Characterisation Studies of Iron Age/Early Roman Coarsewares from Ferry Lane Farm. Collingham (FLF04)

Twelve samples of Iron Age or Early Romano-British pottery from an excavation at Ferry Lane Farm, Collingham, were submitted for analysis (Table 1). The main purpose of the analysis is to clarify the site fabric classification prior to the main recording and analysis of the pottery. A secondary aim is to determine whether the source of the samples can be pinpointed through the use of thin section and chemical analysis.

Macroscopic Analysis

The samples were examined at x20 magnification using a stereo-microscope. The following inclusion types were noted:

- Bivalve shell. Represented entirely by voids. These indicate that the shell fragments were not rounded, included no ornamented shells and were often over 1.0mm thick. There is little doubt that these would have been fragments of fossil shell, probably *gryphaea* (which includes shells with a flattened shape, similar to the modern oyster, as well as the well-known 'devil's toe-nail' shell, which tends to be so robust that it would not be present in a pottery clay, since it would be seen/felt and picked out by eye.

- Quartzose sand. Most of the samples include quartzose sand in which the major element is rounded quartz grains of Permo-Triassic origin. These probably originated in the Triassic Sherwood Sandstone. At x20 magnification, it can be seen that most of these grains have matt surfaces due to wind blasting. In addition, some overgrown quartz grains are present. In the hand specimen these can be confused with feldspars or other colourless minerals with strong cleavage but these come from sandstones which are cemented by secondary silica, which in these cases have grown in crystal unity with the original detrital grains. Small overgrown grains might originate in Jurassic sandstones, although most of these outcrop on the dip slope of the Jurassic ridge and are not found in Trent valley cover sands. It is more likely that these grains come from Carboniferous sandstones, from the Millstone Grit or Coal Measures. They are probably present both through the erosion of rocks of this type in the upper reaches of the Trent, in west Nottinghamshire or Derbyshire, but are also likely to be re-worked from fluvio-glacial sands. Such sands occur widely in the East Midlands and are of limited use in characterisation.

- Red and grey "grog". Some of the samples include red and grey fragments composed of baked clay minerals, mostly with no visible inclusions but sometimes containing quartz grains. These might be either mudstones of Triassic or Jurassic origin or deliberately fired ceramics, crushed for use as temper (grog).

- Slag. Two of the samples contain sub-rounded dark grey fragments of vesicular slag. IN higher-fired ceramics these can be formed *in situ* through the action of heat on iron-rich inclusions but in this case it is clear that these are detrital grains (hence the rounding). Slag is a known temper used in Iron Age ceramics in Yorkshire and the East Midlands and is also present as the trituration grits in Swanpool greyware mortaria.

In most cases, where the groundmass was visible (a number of sherds were very abraded and coated with concretions), it is fine-textured with some visible muscovite but no quartz silt. The exception is Sample 12, which has a silty, micaceous groundmass.

Petrological Analysis

Thin sections were produced at the University of Manchester by Steve Caldwell and stained using Dickson's Method (Dickson 1965).

The thin sections could be grouped into six fabric groups, numbered here Groups 1 to 6.

Group 1 (V2852, V2854, V2862)

The distinguishing features of this fabric group are sparse large bivalve shell voids, moderate quartzose sand and moderate very fine quartz/muscovite sand in the groundmass. The following inclusion types were noted in thin section:

- Quartz. Moderate rounded grains up to 0.4mm across.
- Shell. Moderate voids probably once containing bivalve shell, up to 1.0mm long.
- Sandstone. Sparse fine-grained sandstone grains up to 0.5mm across.
- Grog/Relict clay. Moderate angular fragments up to 1.5mm across with similar colour and texture to the groundmass. Sparse dark-stained spherical pellets up to 1.0mm across.
- Limestone. Sparse angular fragments of limestone up to 1.5mm across containing bivalve shell fragments, preserved through clay casts despite leaching of the limestone.

The groundmass consists of optically anisotropic baked clay minerals, moderate angular quartz grains up to 0.05mm across and sparse muscovite up to 0.1mm across.

Group 2 (V2853, V2855)

The distinguishing features of this fabric are abundant bivalve shell voids, sparse quartzose sand and very few visible inclusions in the clay groundmass. The following inclusion types were noted in thin section:

- Shell. Abundant voids from the leaching of bivalve shell fragments, up to 1.0mm long.
- Quartz. Sparse rounded grains up to 0.5mm across.

The two sections have different groundmasses. In one the groundmass is opaque whilst in the other it is oxidized and contains moderate rounded opaque grains up to 0.2mm across. Both contain sparse angular quartz grains up to 0.05mm across.

Group 3 (V2856, V2858, V2861)

The distinguishing features of this fabric are moderate bivalve shell voids, moderate quartzose sand and moderate clay/mudstone/grog fragments. The following inclusion types were noted in thin section.

