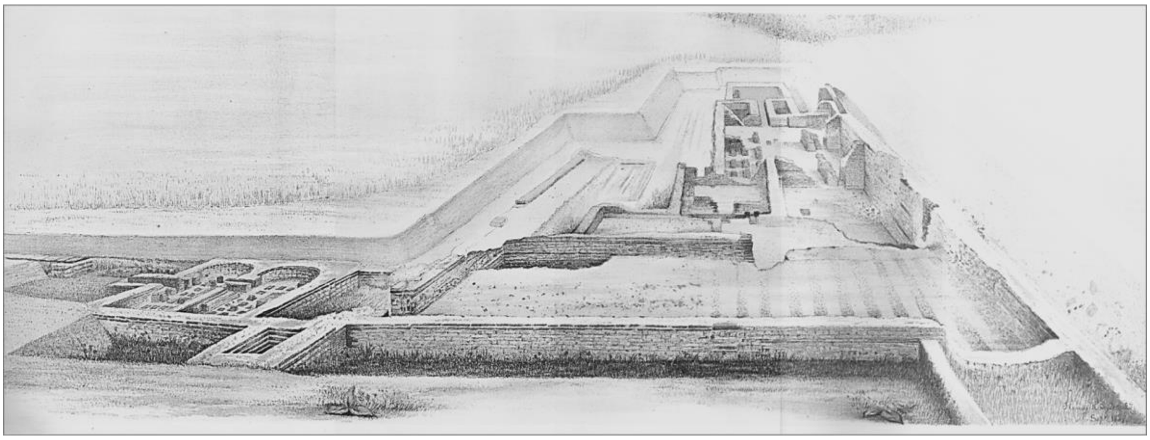
Constructing *Calleva*:

a multidisciplinary study of the production, distribution, and consumption of ceramic building materials at the Roman town of Silchester, Hampshire.



Submitted for the Degree of Doctor of Philosophy

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Declaration:

I confirm that this is my own work and the use of all material from other sources has been properly and fully acknowledged.

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Abstract

Ceramic building materials (CBM) typically represent the largest category of artefacts recorded at Romano British sites. As it is subject to selective retention policies, the potential of CBM to contribute to our knowledge and understanding of the construction industry and the development of both individual buildings and settlements more generally is often overlooked.

This project investigated an urban CBM assemblage, incorporating all forms of CBM recovered. A detailed analysis of the fabric and forms of all the CBM retained from excavations at the Roman town of *Calleva Atrebatum*, Silchester, has been completed (n=2049). A fabric series of the material has been established and compared with the local geology and known production centres to ascertain raw material sources and potential supply networks. The results have shown a reliance on local raw materials, with *London Clay Formation* sources dominating the collection (49.68%). Changes in the incidence of fabrics over the life of the Roman town demonstrates that other, more distant sources of material were sought when local supplies were unable to meet demand, such as the production centres at Minety, Wiltshire and Eccles, Kent. Comparison of the fabrics used contemporaneously at the forum-basilica and Insula IX has highlighted the use of different production centres for different building projects. Although relief-patterned flue-tiles have been shown to be part of the regular repertoire of tile makers, not a product of specialist workshops, they nevertheless provide evidence of the complexities of their manufacture and distribution. Footprint evidence gives insight into the environment in the vicinity of the different tileries and the footprints of neonate and young cattle, sheep, and pigs show that small-scale animal husbandry was practised alongside brick and tile production.

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This thesis would never have been started or finished without the love of my family. To Nick, who doesn't care about bricks, thank you for being you. A big kiss and a mummy cuddle for my beautiful daughter, for her never-ending distractions and for making me smile every day.

For my husband

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My magnificent Octopus (Baldrick)

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Chapter 1: Introduction

1.1 Background and rationale

The buildings of the Iron Age were predominantly timber structures with thatched roofs. Soon after the conquest the Roman military constructed more permanent structures built from stone and ceramic building materials (CBM). The Roman building industry represented an important economic activity and the resultant buildings were a highly visible method of transmitting Roman ideas and lifestyle (McComish 2012, p.30). The well-established pottery industry in Britain before the conquest, with craftsmen used to working clay, may have provided a pool of skilled labour ready to learn the new craft. Alternatively, the army may have supplied all the craftsmen and closely controlled the production and distribution of brick and tile (McWhirr & Viner 1978, p.360).

Trade and economy in the Roman world has been studied in detail though rarely using CBM as the marker. The production and distribution of pottery has been investigated with trade networks established by the movement of materials from kiln sites. (e.g. Peacock 1977b; Fulford 1981; Wacher 1995, p.126). Pottery studies have shown the degree to which Roman cities were interconnected and the relative importance of imports from different sources (Fulford 1987; Fulford 1989). More recently the Roman Economy Project (www.romaneconomy.ox.ac.uk) has looked at all aspects of the Roman economy, trade networks and material distributions across the Empire. Archaeological data from the last 30 years or so has shown that long-distance trade in the Roman world was normal and common, and was not merely focussed on luxury goods (Wilson 2009, p.214). The 1st-century A.D. shows some significant departure from the pre-Roman pattern, interprovincial movement of pottery reduces as the indigenous pottery industry grows.

The stimulation by the Roman governor of Britain (AD 78-84), Agricola, to give encouragement to the building of 'templa fora domos ' (temples, public squares and houses) (Tacitus, Agricola 21) is often discussed as a visible sign of the development of the province and cited as the reason for an increase in coinage circulation, and has also been correlated in the ceramic (pottery) record with the development of the new Romano-British pottery industries (Fulford 1981, p.200). This programme of work would also have placed a huge demand on the brick and tile industry that supplied the developing towns in the province.

Whilst, there is no doubt that the new form of settlement directly resulted from Roman influence, the extent of official stimulation is unclear, though it is likely less prevalent than was described by Frere (1999). For example, the establishment of *civitas* capitals, formed from existing tribal groups, suggest the development of the settlement, including the construction of town-houses, was chiefly led by the indigenous population with native aristocrats emulating Roman ways (Millett 1990, p.69).

