Characterisation of Roman Pottery from Lease Rigg, North Yorkshire

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Excavations at the Roman fort at Lease Rigg undertaken in the 1970s produced a collection of pottery most of which was associated with a late 1st century occupation. A smaller quantity of pottery of early to mid 2nd century date is evidence for a limited re-occupation after which the site was abandoned.

A binocular microscope study suggests that there is one main source for both the oxidized sandy wares and the greywares used on the site and that some of the mortaria have a similar fabric.

In order to test the hypothesis that the fort initially had an associated pottery industry, samples of oxidized ware, greyware and mortaria were selected. Two other mortaria were sampled, of Hartley's Fabrics 1 and 1v, both of which she identifies as northern Gaulish products from Noyons, Oise.

Table 1

TSNO	DN NO	Action	Context	Cname	Subfabric	Description	Form	Part
V4089	2	DR;ICPS	B III 8	OXID	FAB1		JAR	R
V4090	4	DR;TS;ICPS	I X 1	OXID	FAB2	SIMILAR TO GILLAM 5	FLAGON	R
V4091	8	DR;ICPS	A I/II 21	GREY	A SA Q		BEAKER	R
V4092	10	DR;TS;ICPS	A IV 45	GREY	A SA Q		JAR	R
V4093	11	DR;ICPS	Z V 20	OXID	FAB1		JAR	BS
V4094	15	DR;TS;ICPS	I X 7	OXID	FAB1	DOUBLE HANDLED	FLAGON	R;H;BS
V4095	16	DR;ICPS	X I 1	OXID	FAB1		JAR	R
V4096	17	DR;ICPS	C I 1	GREY	A SA Q		JAR	R
V4097	18	DR;ICPS	Z IX 2	OXID	FAB1	NO CONDITION TO DRAW	FLAGON	R; BS
V4098	0	TS;ICPS	H I 1	GREY	A SA Q		LID	R;H
V4099	0	ICPS	A I/II 21	GREY	A SA Q		JAR	BS
V4100	0	ICPS	C III 5	GREY	A SA Q	NOT ENOUGH FOR DRAWING	JAR	R
V4118	0	TS;ICPS	A I 20	MORT	FABRIC M1	LIP	MORT	R
v4119	0	TS;ICPS	Z X 1	MORT	FABRIC M4		MORT	B
V4120	0	ICPS	I X 3	MORT	FABRIC M5	EDGE OF RIM BROKEN OFF	MORT	BS
V4121	0	ICPS	W I 11	MORT	FABRIC M1V		MORT	R

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The samples (Table 1) were analysed using thin sections and chemical analysis. The thin sections were prepared by Steve Caldwell, University of Manchester, and stained using Dickson's method (Dickson 1965). This staining distinguishes non-ferroan and ferroan calcite and dolomite. The chemical analysis was carried out at Royal Holloway College, London, under the supervision of Dr J N Walsh, Dept of Geology. Inductively-Coupled Plasma Spectroscopy was used to measure the frequency of a suite of major elements (expressed as percent oxides, App. 1) and a suite of minor elements (expressed in parts per million, App.2). The results indicate that the greyware, oxidized ware and redware mortaria are all produced in a similar fabric, which is best paralleled, within data available to the author, by material from the eastern side of the Vale of York. However, samples of Eboracum ware, especially the products of the Appletree Farm, Heworth kiln, should be analysed to confirm this conclusion.

Thin-Section Analysis

Greyware (V4092, V4098)

The following inclusion types were present n thin section. Unless otherwise stated, they occur in both sections:

Quartz. Moderate subangular and rounded grains between c.0.2mm and 0.4mm across.

Chalcedony. Sparse spherical grains up to 0.2mm across with radial extinction.

Chert. Sparse subangular fragments up to 0.4mm across.

Clay/iron. Sparse rounded grains with opaque staining, up to 0.5mm across.

Feldspar. Sparse rounded fragments of microcline, up to 0.4mm across.

The groundmass of V4098 consists of optically anisotropic baked clay minerals with few inclusions. That of V4092 consists of optically anisotropic baked clay minerals, sparse angular quartz and muscovite laths.

Oxidized ware (Fabric 1, V4094)

The following inclusion types were noted in thin section:

Quartz. Moderate rounded and subangular quartz grains up to 0.4mm across.

Chert. Sparse rounded grains up to 1.0mm across (possibly altered rhyolite).

Feldspar. Sparse plagioclase feldspar up to 0.4mm across.

