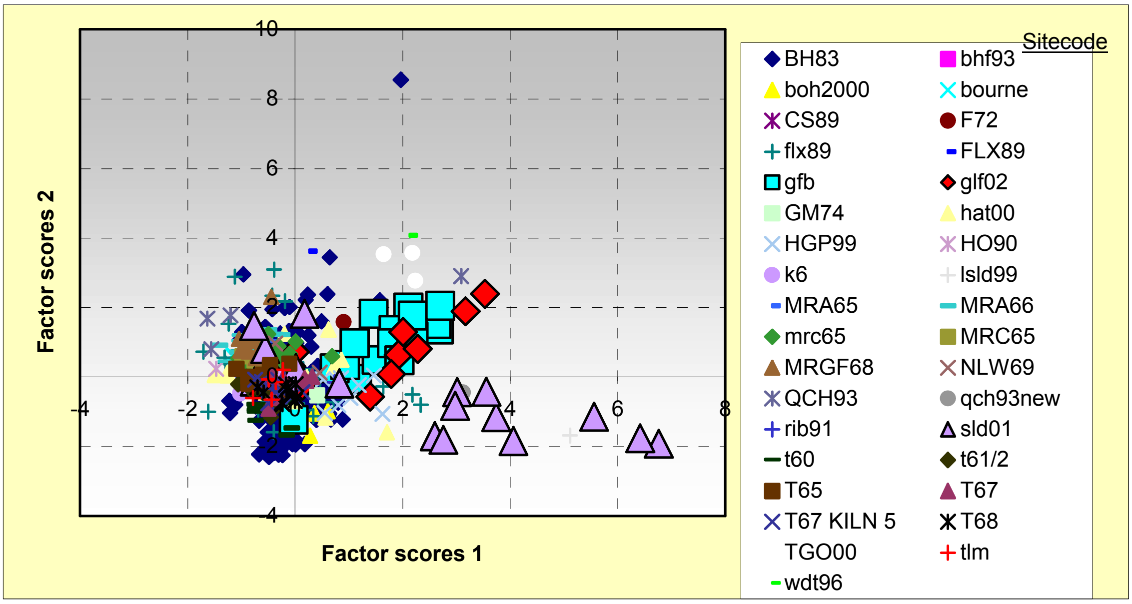

Figure 3

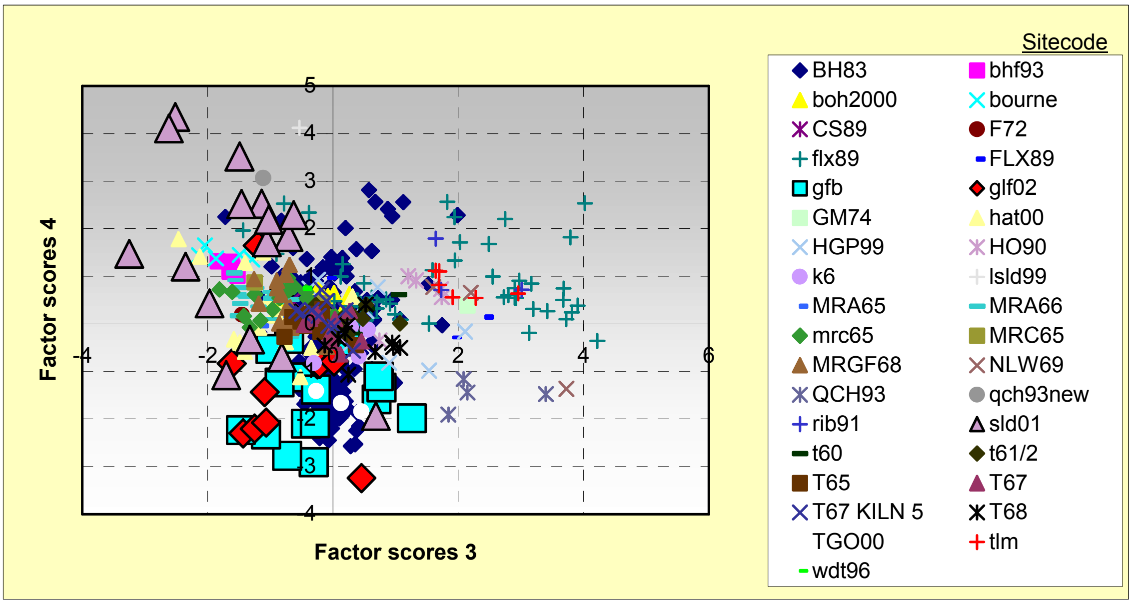

Figure 4