Official stimulation is evident in the setting up of public buildings, for example a basilica and public baths, with this evidenced by the Nero-stamped tiles associated with Silchester, for example. Whilst military craftsmen were clearly responsible for the construction of the legionary and auxiliary forts, it is difficult to substantiate the involvement of the military on civil building projects (Blagg 1980). The CBM industry supplying this development was therefore a complex network of military and civilian production centres, funded centrally or privately to facilitate the construction of an urban infrastructure in the Roman style. Each town has its own individual history from its origins to establishment as a Roman urban centre and as such would have been supplied from a number of brick and tile production centres as building projects demanded. The extent to which these were centrally or locally financed, and how their distribution was managed is very difficult to establish through the CBM record.

In this regard a small number of attempts have been made to understand the Romano-British brick and tile industry as an important and complex element within the Romano-British economy (Darvill & McWhirr 1984, p.240), often beginning as a study of the distribution of stamped material. This is then used to formulate conclusions regarding the industry as a whole across a region or even the entire province. The resulting models generally posit that the material, considered low-value and high-bulk, was made close to the demand centre with limited movement further afield (Hodder 1972; Hodder 1974). However, there are few studies that utilised detailed fabric analysis alongside the distribution maps to highlight the movement of material from producer to consumer.

Whilst brick and tile are certainly very well represented as bulk finds on most Roman-period excavations in Britain, it is undoubtedly under-represented in terms of analysis and incorporation into research agendas. The methods described here, as applied to the ceramic building material collections from Silchester, will look to provide a framework for the analysis of building materials that already exist in archives as well as newly excavated assemblages. The material being studied is the result of a typically discriminatory retention policy applied at the time of excavation on-site. This retention bias has traditionally led to the opinion that existing CBM archives are unsuitable for quantitative analysis. On-site retention policies are inconsistent and highly subjective, characteristically focussed on the retention of unusual examples and never truly representative of the complete assemblage. Ideally, the retained sample should be representative of the forms and fabric series and an explicit statement of the retention strategy employed should be documented to allow more accurate conclusion to be made when extrapolating the whole from the retained sample of the recorded assemblage. The volume of ceramic building materials recovered is such as to prohibit a 100% retention policy since there is a significant lack of storage space available within archives and museum are curators under increasing pressure to rationalise existing collections. However, it is hoped to demonstrate the value of existing collections, and how they can be used to illuminate aspects of the Roman brick and tile industry and its role in the industrial economy of Roman Britain. All conclusions are drawn with the caveat that they are based on a proportion of the excavated material and cannot necessarily be extrapolated to the whole assemblage.

This study reviews previous approaches to CBM as individual ceramic artefacts as well as components of buildings as composite artefacts in order to understand the role that CBM played in the development and re-development of a Roman urban centre. This study challenges common assumptions about the production and distribution of Roman brick and tile: first, that fabric analysis has little to offer in the study of Roman brick and tile; second, that CBM was made locally to the point of consumption and not transported over long distances. Finally, despite the selective nature of retained assemblages, qualitative and quantitative analysis can provide useful results.

1.2 Research aims

The aim of the study is to characterise the ceramic building material assemblage from the Roman town of *Calleva Atrebatum,* Silchester, Hampshire, in terms of the range of fabrics and forms, the potential production centres and to identify changes in supply and consumption of building materials over the life of the Roman town. To use the results of the fabric analyses to understand the nature of production of CBM in terms of infrastructure, specialist products, and movement of materials to consumers.

It is often stated that brick and tile distribution processes can only be understood by tracing material from a known production centre outward. This study is looking at the material from a different perspective. First, working from the known to the unknown, this project begins by recording the form, fabric, and features of all the CBM retained from the Silchester excavations to produce a catalogue of an urban assemblage. The application of scientific analyses allows for the development of a detailed fabric series that can be applied to any future excavations and assist in the identification of potential raw material resources and production centres. Second, the characterisation of fabric from known tileries, the plotting of the distributions of similarly roller-stamped tiles and their fabrics are used to illustrate the movement of material and/or craftsmen.

1.3 Objectives

The aims of this these will be achieved by:

- Establishing a fabric series for the Silchester CBM assemblage held by the University of Reading, Reading Museum, and the Hampshire Cultural Trust incorporating antiquarian archive material and recent excavation assemblages
- Petrological and geo-chemical analysis of the fabrics to understand the raw materials resources exploited and to identify potential raw material sources and production centres

- Establish how the supply of the building materials changed over the life of the Roman town by establishing a chronology of fabrics and a narrative of building material supplies
- Using the fabrics and forms to investigate movement of building materials from production centres and so identify links between Silchester and the wider Romano-British landscape
- Identification of the footprints found on the collection and using the resulting data to interpret the environment and infrastructure of the production centres
- Compare the results from Silchester with the Roman provincial capital, *Londinium*

1.4 Thesis Outline

The thesis starts with a review of previous studies of the Romano-British ceramic building material industry and its contribution to Roman studies (Chapter 2). The methods employed for the analysis of the CBM fabrics are presented, along with some considerations of their benefits and potential limitations (Chapter 3). An overview of the Silchester ceramic building material collections held in the Reading Museum archive is given, tying it to the published excavation reports where possible (Chapter 4). The geology of the area surrounding Silchester and the results of clay sampling in the area around the town are then presented (Chapter 5). Detailed analysis of the CBM fabrics is presented and the fabric series for the CBM assemblage is compared with the results of the clay sampling (Chapter 6). Potential production centres are then discussed, and the fabrics of their products described and compared to the Silchester fabric series to establish if any can be matched to local production centres (Chapter 7). The fabric series is then used alongside the chronology of the development of the town in two specific areas, the forum-basilica and Insula IX, to establish if the suppliers of CBM to the Roman town changed over time. The assemblages from these two locations are also compared to ascertain if there are differences in the CBM supply for public and private building projects (Chapter 8). Focussing on one specific type of CBM, relief-patterned flue-tiles, fabric analysis of examples from Silchester and other sites across Roman Britain is used to characterise the organisation of production of this distinctive form of material (Chapter 9). Analysis of the footprints and tracks left on the surface of bricks and tiles is then presented to illustrate the environments and infrastructure surrounding the tileries and to consider the full- or part-time nature of the trade (Chapter 10). The results of all the analyses are discussed in terms of interpreting the brick and tile industry supplying the Roman town at Silchester and whether the results support assumptions of the restricted movement of ceramic building materials (Chapter 11). Finally, conclusions are drawn, highlighting the key outcomes of the study along with some recommendations for future work (Chapter 12).

