Characterisation Studies of Grooved Ware from Durrington Walls, Wiltshire (DW07): Pilot Study

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Excavations at the Neolithic henge at Durrington Walls in 2007 revealed a considerable quantity of domestic debris, suggesting that the site, in contrast to the neighbouring Stonehenge, was intensively occupied.

In order to investigate this occupation in more detail, it is proposed to carry out a study of the catchment area of the site. This study will concentrate on the supply of animals, utilising isotope analyses. However, the author was asked to advise on the potential of the pottery from the site, of which over 10,000 sherds have been recovered. Pottery from Wainwright's excavations at Durrington Walls has been analysed in thin section by Finch (Finch 1971) and subsequently 49 vessels from those excavations were re-examined by Cleal at x20 magnification (Cleal 1995). The results of these studies indicate that shell is a major component of the inclusion suites, being noted in five of the fourteen thin sections described by Finch and in 34% of the vessels studied by Cleal.

Neither study was able to establish the source of the shell temper, although Finch suggests that it is "probably fossil shell-brachiopods", for which a Jurassic limestone would be the closest source. This suggests that a sizable proportion of the Durrington Walls Grooved Ware might have been brought to the site from sources at least 20 miles to the west.

It was thought that a larger study, employing stained thin sections and chemical analysis might provide clearer indications of the source(s) of the Durrington Walls Grooved Ware but that before applying to undertake a large project a small pilot study should be carried out. For this, five vessels from the 2007 excavations were sampled (Table 1). Thin sections were produced by Steve Caldwell, University of Manchester, and stained using Dickson's method (Dickson 1965). Sub-samples of each sherd were submitted to Dr J N Walsh, Royal Holloway College, London, where they were analysed using Inductively Coupled Plasma Spectroscopy.

Table 1

TSNO	Sitecode	Context	REFNO	cname
V5090	DW07	1386	10180	GROOVED WARE
V5091	DW07	868		GROOVED WARE
V5092	DW07	1383	10208	GROOVED WARE
V5093	DW07	1359	11870	GROOVED WARE
V5094	DW07	1386		GROOVED WARE

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http://www.postex.demon.co.uk/index.html
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http://www.avac.uklinux.net/potcat/pdfs/avac2008090.pdf

Thin Section Analysis

Although there are strong similarities between several of the thin sections they are each individually described below.

V5090 (Fig 1)

The following inclusion types were noted in thin section:

- Quartz. Moderate well-rounded grains up to 0.5mm across. At x20 magnification, many of these rounded grains are seen to be polished.
- Clay pellets. Moderate angular and subangular fragments up to 2.0mm across.
- Siltstone. Rare rounded grains up to 0.5mm across.
- Sandstone. Rare rounded grains up to 0.5mm across composed of interlocking subangular quartz grains up to 0.2mm across.
- Chert. Rare subangular fragments up to 0.5mm across containing angular quartz grains and dark brown opaque grains with a cryptocrystalline silica matrix.
- Bivalve shell. Rare non-ferroan calcite shell up to 0.5mm long.
- Ferroan calcite. Rare subangular fragments up to 0.3mm across.
- Bone. Rare subangular fragment 0.3mm across.
- The groundmass consists of dark brown anisotropic baked clay and moderate angular quartz grains up to 0.1mm across and rare muscovite laths up to 0.1mm long.

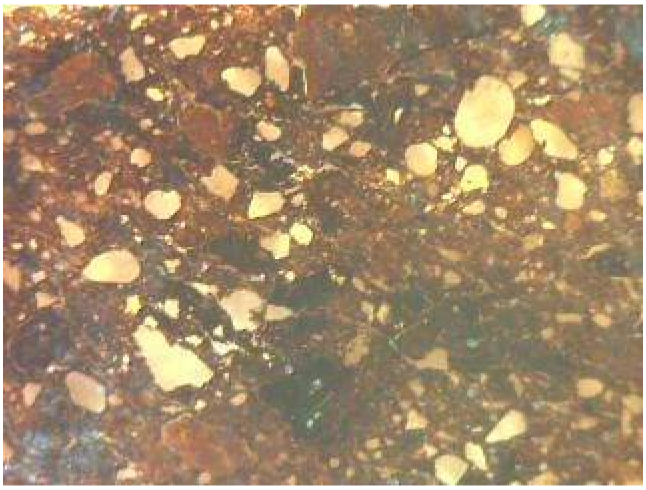


Figure 1

V5091 (Fig 2)

