Petrological Analysis of Roman Pottery from Market Rasen

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The pottery from excavations on the Market Rasen Roman kiln field has been examined using thin-sections and chemical analysis (Vince 2001) in order to determine what raw materials were used by the potters and the potential of scientific methods to answer questions about the production and distribution of these products.

This report is based on a visual examination of 66 samples of Market Rasen pottery under a binocular microscope, augmented by 12 thin-sections (Table 1).

The thin-sections were prepared by Paul Hands, Department of Earth Sciences, University of Birmingham. The sections were polished, to allow future study of opaque inclusions using reflected light microscopy, and stained using Dickson's method. This staining distinguishes various carbonates. Non-ferroan calcite stains pink, ferroan calcite stains blue and dolomite is unstained. The thin-sections have been given sample numbers and added to the AVAC reference collection where they can be consulted by appointment.

Table 1

TSNO	FIRING	SITECODE	REFNO	CNAME	FORM
V0939	black	mrc65	TS07	VESIC	JEV
V0944	black	MRGF68	TS12	VESIC	JLS
V0947	grey	MRGF68	TS15	GRRO	JCUR
V0963	grey	MRC65	TS31	VESIC	DFL
V0965	grey	MRA66	TS33	GREY	DTR
V0975	black	MRA66	TS43	PART	BCO
V0977	black	MRGF68	TS45	PART	CLSD
V0981	black	mrc65	TS49	PART	BK
V0991	black	MRA65	TS59	PART	CLSD

Petrological Description

The Market Rasen products were divided into four fabric groups during recording under the supervision of M J Darling. These groups are the basis for the description given here. There is evidence for post-burial concretions in most of the samples. These consist of brown phosphate filling some laminae and sandy clay adhering to several sherd surfaces and filling those voids and laminae closest to the surface of the sherd. In addition, there are more complex post-depositional changes visible in one of the fabrics, VESIC, which seems to have undergone both leaching and subsequent deposition within the leached voids.

GREY

Only one sample of Market Rasen greyware was thin-sectioned (V965). A second sample was reclassified after binocular microscope study as VESIC. A further 10 samples were examined visually using a binocular microscope.

The thin-section reveals an abundant illsorted quartzose sand, composed mainly of monocrystalline quartz grains with sparse orthoclase feldspar, fine-grained sandstone fragments and chert. The grains include both well-rounded and sub-rounded examples and range from c.0.2mm to c.1.0mm. Sparse rounded opaque grains up to 0.5mm were also present. The groundmass consists of moderate silt-sized quartz grains, sparse titanium oxides (identified in reflected light) and sparse unidentified accessory minerals in a matrix of anisotropic clay minerals.

All of these characteristics can be paralleled in thin-sections of sand-tempered wares produced in the Trent Valley and at Lincoln. Presumably non-calcareous Quaternary sands in the Witham and Ancholme valleys have similar characteristics. The clay matrix is too silty to be obtained from the Oxford clay which underlies the Ancholme valley, nor is there any sign that it was an organic clay. Of the 11 samples examined, 3 were oxidized throughout, 7 were reduced and only one had a black core, indicating the presence of carbon.

The petrological similarity of this fabric to that produced at various sites in the Trent valley, from Knaith down to Torksey, and in the Swanpool area south of Lincoln, mean that there is no simple petrological characteristic which could be used to identify Market Rasen greyware.

GRRO

A single sample of Market Rasen greyware with rounded quartz sand temper was thin-sectioned (V947). A further 8 samples were examined visually using a binocular microscope.

The thin-section reveals a moderately abundant quartz sand, the grains of which are monocrystalline and rounded. These grains range from 0.5 to 1.5mm across. The grain outlines include re-entrant angles and are typical of those found in lower Cretaceous deposits, such as the Spilsby sandstone. No evidence for any cement was noted on the grains, however, and their immediate source is therefore likely to have been a detrital sand. A finer sand was also present, with few grains larger than 0.5mm. The grains were subangular. No examples of either fine-grained sandstone or rounded chert were noted. The groundmass consists of moderate silt-sized quartz grains, rounded opaque inclusions up to 0.2mm across (these appear to be clay-based in reflected light) and sparse to moderate muscovite laths of similar size in a matrix of anisotropic clay minerals. Sparse titanium oxide grains of silt size were noted in reflected light.

Neither the groundmass nor the sand temper in GRRO is identical to that in GREY and it seems therefore that both the clay and sand come from different sources. However, this conclusion would need

to be confirmed by further thin-sectioning. The source of the rounded sand is probably a detrital sand derived from the Spilsby sandstone and therefore is probably a sand from a stream or river draining the western side of the Wolds south of Market Rasen. The source of the clay itself is not known. Glauconite, which is characteristic of many of the lower Cretaceous clays, is not present. The original organic content of the clay is not clear. Four of the 9 samples examined visually had black cores, four were grey and one oxidized.