Chapter 2. The Romano-British brick and tile industry

2.1 Introduction

This chapter reviews the key themes discussed in the study of Roman ceramic building materials. A brief overview is given of the production of brick and tile in Roman Britain. The existing literature is then reviewed in broadly chronological order, moving from a focus on the typology and use of materials, to modes of production and distribution which include some consideration of the infrastructures needed to meet the fluctuating episodic demands on the industry. This is concluded with a review of the economic models that have been applied to the organisation of Romano-British brick and tile production.

2.2 Summary of brick and tile production in Roman Britain

Brick and tile production in the Roman period in Britain represents an introduced system. Despite the tile and brick industry being well established elsewhere in the Roman Empire before the conquest of Britain in A.D.43, the craft did not reach Britain before the Roman occupation. The use of unfired clay bricks in Roman Britain, made of grass-tempered brickearth, was limited, though they may have been used more widely and not recognised in excavation (McWhirr 1984, p.21). Most of the building construction dating to the early first century in lowland Britain was in timber and this native tradition persisted for some time before some structures were replaced with stone and ceramic building materials (Millett, 1990). Evidence from the early foundations at Colchester, Essex, Verulamium, Hertfordshire and London (Crummy, 1984, p. 23) suggests that roofs were mainly thatched and walls constructed of wattle-and-daub. The first Roman-style buildings (c.A.D.50-60) including the higher status houses of the period had wattle-and-daub walls, earth floors and thatch roofs. These materials lend themselves to fast and economical construction without the dependency on the large-scale industrialised production of building materials or the development of systems of production and supply (Perring, 2005, p. 32). Evidence of pre-Boudiccan use of ceramic building materials have been found at Ludgate Hill and Cornhill in London (Wallace, 2014, p. 58) along with pre-Flavian examples of the existence of more elaborate Roman building techniques such as the use of painted wall-plaster and *opus signinum* flooring (Creighton, 2006, p. 94).

Large-scale brick and tile production would have been necessary in Britain once the army set up permanent quarters and all the legions at the time of the conquest would have had craftsmen skilled in the art of tile and brick making. Early evidence of brick production has been found at Exeter in the form of tile wasters, dating to the mid-A.D.50s (Bidwell, 1979, p. 148). The earliest phases of construction at Fishbourne, which have been described as a military supply base, demonstrate the use of ceramic roofing tiles from the A.D.40s (Cunliffe, 1971, p. 39). The presence of thin-walled scored flue-tiles at a Colchester bathhouse evidence pre-Boudican construction, however no structural remains have been found (Black, 1996, p. 60). Elsewhere, the Neronian tile-stamps from Silchester provide further evidence of mid-1st century A.D. tile production.

Gradually, as the military and their craftsmen moved north and west, the demand for tile and brick increased with the growth of building works associated with the towns and cities that were evolving over the final quarter of the 1st century AD. Romano-British towns were organic institutions, continually changing in character and form, with regular street grids established framing new types of buildings (Creighton, 2006, p. 70). This increased demand for CBM in the Flavian period therefore, had to be fulfilled by civilian craftsmen, perhaps with some limited help from military brickcasters (Darvill and McWhirr, 1982, p. 137). At Colchester, for example, a brick-kiln has been dated to A.D.50-60; after the date of departure of the 20th Legion. The production here was, therefore, no longer overseen by the military and the kiln must have been used by a civilian craftsman (Hawkes and Hull, 1947, p. 71) or, perhaps retired veteran brickmakers continuing their craft in a civilian market.

Some 2nd -century dwellings continued to be constructed in the traditional way with timber frames and wattle-and-daub walls, foregoing the refinements of hypocaust heating systems, with braziers used to warm the spaces. The increased use of brick and stone brought about reduced risk of fires and braziers were replaced by ducted, underfloor heating with additional channels carrying the heat up through the walls (Wacher, 1995, p. 49). Following the visit of Hadrian in A.D.122, there was a significant stimulation of construction in the province. This, along with increased demand from the towns where urban timber buildings were being replaced in stone and the growing number of rural establishments being rebuilt in a Romanised manner, led to a further overall increase in demand for tile production. For the first time there is evidence in the form of stamps that private tileries were in operation (McWhirr, 1984, p. 30), with the earliest private tile manufacture suggested by the discovery of a name-stamped tile recovered from the fortress baths at Caerleon (Mills, 2013b, p. 456).

There is likely to have been a reduction in general demand in the south of the province, once the major towns and settlements were established. Production of brick and tile in London recommenced around A.D.190-220 to provide the considerable quantities of tile used as bonding courses in the defensive walls, as it is unlikely there was sufficient reusable material for such a vast building project (Betts, 2017, p. 377). The ceramic building material industry in Britain declined in the late Roman period with an increase in the use of stone for roofing material and paving, implying insufficient demand for standardised ceramic building materials. The use of ceramic roofing tiles at Silchester continued to at least A.D.300 (Warry, 2012, p. 49) whilst at Cirencester ceramic tiles are rarely found on 4th-century buildings (McWhirr and Viner, 1978, p. 371). In Rome, kilns still in use by the middle of the 4th century were only producing roofing tiles and this production was limited in volume and possibly connected with specific building projects (Valenzani, 2006, p. 441), thus leading to the increased re-use of existing building materials. The reduction in the use of CBM is also reflected in the prevalence of stone-built 'channelled' hypocausts which are also more common in the later Roman period (Williams, 1971, p. 183) as an alternative to tile and brick construction. Late Roman 5th -century production of brick and tile has been discovered at St-Martin-in-the-Field, London where a kiln has been archaeo-magnetically dated to c.A.D.400-450 which is towards the very end of the life of the Roman settlement (Betts, 2017, p. 381).