The following inclusion types were noted in thin section:

- Quartz. Moderate grains of varying roundness up to 0.5m across. Some of these are well-rounded with a high sphericity and others have one or more flat edges, indicating that they come from a sandstone with overgrown quartz grains. At x20 magnification, many of these rounded grains are seen to be polished.
- Calcareous sandstone. Rare fragments with subangular quartz grains up to 0.3mm across in a groundmass of ferroan calcite.
- Clay pellets. Moderate subangular fragments up to 2.0mm across. These contain the same range of inclusions as the groundmass but are sometimes slightly darker or lighter in colour than the surrounding groundmass.
- Voids. Sparse well-rounded voids up to 1.0mm across
- Chalk. Sparse well-rounded light brown stained micrite pellets up to 2.0mm across with sparse spherical microfossils c.0.01mm across.
- Muscovite. Sparse laths up to 0.2mm long.
- Altered glauconite. Moderate well-rounded grains up to 0.5mm across, many of which are almost opaque.
- Calcareous concretions. Fine-grained, calcium carbonate concretions coat the broken sherd edges and fill those voids closest to the sherd edges.
- Shell. Sparse non-ferroan calcite bivalve shell up to 0.5mm long.
- Flint; Sparse angular fresh flint up to 0.5mm across.
- The groundmass is mainly black, opaque, except at the margins where it can be light brown and anisotropic. Moderate angular quartz up to 0.1mm across.

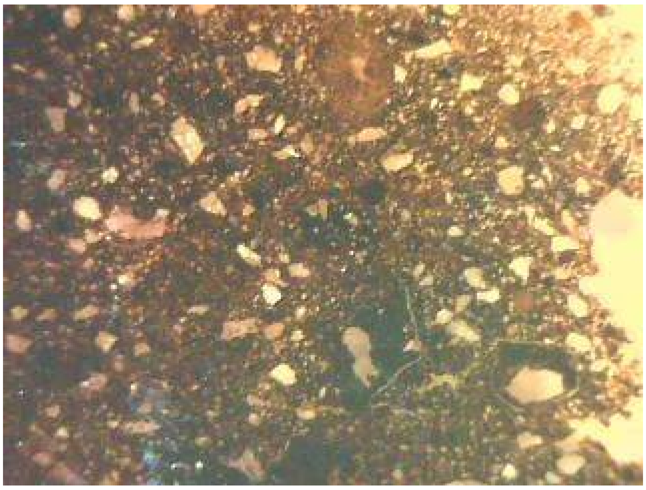


Figure 2

V5092 (Fig 3)

The following inclusion types were noted in thin section:

- Quartz. Abundant subangular and angular fragments up to 0.3mm across, several with one or more flat faces. Sparse well-rounded grains, some probably of Lower Cretaceous origin. At x20 magnification, some of these rounded grains are seen to be polished.
- Clay Pellets. Moderate subangular fragments up to 3.0mm across. Similar in texture and inclusion range to the groundmass but with either lighter or darker colour than the surrounding groundmass.
- Opaques. Sparse angular fragments with some quartz inclusions, up to 1.0mm across
- Flint. Sparse angular unstained fragments up to 0.5mm across.
- Altered Glauconite. Moderate rounded grains up to 0.3mm across.
- Chalk. Sparse rounded fragments up to 2.0mm across.
- Calcareous concretions. Fine-grained non-ferroan calcite concretions around the broken edges of the sherd.
- Phosphate. Sparse, probably secondary infill of voids, up to 1.5mm across.
- The groundmass is mainly opaque black but at the margins it is dark brown and anisotropic. Abundant angular quartz and sparse muscovite laths up to 0.1mm long.