Clay pellets.

Basic igneous rock. Rare rounded fragment 0.5mm across with euhedral feldspar phenocrysts in brown glassy matrix.

Phosphate. Sparse dark brown angular fragments up to 0.5mm across.

The groundmass consists of optically anisotropic baked clay minerals, abundant angular quartz and muscovite laths up to 0.1mm long.

Oxidized ware (Fabric 2, V4090)

The following inclusion types were noted in thin section:

Quartz. Moderate subangular grains up 0.4mm across.
Sandstone. Sparse rounded fragments, up to 1.0mm across, consisting of subangular quartz grains up to 0.3mm across.
Chert. Sparse rounded grains up to 0.4mm across.
Clay/iron. Sparse rounded grains of dark brown to opaque clay up to 0.5mm across.
The groundmass consists of optically anisotropic baked clay minerals, sparse angular quartz up to 0.1mm across and rare muscovite laths up to 0.1mm long.

Mortaria Fabric M1 (V4118)

The following inclusion types were noted:
Quartz. Moderate rounded and subrounded and angular grains up to 0.3mm across.
Flint. Sparse colourless, angular fragments up to 0.4mm long.
Altered Calcareous. A single rounded void filled with heat-altered calcite.
Clay/iron. Sparse rounded grains up to 0.3mm across.
The groundmass is an altered calcareous clay consisting of isotropic light brown baked clay minerals and sparse angular quartz.

Mortaria Fabric M4 (V4119 and comparative sample from Aldborough – V4122)

The following inclusions were noted in thin section V4119:
Quartz. Moderate subangular and angular grains, mainly c.0.2mm to 0.4mm across.
Sandstone. Sparse fragments consisting of quartz grains up to 0.2mm across with sparse brown clay cement.
Chert. Sparse subangular grains of similar size and roundness to the quartz grains.
Feldspar. Rare euhedral laths up to 0.4mm long.
Clay/iron. Moderate rounded concretions with opaque staining, up to 1.0mm across.
Phosphate. Sparse angular dark brown fragments up to 0.4mm across.
The groundmass consists of optically anisotropic baked clay minerals, sparse angular quartz up to 0.1mm across and rare muscovite laths up to 0.1mm long.
A sample of redware mortarium produced at Aldborough was thin sectioned for comparison and the following inclusions were noted:
Quartz. Sparse rounded and angular grains. The rounded grains are less than 0.3mm across and the angular grains up to 0.5mm across.
Clay/iron. Moderate rounded dark brown concretions with opaque staining. They have a lower quartz and muscovite content than the groundmass but contain the same range of inclusions.
Sandstone. Sparse rounded fragments (trituration grits?) up to 1.5mm across. They contain ill-sorted subangular quartz grains and have a light brown isotropic cement.
Muscovite. Moderate laths up to 0.3mm long.
Mudstone. A single rounded mudstone pellet, 2.0mm long. The mudstone, which contains sparse muscovite and quartz inclusions, is light brown in plane-polarized light but isotropic in crossed polars.
Altered rhyolite? A single rounded grain 0.5mm across.

The groundmass consists of optically anisotropic baked clay minerals and abundant angular quartz, muscovite and sparse plagioclase feldspar up to 0.1mm across.

Interpretation of thin section evidence

The thin-section of the putative Noyons mortaria is consistent with the use of a calcareous clay tempered with a fine quartz and flint sand. Nothing further can be said without more detailed information on the character of the clay and sand resources of the Noyons area.
The remaining thin sections could all come from the same outcrop although they vary in the character of the groundmass. Sections V4119 and V4098 (greyware and mortaria fabric M4) have a similar fine-textured groundmass whilst that of the remaining Lease Rigg grey and oxidized wares is more micaceous and silty. However, all are much finer in texture than the Aldborough sample.
The groundmass of the Lease Rigg samples is paralleled by the Middle Jurassic mudstones which outcrop around the fringes of the North Yorkshire Moors, and in the sides of valleys cutting through the moors (such as Ryedale). However, similar textures are also found in boulder clays consisting of redeposited Middle Jurassic marls, such as that found at Easingwold, and can also be paralleled on the west side of the Vale of York, where they consist of mudstones of upper Millstone Grit series and Coal Measures.
The inclusions in the Lease Rigg grey, oxidized and redware mortaria fabrics are very similar and include little coarser than c.0.4mm across. By contrast, the sands found to the west of the Vale of York (e.g. at Aldborough, are derived mainly from the Millstone Grit and Coal Measures of the Pennines and County Durham. None of the inclusions were clearly well-rounded grains of Permian or Triassic origin and all can be paralleled in the Upper Jurassic sandstones of the North Yorkshire Moors, which form the majority of the sands both on the rivers draining the moors themselves and in the fluvioglacial sands on the eastern side of the Vale of York, north of Wolds (to the south, a contribution from the chalk – rounded water-polished quartzes and flint – is found). The presence of rare basic igneous inclusions is probably an indication of glacial erratics, but these occur both in the boulder clays capping the moors and in the Vale of York.
The thin sections therefore indicate that the M4 mortarium was produced in a similar fabric to one of the two greyware samples and that both of these samples are similar in their sand-sized inclusions to the remaining three greyware and oxidized samples. Given the amount of variability found within medieval wares produced from the Middle Jurassic mudstones it would not be surprising if all six samples were produced at the same site.

