Petrological Analysis of Late Medieval Pottery from Stoke-on-Trent

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Excavations at the School of Art in Burslem revealed evidence for late medieval pottery production. The products of this industry were divided visually into four fabric groups, A to D. Of these, Groups A and D were examples of Midlands White Ware (MWW), Group B was a Late Medieval Orange ware (LMO) and Group C was a Midlands Purple ware (MP). Samples of these four groups were selected for thin section analysis to establish the raw materials used by the potters, evidence for preparation of the clay and the relationship of the visual groups to raw materials (i.e. were the groups produced by firing the same fabric in different ways or were different materials used for each group?).

The Burslem School of Art samples were also compared with production waste from the Market Place, Burslem (BMP01) and samples from a medieval moated site at Lawn Farm, Berry Hill, Stoke-on-Trent (LAF00). Samples of the products of the Sneyd Green kiln were previously taken by the author but these were studied using chemical analysis without any thin sectioning as they were part of a pilot study to test the feasibility of using this technique for characterising northern English medieval whitewares. Late to post-medieval pottery from sites in Staffordshire was also examined by Dr R. Ixer, then of the School of Earth Sciences, University of Birmingham, but these wares are black-glazed redwares of later date.

The samples were prepared by Dr Peter Hill and thin sections were made by Steve Caldwell of the School of Earth Sciences, University of Manchester. The thin sections were stained using Dickson's method which distinguishes calcites from dolomite but no calcareous inclusions were present. The samples were added to the AVAC reference collection under the codes V1880 to V1898. They can be consulted at the AVAC offices by prior arrangement (Table 1).

Table 1

Sitecode	Context	TSNO	Action	cname	subfabric
bsa00	1501	V1880	TS	MWW	A
bsa00	1501	V1881	TS	MWW	A
bsa00	1252	V1882	TS	MWW	A
bsa00	1204	V1883	TS	LMO	B
bsa00	1204	V1884	TS	LMO	B
bsa00	1204	V1885	TS	LMO	B
bsa00	1501	V1886	TS	LMO	B
Bsa00	1204	V1887	TS	MP	C
Bsa00	1511	V1888	TS	MP	C
Bsa00	1511	V1889	TS	MP	C

Bsa00	1204	V1890	TS	MWW	D
Bsa00	1605	V1891	TS	MWW	D
bmp01	5003	V1892	TS	MWW	
bmp01	5003	V1893	TS	MWW	
bmp01	503	V1894	TS	MP	
bmp01	573	V1895	TS	LMO	
bmp01	531	V1896	TS	MWW	
laf00	1101	V1897	TS	MWW	
laf00	1117	V1898	TS	MWW	

Description

The thin sections reveal that the samples have a restricted range of inclusion types and other characteristics and are best described as a single group, followed by a discussion of the relationships of the various fabric groups and of the material from the three sites.

Quartzose sand

All the samples contained rounded quartzose sand. There were variations in the composition and grain size distribution of these sands however. All the samples contained rounded quartzose grains up to 0.5mm across. A small proportion of these grains were polycrystalline quartz, some of which showed evidence of a metamorphic origin. Another small proportion, less than 12.5%, were derived from siltstones and fine-grained sandstones. No matrix was visible and the grains were presumably bonded through contact solution of the quartz. The majority, however, were monocrystalline grains.

In addition to these grains, larger, rounded grains were also present in some samples. These grains included monocrystalline quartz, chert and sandstones containing rounded quartz grains and ranged up to 1.5mm across.

Iron-rich inclusions

Rounded and subangular opaque black inclusions up to 0.5mm across were present in all the thin sections. The rounding suggests that they are detrital origin. The alternative interpretations, that they are of biological origin (faecal pellets) or authigenic (concretionary nodules) were considered and rejected.

In some samples the grains have been altered by firing. In some cases this resulted in an opaque halo around the inclusion, which was sometimes still present but shrunk, leaving a void around the central grain, and sometimes completely void (possibly plucked out of the section during preparation).

Groundmass

There were four distinct types of groundmass present. One of these, Groundmass 1, was red-firing and included sparse quartz silt inclusions (LMO and MP samples). The others were light-firing and included relict clay fragments together with abundant rounded brown inclusions c.0.1mm across (possibly faecal pellets). The majority of these light-firing clays, Groundmass 2, contained few silt-sized inclusions but in one case, Groundmass 3, the fabric contained abundant quartz silt up to 0.1mm across. To judge by their colour, there is actually little difference in iron content between the more iron-rich examples of Groundmass 2 and the samples of Groundmass 1. Finally, there was a group of samples whose groundmass had the same characteristics as the whitewares but whose iron content, and colour, were comparable with the samples with Groundmass 1. These are assigned to Groundmass 4.

By and large, the vessels made from the Groundmass 1 had isotropic clay matrices, in which the majority of the clay minerals had been altered to form isotropic ceramics. In some cases vitrification had gone further, producing a black fabric with the start of a vesicular fabric developing.