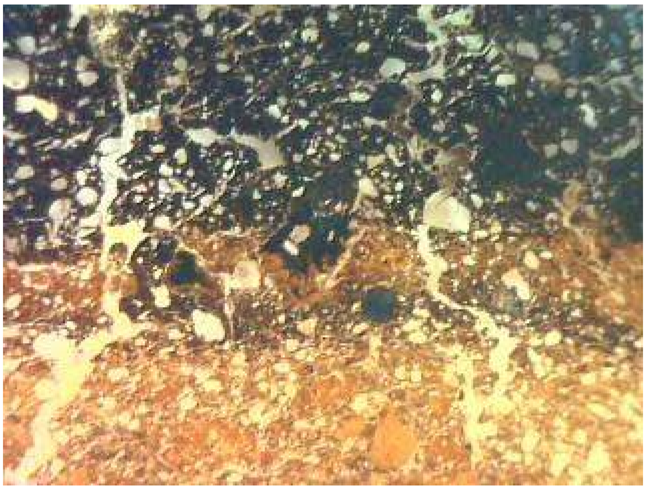


Figure 3

V5093 (Fig 4)

The following inclusion types were noted:

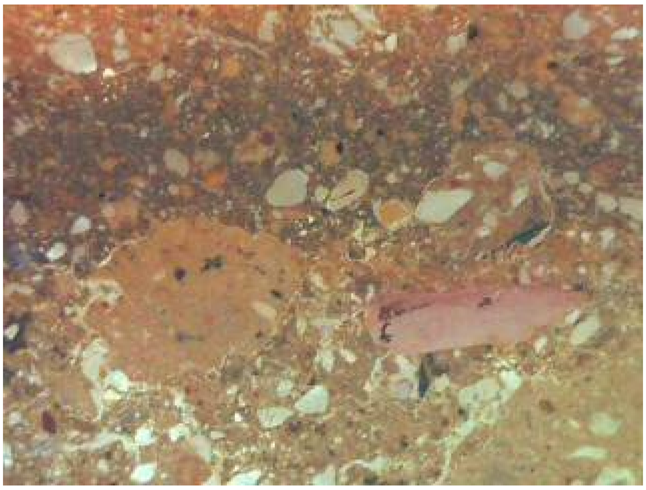
- Quartz. Abundant angular and subangular grains up to 0.3mm across. Sparse well-rounded grains up to 0.5mm across, some cracked. At x20 magnification, many of these rounded grains are seen to be polished.
- Clay Pellets. Moderate subangular fragments up to 2.0mm across with a similar texture to the groundmass but often differing in colour to the surrounding groundmass.
- Altered Glauconite. Moderate rounded grains up to 0.3mm across.
- Chalk. Sparse rounded fragments up to 0.5mm across.
- Bivalve shell. Moderate non-ferroan calcite fragments up to 1.5mm long, some with brown staining.
- Opaques. Sparse rounded grains up to 0.3mm across.
- Bone. Rare rounded unstained fragment up to 0.3mm across.
- Plagioclase feldspar. Rare subangular fragments up to 0.3mm across.
- Siltstone. Rare subangular fragments up to 0.3mm across.
- Calcareous concretions. Fine-grained non-ferroan calcite concretions around the broken edges of the sherd enclosing opaque angular fragments (carbonised organics?).
- The groundmass is dark brown anisotropic baked clay with a small area of opaque black clay at the core. Abundant angular quartz and sparse muscovite up to 0.1mm long.
- 

Figure 4

V5094 (Fig 5)

The following inclusion types were noted in thin section:

- Quartz. Abundant angular and subangular grains up to 0.3mm across.
- Clay pellets. Abundant subangular fragments up to 2.0mm across. Similar in texture and range of inclusions to the groundmass.
- Bivalve shell. Moderate angular fragments up to 2.0mm long, mostly with clearly visible laminae parallel to the surfaces of the shell and some brown staining.
- Organics. Rare carbonised organic inclusions up to 1.5mm long and c.0.2mm wide.
- Flint. Rare angular unstained fragments up to 0.5mm long.
- Chert. Rare angular fragment containing angular quartz grains up to 0.3mm across in a cryptocrystalline silica matrix.
- Calcareous concretions. Fine-grained calcite coating broken sherd edges.
- The groundmass consists of opaque black baked clay, ranging to dark brown anisotropic clay at the margins.