Chemical Analysis

The ICPS analysis does not measure silica, which was estimated by subtracting the total measured oxides from 100%. The data were then normalised to aluminium and examined using the Factor Analysis program from WinStat (Fitch 2001). This method calculates a small number of factors which can be substituted for the large number of variables (in this case element frequencies) as well as calculate what proportion of the total variability in the sample

is “explained” by each factor. Certain element frequencies are strongly affected by burial conditions (for example calcite, strontium and phosphorus) and these were omitted from the analysis. Furthermore, there is a strong correlation between each of the measured rare earth elements, causing a minor difference in rare earth frequency to be given undue prominence and these elements were therefore excluded from the main analyses but then examined separately to see if patterns revealed in the main dataset are also present in the rare earth element data. Finally, zirconium is only partly digested in the sample preparation used and although differences in frequency between fabric groups may be revealed the use of zirconium in the main analysis introduces a possible source of error, due to the fact that the samples are analysed in batches. Zirconium is therefore also analysed in a second stage alongside the rare earth elements.

Internal variability

Factor Analysis was carried out on the Lease Rigg data, including in this case (since all the samples experiences similar burial conditions) the rare earth elements, calcium, phosphorus and strontium, and six factors found. Factor 1 distinguished the M1V mortarium sample from the remainder, a high Factor 2 score distinguished the M1 mortarium sample and a negative F2 score distinguished the M5 mortarium from the remainder. Examination of the normalised data indicates that the two Noyons mortaria have a higher calcium content than the remainder but a lower strontium value, an indication of a very different calcium:strontium ratio between the two groups. The third factor distinguishes the two Noyons samples from the remainder whilst the fourth, fifth and sixth factors do not separate any of the sampled groups.

Since it is possible that the difference between the two Noyons samples and the remainder is so strong that it masks variability within the remaining samples, these two samples were omitted and the analysis repeated. Again, six factors were found and a plot of F1 against F2 scores indicates that most of the samples have a similar composition with the two redware mortaria samples, one of the oxidized ware samples and one of the greyware samples forming outliers (Fig 1). The F1 scores are due mainly to high rare earth element scores (positive scores) and high potassium and barium scores (negative scores,) and the F2 scores are mainly due to high Rare Earth Element scores (positive, the Fabric M4 sample and V4092) and high lithium scores (negative, the Fabric M5 sample and V4097).

