Characterisation Studies of the Anglo-Saxon Pottery from Bloodmoor Hill, Carlton Colville, Suffolk: b) Comparison with the underlying Geology

In 2004, characterisation studies were carried out on a range of samples of early Anglo-Saxon pottery from Bloodmoor Hill, Carlton Colville, Suffolk (Vince 2003). This work concluded that a wide range of rock and mineral types were present in thin section and that these, according to the local geological literature, should not be present in the quaternary sands and clays. A recommendation in that study was to carry out a survey of the local clay and sand sources. Consequently, Dr J Tipper collected samples of the geological bedrock from 14 localities within the Bloodmoor Hill area. These samples came from areas shown on the BGS 6” geological map of the area either as undifferentiated till or the Aldeby Sands.

The clay samples were worked into briquettes and fired at c.1000 degrees C in an oxidizing atmosphere. Samples of the briquettes were then thin sectioned (by Steve Caldwell, University of Manchester) whilst samples of both the briquettes and loose sands were ground to a fine powder and submitted to Royal Holloway College, London for ICP-AES analysis(Table 1).

Table 1

TSNO	Group	Sample	Action	Visual Analysis (sands only)
V2816	Aldeby Sands	01	ICPS	RQ <0.5MM;ANG FLINT <20MM
V2817	Aldeby Sands	02	ICPS	RQ <0.5MM; C.10% CLAY
V2818	Aldeby Sands	03	ICPS	RQ <0.5MM (MAINLY <0.3MM);M R BLACK FE <0.3MM
V2819	Aldeby Sands	04	ICPS	RQ <0.5MM;R BLACK FE <0.3MM
V2820	till2	05	ICPS;TS	
V2821	till1	06	ICPS;TS	
V2822	Aldeby Sands	07	ICPS	RQ <0.5MM (MAINLY <0.3MM);M R BLACK FE <0.3MM;S ANG FLINT <2.0MM
V2823	till1	08A	ICPS;TS	
V2824	till2	08B	ICPS;TS	
V2825	till1	09A	ICPS;TS	
V2826	till1	09B	ICPS;TS	
V2827	till1	10	ICPS;TS	
V2828	Aldeby Sands	11	ICPS	RQ <0.5MM;SPARSE ANG FLINT <2.0MM;C 20% CLAY
V2829	Aldeby Sands	12	ICPS	RQ <0.5MM;R BLACK FE <0.5MM;S ANG FLINT <5MM

V2830	Aldeby Sands	13	ICPS	RQ <0.5MM;SPARSE ANG FLINT <10MM
V2831	till3	14	ICPS;TS	

Thin Section Analysis

All the samples were stained using Dickson's method (Dickson 1965) but in practice the high oxidizing firing was sufficient to alter all of the calcareous inclusions to slaked lime (and subsequently to calcium hydroxide). The former presence of calcareous inclusions was often clearly visible in thin section.

Three distinct fabric groups were present in the briquette thin sections; these were given the group codes Till1 to Till3. The sands could not easily be thin sectioned (they could have been mounted in a block of resin) and were instead examined at x20 magnification (Table 1).

Till 1

The following inclusion types were noted in thin section:

- Rounded quartz of probably Permo-Triassic origin. Abundant rounded grains with a high sphericity up to 1.0mm across. Most are monocrystalline and unstrained. Some polycrystalline grains, possibly of vein quartz origin, are also present.
- Rounded chert. Moderate grains of similar size and shape to the Permo-Triassic quartz.
- Rounded quartz of Lower Cretaceous origin. Moderate well-rounded grains with a lower sphericity and haematite veins, up to 1.0mm across.
- Fresh angular flint. Sparse fragments up to 4.0mm across in V2823.
- Brown-stained subangular flint. Moderate fragments up to 1.0mm across.
- Rounded voids. Rounded voids up to 4.0mm across, probably chalk, Noted in two samples (V2827 and V2826).
- Rounded opaque grains. Sparse rounded grains up to 1.0mm across.

The groundmass consists of optically isotropic baked clay minerals and sparse angular quartz and muscovite up to 0.2mm across.

Till 2

The inclusion types present in these two samples were very similar to those in Till 1 samples but the groundmass contained moderate angular quartz grains, up to 0.2mm across.

Till 3

The following inclusion types were present in thin section:

- Rounded quartz of probably Permo-Triassic origin. As in Till 1 but less common.
- Rounded chert. Sparse grains up to 1.0mm across containing sponge spicules.
- Fresh angular flint. Sparse fragments up to 1.0mm across.
- Rounded opaque grains. Sparse grains up to 0.3mm across.