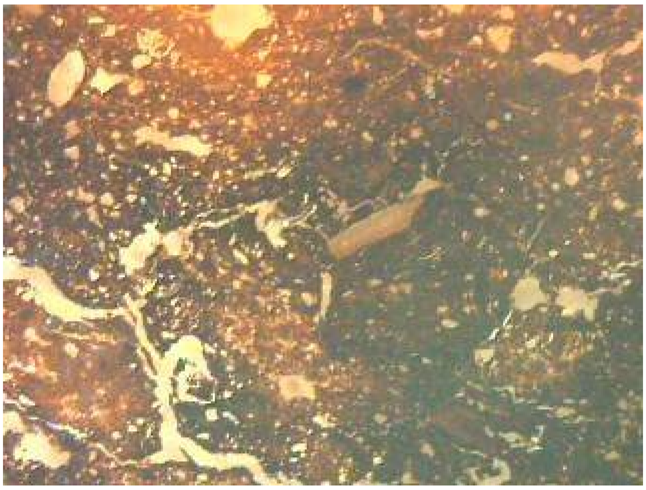


Figure 5

Discussion of thin section evidence

Clay pellets

A feature of much prehistoric pottery is the presence of angular or subangular clay fragments with similar inclusions to those found in the groundmass. These might be interpreted as relict clay, fragments of the potting clay which were not broken down during preparation, or they might be interpreted as grog, fragments of broken pottery vessels ground up and added to the potting clay. In the Durrington Walls thin sections most of these fragments have a higher organic content than the surrounding groundmass, which is not consistent with their being twice-fired. However, in some cases, although similar in composition to the groundmass they are not identical, having either slightly fewer or more inclusions, or differing in the relative proportions of inclusion types. Such a contrast is consistent with these being relict clay fragments in which the groundmass has been homogenised by kneading the clay, leaving the relict clay fragments to vary in texture. The lack of rounding may suggest that this relict clay was added as dry clay, to control the working properties of the potting clay and to give the vessel some stability during production.

Upper Cretaceous inclusions

Both chalk and angular flint fragments occur in some of the sections (one or the other is present in all sections except for V5090). The chalk fragments are consistently well-rounded and this suggests that the material is present as part of a detrital sand rather than weathering of chalk *in situ.* Clay-with-flints occurs in patches over the chalk and fills solution holes and joints in the chalk. However, the frequency of flint fragments in this clay is much higher than seen in any of the five thin sections, allowing clay-with-flints to be discounted as a potential source of the potting clay.

Lower Cretaceous inclusions

Altered glauconite is present in moderate quantities in three of the sections (V5091-3). Possible Lower Cretaceous chert is present in a further section (V5094) and rounded quartz grains with the distinctive outline found in quartz from Lower Cretaceous deposits was noted in one section (V5092). In one section, rounded opaque grains were present which may have originally been glauconite (V5093).

In addition, examination of the sherds at x20 magnification revealed polished quartz grains, clearly ultimately of Lower Cretaceous origin, were present in all but one sample (the exception is V5094).

In no case are there large fragments of sandstone or chert which might indicate that the clay came from a weathered outcrop of Lower Cretaceous rocks and it is likely that in each case the inclusions are detrital. However, glauconite is a soft mineral and the presence of these inclusions in quantity suggests that the outcrop is relatively close to the source of the potting clay (for comparison, the frequency of Lower Cretaceous inclusions is much higher in these sections than it is in ceramics made from terrace sands in the London area, where the material has been transported over 30 miles from the closest source, Vince and Jenner 1991).

