Petrological Analysis of Selected Early Anglo-Saxon Pottery from Springhead and Northfleet, Kent

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Samples of eight early Anglo-Saxon pottery vessels from excavations at Springhead and Northfleet, Kent, were submitted by Lorraine Mepham for thin-section analysis following a visual study which suggested that they contained unusual inclusions (Table 1). This analysis indicated that all but one of the samples did indeed contain rock fragments not local to North Kent. The vessels could be grouped into five fabric groups on the basis of the most common or distinctive inclusion types: oolitic limestone; quartz-microcline granite; coarse-grained sandstone; volcanic rock; and sandstone. It is suggested that three of these fabrics are regional imports from East Anglia whilst the remainder were produced in North Kent, but with the addition of angular volcanic rock fragments to the fabric.

Table 1

Site Code	TSNO	Context	Subfabric
ARC SPH00	V4541	2869	
ARC EBB01	V4540	30076	FT: Q400
ARC EBB01	V4539	10045	FT: Q405
ARC EBB01	V4538	10179	FT: R403
ARC EBB01	V4537	3971012	FT: R402
ARC EBB01	V4536	10274	FT: R400
ARC EBB01	V4535	10536	FT: C401
ARC EBB01	V4534	10415	FT: Q410

Oolitic limestone (V4535 and V4541)

The two sections containing oolitic limestone are sufficiently similar to be given a single fabric description. Even so, there is a considerable difference in the range of inclusions found in the two sections. The following inclusion types were noted:

- Oolitic limestone. Mainly moderate ooliths, usually with no trace of cement. The ooliths range from c.0.3mm to 1.0mm across. The outer layer usually consists of almost colourless micrite whilst the inner layers consist of brown-stained micrite surrounding a core composed often of an angular shell fragment or amorphous micrite pellet. In a few cases rock fragments composed of several ooliths occur, ranging up to 1.5mm across. These show no signs of rounding. The cement consists of light brown micrite.

- Fossiliferous Limestone (only in V4535). Moderate angular fragments up to 0.5mm across consisting of a ferroan calcite groundmass containing small angular fragments of shell and amorphous brown micrite. One fragment contains a brown spherical grain c.0.3mm across.
- Quartz. Moderate angular overgrown grains were present in V4541 and sparse well-rounded grains up to 0.5mm across were present in V4535.
- Coarse-Grained sandstone (only in V4541). Sparse fragments of coarse-grained sandstone composed of overgrown quartz grains with a grey kaolinitic cement filling some pores.
- Flint (only in V4535). Rare angular fragments of unstained flint.
- Organics (only in V4535). Sparse carbonised matter in elongate voids.
- Microcline feldspar. Rare angular fragment up to 0.3mm across.
- Plagioclase feldspar. Rare angular fragments up to 0.3mm across.
- Opaques. Sparse rounded grains up to 0.5mm across.
- Chert. Sparse brown grains.
- Gastropod (only in V4541). Rare fragment of non-ferroan calcite gastropod shell 1.5mm across with non-ferroan calcite micrite filling.
- Bivalve shell. Sparse fragments of thin-walled shell (c.0.05mm thick and up to 0.3mm long).
- Siltstone (only in V4541). Rare rounded fragment of brown siltstone finer in texture than the groundmass.
- Mudstone (only in V4541). Rare rounded fragment of brown mudstone finer in texture than the groundmass.
- The groundmass consists of dark brown optically anisotropic baked clay minerals, moderate angular quartz and feldspar laths up to 0.2mm long and sparse rounded opaque grains up to 0.1mm across.