- Grog/clay pellets. Moderate fragments up to 3.0mm across. Several are angular and some have blackening of their edges.
- Shell. Moderate voids from the leaching of bivalve shell inclusions, up to 1.0mm long.
- Quartz. Sparse rounded grains up to 0.4mm across. Sparse angular grains, up to 0.4mm and probably overgrown.
- Chert. Sparse rounded grains up to 0.4mm across.

The groundmass consists of optically anisotropic baked clay minerals and sparse angular quartz up to 0.05mm across and muscovite laths up to 0.2mm long.

Group 4 (V2851, V2859)

The distinguishing features of this fabric are moderate to abundant quartzose sand. the following inclusion types were noted in thin section:

- Quartz. Abundant grains up to 1.0mm across, some spherical, some mosaic and some with abundant chlorite inclusions.
- Sandstone. Sparse fine-grained fragments up to 0.4mm across.
- Feldspar. Sparse rounded fragments of microcline up to 0.4mm across.
- Grog/clay pellets. Moderate rounded and angular fragments of similar colour and texture to the clay matrix, up to 1.5mm across.

The groundmass consists of optically anisotropic baked clay minerals, and moderate angular quartz ranging from c.0.05mm to 0.1mm across. Except at the surfaces, however, the matrix is opaque due to carbon content.

Group 5 (V2860)

The distinguishing feature of this fabric is the presence of angular fragments of vesicular slag. The following inclusions were noted in thin section:

- Slag. Moderate angular fragments of vesicular slag, consisting mainly of a dark grey glass with sparse angular quartz inclusions c.0.1mm to 0.2mm across.
- Quartz. Moderate subangular grains ranging from c.0.1mm to 0.2mm across. Sparse rounded grains, some with a high sphericity. Also, sparse angular grains up to 0.5mm across, probably overgrown.
- Sandstone. Sparse fragments composed of iron-cemented quartz and chert grains up to 0.3mm across with a red clay/iron cement. Sparse fine-grained fragments up to 0.4mm across.
- Phosphate. Sparse brown fragments up to 1.0mm across. Probably secondary filling of shell voids.
- Clay pellets. Moderate to abundant rounded fragments of red clay up to 1.0mm across.
- Chert. Sparse rounded fragments up to 0.5mm across.

The groundmass consists of optically anisotropic baked clay minerals, abundant iron-rich ref clay grains and few other visible inclusions. The core and interior of the vessel are almost opaque due to the presence of carbon.

Chemical analysis

Sub-samples of each vessel were prepared by Peter Hill and submitted to Royal Holloway College, London, for analysis using Inductively Coupled Plasma Spectroscopy (ICP-AES).

This technique calculates the frequency (relative to sample weight) of a range of major and minor elements. The major elements are measured as percent oxides (App.1) and the minor elements as parts per million (App.2).

Silica is not measured and is present in both the groundmass and in the quartzose inclusions. It can be calculated by subtracting the total measured oxides from 100%, although this will also include carbon and chemically combined water, for example. The estimated silica content shows that the sandy fabric, Group 4, has a higher silica content than the remainder (Mean 73% versus 67% to 70% for the various shelly groups).

The data were normalised to Aluminium, to take account of this variation in silica. The resulting dataset was then studied using Factor Analysis (Winstat for Excel,). This revealed that five factors accounted for the majority of the variation in the data. A plot of the first two factor scores indicates no difference in chemical content between the sandy fabric and the majority of the shelly wares but does separate the two Group 2 samples from the remainder. Since the Group 2 fabric contains the least quartz sand it is possible that this is the reason for the separation. However, an examination of the normalised data shows that it is in fact a high Nickel content which distinguishes this fabric. There is a slight correlation of Nickel and Zinc in the data but otherwise the Nickel values have no correlation, positive or negative, with the remaining measured elements and the geochemical explanation for the high Nickel content is not known. In Northern England, the BGS geochemical atlas shows enhanced Nickel values correlating with outcrops of Lower Lias clays and, since Group 2 has the highest quantity of shell inclusions, and consequently the highest number of voids in the sample it may be that the high Nickel content is due to contamination by Lias-derived subsoil.

A plot of Factors 3 and 4 indicates that the Group 4 samples can be distinguished from the remainder using both factors. This appears to be due to a combination of Iron, Barium, Copper, Chromium and Titanium values (and lower values for most other elements). These differences are likely to be due to minerals in the sand fraction. No differences can be observed in the F3 and F4 scores of the shelly wares.

The ICPS data therefore points to a possible difference in clay source between Group 2 and the remainder, confirms the high sand content of Group 4 and otherwise suggests that the samples have a similar composition.