Two rivers whose alluvial deposits probably contain Lower Cretaceous material are the Avon, which runs past Durrington Walls, and whose headwaters originate in the Lower Cretaceous deposits of the Vale of Pewsey, and the Wyle, whose headwaters rise well to the west of Salisbury Plain. By contrast, the Nadder cuts through a complex mixture of Lower Cretaceous deposits, including cherts and the Gault clay and alluvial deposits in this valley might be expected to have more chert and a mica-rich silty groundmass than was noted in the Durrington Walls thin sections.

Bivalve shell

Bivalve shell fragments occur in all but one of the sections (V5092 is the exception, despite the fact that other calcareous inclusions are present). In no case was any matrix seen adhering to the shell fragment but in some cases it was clear that the shell had been abraded and stained. Therefore, it is most likely that the shell is present in the detrital sand rather than being added separately or being naturally present in the potting clay when dug. The shell fragments have taken up less staining than the chalk fragments but more than the calcareous concretions on the potsherds. But this does not really give a clue as to the source of the shell. One possibility is that they are freshwater aquatic molluscs, such as the pea mussel or the swan mussel. The structure of the shell, with obvious laminae parallel to the shell surface, is consistent with this identification. Recent shell normally has an organic content which is burnt off during firing, giving rise to a dark halo surrounding the shell fragment. However, the organic content of these vessels is so high that this halo would not have been visible even if present. The other possibility is that they are fossil shell of Tertiary age. None of the Tertiary deposits in the Durrington area are reported to be shelly and the nearest source would be in the Hampshire basin, 10-15 miles to the southeast of Durrington. However, such a source would be in conflict with the evidence for a Cretaceous origin noted above. Therefore, it is most likely that the shell is present in the sand component of the potting clay and is of recent freshwater origin.

Triassic-derived Quartzose sand

Several inclusion types are reminiscent of sands found in the midlands and Thames valley which are composed mainly of material of Triassic origin. These include well-rounded quartz grains which in the hand specimen are seen to have matt surfaces as opposed to the water-polished grains of Lower Cretaceous origin (so-called millet-grain quartz); rounded siltstone fragments and rounded sandstone fragments. None of these are distinctive enough for positive identification but taken together they suggest that the quartz sand in V5090 has a Triassic-derived component. Such material might be present in plateau gravels in southern central England but the closest to Wiltshire that the author has actually noted such sand is eastern Berkshire.

Chemical Analysis

The five samples were each taken from an offcut of the sample from which all potentially contaminated material had been mechanically removed. Normally this involved the removal of c.1.0mm of the sample from all surfaces.

The ICPS analysis measured a series of major elements as percent oxides (App 1) and a series of minor and trace elements, measured in parts per million (App 2).

An estimate of the silica and organic content was obtained by subtracting the total measured oxides from 100%. The mean estimated silica/organic content is 72.44% with a standard deviation of 3.22% and indicates no large differences between the samples.

The ICPS data were normalised to aluminium and then examined to establish the structure of the data. Two samples stood out: V5090 has lower iron and higher aluminium, sodium and potassium values than the remainder and V5093 has higher calcium, phosphorus and strontium values. The iron, aluminium, sodium and potassium differences are each greater than one standard deviation from the mean for the remainder suggesting that they are significant. Furthermore neither sodium nor potassium is particular mobile and neither are likely to reflect post-burial leaching or concretion. Since all the samples are essentially unleached, with calcareous inclusions being present in each, the high calcium, phosphorus and strontium values in V5093 are probably a reflection of a higher incidence of shell inclusions than in the remainder. Nevertheless, all three elements were omitted from further analysis.

Factor analysis of the normalised data, excluding calcium, phosphorus and strontium, found four factors with eigenvalues of 1 or over. Cumulatively they account for 99.6% of the variability in the dataset.

