Characterisation and Interpretation of Burnt Clay from Partney, Lincolnshire

Alan Vince

As part of a study of the source of ceramics from excavations at Partney carried out by the Archaeological Field Unit of Cambridgeshire County Council, two samples of daub and a collection of burnt clay fragments were examined.

The burnt clay fragments were examined at x20 magnification using a binocular microscope and classified into fabric groups from which samples for thin section and chemical analysis were chosen (Table 1).

Table 1

TSNO	Action	site name	Sitecode	Context	subfabric
V3662	TS;ICPS	Partney Site 5	PTN 5 04	79	DAUB2
V3664	ICPS	Partney Site 1	PTNI03	454	DAUB2
V3663	TS;ICPS	Partney Site 1	PTNI03	559	DAUB1
V3666	ICPS	Partney Site 4	ptn 4	541	FCLAY1
V3671	TS;ICPS	Partney Site 4	ptn 4	454	FCLAY2
V3667	ICPS	Partney Site 4	ptn 4	404	FCLAY1
V3668	TS;ICPS	Partney Site 4	ptn 4	457	FCLAY1
V3669	ICPS	Partney Site 4	ptn 4	455	FCLAY1
V3665	ICPS	Partney Site 4	ptn 4	541	FCLAY1
V3670	ICPS	Partney Site 4	ptn 4	455	FCLAY1

Visual Examination

The two submitted samples of daub, from Sites 3 and 5, have different fabrics, here coded DAUB1 and DAUB2. The DAUB1 sample, from Site 3, consists of poorly-mixed lenses of clay, with sparse rounded, polished quartz inclusions. The DAUB2 sample, from Site 5, is more homogenous and consists of a fine sandy clay with moderate organic inclusions.

The other burnt clay consisted in some cases of abraded fragments of DAUB1 but mainly consisted of two different fabrics, FCLAY1 and FCLAY2. FCLAY1 contained abundant coarse voids from the presence of organic inclusions in a poorly mixed groundmass containing some silty/fine sandy lenses and others with few inclusions. The FCLAY2 sample has a homogenous groundmass, consisting of a silty, micaceous clay, with moderate organic voids.

The Alan Vince Archaeology Consultancy, 25 West Parade, Lincoln, LN1 1NW
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Thin Section Analysis

DAUB1

Description

The following inclusion types were noted in thin section (V3663):

- Rounded quartz. Moderate grains up to 1.5mm across, some with opaque coating and veins.
- Subangular quartz. Abundant subangular grains up to 0.2mm across.
- Angular quartz. Sparse grains up to 1.0mm across with one or more flat faces.
- Clay pellets. Moderate subangular pellets up to 3.0mm across of several types including red-firing inclusionless pellets; light-firing inclusionless pellets (possibly mudstone) and light-firing pellets with opaque dendritic staining.
- Opaques. Sparse rounded grains up to 0.3mm across with a high sphericity.

The groundmass consists of optically anisotropic baked clay minerals with lenses and laminae of differing colour and quartz content.

Interpretation

The parent clay has similar characteristics to Jurassic clays whilst the clasts are probably derived from Carboniferous and lower Cretaceous sands. The mixed character of the fabric suggests the use of a boulder clay.

DAUB2

Description

The following inclusion types were noted in thin section (V3662):

- Organics. Moderate voids up to 1.0mm long. Includes large voids with a circular cross-section (up to 0.6mm diameter) and smaller voids, up to 1.0mm long and mainly up to 0.2mm wide.
- Angular quartz. Abundant well-sorted grains c.0.15mm across.
- Clay pellets. Sparse pellets, up to 1.5mm across, some varying in colour from the groundmass but with a similar texture.
- Altered glauconite. Sparse rounded grains up to 0.3mm across.
- Opaques. Sparse rounded grains up to 0.3mm across.
- Sandstone. A single rounded grain 0.8mm across containing angular quartz with a similar size range to the angular quartz.