Interpretation

No oolitic limestones outcrop in the geology of southeast England although oolitic limestone fragments do sometimes occur in calcareous Thames gravels. Similarly, no source for the overgrown quartz grains and coarse-grained sandstone fragments found in V4541 outcrops within the Wealden district and the material is identical in thin section to coarse-grained Carboniferous sandstones, such as the Millstone Grit and the Pennant sandstone of the Forest of Dean and the Bristol coalfield. Oolitic limestones and Millstone Grit sandstones occur together in fluvio-glacial deposits in East Anglia (predominantly in Suffolk, in the

Chalky-Jurassic drift) and examples have been noted in thin-sections of early Anglo-Saxon pottery vessels from Thetford, interpreted there as being of local production. The presence of flint excludes the possibility of a Leicestershire source but a source in a boulder clay to the southeast of the Mountsorrel outcrop, in Cambridgeshire, south Norfolk or Suffolk is quite possible.

Quartz/Microcline granite (V4536)

The following inclusion types were noted:

- Acid igneous rock. Angular fragments of a rock composed of microcline feldspar, quartz, perthite and zoned orthoclase feldspar with the inner zone being heavily altered to sericite and biotite. The fragments range up to 2.0mm across.
- Coarse-grained sandstone. A rock composed of overgrown quartz grains.
- Limestone. Sparse rock fragments up to 0.5mm with a ferroan calcite groundmass containing grains of rounded brown micrite and shell fragments, including punctate brachiopods.
- Oolitic limestone. Sparse fragments up to 0.5mm across. Similar to those in V4535 and V4531.
- The groundmass consists of optically anisotropic baked clay minerals, moderate angular quartz and feldspar, muscovite laths up to 0.2mm long and sparse angular opaque grains up to 0.1mm across.

Interpretation

The groundmass of this sample is very similar to that of the two oolitic limestone tempered samples and probably the interpretation of all three should be considered together. The angular igneous rock fragments could be erratics of Scottish or Scandinavian origin or could be from the Mountsorrel granodiorite outcrop in north-east Leicestershire. Given the presence of oolitic limestone, which does not outcrop along the east coast of England and is not a feature of Northern Drift deposits of Scottish/Scandinavian origin in Yorkshire, Lincolnshire or Norfolk, a Leicestershire origin for the igneous rock seems certain. Chalky-Jurassic boulder clays outcrop in south Cambridgeshire, South Norfolk and Suffolk.

Coarse-grained Sandstone (V4540)

The following inclusion types were noted in thin section:

- Coarse Grained Sandstone. Abundant fragments of similar character to those in the oolitic limestone-tempered and granite-tempered fabrics.
- Opaques. Rounded grains up to 1.0mm across with sparse angular quartz inclusions.

- Biotite. A single large sheaf of biotite 1.0mm long.
- Organics. Sparse elongate voids containing carbonised material and surrounded by darkened haloes.
- Plagioclase feldspar. Sparse angular fragments up to 0.5mm long.
- The groundmass consists of optically anisotropic baked clay minerals, moderate angular quartz and feldspar, muscovite laths up to 0.2mm long and sparse angular opaque grains up to 0.1mm across.

Interpretation

The groundmass in this section is identical to those found in the oolitic limestone and granitic fabrics. All the inclusions are of types found in those two fabrics, differing in the much greater frequency of coarse-grained sandstone fragments.

Volcanic rock (V4534, V4537-9)

The four sections containing volcanic rock fragments all sufficiently different to be given individual fabric descriptions. The volcanic rock fragments are similar in each case.

- Volcanic rock fragments. Sparse to rare fragments between c.0.2mm and 1.0mm across. The larger fragments show some sign of rounding but the smaller ones are angular. The rock has a cryptocrystalline groundmass similar to that of chert but with laths of feldspar and some unidentified minerals with a zoned structure, up to 0.2mm long and abundant euhedral opaque grains less than 0.05mm across. There are sparse pores up to 0.1mm across some of which are filled with ferroan calcite.
  The glassy groundmass is recrystallised indicating a possible Palaeozoic date. Such volcanic outcrops occur in Leicestershire, Devon, the Welsh border and the Scottish border. Tertiary volcanic activity in the Massif Central and the Eifel mountains produced rocks which are similar in appearance in thin section but there are no obvious geological processes which could have led to the deposition of rounded fragments from these sources in North Kent. An ash fall would consist solely of sharply angular shards or spheroidal glass, neither of which are present and given the distance from either of these sources the size of the fragments precludes these sources. The pores are not numerous enough for the material to have drifted, the explanation for pumice found along the strand line around the Mediterranean coast (pumice has an average porosity of 90% (http://en.wikipedia.org/wiki/Pumice). Thus a Canary Islands or Mediterranean source can be excluded.
  The closest sources of volcanic rock to Northfleet are the pre-glacial gravels of the proto-Thames, which ran well to the north of the modern river and the pebble beds of the Wealden Series (Gallois 1965, 22) which have been identified as being of Old Red Sandstone age. The author's experience of these Devonian rocks, in the sand