Factor 1 scores are mainly due to high weightings for magnesium, potassium and sodium, and negative weightings for iron and cerium. Factor 2 scores are mainly due to high weightings for copper, manganese, zinc, dysprosium, yttrium and ytterbium.

A plot of the F1 and F2 scores (Fig 6) shows that V5090 is distinguished by its F1 score but that the F2 scores do no seem to have much patterning.

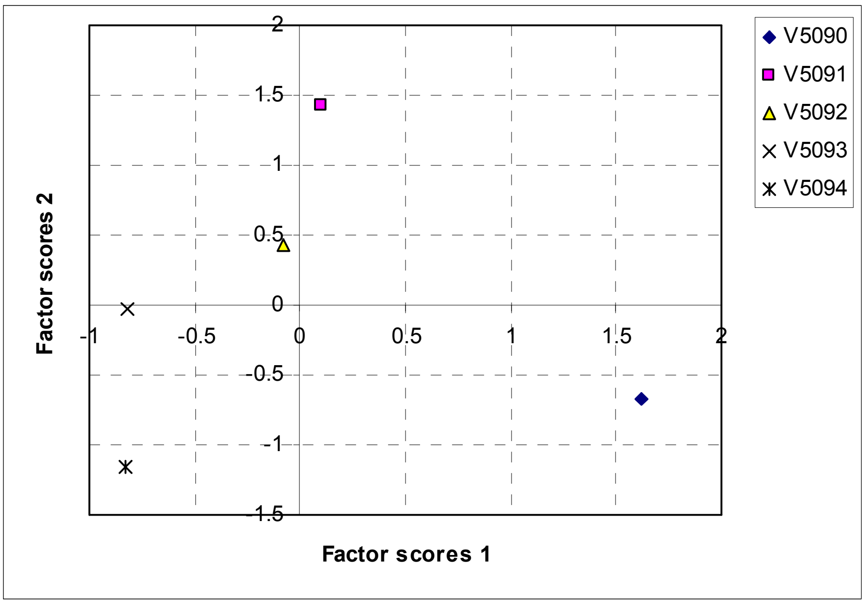


Figure 6

The F3 scores depend mainly on a high nickel weighting and the F4 scores depend on a high vanadium weighting. A plot of F3 against F4 scores (Fig 7) shows no obvious patterning.

