Chemical Analysis of Pottery from Aldin Grange: Assessment of potential.

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Summary

The fabrics of the medieval pottery produced at the Aldin Grange site was examined to investigate the potential of the material for characterisation studies. Two main objectives were set:

- to establish the possibility of identifying Aldin Grange products on consumer sites
- to establish the possibility of identifying clay and temper sources and interval variations in source materials.

The results of chemical analysis show that it is possible to distinguish Aldin Grange wares from any other sampled whiteware kilns in northern England or Scotland but that there is also variation within the fabrics used on the site, allowing products of the two kilns, A and B, to be distinguished.

It is therefore clear that two further stages of analysis would be fruitful:

a) Establishing the market for Aldin Grange wares through sampling of whitewares from consumer sites in County Durham and, if necessary, neighbouring counties.

b) Using chemical analysis to understand work practices on the Aldin Grange kiln site

Methodology

Twelve sherds were sampled by Philip Abramson using criteria set down by Alan Vince. The sampling strategy was to maximise the representivity of each sample by only sampling stratified, featured sherds. Each sherd was taken from a larger sherd or sherd family (ie all the sherds from a single vessel) and the remainder was marked with its sample number (1 to 12) and retained at the NAA offices.

At Lincoln, a sample was sawn off each sherd in order to produce a section through the vessel from outer to inner surface (see *thin-section analysis assessment*). The remainder was divided into two and one part kept for reference. The other part was prepared for analysis by having all surfaces and glaze removed with a grinding wheel and then crushing the sherd to a fine powder in a mortar. The powder is then submitted to Royal Holloway College , Department of Geology, for ICP-AES analysis using their standard programme, plus lead (to check for glaze contamination). The results consist of a spreadsheet containing element frequencies measured as percentage of oxides for the major elements and parts per million for the minor ones. This data, together with information on the sample, was entered into an Access 97 database and exported to excel 5 and WinBASP (Bonn Archaeological Statistics Package for Windows) for analysis.

Statistical analysis

The twelve samples were given sample numbers V123 to V134 (Table 1).

TS No	Sherd No	Context	Grade	
V123	1	69	1	Kiln A
V124	2	69	1	Kiln A
V125	3	69	1	Kiln A
V126	4	60	1	Kiln A
V127	5	60	1	Kiln A
V128	6	73	1	Kiln A
V129	7	54	1	Kiln A
V130	8	22	1	Gully 47
V131	9	201	1	Kiln B
V132	11	201	1	Kiln B
V133	10	203	1	Kiln B
V134	12	203	1	Kiln B

The analyses were divided into two groups based on their archaeological context. All the sherds from Kiln A together with samples V130 from gully 47 were assigned to the first group and the four sherds from Kiln B were assigned to the second group.

The mean values of each element in each group were calculated and these values used to create two new records, 'kiln A mean' and 'kiln B mean'. Comparison of the mean values for the two groups showed that several elements differed in frequency between the two groups (See Appendix One). In particular, Calcium, Barium and Strontium are more common in Kiln A samples. This variation might, however, be a result of the kiln B material being subjected to greater weathering than that from Kiln A, or to a variation in firing temperature (Calcium carbonate is changed by heating to Calcium hydroxide which adsorbs water to become slaked lime, which is water soluble, at temperatures above 850 degrees C).

The fourteen records (12 samples plus 2 mean values) were then analysed using Principal Components Analysis in which fourteen components were calculated, of which the first PC1 accounted for the most variation between samples, the second, PC2, the next most variation and so on. Of these, the first two

distinguished the two groups and separated both these groups from the means calculated for other whiteware kiln products in midland and northern England and Scotland (Fig 1) and from analyses of whitewares from consumer sites, some of which are thought to be products of known kilns and others the products of as yet unknown kilns.

PC1 was composed of high values for Na, Ba, Co, Zn and Mn and for low values for the rare earths. PC2 was composed of high values for V, Ti., Ca, Zr, Nb, Sc and Li and low values for the rare earths, Na, K and Ba.

The separation of Kilns A and B was less clearcut using PC3 and following components although Aldin Grange wares still formed a distinct cluster with the two groups more or less visible as discrete subgroups.