used to temper Exeter Bedford Garage ware, suggests that they would be more altered that those in these samples (Vince in Allan 1984) but this is also true of the volcanic rocks found in the Kesgrave gravels (Sumbler 1996, Fig 31). The other possibility is that the volcanic rock fragments are weathered or deliberately added fragments of central French or Rhenish lava artefacts, of Roman or early Anglo-Saxon date.

Non-volcanic inclusions in each sample suggest a local source.

Sample V4534 (Q410)

- Fossiliferous limestone. Moderate angular fragments with a ferroan calcite groundmass and angular non-ferroan calcite fossil sand. One fragment includes a sponge spicule.
- Rounded quartz. Sparse well-rounded grains up to 0.5mm across, many with dark brown veins and some with a dark brown coating.
- Overgrown quartz. Moderate grains with euhedral faces and often the ghost of the original rounded surface within, between c.0.2mm and 0.5mm across.
- Sandstone. Sparse fragments composed of overgrown quartz grains up to 0.5mm across.
- Flint. Sparse fragments. One well-rounded, spherical grain c.0.4mm across and one brown-stained with a dark brown coating.
- The groundmass consists of optically anisotropic baked clay minerals, abundant angular quartz, sparse muscovite, ferroan calcite, and rounded opaques.

Interpretation

Without the volcanic grains, the inclusions in this sample suggest a source in the Weald, or an alluvial deposit from a river draining the Weald. The flint fragments indicate a small contribution from Tertiary deposits, indicating that the source lies close to the mouth of the river.

Sample V4537 (R402)

- Volcanic rocks. All the fragments have exactly the same mineralogy and could be derived from a single larger fragment. The fragments range from c.0.2mm to 1.5mm across and are all angular.
- Sandstone. Moderate angular fragments of a sandstone up to 2.0mm across consisting of rounded quartz grains, rounded opaque grains and rounded brown grains, all c.0.2mm to 0.5mm across in a groundmass of isotropic light brown phosphate. Some of the quartz grains have brown veins.

- Quartz. Sparse well-rounded grains, some with brown veins, up to 0,.5mm across.
- Flint. Sparse angular colourless fragments up to 0.5mm across.
- Opaques. Moderate rounded grains up to 0.5mm across
- The groundmass consists of dark brown and black optically anisotropic baked clay minerals, abundant angular quartz, sparse feldspar, and angular flint, all up to 0.2mm long, and muscovite laths up to 0.1mm long.

Interpretation

In this section the volcanic rocks have the same size range and distribution as the sandstone fragments and both inclusion types probably therefore share the same history. Most likely the were added to the pottery fabric as crushed rock although a complex geological process cannot be completely dismissed. The sandstone is of lower Cretaceous origin and phosphatic nodule beds occur in several of the members of the Lower Greensand (1965). Excluding the rounded quartz, which probably originated in the sandstone fragments, the remaining inclusions and the groundmass are consistent with an estuarine origin on the north Kent coast or a Tertiary silty clay.