The groundmass consists of optically anisotropic baked clay minerals. There are few inclusions less than 0.1mm across and the most common are rounded opaque grains, including some which appear to be of biological origin (faecal pellets? Bacteria? Microfossils?).

Interpretation

The characteristics of this clay are similar to those of Toynton wares and the clay is likely to be of Upper Jurassic origin.

FCLAY1

Description

The following inclusion types were noted in thin section (V3668):

- Rounded quartz. Sparse grains up to 1.0mm across. The outlines suggest that most of these are of lower Cretaceous origin.
- Organics. Moderate voids, including round voids up to 1.0mm in diameter and elongated voids up to 3.0mm long.
- Chalk. Sparse angular fragments up to 1.0mm across

The groundmass consists of poorly-mixed optically anisotropic baked clay minerals, some of the lenses of clay contain no visible inclusions whilst others contain moderate to abundant angular quartz up to 0.1mm, moderate muscovite up to 0.2mm long, ferroan calcite and non-ferroan calcite microfossils.

Interpretation

The texture of this fabric suggests that it is mixture of boulder clay and estuarine silt. The boulder clay elements include the inclusionless clay lenses (derived from the upper Jurassic), the rounded quartz grains (derived from the lower Cretaceous) and the chalk fragments.

The silt content, even in the silty lenses in the groundmass, is much lower that that found in FCLAY2 but much higher than the silt content of any clay sampled from the Partney area.

FCLAY2

Description

The following inclusion types were noted in thin section (V3671):

- Organics. Moderate voids, some with carbonised contents, up to 1.0mm long and 0.3mm wide (but mostly no more than 0.1mm wide).
- Opaques. Sparse subangular grains up to 0.3mm across.

- Burrows? Sparse rounded voids c.0.2mm to 0.3mm across with a dark brown lining. These may be rootlet voids or animal burrows lined with clay. The character of the clay lining suggests that it has been fired and is therefore part of the original fabric.

The groundmass consists of dark brown optically anisotropic baked clay minerals, abundant angular quartz up to 0.1mm across, moderate muscovite laths up to 0.2mm long and moderate subangular opaque grains up to 0.1mm across.

Interpretation

This fabric is probably an estuarine or coastal marine silt. All the inclusions occur naturally in such silts and the presence of the ?burrows is a feature of fired clay interpreted as being the accidentally burnt subsoil blocks ("turfs") used in the medieval and post-medieval period as part of the filtration units used to wash brine from mud (as described by McAvoy in his description of the late medieval salt production site at Wainfleet (McAvoy 1994).

Chemical Analysis

Samples of the four fired clay fabrics were prepared and submitted to Royal Holloway College, London, for analysis by Inductively Coupled Plasma Spectroscopy (ICP-AES) under the supervision of Dr J N Walsh.

A range of major elements was measured in percent oxides (App 1) and a range of minor elements was measured as parts per million (App 2).

Silica was not measured but an estimate of is frequency was obtained by subtracting the major element oxide counts from 100%. These estimates indicate that all of the samples contain similar quantities of silica, between 62% and 76%, apart from FCLAY2 which has an estimated silica content of 78%.