There is a gap of several centuries between the cessation of Roman brick production in Britain and the re-introduction of the technology in the Middle Ages, with no fired bricks or even clay roof tiles produced between the 5th century and the Norman period. This suggests that special factors are required to sustain the brick-making industry on a substantial scale. It also raises the question, whether the increased use of building stone was the cause of, or response to, the decline of the brick and tile industry (Darvill and McWhirr, 1984, p. 257)? Just as economic growth in the Roman period led to the technological improvements to meet increased demand, which enabled the growth of the construction sector, so economic contraction causes a reversal of these processes (Wilson, 2006, p. 233). The manufacture of fired ceramic bricks was a lengthy process which could only be carried out efficiently under settled social and political conditions allowing buildings of a permanent character to be erected (Davey, 1961, p. 78). This end of production is compared by Wilson (2006, pp. 233–4) to the cessation of the use of the potter's wheel and kiln firings. He states that both may be explained in terms of the collapse of markets and networks of exchange that characterised the Roman economy.

2.3. History of the study of CBM in Roman Britain

Early archaeological interest in brick and tile production was typically represented by the publication of the excavations of tile kilns, for example at Holt, Denbighshire (Grimes, 1930), St Albans, Herts. (Davey, 1933) and Cranleigh, Surrey (Goodchild, 1937) whose reports contain very limited discussion of the impact of the industry in the areas within which these production centres were situated. Lowther's (1948) study focuses on the production and distribution of relief-patterned flue-tiles based on the decorative schemes used to key the surface, drawing primarily on the material recovered from the production centre at Ashtead, Surrey. His pioneering paper suggested the movement of material as well as the movement of itinerant tile makers between demand centres. McWhirr's edited volume (1979b) summarises the outputs of a conference which highlighted the research potential of CBM and, following up on the work of Grimes (1930), includes a survey of known tile kilns classified according to their shape and arrangement of flues. The volume also includes a wide range of reports and analyses of Roman ceramic building material, a few of which were subsequently followed up in papers addressing the topics in more detail. Darvill (1979, p. 310 Fig 18.1) provides a schematic diagram for the study of Roman tiles; from the recovery of the material in the field, through investigations into the environment and technology of production, characterisation of their function and use, to identifying production centres. This model would, it was hoped, highlight the potential of CBM studies and ultimately lead to an increase in research and a greater understanding of tile production at a regional and provincial level. McWhirr's (1984) thesis reviews the evidence of the production and distribution of brick and tile in Roman Britain, as he describes it "through the objects themselves".

Brodribb's (1979) survey of the tile from Beauport Park, East Sussex involved the analysis of every fragment of tile recovered, demonstrating the range of material and the scale of the practice of stamping bricks and tiles, which had previously been underestimated. Further research by Brodribb culminated in the publication of "*Roman brick and tile"* (1987) which describes the entire corpus of CBM forms from Roman Britain, with reference to some continental examples. The volume describes all forms, including particular features and unusual types, but it draws heavily on his work at Beauport Park. Despite the introduction discussing the increasing awareness of what can be derived from the study of the material (*ibid.* p.1), it is very much a culture-history/typological approach with only three pages given to the discussion of "Colour, fabric & texture" and a further three pages for "Production, distribution & dating" (*ibid*. pp.136–138; 139–141;). Nevertheless, it has become the ceramic building material reference manual, which has yet to be superseded.

2.4 Retention policies

Whilst the majority of the CBM recovered on sites is not distinctive in terms of features or stamps, retained assemblages tend to be dominated by these items. It is rare for an explicit, coherent, and consistent sampling strategy to be outlined in site reports, and retained material tends to be biased towards the unusual or exceptional items. Ideally, the retention strategy employed should ensure a representative, statistically proportional sample of the material is kept thereby ensuring any further analyses are meaningful. Whilst more robust conclusions can arguably be made from entire assemblages (Darvill, 1979, p. 332), the volume of materials recovered from sites does not allow for the retention of CBM assemblages in their entirety. However, if only 'remarkable' examples are being kept then the proportion of impressed tiles, for example, in the retained assemblage is likely to be higher than their true proportion of the entire assemblage. In his paper Wikander (1988) laments the focus on decorative components and tile stamps, and chooses to concentrate on the functional aspects of, what he describes as, plain, ordinary tiles. Whilst his paper was looking at Early Helladic and Mycenaean material, it was a much-needed focus on what is generally the bulk of the material recovered during excavation. The wide range of marks and features, stamps, footprints, signatures, tally-marks, and graffiti, are all useful tools for studying the brick and tile industry. The retention bias has resulted in a focus on the unusual or characteristic features of CBM within the site reports and literature, typically with the aim of describing the modes of production and distribution of the material. One particularly distinctive form of CBM are relief-patterned tiles, where the surface of the tile has been keyed using a roller-die and whose decorative designs generally guarantee their retention after excavation. These have been examined in detail by several scholars and have contributed a great deal to the understanding of the brick and tile making in Roman Britain (see Chapter 9).

2.5 Stamped tiles

A wide range of information can be deduced from the study of stamps found impressed onto the surface of bricks and tiles. Some are explicit in detailing information regarding their production whilst others require detailed study as part of a large corpus. The stamping of tiles with the details owner of the estate where they were made and the name of the tile maker was common practice in the Roman World from the early Republican period (Frere and Tomlin, 1992, p. 125). Stamps and stamp group distributions are particularly useful in facilitating discussions of the production and distribution of materials. The limited life of a stamp die ensures that contemporary, or near-contemporary, products are examined, which allows their distribution patterns to be plotted. This opens the possibility to explore the potential transport mechanisms and commercial networks in operation to move the material from the production centre to the consumer. Tile-stamping by the army is evident in continental Europe from the early Imperial period, and it has been shown that the legions involved in the conquest of Britain adopted the practice of stamping towards the end of the 1st century A.D. (McWhirr, 1979a, p. 253). During the 1st century, many of the buildings constructed by the military would be half-timber with thatch or shingle roofs, therefore requiring little, or no, brick and tile in their construction and therefore creating no necessity to stamp tiles (Frere and Tomlin, 1992, p. 125). Legionary tile-stamps are generally a phenomenon of the 2nd and 3rd centuries in Britain although a few of the *Legio* IX stamps may date from the late-1st century (Grew *et al*. 2010, p.265), c.A.D.90. These stamped tiles provide evidence of the movement of the legions within Britain illustrating, for example, how *Legio* VI contributed to the construction of Hadrian's Wall and they also allow for the identification of auxiliary units associated with particular forts (Warry, 2010, p. 146).