Sample V4538 (R403)

- Volcanic rocks. Moderate subangular fragments ranging from c.0.3mm to 1.5mm across. All of very similar lithology.
- Silicious limestone. Moderate angular fragments of a mixed colloidal silica and fine-grained calcite rock ranging from c.0.3mm to c.1.5mm across. Some fragments contain chalcedony-filled spheres. This is probably a Malmstone from the Upper Greensand.
- Limestone. Moderate fragments of a ferroan-calcite cemented limestone ranging from c.0.1mm to c.0.5mm across. The rock contains fragments of non-ferroan calcite polyzoa and shell together with thin lenses of gypsum.
- Quartz. Sparse well-rounded grains up to 0.5mm across.
- Opaques. Sparse rounded grains up to 0.3mm across.
- The groundmass consists of dark brown and black optically anisotropic baked clay minerals, abundant angular quartz up to 0.2mm across and flint.

Interpretation

The limestone fragments and the volcanic rocks have a similar size range distribution and rounding and probably entered the pot through the same route. The identification of the silicious limestone as an Upper Greensand Malmstone leads one to look for suitable candidates of similar age for the ferroan calcite-cemented limestone but no Wealden

limestone is noted as containing gypsum in the BGS regional guide (1965) and the fossil fragments are too small and fragmentary for close identification.

The flint-bearing silty groundmass is similar to that of V4537 and also must have a Tertiary or Quaternary source.

Sandstone (V4539)

The following inclusion types were noted:

- Quartz. Abundant overgrown grains c.0.3 to 0.5mm across. The original rounded grain boundary is often visible, due to the presence of brown veins and inclusion trails in the original grain.
- Organics. Sparse elongate voids, some containing carbonised materials.
- Flint. Rare brown-stained angular grains up to 0.5mm across.
- Sandstone. Sparse fragments composed of overgrown quartz grains.
- Altered glauconite. Sparse red grains c.0.2mm across.
- The groundmass consists of optically anisotropic baked clay minerals, abundant angular quartz, sparse angular flint, and sparse muscovite laths up to 0.1mm long.

Interpretation

The sandstone and quartz inclusions are derived from one of the Lower Cretaceous sandstones. The purity of the sand suggests the Folkestone Beds. The remaining inclusions are probably naturally present in a Tertiary silty clay or Quaternary estuarine silt.

Discussion

These samples fall into two groups. The first consists of four vessels which have inclusions which in combination only occur in boulder clay in East Anglia. The groundmass in all four samples is similar in texture and mineralogy and is reminiscent of Mercian Mudstones, which because of their deposition in a desert environment contain a high proportion of feldspar in the silt fraction which in a more humid environment would be altered to micaceous minerals. The presence of Mountsorrel granodiorite indicates that this is a Chalky-Jurassic boulder clay whilst the presence of flint indicates that the till is somewhere to the east of the chalk outcrop. This limits the potential source to southeast Cambridgeshire, Suffolk or north Essex. Given its later dominance in coastal trade, it is possible that the vessels were exported through Ipswich.

The second group of vessels is the volcanic rock group. Omitting these rock fragments, the three samples all consist of angular rock fragments in a silty groundmass containing angular flint. This indicates either the use of a Tertiary Clay, probably the London Clay, or Quaternary

estuarine silt. The rock fragments in each sample differ in type and frequency but all can be matched in the Lower Cretaceous geology of the south-east. Most likely all were present in Quaternary sand and the presence of relatively soft inclusions, such as phosphate nodules and limestones, suggests that this sand originated in one of the rivers which cuts through the North Downs, such as the Darent or the Medway, rather than the Thames itself, whose gravels do contain the harder, non-calcareous Lower Cretaceous rock fragments. The Ebbsfleet only rises at Springhead and cannot therefore be the source of this sand. The lack of chalk inclusions is remarkable, given that the sand is calcareous and that the presence of rounded flint and angular flint grains in the matrix clearly indicates that the clay was obtained from a deposit to the north of the North Downs. Fig 1 shows a schematic map of the solid geology of the Springhead area. The green deposit is Lower Greensand, the yellow is Upper Greensand and the dark blue is chalk. Pink is the Woolwich Beds and Oldhaven beds and the light blue is London Clay. The groundmass of the Volcanic rock and sandstone groups matches the Woolwich Beds and London Clay and small outcrops occur to the south of the sites as well as extensively elsewhere in this part of the lower Thames.