The light-firing clays, by and large, had anisotropic clay matrices, composed in the main of kaolinitic clay. However, in some of the latter samples the iron-rich inclusions showed as higher degree of heat alteration than those in the red-firing wares. This suggests that in fact the light-firing wares were sometimes fired at higher temperatures than the red-firing ones but that the red-firing clays were less able to withstand the firing conditions.

There was a considerable variation in colour within the 'light-bodied' samples. Samples V1881, V1890, V1892 and V1893 had the lightest colour with samples V1880, V1882, V1896 and V1898 all being appreciably redder. Sample V1891 had a dark grey colour. It is likely that the division in colour reflects iron content and (in the case of V1891) firing temperature.

Discussion

Without access to samples of unworked clay, either from the production site or from nearby geological outcrops it is impossible to be absolutely certain about the source of the raw materials and their preparation. It is quite clear, however, that the clay used for the whitewares, was derived from the Coal Measures seatearths. These clays are fossilised soils and are often found immediately below coal beds. Their iron content is variable because they were subjected to extreme weathering in which iron and other minerals, probably including silica, were leached from the clay, leaving behind a kaolinite-rich clay with little quartz (Groundmass 2) and producing a lower horizon enriched in iron (Groundmass 4). Running through these coal beds were fossilised riverlets whose fills contain higher quantities of quartz silt. It is possible that the silty whiteware sample, Groundmass 3, came from such a deposit. Because of the redeposition of silica and clay during pedogenesis and subsequent compression, these clays are often hard when dug and if not milled or cleaned (either by sieving or levigation) can contain a high quantity of relict clay pellets.

The red-firing clays with Groundmass 1 appear to have a different origin and are more similar to the Triassic clays found in the Mercian Mudstone. Such clays are often highly calcareous and there is no evidence from these sections to show that the samples contain any calcareous matter nor that calcium carbonate was one present. However, one of the sample of this group had unmixed lenses of whiter clay and it may be that even these fabrics were produced from Coal Measures clays.

The sands present appear to vary in texture and the coarser sands have a higher proportion and wider range of detrital sedimentary inclusions, such as chert, sandstones and the occasional igneous rock fragment. The present of fine-grained sedimentary rock fragments in both the coarser and finer-textured samples suggests that they are derived from the same parent body and that the textural differences are either caused by the selection of sands of differing grades or by the sieving of the finer sands. Without samples of local sands for comparison it is not possible to say which interpretation is correct. The general character of the sands is comparable with that of fluvio-glacial and alluvial sands found over large areas of the west and north-west midlands, in which the majority of the material is probably derived from Triassic sandstones with some more far-flung erratic grains.

The results of the petrological analysis can be summarised in tabular form (Table 2).

Table 2

Texture	Groundmass 1	Groundmass 2 (lighter colour)	Groundmass 2 (redder colour)	Groundmass 3	Groundmass 4
Medium-textured sand		BSA00 MWW (A and D); BMP01 MWW	BSA00 MWW (A and D);LAF00 MWW	LAF00 MWW	
Fine-textured sand	BSA00 MP		BMP01 MWW		BSA00 LMO;BMP01 MP
little or no sand					BMP01 LMO

From Table 2 we can see that both the coarser and finer sands were used at the School of Art but that they were used for different wares: The coarser sand was used for Midlands Whitewares and the finer sand for Midlands Purple and Late Medieval Oxidized wares. Similarly, three of the four groundmass types were found at the School of Art. Groundmass types 2 (lighter and darker variants) and 4 were all derived from the Coal Measures clays but there was clearly a deliberate selection of different coloured clays for different wares.

The samples from the Burslem Market Place include three with similar characteristics to those from the School of Art (V1892-4) and two which differ. The sample of LMO contains almost no quartz sand, in contrast to all the School of Art samples, whilst one of the samples of MWW, V1896, has a finer-textured sand than that used in the School of Art whitewares. However, these differences need not mean that these two samples were made using different raw materials from those used by the School of Art potters since the decision to omit sand is one that they might have occasionally made, whilst the finer-textured sand was being used at the School of Art, but for LMO rather than whitewares.

Of the two samples from Lawn Farm, Berry Hill, one is paralleled by a sample from the School of Art (V1898) and the other has the silty groundmass, V1897, which is unique within the samples.

In summary, there are seven distinct fabrics found within the samples, of which four were found at the School of Art site. The other three are best seen as minor variants and may turn out to be present in the School of Art assemblage but at such a low frequency that they were not sampled.

The main unsolved question is the origin of the clay used for the School of Art Midlands Purple ware. Thin sections may give a misleading impression here, since two of the three samples are partially or completely vitrified, which will have substantially altered the appearance of the texture in thin section. It may be, however, that a different, iron-rich, clay was chosen for the Midlands Purple ware precisely because of its low fluxing point. It is likely that chemical analysis of the two groups with iron-rich groundmasses would show conclusively which of these two options is correct.