The practice of stamping brick and tile raises the interesting question of its purpose but unfortunately, the typically selective nature of retained assemblages makes it virtually impossible to establish the proportion of tiles that would have been stamped. Helen (1975, p. 24) suggests that a proportion of bricks were stamped to aid identification in transport and storage by the middlemen/building merchants, and the relief-patterns keyed onto flue-tiles may have served the same purpose in Britain. Another suggestion is that stamping was a means of registering output. Bocking (1978, pp. 111–17) asserts that every hundredth brick was stamped, but no evidence for this hypothesis is put forward. Such systematic practice seems unlikely as private brickworks were not consistently stamping their output and military bricks bear other marks which are considered a more likely tallying mechanism (Brodribb, 1979, pp. 219–20). Peacock (1982, p. 137) postulates that the military stamping was a deterrent for the misuse of tiles. Whereas it is generally considered that the practice of stamping arose in response to the need to record and perhaps control output (Darvill, 1982, p. 51), there would appear to be a difference between the purpose of military and civilian stamps.

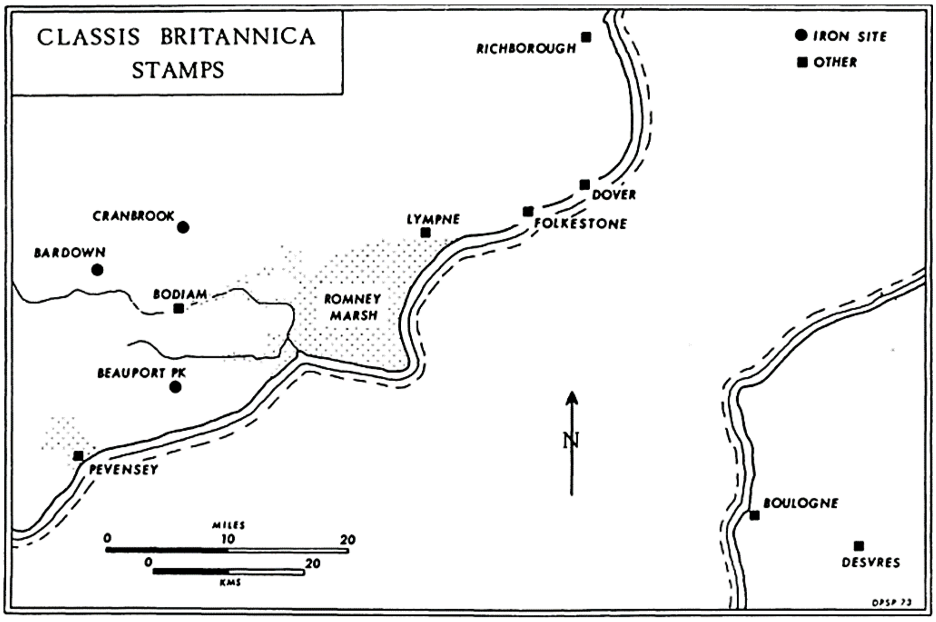


Figure 2.1: The Channel coasts, showing the distribution of site producing Classis Britannica stamped brick (After Peacock 1977 Fig.1.)

Bricks and tiles stamped with the initials of the Classis Britannica, the fleet of Roman Britain, have been found on nine sites around the shores of Sussex and Kent and at two localities in the Boulogne region of France (Peacock, 1977). Petrological analysis of these bricks demonstrated the presence of two distinctly different fabrics therefore showing they were produced in two locations situated on either side of the English Channel. The British material was exported on some scale to Boulogne, whilst movement in the other direction was more limited (Fig.2.1). Very few Boulogne stamps have been recorded in Britain thereby implying that cross-channel ships had more spare capacity when travelling from Britain to the continent than vice-versa, thus inferring that the fleet played an important role in importing goods from Gaul to Britain (Peacock, 1982, p. 146). Brodribb proposed that the Classis Britannica put an official stamp on tiles for the sake of prestige and to prevent unauthorized use. He ascertained that all but one of the complete *tegulae* found at Beauport Park carried a stamp leading to an assumption that every *tegula* would have been stamped (Brodribb, 1979, p. 141). However, a large proportion of the material from Boulogne has been found to be unstamped (Peacock, 1977, p. 236).

There is a concentration of civilian-stamped tiles in the Gloucester region (Mills, 2013b, p. 36), which is the only *colonia* in Roman Britain to record the name of its officials on tile stamps (Frere and Tomlin, 1993, p. 41). In and around Gloucester, tiles stamped with RPG (***R****ei* ***P****ublica* ***G****levensium*) have been found in considerable numbers, with some examples including magistrates names (Heighway *et al.* 1982) which provide dates for their manufacture and indicate the authority under which they were produced (Frere and Tomlin, 1993, p. 41). Many of the RPG-stamped tiles have not been recorded from securely dated contexts, but are found in levels associated with the first decade of the 2nd century A.D. This suggests an earlier production date, conceivably at the time of the foundation of the *colonia* in A.D.96-8 (McWhirr, 1984, p. 37), and believed to have been the continuation of tile production at a tilery that was originally established by the military (Frere and Tomlin, 1993, p. 41). These tiles were manufactured at the extramural tilery at the site of St Oswald's Priory. Their distribution was at one time thought to have been restricted to the *colonia* and its *territorium,* however, examples found further afield at Kenchester and Lower Wanborough evidence a wider distribution network. These two more distant sites have been identified as potential building merchants, with the assemblages of stamped-tiles seen to evidence the curation and stock-piling of building materials (Warry, 2017, p. 28). Most of the examples of RPG-stamped tiles are of one fabric, which has been identified as probably originating from the tileworks at Minety, Wiltshire (Chapter 7.11). However, a small number of examples found at the villa at Hucclecote, Gloucestershire, are in a fabric derived from the *Lower Lias* clay found in the vicinity of the villa (McWhirr, 1984, p. 78). These have a matching stamp to the Minety examples and suggest an itinerant tiler or at least the movement of the stamp die. This example goes to show how typological assessment can be used in conjunction with fabric analysis to contribute to the understanding of the mechanisms in place for the production and distribution of ceramic brick and tile.