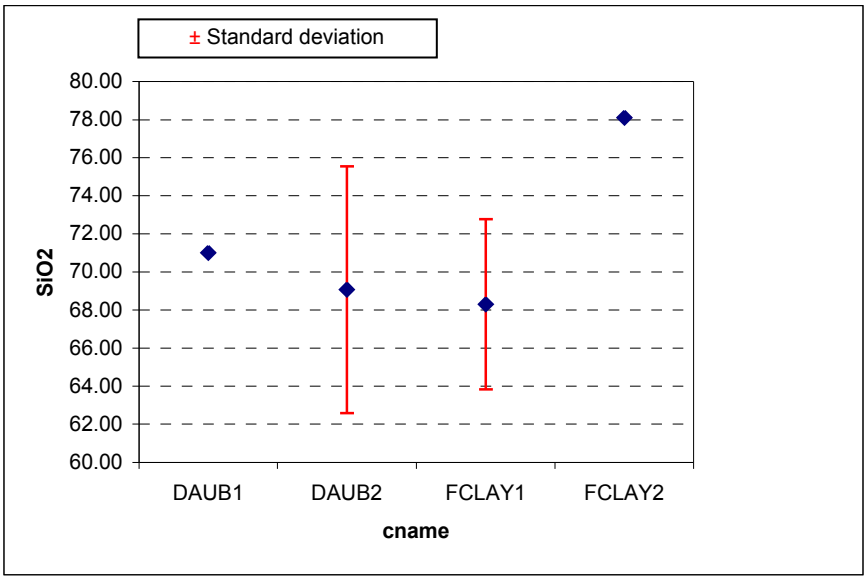

Figure 1

The data were then normalised to aluminium and examined using factor analysis from the Winstat for excel add-in (Fitch 2001). The first two factors separate the four fabrics: DAUB1 has the lowest F1 score; DAUB2 has the highest F2 scores and FCLAY2 has the lowest F2 score. High F1 scores are a consequence of high weightings for a range of rare earth elements whilst high F2 scores are due to high Iron whilst low F2 scores are due to high Sodium, Lithium, and Magnesium scores.

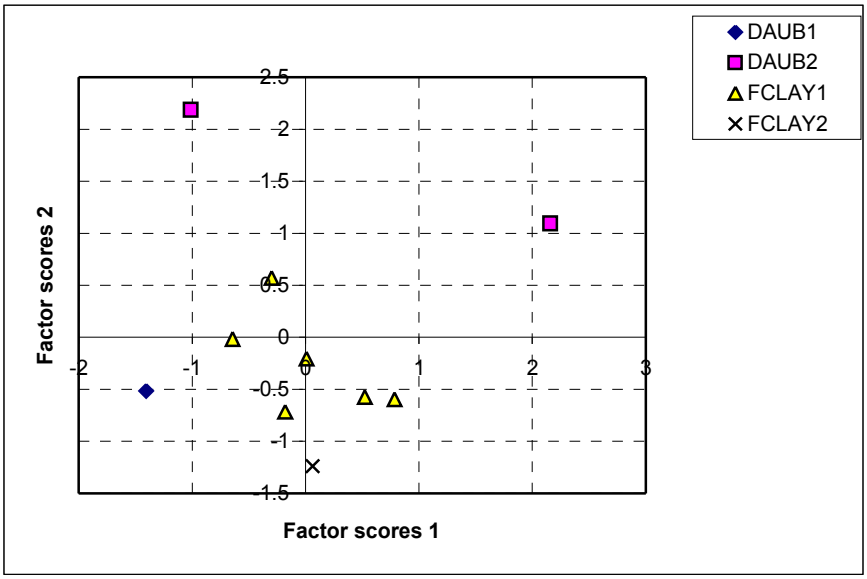

Figure 2

The fired clay data was then compared with other samples from Partney, some of which are probably local, some made in the neighbouring village of Toynton All Saints and others from

other parts of Lincolnshire (e.g. Dales Shelly ware subfabric S, produced somewhere in North Lincolnshire). Data from a group of loom weights from Flixborough, thought to have been made from estuarine silt from the Humber/Trent junction, were also included.

The first two factors show all of these samples as one large cluster but a plot of F3 against F4 separates the Dales Shelly ware (subfabric S) by high F1 and F2 scores and the FCLAY1, FCLAY2 and Flixborough loom weights by their low F2 scores. The three daub samples have similar compositions to the Toynton wares and the medieval roof tiles. Low F2 scores are mainly due to low values for two rare earth elements, Lanthanum and Europium.

There is thus some evidence to suggest that the fired clay samples have a different composition from the local wares. However, the most interesting difference between these fired clay samples and most of the remainder is in their Sodium content.