Future work

The mean values for kiln B are based on only four samples, rather than the 6 recommended in the protocol. In order to have a reliable fingerprint for Kiln B ceramics a further 2 samples are required.

Having established that this ICP-AES technique will discriminate between different fabrics the next stage will be to compare these results with those of ceramic petrology. In particular, the possibility of leaching of Kiln B samples can be tested. Assuming that the results of this chemical analysis are upheld by ceramic petrology the next stages should be to follow two objectives

Objective A: Determining the market for Aldin Grange ware

A number of settlement sites in Co Durham have produced whiteware pottery similar in appearance to those from Aldin Grange. These may be the products of one or other of the recently-discovered Aldin grange kilns, or of other, as yet undiscovered, kilns in the same area or they may be the products of other centres utilising similar raw materials. One worthwhile approach would be to sample sherds from the stratified medieval excavations at Saddler Street, Durham, and Prudhoe Castle to establish where, if anywhere, in those sequences Aldin Grange wares first appear. This would answer two questions:

i) Is the whiteware at the site from Aldin Grange or another source (or sources)?

ii) If Aldin Grange ware is present can it be assigned to one or other of the known kilns?

iii) Can these sites help determine the period of operation of the kilnsite?

Samples would have to be taken in groups of six from whiteware in each phase of the excavation and costs would have to include relating the pottery assemblages to the published or typescript reports and perhaps 30 samples per site (ie five stratigraphic groups)..

A second approach would be to sample individual whiteware vessels from as many sites as possible in Co Durham and perhaps neighbouring counties in order to establish the similarity of these samples to

the kiln products. Should other competing kilnsites be supplying some of this pottery then new and distinct clusters might be expected. Useful results could be achieved with perhaps 40 or 50 samples (ie 6 to 8 sites chosen to test the distribution of the kiln products in different directions) but 80 to 100 samples would be preferable.

A budget of £3000 would allow 130 samples to be processed and cover the sampling procedure and travel.

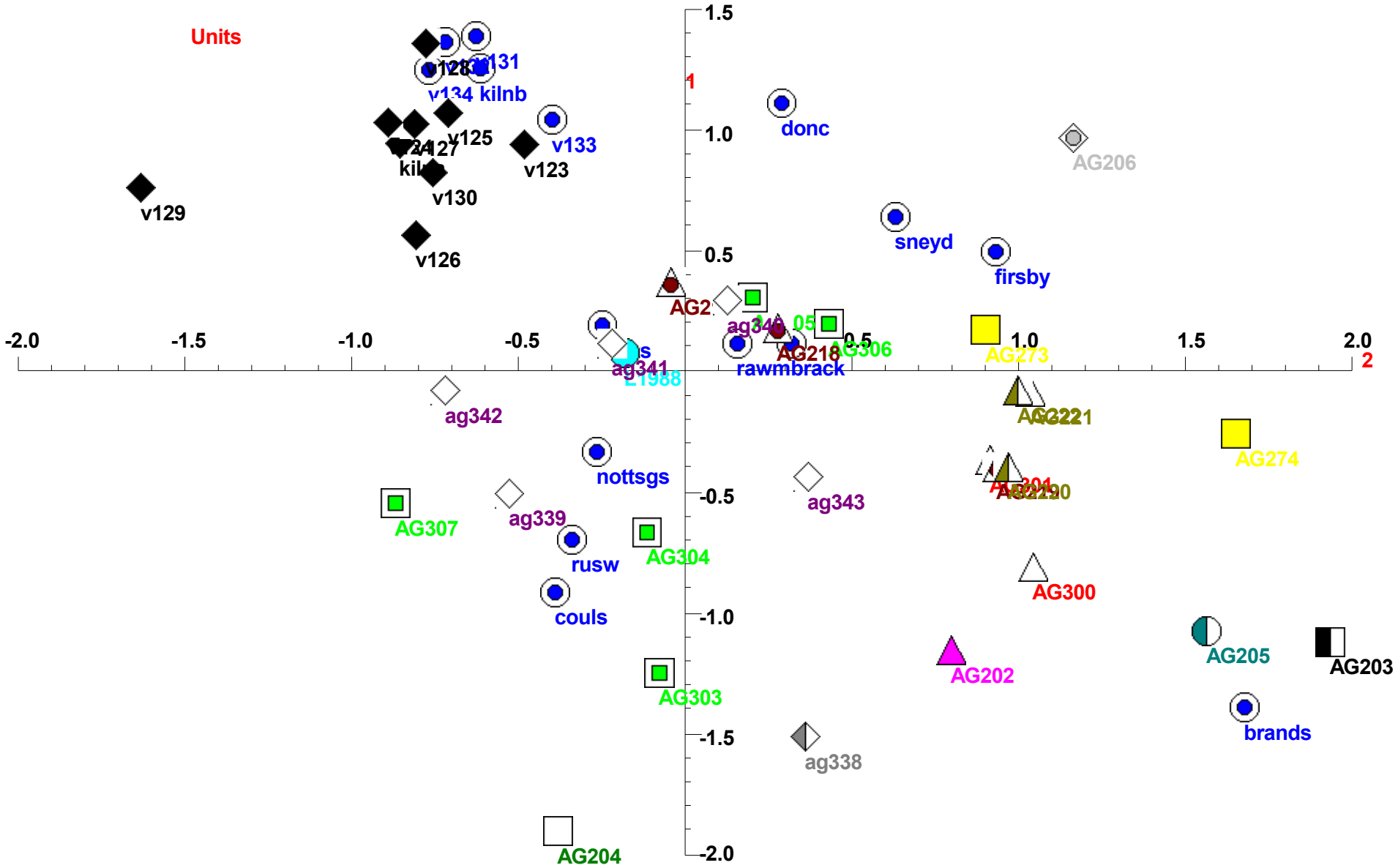
Objective B: Determining the source of raw materials and their preparation