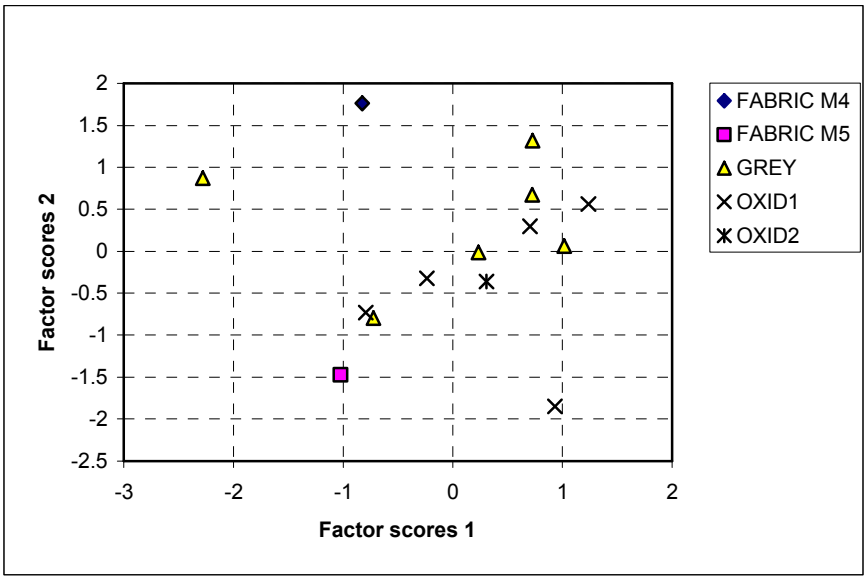

Figure 1

That these differences are very subtle is indicated by a test to find statistical outliers (i.e. normalised element values which lie outside of four standard deviations from the mean for each element). This test fails to distinguish any of the outliers from Fig 1 and instead finds that the calcium content of V4096, a greyware jar, and the sodium and cobalt contents of V4100, another greyware jar, are outside that range whilst all other values are within the range.

Comparison of the Putative Noyons Mortaria and Colchester products

No data on the composition of Noyons products from the kiln sites were available for comparison with the Fabric M1 and M1v samples but it was possible to compare the two Lease Rigg samples with two samples of Colchester mortaria and a group of other Colchester products (Samian ware, Terra Nigra, Colour-coated ware and coarsewares). In addition, a large flagon base from York was included, since visually it has a very similar appearance to the Noyons mortaria.

Factor analysis of this dataset found four factors, of which the first two account for 58% of the variability in the data (eigenvalues of 5.39 and 3.28 respectively). A bi-plot of these two factors indicates that the two Colchester mortaria together with a pentice-rimmed beaker have high F2 scores which distinguish them from the remaining Colchester samples and the two Lease Rigg samples and the York flagon base. Furthermore, the Factor 1 scores distinguish this second Colchester group from the Lease Rigg and York samples, which are probable Noyons products.

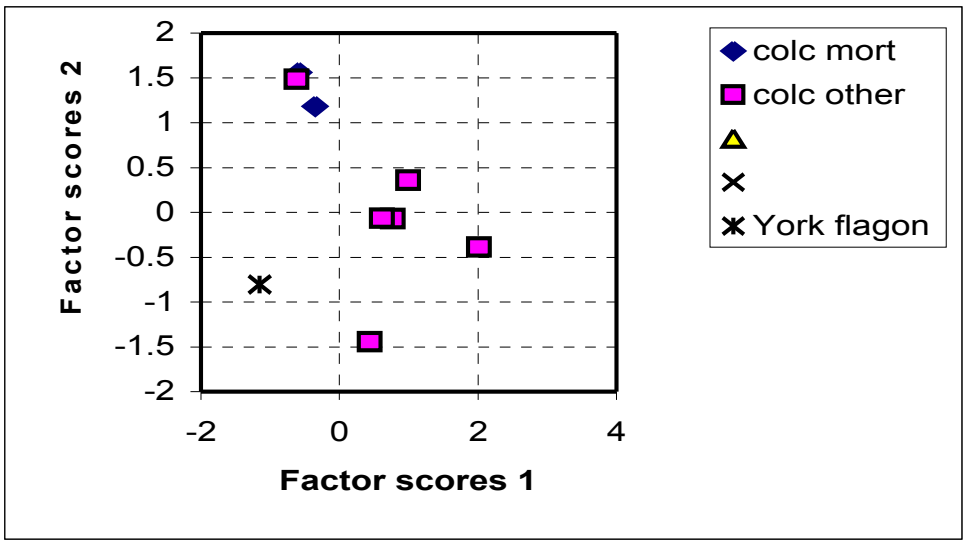

Figure 2

Factor analysis of the omitted elements found two factors (eigenvalues 5.93 and 2.76, cumulative frequency 87%) and a bi-plot of these two factor scores separates the Colchester mortaria from the rest through their high F2 scores and separates the Lease Rigg samples from the remaining Colchester samples, and the York flagon, through the negative F1 scores of the Lease Rigg samples. This is due to the higher zirconium, calcium and strontium values found in the Colchester mortaria and the low rare earth element scores found in the Lease Rigg mortaria.

Comparison with other Yorkshire red earthenwares and clays

Table 2 lists various datasets which were compared with the Lease Rigg 'local' data. Unfortunately, only one analysis of Eboracum ware is known to the author but that analysis shows that its chemical composition is similar to that of late medieval Humberware produced at Fishergate. No samples of Malton/Norton wares are available. Samples of boulder clay from Robin Hoods Bay provide the only data from clays outcropping near Lease Rigg.