The groundmass consists of abundant angular quartz and muscovite c.0.05mm to 0.2mm across with a small amount of clay cement.

Till 1 and Till 2 are probably end-members of a single lithology whereas Till 3 contains a lower quantity of rounded quartz sand and a much higher quantity of angular quartz and muscovite of coarse silt/fine sand grade. There are also differences in the range of inclusion types present, although this may be due in part to the lesser frequency of sand in Till 3.

In all cases, the most common inclusions are rounded quartz grains of Permo-Triassic character. These probably originated in the midlands or in Yorkshire. Lower quantities of Lower Cretaceous, Upper Cretaceous and, probably, Tertiary inclusions were also present in each of the samples.

Chemical analysis

The chemical analysis was carried out using the same methodology as for the Anglo-Saxon pottery. As with those samples, the estimated quantity of silica was calculated by subtracting the total quantity of measured oxides from 100%. This showed that the Till 1 and Till 2 samples contain similar quantities of silica whilst the Till 3 sample contains an amount intermediate between these and the Aldeby Sands samples.

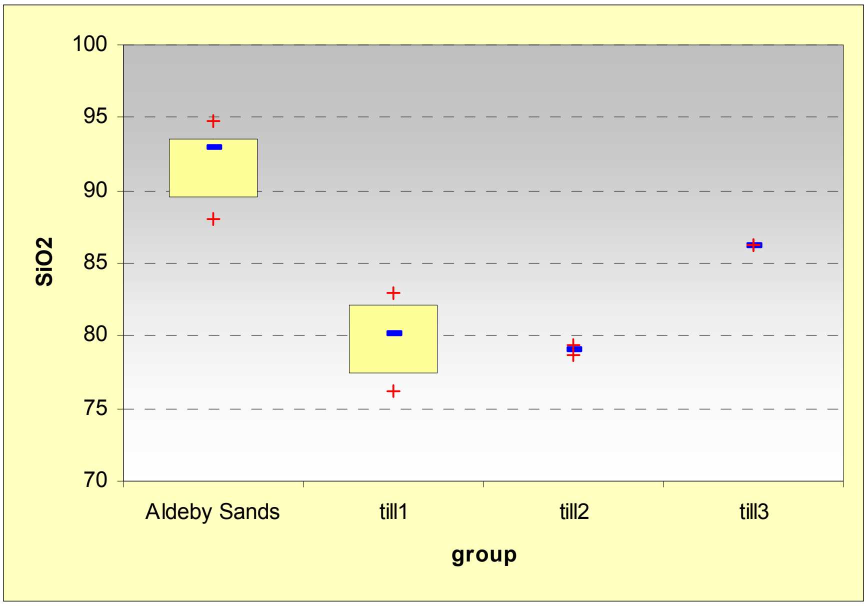

Figure 1

The data were then examined visually to see if any gross structure was present. This showed that the lead values of both the clays and sands were higher than in the pottery samples. Since the sands were not fired this cannot be due to contamination in the kiln. The lead content is in fact higher in the sands than the clays and appears to be positively correlated with silica content.

The data were then normalised to Aluminium and analysed using factor analysis. This analysis found five factors. F1 separated the Aldeby Sands (and Till 3) samples from the other till samples and has high weightings for Barium (Ba), Potassium (K2O), Sodium (Na2O) and Zirconium (Zr). It also has strong negative weightings for Vanadium (V), Scandium (Sc), and Magnesium (MgO). Till 3 is separated from all the other samples by its F3 and F5 scores, probably due to a high TiO value. One of the Till 1 samples, V2826, is distinguished by a high F4 score, due to the survival of some chalk or chalk alteration products. All the remaining factors show no patterning.

The clay and sand analyses were then analysed alongside the Anglo-Saxon pottery samples, and samples of fired clay (which had two distinct fabrics, one chalk-tempered and the other not).

This analysis found six factors. Factor 2 differentiated between the Aldeby Sands (and Till 3), a group of pot samples containing chalk and a silty groundmass and the remainder. The Till 1 and Till 2 samples could not be distinguished from the remaining pottery and fired clay samples in this analysis (Fig 2).