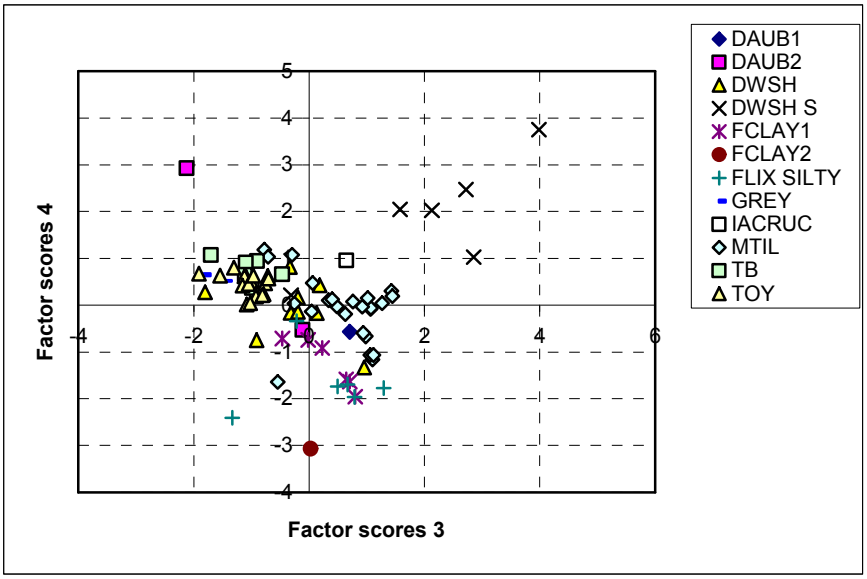

Figure 3

Fig 4 shows a bi-plot of Sodium against estimated silica content. The FCLAY2 sample has a much higher Sodium content than the remainder, with the FCLAY2 and Flixborough samples having similar Sodium contents, which are higher than those of the remaining samples.

Sodium is often present in pottery samples through its presence in certain feldspars and it is possible that this is the correct interpretation of these results. The FLAY2 sample not only has the highest sodium content but also the highest estimated silica content. However, within the Flixborough loom weight and FCLAY1 samples there is no correlation of estimated silica and sodium content. Fig 5 plots the raw sodium oxide values against estimated silica content and this shows, for the Flixborough and FCLAY1 samples, an inverse correlation, indicating that high silica content in those cases dilutes the sodium content. It is therefore possible that the sodium is present in the clay fraction, either in the form of salt or a sodium-aluminum

silicate. It is the formation of such minerals which cause the light yellow colouration associated with “salt surfacing”, formed when calcareous clays are fired in contact with salt.