Both fired and unfired clay was collected from the Aldin Grange excavation. It would be interesting to know how similar this was to the kiln products, and whether or not the kiln superstructures were also built from distinctly different fabrics or only the products. A further point worth establishing is whether or not different products in the kilns were made in distinguishable fabrics: Probably the only hypothesis worth testing is that different fabrics were used for jugs and cooking vessels.

The total number of samples required for this objective would be 42. Sampling should be carried out by J Vaughan or the project manager and the total cost would therefore be £840.

Northern English and Scottish East Coast Gritty ware projects

The results of these analyses should be made available to the Northern English Medieval Whiteware project and its Scottish Counterpart, the Scottish East Coast Gritty ware project. These projects aim to characterise and source medieval whitewares throughout northern England and Scotland and to use this data to study trade and interaction on either side of the English/Scottish border.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Appendix One: the ICPS Data

Kiln A

TSNO	AL2O3	FE2O3	MGO	CAO	NA2O	K2O	TIO2	P2O5	MNO	BA	CO	CR	CU	LI	NB	NI	SC	SR
v130	20.30	3.06	0.92	0.16	0.45	2.43	0.86	0.08	0.02	528.00	8.00	119.00	17.00	106.00	16.00	41.00	13.00	90.00
v129	19.64	3.70	0.99	0.16	0.48	4.00	0.76	0.09	0.02	990.00	9.00	118.00	22.00	88.00	14.00	37.00	14.00	84.00
v128	17.35	2.60	0.62	0.18	0.50	2.17	0.76	0.11	0.01	608.00	6.00	100.00	17.00	81.00	13.00	34.00	12.00	72.00
v127	18.78	3.10	0.78	0.18	0.49	2.40	0.81	0.13	0.01	577.00	8.00	106.00	17.00	82.00	14.00	35.00	12.00	86.00
v126	20.63	3.45	0.94	0.18	0.49	2.62	0.96	0.06	0.02	532.00	9.00	120.00	20.00	98.00	18.00	35.00	14.00	99.00
v125	18.36	3.72	0.77	0.18	0.46	2.26	0.81	0.06	0.02	458.00	8.00	104.00	23.00	106.00	14.00	34.00	12.00	89.00
v124	18.07	2.41	0.77	0.33	0.49	2.51	0.80	0.14	0.04	514.00	47.00	106.00	34.00	88.00	15.00	72.00	12.00	98.00
v123	17.56	3.93	0.73	0.24	0.41	2.28	0.79	0.06	0.02	448.00	9.00	99.00	104.00	84.00	15.00	29.00	12.00	89.00
Mean	18.84	3.25	0.82	0.20	0.47	2.58	0.82	0.09	0.02	581.88	13.00	109.00	31.75	91.63	14.88	39.63	12.63	88.38
Sd	1.23	0.55	0.12	0.06	0.03	0.59	0.07	0.03	0.01	173.43	13.77	8.67	29.73	10.31	1.55	13.50	0.92	8.47