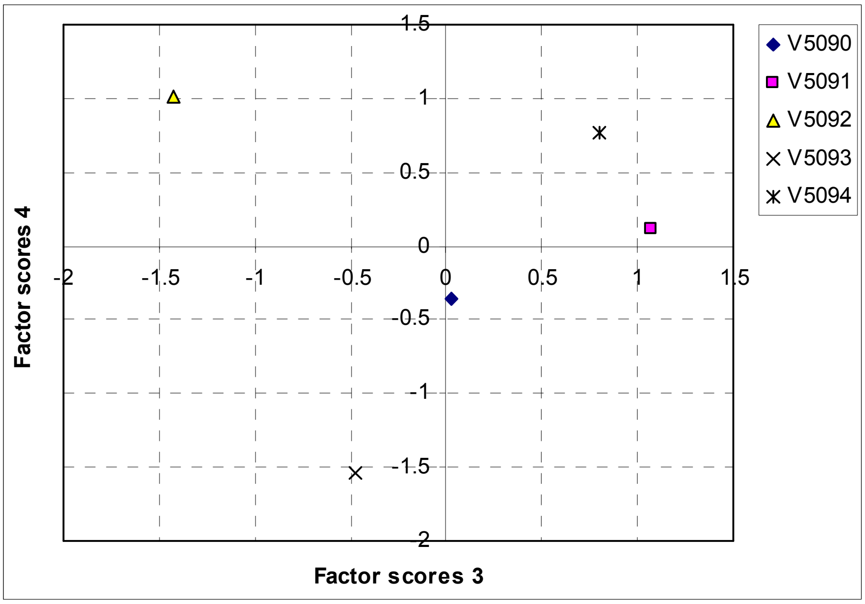


Figure 7

The ICPS data were then compared with other data from Wessex. The Durrington Walls samples were clearly distinguishable from samples of pottery produced at Michelmersh, Hampshire, but more similar to samples of Iron Age flint-tempered wares from various sites in Hampshire, and two samples of fired clay, from Basingstoke and Corhampton. Factor analysis of this dataset revealed four factors, of which the first and second show some patterning. In a plot of the F1 and F2 scores (Fig 8) four of the Durrington Walls samples show higher F1 and F2 scores than the various other samples whilst one sample, V5090, has scores similar to those of flint-tempered wares from a variety of Hampshire localities (Corhampton, Andover, Danebury, Southampton. The only samples which do not match are two flint-tempered vessels from Silchester and the fired clay samples.

It is likely that all the flint-tempered samples, and the fired clays, were produced from clay-with-flints and that the majority of the samples (those which match V5090) were produced at a single centre in southern Hampshire.

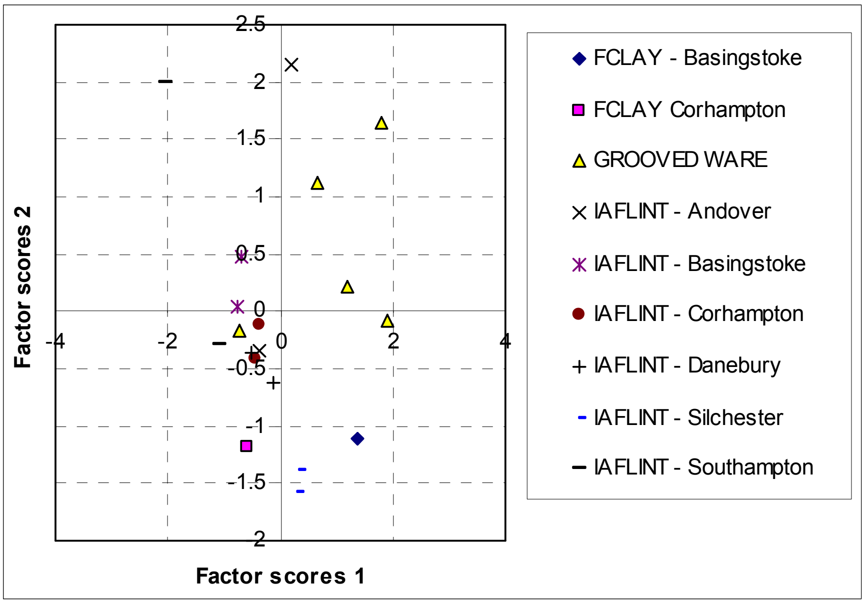


Figure 8

Discussion of ICPS evidence

The ICPS data suggests that V5090 was made from different raw materials than the remaining four samples. The main group of four samples have compositions which distinguish them from various samples from Hampshire (no relevant Wiltshire data is available for comparison, only samples of white-firing wares produced from Tertiary Reading Beds which outcrop to the southeast of Salisbury) whilst V5090 is similar to samples probably made from clay-with-flints in southern Hampshire.

Conclusions

The thin section evidence suggests that four of the five samples were produced from an alluvial clay which contains detrital sand derived from Lower and Upper Cretaceous sources, together, probably, with freshwater bivalve shell. The closest source for this material is the Avon valley immediately to the east of Durrington Walls.

The fifth sample has a slightly different range of inclusions, but includes bivalve shell and bone. It is also distinguished by a difference in chemical composition, principally a lower iron content and higher sodium and potassium values. Since feldspars were not noted in V5090, these differences may be due to the clay mineral composition.

These results, when compared with those of Finch and Cleal, suggest that the majority of the Durrington Walls Grooved Ware pottery was locally produced. Of the 49 vessels examined by Cleal, 8% (4 vessels) contain no visible inclusions, 6% (3 vessels) contain sand (presumably rounded quartz) and 34% (16 or 17 sherds) were of “other fabrics”. These are the only sherds for which a non-local origin can be postulated. They presumably include the two oolitic sherds listed in Cleal’s Table 16.1.