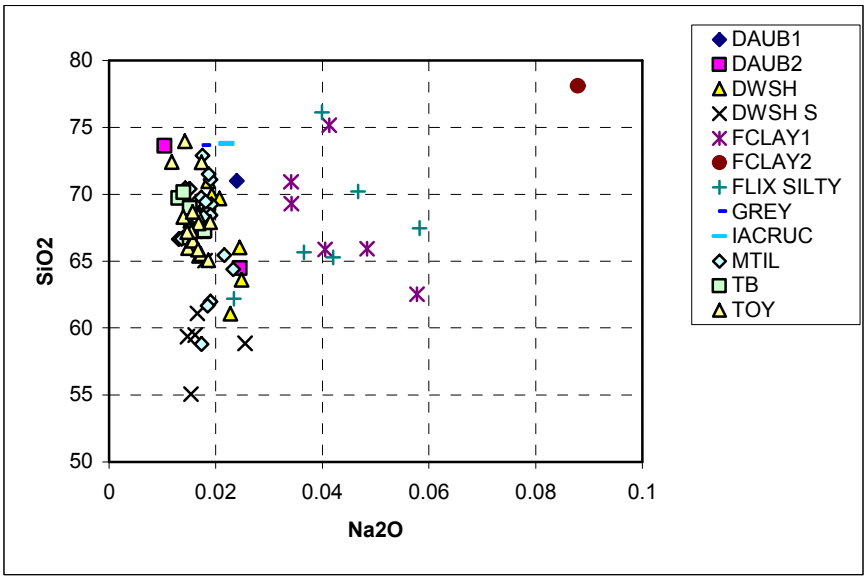

Figure 4

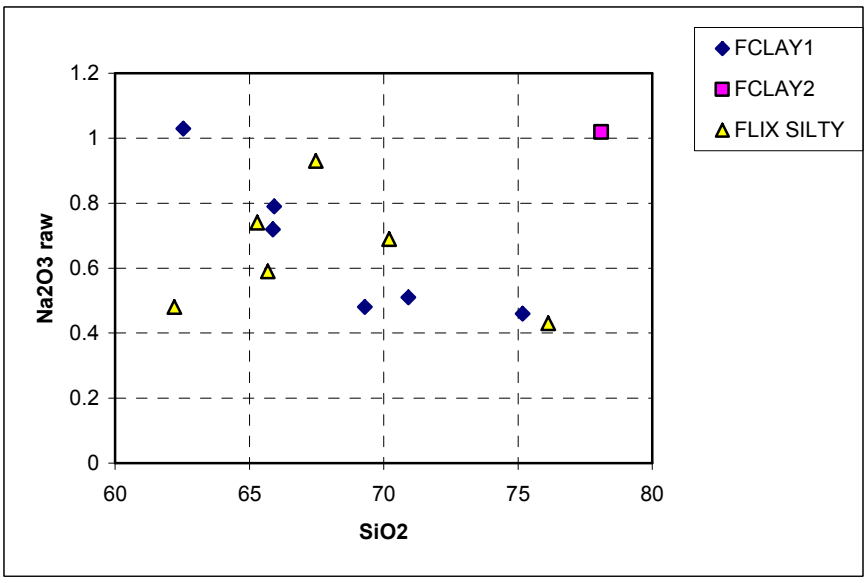

Figure 5

Finally, a bi-plot of Sodium against Magnesium distinguishes the Flixborough loom weights from the two fired clay fabrics (Fig 6). This is possibly due to the present of dolomite, derived from the Permian limestone hills of South and West Yorkshire, in the Humber silt.

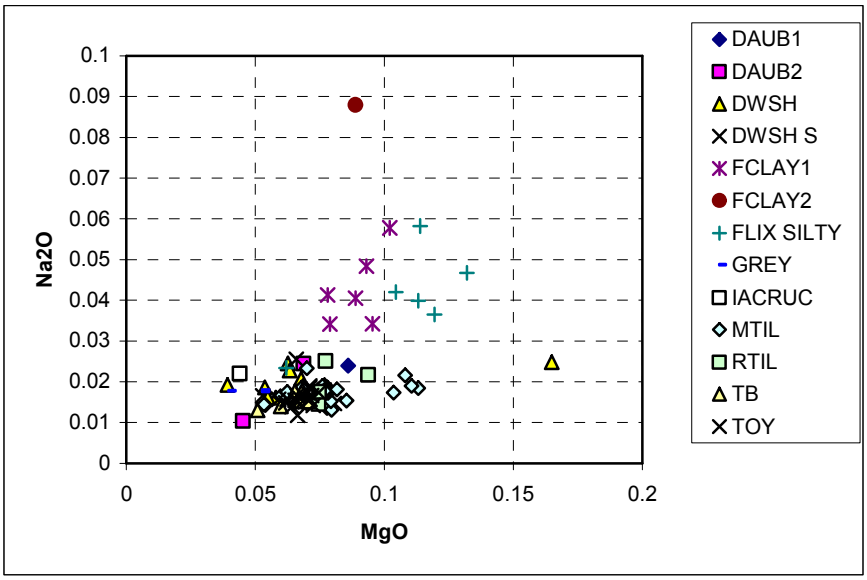

Figure 6

Conclusions

The analysis of the fired clay and daub from Partney confirms that the daub is consistent with the use of local resources, and allows us to identify two sources: boulder clay (DAUB1) and Upper Jurassic clay (DAUB2).