TSNO	V	Y	ZN	ZR_	LA	CE	ND	SM	EU	DY	YB	PB
v130	93.00	11.00	56.00	44.00	44.00	89.00	40.00	7.00	1.00	1.50	1.00	940.00
v129	104.00	14.00	70.00	40.00	44.00	91.00	41.00	7.50	1.20	2.20	1.10	1030.00
v128	80.00	11.00	55.00	43.00	36.00	71.00	32.00	4.90	0.90	1.50	1.00	2670.00
v127	93.00	12.00	54.00	49.00	41.00	81.00	36.00	5.80	0.90	1.60	1.20	352.00
v126	106.00	14.00	58.00	47.00	47.00	93.00	43.00	7.00	1.10	1.90	1.20	780.00
v125	94.00	12.00	67.00	43.00	44.00	84.00	36.00	5.50	0.90	1.40	1.00	2360.00
v124	86.00	12.00	111.00	47.00	43.00	83.00	38.00	5.70	1.00	1.40	1.00	21600.00
v123	82.00	15.00	337.00	55.00	42.00	80.00	38.00	6.50	1.00	2.10	1.30	2130.00
Mean	92.25	12.63	101.00	46.00	42.63	84.00	38.00	6.24	1.00	1.70	1.10	3982.75
Sd	9.45	1.51	97.18	4.63	3.20	7.07	3.42	0.90	0.11	0.32	0.12	7167.13

Kiln B

TSNO	AL2O3	FE2O3	MGO	CAO	NA2O	K2O	TIO2	P2O5	MNO	BA	CO	CR	CU	LI	NB	NI	SC	SR
v134	18.08	3.36	0.75	0.12	0.35	2.15	0.78	0.08	0.04	408.00	43.00	103.00	13.00	83.00	15.00	63.00	12.00	85.00
v133	17.34	2.70	0.55	0.14	0.42	1.35	0.65	0.11	0.03	345.00	6.00	93.00	44.00	107.00	12.00	50.00	11.00	57.00
v132	16.72	2.97	0.71	0.14	0.45	1.97	0.72	0.07	0.02	433.00	6.00	95.00	18.00	87.00	13.00	32.00	11.00	75.00
v131	16.46	2.85	0.55	0.10	0.43	1.83	0.76	0.14	0.02	375.00	6.00	93.00	12.00	70.00	14.00	30.00	10.00	68.00
mean	17.15	2.97	0.64	0.13	0.41	1.83	0.73	0.10	0.03	390.25	15.25	96.00	21.75	86.75	13.50	43.75	11.00	71.25
sd	0.72	0.28	0.11	0.02	0.04	0.34	0.06	0.03	0.01	38.40	18.50	4.76	15.06	15.33	1.29	15.67	0.82	11.79

TSNO	V	Y	ZN	ZR_	LA	CE	ND	SM	EU	DY	YB	PB
v134	77.00	11.00	52.00	42.00	39.00	78.00	31.00	5.20	0.90	1.10	0.90	1970.00
v133	85.00	15.00	118.00	62.00	37.00	79.00	34.00	6.40	1.00	2.00	1.40	2560.00
v132	82.00	11.00	50.00	41.00	38.00	79.00	33.00	5.30	0.80	1.40	1.00	521.00
v131	74.00	11.00	45.00	45.00	38.00	76.00	33.00	5.70	0.80	1.50	1.00	259.00
mean	79.50	12.00	66.25	47.50	38.00	78.00	32.75	5.65	0.88	1.50	1.08	1327.50
sd	4.93	2.00	34.63	9.81	0.82	1.41	1.26	0.54	0.10	0.37	0.22	1114.15