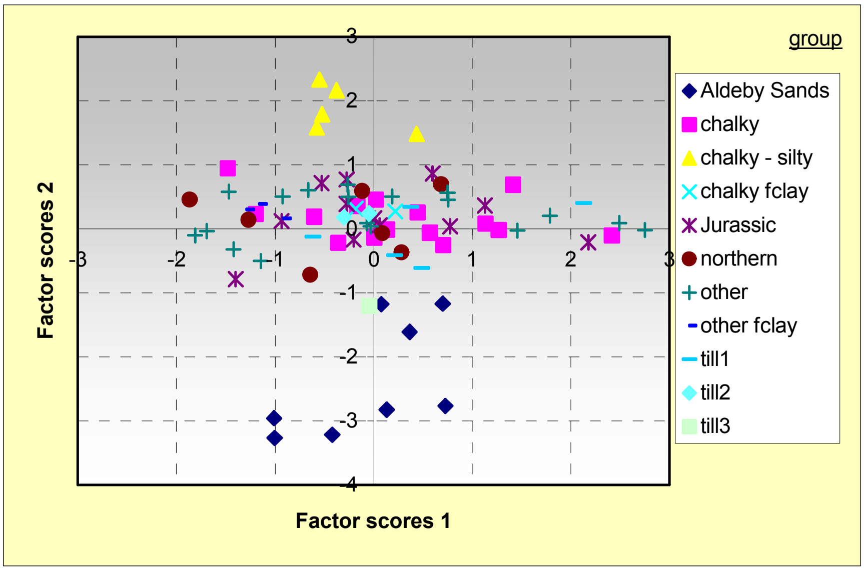

Figure 2

Factor 3 distinguishes the Till samples (all three fabrics) from the remainder. This is due to a lower Phosphorus content (P2O5) and Zirconium content and, to a lesser extent, a lower Barium, Zinc (Zn) and Strontium (Sr) content. Factor 4 distinguishes the Aldeby Sands and the Chalky, silty pot group from the remainder. This factor also distinguishes the non-chalky fired clay samples (which have negative F4 scores) from the remainder.

In summary, the chemical analysis shows that the only difference between the Till samples and the Anglo-Saxon pottery is due to lower Phosphorus, Strontium and Barium. Phosphate is enriched in archaeological deposits and is often found lining the pores in pottery sections. Therefore, it is likely that in this case too the phosphorus is absent because of the lack of groundwater contamination. Both Strontium and Barium easily bond to Phosphorus and are probably also lacking because of the lack of phosphate contamination. The low Zirconium values found in the tills contrasts with the high Zirconium values found in the sand samples and a value comparable with that found in the pottery could be achieved by mixing the sand and clay samples. However, the Till 3 sample, which has a very high fine sand content, has the lowest normalised Zirconium value in the entire dataset. Finally, the low Zinc content in the till samples is remarkable. The Zinc content of the sands is also lower than in the pottery and it is tempting to see Zinc as another post-burial contaminant.

Discussion

A case could therefore be made from the chemical composition for the local till being the source of the clay used to make the Bloodmoor Hill pottery and fired clay, with the exception of the chalky, silty group and the non-chalky fired clay. However, the petrological characteristics of the clay samples, and a x20 binocular microscope study of the sands, shows that no glauconite is present, nor any of the igneous, metamorphic or non-local sandstones which distinguish several of the pottery fabrics. Thus, 25 of the 63 pottery thin sections can definitely be said to contain inclusions not available locally whilst a further 7 samples contain no rounded quartz of Permo-Triassic character and these too are unlikely to be local. Finally, no Jurassic limestones were noted in the clays or sands, nor any large sheaves of muscovite. Pots with these inclusions too are probably non-local.

This leaves a total of 26 samples which contain only inclusion types which occur in the local clays and sands. Of these, 10 were classed as chalky fabrics, although in every case the inclusions were leached; one was classed as chalky, silty (although the remaining samples in this group contained non-local inclusion types), and 15 were classed as 'other', containing neither calcareous inclusions nor voids. All of these 15 sections contain the same range of inclusions as those found in Till 1 and Till 2 with the addition of sparse to abundant organic inclusions (Table 2). However, factor analysis of the chemical data from these samples together with the till samples still indicates that Till 3 and the chalky – silty pot sample are clearly distinguished whilst the remaining till samples can still be separated from the pottery by their Chromium, Zirconium, Lead, Potassium, Sodium and Titanium values.

Three further approaches might be tried next to try and determine the sources of the Bloodmoor Hill pottery and fired clay:

- Analysis of comparable pottery from other parts of East Anglia, to establish the distribution of pottery with the inclusion types and chemical compositions noted at Bloodmoor Hill.
- Samples of till could be made into briquettes with varying quantities of animal dung, to try and replicate the 'chaff-tempering' found in the pottery and to determine its effect on chemical composition.
- Clay samples from other geological deposits in the Lowestoft area could be sampled.