Over 200 examples of procuratorial-stamped tiles have been found in Roman Britain, primarily in the City of London (Betts, 1995, p. 207). These examples are stamped **PPBRILON (*****P****rocuratores* ***P****rovinicae* ***Bri****tanniae* ***Lon****dini)*, **PPBRLON** (***P****rocuratores* ***P****rovinciae* ***Bri****tanniae* ***Lon****dini)* or **PPBR (*****P****rocuratores* ***P****rovinciae* ***Br****itanniae)*. Many of the sites in London which have produced procuratorial stamped tile, are associated with, or are near to, major late 1st- to early 2nd-century public buildings. The use of tiles with the same stamps in different buildings allows for the identification of contemporary constructions, or building work commencing within a relatively short period. This supports Perring's suggestion that the Flavian public building programme must have been carefully co-ordinated by the government officials responsible for running London (Perring, 1991, p. 42). There is no single concentration of the use of these procuratorial stamped-tiles and it has been suggested that the products of the official tilery were sold commercially as evidenced with the RPG stamped-tiles (Frere and Tomlin, 1993, p. 30). Ten of the procuratorial dies are used exclusively on tile, one solely found on *mortaria* and two on both tile and *mortaria*, implying that both the products were made at the same workshop (Hartley, 1996, p. 147). The discovery of two tile fragments, along with evidence of stamped *mortaria* at the pottery kiln-site at Brockley Hill suggests this as a potential source for at least some of the stamped output (Frere and Tomlin, 1993, p. 30), no trace of brick and tile production has been discovered. Here, the small number of examples of procuratorial stamps on *mortaria* suggests that their manufacture was a side-line, though they may have been used during official building activities, e.g. for preparation of plaster or pigments (Betts, 1995, p. 209) or they were a form of payment-in-kind from the potter to the procurator, perhaps as a form levy or tax in proportion to output (*ibid.*, p.151). There is no other evidence for tile and *mortaria* being made together elsewhere in Britain, but the practice was common in the Italian brickyards (Hartley, 1973, 1996).

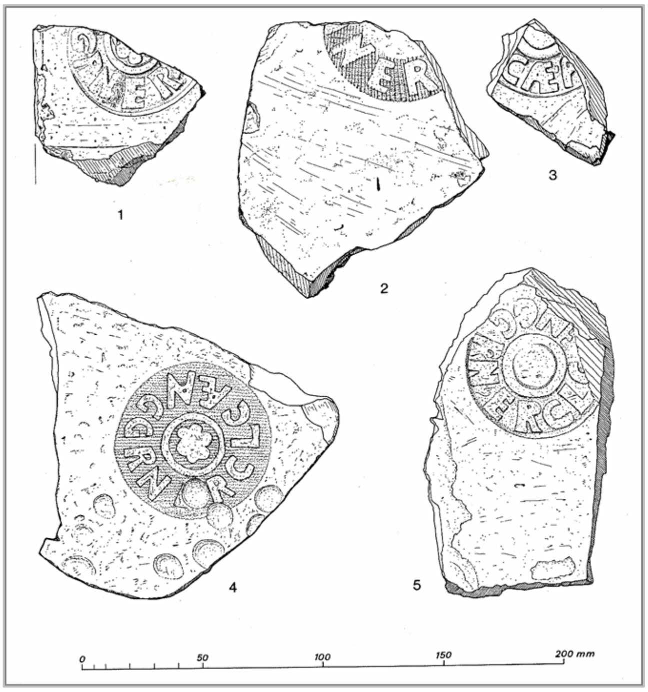


Figure 2,2: *Examples of the Nero-stamped tile (After (Fulford & Timby 2000 Fig. 95))*

The Imperial tile-stamps from Silchester comprise the title of the Emperor Nero **NER·CL·CÆ·AVG·GER** i.e. Nero Claudius Cæsar Augustus Germanicus. A total of 19 tiles impressed with a stamp of Nero have been recovered in Britain (Fig.2.2), found during excavations within the city walls at Silchester and from fieldwalking and excavation at the tilery at Little London (Chapter 7.4). Stamps found on British tiles are usually rectangular with a single line of text and rarely include any pattern; these stamps are more closely paralleled with the circular-style common of Italian examples (McWhirr 1984, p.65).

At the time of publication, RIB2482 comprised five stamps; all thought to be of different dies (Frere and Tomlin, 1993, p. 26). The stamps are mainly found on the surface of *tegulae*, located to the lower edge of the tile and would therefore have been visible once the roof tile was in place. The only other examples of circular tile-stamps from Roman Britain are those of the Classis Britannica (RIB2481.89-99). These Nero-stamped tiles are the earliest tiles with stamps in Britain and indicate a tilery in Imperial ownership working between A.D.54 and A.D.68 (Greenaway, 1981, p. 290). The practice of stamping bricks by Roman tilers commenced around the middle of the 1st century B.C. The stamped CBM from Rome and the surrounding areas are restricted to two clear date groups. The first group ends with stamps of Caracalla (A.D. 198-217) and the practice recommences from the time of Diocletian (A.D. 284-305), with a blank period of several decades between (Helen, 1975, p. 7). The Roman form of stamps recorded in CIL XV are typically lunate in shape, along with circular and rectangular examples (Dressel, 1891). In view of the Nero-stamps early date and similarity in design to Italian examples, it has been suggested that they reflect the work of immigrant craftsmen brought to England to make brick and tile in a workshop that was in Imperial ownership (Frere and Tomlin, 1993, p. 26). The establishment of an Imperial tilery has been connected to the initial building boom at *Calleva Atrebatum* under *Cogidubnus* early in his reign (Greenaway, 1981, p. 291). It has been suggested that Silchester had become, for a short period, the base of a legionary vexillation, perhaps in the aftermath of the Boudican rebellion (Fulford, 1985, pp. 56–7) and before the introduction of military tile stamping in Britain. The early date of these tiles also implies military involvement in their production as it is unlikely there were skilled civilian tilemakers involved in large scale building projects so soon after the conquest, with the earliest brick and tile production associated with military craftsmen, either still in service or veterans. However, Frere & Tomlin assert that this would have had no causal connection with the establishment of an Imperial tilery (1993, p. 26). Nevertheless, it is apparent that there was development in the town to the west of the forum and this development project appears to have been supported by Nero (Fulford, 2008, p. 8). The city's baths, as yet undated, may be of approximately the same period. Only one stamped tile was found during the Antiquarian excavations of the baths complex and it came from a cess-pit associated with the latrine (Hope and Fox, 1905, p. 366).