Discussion

It is difficult to be say much about the thin section data from Collingham because, as at the nearby Gallows Nooking Common site (Vince 2002), the calcareous inclusions in the samples have completely leached away, to be replaced by phosphate and subsoil. The effect of this leaching and subsequent concretion will also be present in the chemical data but, since all the samples have been subjected to a similar burial environment, the effects of post-burial alteration are probably similar in each case, excepting that the frequency of shell and quartz sand inclusions may well be reflected in the data, due to infilling of voids or, in the case of Group 4, the lack of such voids.

There are hints that there may be differences in the clay groundmass, both in the chemical data (although as noted above this may be due to post-burial contamination) and in the character of the clay groundmass. However, here too there is a methodological problem, in that the high organic content of some of the samples has led to a completely opaque matrix in which it is not possible to observe opaque inclusions or clay pellets. Nevertheless, differences in the size and frequency of quartz and muscovite in the groundmass could be observed and may indicate differences in clay source.

Despite these essentially negative conclusions, it can nevertheless be stated that the fabrics are distinguishable from other shell-tempered wares of Iron Age and Roman date, such as the Dales Shelly ware of north-western Lincolnshire, the shelly wares produced at Bourne in South Lincolnshire and the Iron Age shelly wares characteristic of Cambridgeshire and the southeast Midlands. Thus, a relatively local source (i.e. Central Lincolnshire) can be suggested for the shelly wares and, because of the overall similarity in chemical composition, the sandy ware.

The presence of slag as a major tempering material in Group 5 is interesting but it is clear from the thin section and chemical evidence that this fabric is otherwise similar to the other shelly wares and is also likely to be of Central Lincolnshire source. Furthermore, there is no sign of fayalite in the slag, which might therefore be a fuel ash slag rather than waste from Iron production.

Appendix 1

TSNO	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO
V2851	13.83	7.03	0.7	0.74	0.34	1.57	0.65	1.28	0.039
V2852	14.8	6.82	2.03	0.67	0.46	2.75	0.72	1.01	0.246
V2853	16.43	8.25	1.39	0.56	0.22	2.07	0.77	0.73	0.218
V2854	18.48	9.03	0.88	0.63	0.2	2.1	0.81	0.52	0.103
V2855	18.75	8.51	1.27	1	0.21	2.45	0.78	1.42	0.331
V2856	16.46	6.91	0.96	0.75	0.33	2.13	0.73	0.69	0.039
V2857	18.67	7.57	1.67	0.77	0.25	2.5	0.79	0.65	0.098
V2858	15.53	7.07	1.47	1.08	0.26	2.27	0.55	2.9	0.218
V2859	12.9	7.12	0.77	0.73	0.27	1.8	0.56	3.44	0.213
V2860	15.44	7.5	1.46	1.15	0.41	1.95	0.61	1.99	0.154
V2861	20.8	8.43	0.72	0.6	0.19	1.78	0.89	0.99	0.114
V2862	15.62	6.16	2.14	0.68	0.45	2.63	0.68	1.05	0.398

Appendix 2

TSNO	Ba	Cr	Cu	Li	Ni	Sc	Sr	V	Y	Zr*	La	Ce	Nd	Sm	Eu	Dy	Yb	Pb	Zn	Co
V2851	563	109	35	55	41	14	83	120	22	55	31	59	33	6	1	4	2	54	178	13
V2852	554	112	42	57	65	14	69	87	30	70	29	68	34	6	1	7	3	37	148	29
V2853	612	120	36	73	119	16	59	129	24	81	33	65	37	7	1	6	3	29	359	27
V2854	536	128	39	56	73	19	54	158	34	77	44	84	47	10	2	6	3	29	165	21

TSNO	Ba	Cr	Cu	Li	Ni	Sc	Sr	V	Y	Zr*	La	Ce	Nd	Sm	Eu	Dy	Yb	Pb	Zn	Co
V2855	1,004	130	56	61	159	19	91	156	24	104	38	76	43	7	1	8	3	28	1,213	23
V2856	544	114	32	48	47	16	60	117	22	67	36	64	38	6	1	4	2	33	146	11
V2857	484	126	29	118	66	19	82	153	28	86	39	75	41	7	1	5	3	26	154	18
V2858	923	107	49	57	50	15	148	103	23	79	35	63	38	6	1	6	2	29	260	19
V2859	825	93	39	44	63	14	119	98	27	58	40	70	44	7	1	6	3	32	305	18
V2860	867	109	43	87	82	17	127	125	31	82	41	84	44	9	2	6	3	28	379	16
V2861	471	156	38	55	70	20	56	158	32	91	42	77	44	7	1	5	3	36	115	16
V2862	601	107	36	42	82	15	78	92	23	69	30	69	37	6	1	9	2	28	520	23

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