Of the 14 sherds thin sectioned by Finch only one, 697121, contains different inclusions from those seen in these five sherds (shelly limestone) whilst a local origin is likely for the remaining 13 samples.

These results pose problems for further analysis. On the one hand, one of the major inclusion types present, altered glauconite, is not identifiable reliably by eye even at x20 magnification whilst on the other, the four vessels which both thin section and chemical analysis suggest are locally produced include three with moderate altered glauconite and one in which no glauconite was present. These differences probably reflect variability in a single outcrop of local alluvial clay but might be more significant. Cleal's approach, to classify the fabrics according to the predominant inclusion types, produces eight groups for Durrington Walls where perhaps only one was actually present. Nor is it likely that this approach would distinguish pottery made in any of the valleys cutting across the Plain (although those whose headwaters do no lie outside the chalk ought not contain glauconite).

One approach would be a binocular microscope study of a sample of the pottery followed by thin section and chemical analysis of samples highlighted by this study as having unusual inclusions, texture, colour or appearance. Another approach would be take a random sample stratified according to site interpretation, to establish whether there is any difference in source for the pottery used in different parts of the site or different phases or perhaps stratified according to decoration or typological features to determine whether different groups of potters can be identified.

Perhaps the best approach would be an amalgamation of all three approaches.

The other approach which might prove informative is to take samples of Grooved Ware from other sites and to compare the Grooved Ware pottery with fired clay from Durrington Walls and with clay and sand samples taken from the alluvium of the Avon valley. In all cases a combination of thin section and chemical analysis is likely to be the most useful.

Bibliography

Cleal, R. M. J. (1995) "Pottery fabrics in Wessex in the fourth to second millennia BC." in I. Kinnes and G. Varndell, eds., *Unbaked Urns of Rudely Shape*, Oxbow Monograph 55

Dickson, J. A. D. (1965) "A modified staining technique for carbonates in thin section." *Nature*, 205, 587

Finch, L. A. (1971) "IX. Report on the petrological examination of sherds frm Durrington Walls." in G. J. Wainwright and I. H. Longworth, eds., *Durrington Walls: Excavations 1966-1968*, Reports of the Research Committee of the Society of Antiquaries of London XXIX The Society of Antiquaries, London, Vince, A. G. and Jenner, M. A. (1991) "The Saxon and Early Medieval Pottery of London." in A. G. Vince, ed., *Aspects of Saxo-Norman London: 2, Finds and Environmental Evidence*, London Middlesex Archaeol Soc Spec Pap 12 London Middlesex Archaeol Soc, London, 19-119

Appendix 1

TSNO	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO
V5090	13.34	5.30	3.14	2.79	0.40	2.93	0.57	0.20	0.054
V5091	10.99	6.30	1.16	3.55	0.18	1.60	0.53	0.54	0.148
V5092	11.85	6.04	0.74	2.64	0.22	1.20	0.57	1.88	0.130
V5093	11.56	7.22	0.59	6.18	0.23	1.00	0.46	5.35	0.096
V5094	12.85	7.09	0.95	2.41	0.20	1.42	0.54	0.55	0.085

Appendix 2

TSNO	Ba	Cr	Cu	Li	Ni	Sc	Sr	V	Y	Zr*	La	Ce	Nd	Sm	Eu	Dy	Yb	Pb	Zn	Co
V5090	403	96	25	71	40	12	99	82	18	92	31	65	33	4	1	4	2	12	105	12
V5091	396	102	33	59	57	12	97	76	62	68	56	88	63	11	3	11	4	16	121	14
V5092	298	109	29	41	26	12	106	85	48	75	57	82	62	9	2	9	3	18	108	13
V5093	473	105	27	34	34	12	270	61	46	69	58	97	61	9	2	7	3	15	108	14
V5094	376	113	22	62	55	13	101	96	37	84	46	101	50	11	2	7	3	21	110	14