Outside of Rome, Imperial control of brick and tile production can be seen at the Pansiana brickworks. Here stamped brick production began around the mid-1st century B.C., under owner Consul *Gaius Vibius Pansa*. The workshop passed into Imperial control during the reign of *Tiberius* and continued production through to the reign of *Vespasian*. The outputs were stamped with the name of the Emperor and the marque of the tilery though the form of the stamps differs from the Romano-British examples of Nero-stamped tiles (Fig.2.3). The bricks and tiles were stamped with the abbreviated name of the ruling Emperor and the marque *Pansiana*. After *Vespasian*, the Emperor's name was no longer included on the stamps but a derivative of the original owners cognomen was retained, PANSA (Pedišić and Podrug, 2008, p. 89). The homogeneity of the brick fabric suggests production focussed on a limited region in north-eastern Italy (Matijašić, 1983, p. 988) though the products are widespread throughout the Adriatic and Dalmatian coast (Wilkes, 1979, p. 68).

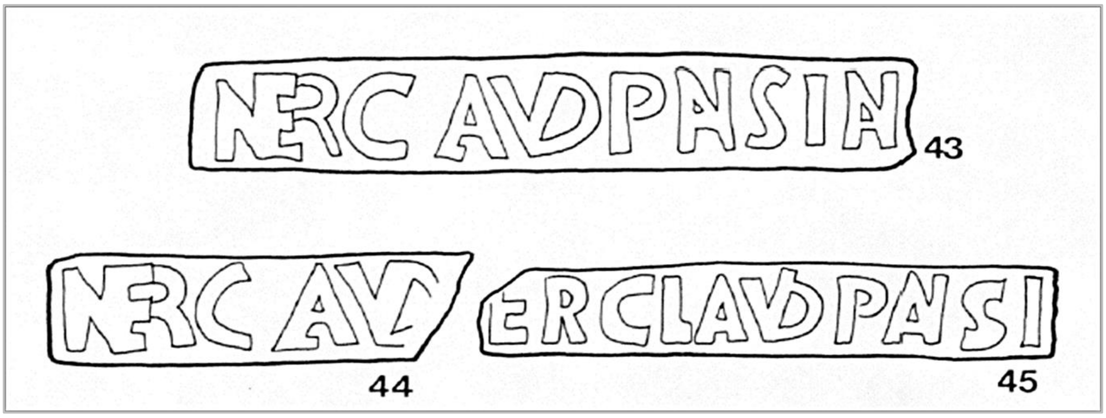


Figure 2.3: Examples of Neronian stamps from the Pansiana tilery (After Matijašić 1983 Tav. IV.)

Helen's (1975) study of the Roman practice of stamping brick and tile concludes that the inconsistent occurrence of stamps makes it impossible to suggest a universal purpose for the stamping of bricks; and there is no single answer that would take account of all the components of the archaeological record and therefore be applicable to all examples of stamping. Stamping customs clearly varied between sites and no single approach was enforced or adhered to. The value of the study of bricks stamps is great, allowing for the movement of material to be mapped to show the nature of the transport and marketing systems. Where a stamp group has been established, petrology can be used to identify common and diverse origins (Darvill, 1979, p. 311).

2.5 Other anthropogenic markings on brick and tile

Tile makers, or at least people with access to drying tiles, often used them to practise writing, record information about their day or just doodle. RIBII–Fascicule 5 (Frere and Tomlin, 1993, pp. 92–160) catalogues all the known examples of graffiti from Roman Britain at the time of publication (RIB2841-2491) showing the wide range of information inscribed onto tiles. Some of the graffiti seems to record details of the manufacturing process and Tomlin summarises that the three main reasons for the application of graffiti were: to date a batch; record a total, or note the tile makers name (1979, p. 233). A study of graffiti on tiles sees the recurrence of the number CCXX (220). Spitzlberger interprets 220 as the daily production requirement for brick workers, his conclusion is supported by an example (Dressel, 1891 (CIL11385)) where it is noted that Artemas' total of 199 was recorded as 21 short (McWhirr, 1984, p. 16).

Little study has been made of other marks found on the surface of tiles, referred to by Williams in 1895 as "the *signum* of the maker" with which he "signed his work", (1895, p. 77). They generally take the form of semi-circular impressions made to the edge of the tile with one or more fingers. Now referred to as signatures, not all tiles bear these marks, although they are very common. It may be that the top of a stack was marked to aid identification. This would be particularly important where a brickyard was shared by several groups of producers or as a form of stock control to calculate rates of pay (McWhirr, 1984, p. 63). Ward regarded these signature marks to be decorative (1911, p. 263), whilst Brandl suggests that because the signatures are located at the lower side of the *tegulae* they were meant to conduct rainwater to the next tile below, and eventually off the roof (1999, pp. 14–17). However, if this were the case then surely all *tegulae* would have the same marks applied. At Silchester, of 518 complete *tegulae*, 91 (17.6%) were found to have signatures (Warry, 2012, p. 55). The reasons for the use of signatures on tiles are probably the same as those suggested in the case of tile stamps. The analysis of signatures from Beauport Park showed that 60% of *tegulae* carried signatures, of which two-thirds were found to be semi-circular (Brodribb, 1987, pp. 100–101). There is a wide variety of forms of signature, illustrated by Warry (2006, p. 149) which would suggest that they are intended to identify batches of products made by different producers.

Tally-marks, usually a number represented in Roman numerals, are found to be scored onto the edge of the tile. Brodribb recorded these marks from Beauport Park and similar marks have been found at several sites in the south also thought to have been linked to the Classis Britannica, leading to the conclusion that these marks were a military practice (McWhirr, 1984, p. 63). Tally marks were found on bricks from the forum-basilica at Silchester (Timby 2000 Fig 94.1-5) thus implying military involvement in its construction. It has also been proposed that they were an indication of the Legionary number, where brick stamps were not being used, however, I or X incised before firing on edge of the lower base of tiles found at Saône-et-Loire were definitively identified as stock marks and not legionary numbers (Chauffin, 1956, p. 85). Kurzmann (2005, pp. 20–21) discusses tally marks and signatures interchangeably and concludes that some of the marks appear to represent a counting system whilst others would appear to be purely decorative.