PART

Four samples of Market Rasen Parisian ware were thin-sectioned (V975, V977, V981 and V991). A further 21 samples were examined visually using a binocular microscope.

The four thin-sections each have similar petrological characteristics and therefore a single description is given here. A quartzose sand is present in all the samples, but mainly only as sparse grains. In one, V975, however, the sand occurs more frequently, as lenses within a much finer-textured fabric. It is likely, however, that the sand is an accidental contaminant rather than deliberate temper. The sand is composed of the same range of minerals and rocks as that in GREY, although no grains as large as those found (rarely) in GREY were present. The groundmass consists of abundant silt-sized quartz grains, sparse muscovite and rare unidentified accessory minerals in a matrix of carbon-rich clay minerals. Around the margins of the section the carbon had been burnt away revealing a light-coloured anisotropic clay with dark staining, perhaps of manganese. Rare rounded laminated clay pellets of similar colour and texture to the groundmass were present, ranging up to 3.0mm across. Sparse microfossils, represented as voids, were present. These included one from a bivalve with an ornamented shell.

The quartz sand is probably from the same source as that in GREY. The groundmass may also be the same as that in GREY although no muscovite was noted in the single section of GREY, where the quantity of quartz silt is also lower than that in two of the sections, but similar to that in the remaining two. These two sections contain abundant angular silt-sized inclusions which are opaque in thin-section and only moderately reflective under reflected light. They cannot, therefore, be iron oxides. So far as can be seen there is no correlation between these differences and their chemical composition. Two compositional sub-groups were noted in the study of the ICPS analyses and the four sectioned samples fall into both groups. There is no obvious petrological explanation for these groups, which cut across the division based on opaque inclusions (Table 2). The relict clay pellets suggest that the parent clay was bedded, silty and organic. This indicates that the clay was used 'as dug' without either additional tempering or cleaning.

Table 2

TSNo	Chemical sub-group	Abundant opaques?	Comments

V981	B	No	
V977	B	Yes	
V991	A	Yes	
V975	A	No	Lenses of quartz sand

VESIC

Three samples of Market Rasen vesicular ware were thin-sectioned (V939, V944 and V963). A further 14 samples were examined visually using a binocular microscope. All three thin-sectioned samples proved to be heavily leached, removing virtually all calcareous inclusions.

The three thin-sections all have similar petrological characteristics. The fabric is tempered with a rounded quartz sand, similar to that used in GRRO, in which the larger grains are rounded and of Cretaceous character whilst the smaller grains are sub-rounded. In addition, they contain rounded opaque grains of iron oxide (identified in reflected light), rounded fragments of phosphate and rounded fragments of flint. These inclusions range up to 1.5mm across. Angular shell fragments, almost all represented by voids, some of which are filled with secondary phosphate occur in all three sections. In the few cases where calcite remains in the shell void it consists of prisms of ferroan calcite lining the void with an empty core. This too is likely to be secondary, post-burial, deposition. The groundmass consists of anisotropic clay minerals with sparse quartz silt and muscovite laths. Sparse rounded clay pellets occur. These are not laminated and do not contain quartz sand grains.

The lack of silt in the clay matrix distinguishes this fabric from the other three and indicates the use of a different clay source, perhaps the Oxford Clay. The inclusions seem to have two sources. The finer quartz sand is similar to that in GREY and PART whereas the coarser sand is coarser and more varied in character than that in the single section of GRRO, but probably of similar Cretaceous origin. It is difficult to say much about the shell temper since no original material remains in the sectioned samples.

Discussion

There are petrological differences between all four fabrics, although the small number of thin-sections makes it impossible to say how significant some of these might be. Nevertheless, it seems that GRRO and VESIC include coarse sand/gravel temper derived from the western side Wolds south of Market Rasen. It is likely that PART and GREY utilised the same raw materials, with the greyware being a sand-tempered version of the fine Parisian ware fabric. The finer-textured matrix of VESIC, together with its range of inclusions, suggests that this ware was produced from different raw materials and this is also true for GRRO.

There is no obvious reason why there should be differences in sand temper if all three of these fabric groups were produced at Market Rasen and it is tempting to suggest that only PART and GREY were produced on site and the other two wares were made locally and brought onto the site for use. This could be tested by studying the character of the underlying sands and gravels in the Market Rasen area to determine whether the two rounded sands used in GRRO and VESIC were locally available. The origin of the shell temper used in VESIC remains unknown. Samples of unleached VESIC in which the shell remains intact would need to be sectioned before one could say, for instance, whether the shell is of fossil or recent origin and whether or not it comes from a cemented rock or not.