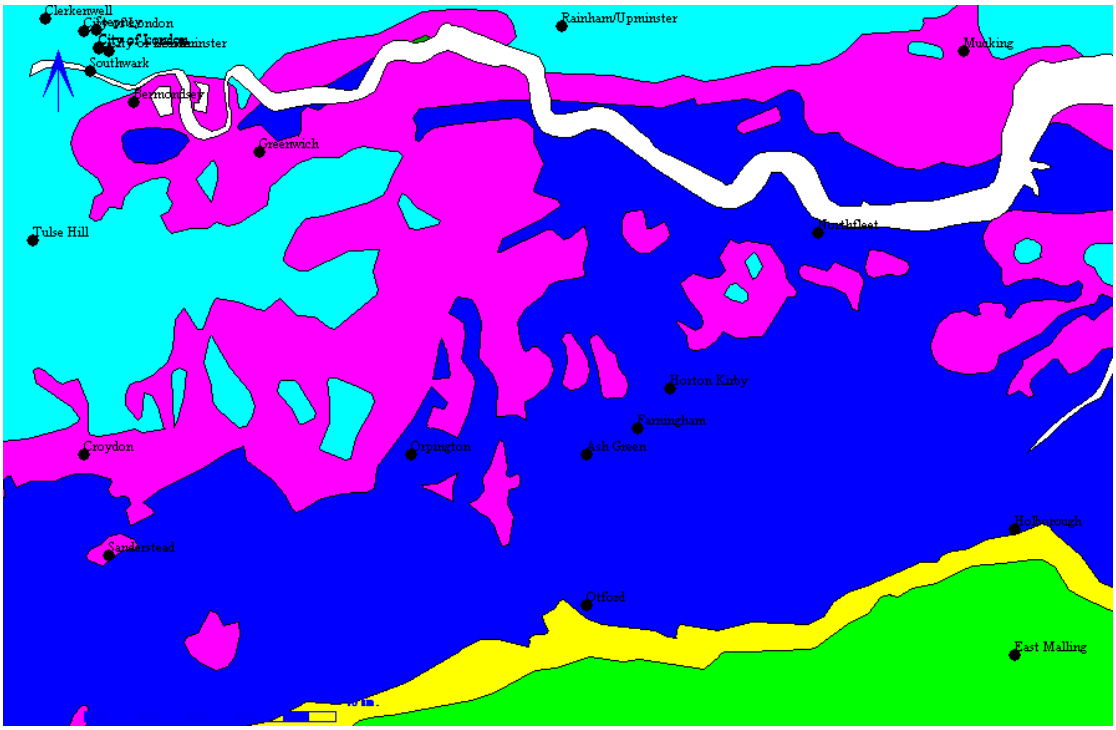

Figure 1

The variations in the character of the sand fraction in the Volcanic rock and sandstone groups could indicate different sources for each sample but is more likely to reflect the variably nature of the sand. The presence of volcanic rock in three of the samples makes it likely that these three samples at least come from a single source. It is conceivable that this volcanic rock is of natural origin, derived from the Wealden pebble beds, and the presence of lower Cretaceous rock fragments in the sand would be consistent with this. However, this would require testing through the sampling and analysis of sands from the area. A more likely

possibility is that the rock fragments are derived from lava quern stones, although the similarity in size, roundness and sorting of the volcanic rock fragments to the other coarser inclusions in these three samples suggests that all the coarser inclusions have a similar origin. Either a selection of rocks was crushed for used as temper or a sand incorporating weathered quern fragments was used.

The suggestion that the samples essentially come from two sources, East Anglia and North Kent, could be tested by chemical analysis of the clays to see if they fall into two groups.

Bibliography

Allan, J P (1984) *Medieval and Post-Medieval Finds from Exeter, 1971-1980*. Exeter Archaeol Rep 3 Exeter City Council & University of Exeter

Gallois, R. W. (1965) *The Wealden District* , HMSO, London