However, the analysis also confirms that the two fired clay fabrics, FCLAY1 and FCLAY2, were not made from local clays, although FCLAY1 appears to have been made from a (natural?) mixture of boulder clay composed of Upper Jurassic and Lower and Upper Cretaceous material and an estuarine silt.

Chemical analysis indicates that these fired clay fabrics contain enhanced levels of sodium and that this is unlikely to be due to the presence of sodium-rich feldspars in the silt fraction. Instead, it suggests that when the clays were heated there was salt present in the clay. This is consistent with the presence of “salt surfacing” on one of the samples.

It is likely that the two fired clay fabrics are waste from processes carried out in the production of salt in the medieval period but this is the first time that (a) the association with salt production has been tested chemically) and (b) that these fired clay types have been found at some distance from the Lincolnshire coast.

At present, the nature of the activity which gave rise to these fired clay types is not known for certain although it is suggested that one, FCLAY2, is associated with the concentration of brine using a filtration tank. It seems most likely that these clay fragments were accidentally brought to the site, perhaps with consignments of salt from the coast.

The recognition of the likely function of this material and its discovery at some distance from the coast opens up a new avenue for research into the economy of medieval Lincolnshire, and emphasises the potential importance of collections of fired clay.

Bibliography

McAvoy, F. (1994) "Marine Salt Extraction: The Excavation of Salterns at Wainfleet St Mary, Lincolnshire." *Medieval Archaeology*, XXXVIII( ), 134-163.

Appendix 1

TSNO	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO
V3662	13.47	7.24	0.61	0.47	0.14	1.92	0.74	1.75	0.014
V3663	15.47	6.98	1.33	0.67	0.37	2.52	0.65	0.93	0.07
V3664	16.31	11.25	1.12	1.02	0.4	2.9	0.68	1.73	0.105
V3665	17.83	8.03	1.82	3.88	1.03	3.19	0.76	0.83	0.093
V3666	11.15	6.56	0.87	1.25	0.46	1.87	0.48	2.14	0.047
V3667	17.78	7.95	1.58	1.41	0.72	3.07	0.77	0.77	0.074
V3668	14.04	6.08	1.34	5.06	0.48	2.24	0.6	0.77	0.092
V3669	14.96	6.85	1.18	1.67	0.51	2.43	0.65	0.79	0.037
V3670	16.33	7.2	1.52	4.2	0.79	2.67	0.72	0.49	0.149
V3671	11.6	3.8	1.03	1.15	1.02	2.17	0.54	0.56	0.027

Appendix 2

TSNO	Ba	Cr	Cu	Li	Ni	Sc	Sr	V	Y	Zr*	La	Ce	Nd	Sm	Eu	Dy	Yb	Pb	Zn	Co
V3662	976	119	21	43	38	15	71	140	49	99	42	92	52	11	2	7	4	42	65	16
V3663	452	110	28	77	54	16	95	129	21	109	37	75	39	6	1	4	3	29	100	15
V3664	607	113	26	61	48	15	143	141	20	85	39	77	45	8	1	4	3	31	98	17
V3665	542	124	18	91	56	18	146	140	29	103	48	92	59	9	1	5	3	31	125	19
V3666	419	83	57	40	30	11	115	101	18	81	32	59	33	6	1	3	2	38	166	16
V3667	429	121	42	74	66	18	138	139	39	106	50	111	66	11	2	7	4	272	100	19
V3668	415	96	46	69	43	14	146	113	37	85	39	74	55	7	1	4	3	48	100	16
V3669	392	102	39	64	39	14	124	124	22	93	38	69	46	7	1	4	2	35	81	14
V3670	440	105	38	80	49	15	167	124	25	94	43	79	59	8	1	5	3	37	114	19
V3671	376	76	32	49	28	10	113	75	18	71	32	57	37	6	1	3	2	24	64	12