Table 2

locality	Description	Reference	Total
Aldborough	A stamped mortarium	This paper	1
Easington	Till from the sea cliff	AVAC collection	1
Easingwold	Samples of fired and unfired clay from a medieval industrial site	AVAC collection	6
Ebberston	Sample of clay from surface of weathered Upper Jurassic sandstone	AVAC collection	1
Filey	Till from the sea cliff	AVAC collection	1
Hawnby	Slumped Middle Jurassic mudstone	AVAC collection	1
Mappleton	Till from the sea cliff	AVAC collection	2
North Cave	Sample of clay overlying flint/chalk gravel	AVAC collection	1
Ravenscar	Sample of clay overlying Upper Jurassic sandstone	AVAC collection	1
Rievaulx	Medieval roof tiles, probably produced at Wethercott, Hawnby	Senior 1999; 2005; vince 2006/61	6

Robin Hood's Bay	Till from the sea cliff	AVAC collection	1
Sancton	Sample of clay from surface of blown sand (2 different exposures)	AVAC collection	2
Scarborough	Slumped Middle Jurassic mudstone	AVAC collection	2
West Heslerton	Unfired clay from Anglo-Saxon settlement (one unfired and one fired sample from 6 pieces)	AVAC collection	12
York	1 sample of Eboracum ware tazza from Coppergate and samples of late medieval Humberware wasters from Fishergate.	Vince and Steane 2005	11

Factor analysis (omitting calcium and other mobile elements) indicated that the clay samples from Ebberston, Scarborough, Sancton, North Cave, Easington, Mappleton, and West Heslerton were very different in composition from the Lease Rigg samples, as were the Ryedale tile samples, the York samples and these acted to mask any differences within the remaining samples.

This left samples of a mortarium produced at Aldborough and clay from Easingwold, both in the Vale of York; boulder clay from Filey; Middle Jurassic clay from Hawnby; boulder clay from Ravenscar and Robin Hood's Bay. Factor analysis of this reduced dataset found six factors. Factor 1 and 2 scores separated the Aldborough, Filey, Ravenscar and Robin Hoods Bay samples from the remainder (i.e. Lease Rigg, Hawnby and Easingwold) and Factor 3 and 4 scores separated the Easingwold and Hawnby samples from those from Lease Rigg. Thus, the Lease Rigg samples are more similar to each other than they are to any of the comparanda, and they are closest in composition to clays from Easingwold. These Easingwold clays were boulder clay formed mostly from mixed red-firing and light-firing Middle Jurassic clays and this is precisely the source inferred from x20 binocular microscope study of the Lease Rigg wares.

Conclusions

The thin section and chemical analysis are consistent with the M1 and M1V mortaria being imported from the Noyons area of northern Gaul and with the Lease Rigg samples being produced locally. However, the closest chemical comparison is with boulder clay from Easingwold, which also has similar sand inclusions in thin section, and this suggests that any boulder clay formed from a mixture of red-firing and light-firing Middle Jurassic clays in the North Yorkshire Moors area would have a similar appearance and chemical composition. It is quite likely that some of the clays used to produce Eboracum wares are also composed mainly of redeposited Middle Jurassic clays whilst the Fishergate Humberware and Eboracum ware tazza analysed were made from clays with a different origin, probably the warp and lacustrine clays which underlie York and form much of the surrounding terrain.

The samples include a mortaria in a fabric (M4) which Kay Hartley suggests was produced at York or at Malton as well as a white-slipped flagon whose typology suggests is of early 2nd-century date. Two of the M4 mortaria have typological features which also suggest an early 2nd-century date. If a single source was supplying Lease Rigg in the late 1st and early 2nd

centuries, then this would either imply that the pottery continued in production. Furthermore, the finish of the M4 mortaria suggest to Hartley that they more competently produced than the M5, “local” mortaria.

Therefore, although a local source is consistent with the thin section and chemical analyses it would have to have been a long-lived source and would imply either a continuous occupation of the fort or the re-starting of pottery production in the early 2nd century. The close similarity in composition between the Lease Rigg samples and the Easingwold boulder clay suggests that a source in the Vale of York is also possible and would be consistent with the one stamped mortarium known from the site, which was not sampled but which on stamp evidence Kay Hartley identifies as a product of the Appletree Farm pottery at Heworth. This pottery was situated on warp and lacustrine clay but is less than a mile from the outcrop of the same boulder clay which occurs at Easingwold. Unfortunately, therefore, further work is required to establish beyond doubt the source of the Lease Rigg pottery.

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