Table 2. Potentially local Anglo-Saxon pottery samples

TSNO	chalky	chalky - silty	other	Grand Total
V2031			1	1
V2032	1			1
V2033			1	1
V2034			1	1
V2035			1	1
V2037		1		1
V2038	1			1
V2040	1			1
V2041			1	1

V2042	1			1
V2044	1			1
V2050			1	1
V2053			1	1
V2054			1	1
V2055			1	1
V2057			1	1
V2060			1	1
V2064	1			1
V2065			1	1
V2067			1	1
V2069	1			1
V2073			1	1
V2077	1			1
V2078	1			1
V2081			1	1
V2083	1			1
Grand Total	10	1	15	26

Appendix 1. ICPS Analyses. Percent Oxides

TSNO	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO
V2816	4.1	1.62	0.13	0.25	0.189	0.91	0.15	0.12	0.01
V2817	5.98	2.61	0.38	0.32	0.414	1.16	0.31	0.07	0.014
V2818	3.44	1.26	0.09	0.18	0.27	0.93	0.14	0.07	0.008
V2819	3.31	0.82	0.07	0.17	0.153	0.59	0.08	0.07	0.006
V2820	11.81	5.48	0.71	0.54	0.279	1.92	0.52	0.08	0.041
V2821	11.21	4.61	0.73	0.54	0.243	1.9	0.46	0.06	0.058
V2822	3.51	1.36	0.11	0.21	0.288	0.95	0.15	0.07	0.028
V2823	11.04	3.96	0.62	0.64	0.279	1.75	0.52	0.05	0.012
V2824	12.12	4.16	0.71	0.9	0.279	1.81	0.53	0.06	0.015
V2825	11.95	5.02	0.84	0.8	0.252	1.91	0.47	0.06	0.057
V2826	9.6	3.08	0.76	7.53	0.405	1.87	0.42	0.08	0.033
V2827	9.16	3.57	0.52	1.29	0.279	1.59	0.4	0.07	0.121
V2828	6.46	2.54	0.32	0.4	0.306	1.32	0.35	0.19	0.05
V2829	3.52	1.46	0.11	0.22	0.261	0.87	0.17	0.07	0.014
V2830	4.42	1.88	0.18	0.23	0.171	0.9	0.18	0.09	0.033

TSNO	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO
V2831	8	2.21	0.4	0.48	0.486	1.66	0.44	0.07	0.028

Appendix 2. ICPS Analyses. Elements measured as parts per million

TSNO	Ba	Cr	Cu	Li	Ni	Sc	Sr	V	Y	Zr*	La	Ce	Nd	Sm	Eu	Dy	Yb	Pb	Zn	Co
V2816	193	16	6	19	9	2	42	23	5	26	13	19	13	1	0	1	1	139	19	18
V2817	242	36	8	25	17	5	51	40	8	42	19	36	20	3	0	2	1	67	34	12
V2818	201	13	4	10	7	2	43	18	4	23	8	16	8	1	0	1	0	59	21	8
V2819	130	4	4	13	7	2	31	15	4	15	8	17	8	1	0	1	0	87	17	15
V2820	291	72	23	50	39	11	66	98	15	36	33	58	34	5	1	3	2	65	78	18
V2821	273	70	18	47	39	11	63	94	18	34	32	64	33	6	1	4	2	45	66	15
V2822	210	14	7	11	10	2	48	19	6	24	11	19	11	1	0	1	1	52	28	8
V2823	274	49	15	49	22	10	69	85	17	36	30	53	30	4	1	2	1	62	63	13
V2824	302	71	30	57	37	11	74	97	16	33	34	63	35	6	1	4	2	60	86	15
V2825	275	75	24	55	61	11	73	103	35	35	45	77	48	9	1	6	3	67	71	17
V2826	281	51	18	40	30	8	161	69	15	29	28	53	29	4	1	3	2	47	54	11
V2827	273	45	16	36	35	8	70	67	13	25	29	61	30	5	1	3	2	71	49	21
V2828	246	34	13	25	17	5	59	44	12	46	23	45	24	3	0	2	1	65	54	11
V2829	196	14	7	12	11	2	43	19	6	29	13	24	14	1	0	1	1	57	28	9
V2830	177	21	9	18	10	3	41	31	7	25	15	25	16	2	0	2	1	70	31	11
V2831	310	42	12	24	16	5	69	52	9	21	28	50	28	4	1	2	1	51	40	10

Bibliography

Vince, Alan (2003) Characterisation studies of the Anglo-Saxon pottery from Bloodmoor Hill, Carlton Colville, Suffolk . AVAC Reports 2003/124 Lincoln.