2.7 Dating

It is rarely possible to date bricks and tiles from the buildings from which they were recovered as they are frequently re-used from earlier features. Whilst some stamps found on tiles, such as the Nero-stamped tiles from Silchester, can provide a date for their production. However, the dating of brick and tile by context will only ever provide a *terminus ante quem* for the material as it may have been in use elsewhere previously or not have been used immediately after production (Kurzmann 2006, p.3). Even where a building can be given a firm date, there is no guarantee that the tile used was new at the time of construction (Brodribb, 1987, p. 141). However, large scale building projects would probably demand a dedicated brick and tile production to deliver the volume of material in demand. Whilst tiles were generally designed for specific functions (Webster, 1979, p. 287), they were often used, or re-used for quite different purposes. The resilience of the material means it can be re-used over again, thus making it difficult to fix chronological limits on output from a particular production source (Darvill, 1982, p. 51). *Vitruvius* (II – *de architecture* 8.19) advocates the use of old tile in wall construction as its strength has already attested by surviving use on the roof of a building. During phases of redevelopment or renewal, CBM is likely have ended up in dumps. Material for hard-core would be mined from these dumps or sourced directly from a building site, with excess mortar removed before re-use (Mills, 2013a, p. 95). Old roofing material was often re-used as oven bases or for flooring. Curation of material for re-use is evidenced at Verulamium where a stack of *imbrices* was found, stripped of their mortar (Frere, 1983, p. 207) and further demonstrated by the use of *imbrices* to construct hypocaust *pilæ* as seen at the villa at Rockbourne, Hants (Brodribb, 1987, p. 94 Fig.43). It has been possible to assign date ranges to some CBM forms in London and elsewhere. At the Winchester Palace site, nearly 40% of the tile comprised *tegula* and *imbrex* roof tiles, but there were also significant quantities (19%) of *voussoir* and flue tiles using for vaulting and hypocausts. The tile fabrics are consistent with other pre-Flavian sites in London, albeit the presence of flue and *voussoir* tiles in such an early context is unprecedented in Britain (Yule, 2005, p. 25). Early bathhouses are rare in Britain and, as Tacitus claims, it was his father-in-law Agricola who encouraged their construction c.A.D.80 (Tacitus *Agricola* 21.2). Black (1996) uses distinctive forms of *tubuli* to date and map the spread of hypocaust construction in Roman Britain, citing the presence of thin-walled lattice-scored flue-tiles as evidence of early hypocaust construction.

In an attempt to provide a chronology for, and allow the use of, *tegulae* as a valuable and ubiquitous dating tool, Warry (2006) uses tile stamps and *tegulae* dimensions to establish a chronology based on the evolution of lower cutaway forms. These features are the cut-outs to the base the roofing tiles to facilitate the overlap with the upper cut-out of the *tegula* beneath. He found that the lower cutaway forms correlated with flange sizes which in turn correlated with military stamps. Though as Warry admits, the presence of a legionary stamp does not give a direct date, the dating is often reliant on the association of the *tegulae* with other dateable artefacts (2006, p. 58), and would also assume primary use of the building material along with its associated dateable artefact. Each cutaway form was assumed to be representative of different periods of production. On this basis, a chronology of cutaway forms [A B C D etc.] was devised. Mills (2013b, p. 457) tested this chronology using examples from York which indicated the overlap in dates between cutaway types B and C is more extensive than is allowed for in Warry's published chronology. Ian Betts (*pers. comm*.) has found a majority (c.72%) of the Type-C cutaways in London date to A.D.50-120 rather than A.D.160-260 as per Warry's chronology.

2.8 Production and distribution

The study of Roman CBM has potential to inform the understanding of some socio-economic structures of the Roman world. Some scholars dismiss the value of CBM assemblages, skewed by retention bias, negating the possibility of meaningful analysis (Mills, 2013a, p. 3) leading to CBM being dismissed in the construction of site narratives. It is evident that a wide range of methods for the co-ordination of brick supplies was in place across Roman Britain. Urban centres were in a constant state of planning, construction, usage, repair, decay, dereliction and demolition resulting in episodic demand for building materials (Warry, 2012, p. 57). With most major towns showing little evidence of brickmaking, there must have been systems in place to meet these ever-fluctuating demand for a range of products to serve the multiplicity of functions present in construction projects (Darvill and McWhirr, 1984, p. 239). Both production and distribution within the industry are common themes in the literature, though there is a tendency to focus on one or the other in isolation, rather than as interconnected processes.

The primary sources of information on the production of CBM are kiln sites. These are generally located with principal consideration for access to raw materials : water, clay and fuel (Mills, 2013a, p. 5). The excavations of brick and tile production centres tend to focus on kiln structures, their form, and methods of construction. Kiln debris is useful for cataloguing the types of the products and establishing a fabric series for comparison with material from recovered consumer sites. In his gazetteer of kiln sites, McWhirr (1979c) catalogues in the region of 60 kilns, both civilian and military, to which many more recent discoveries can now be added (Fig.7.1). Kilns are generally constructed of tiles, with few stone-built examples, with the first kilns believed to have been built of 'green' unfired bricks (McWhirr, 1979c, p. 101) fired in-situ before the first load. Brick and tile kilns are typically square or rectangular, being the logical shape for the stacking of square or rectangular ceramic building materials for firing. In Italy, Sicily, and the rest of the continent, however, circular tile kilns are also common (Kurzmann 2006,p.17) and thus the possibility for these to be discovered in Britain should not be excluded (McWhirr, 1979c, p. 98). Whilst the structure of kilns is well understood, less is known about how the tileries would have operated and the number of workers that would have been employed in the production process (Warry, 2012, p. 49) and the marketing of the products.

At the time of publication of the McWhirr's (1979c) corpus of kilns, 60% of the known tile kilns from Roman Britain were located more than 20km from a *civitas* capital, in rural areas away from centres of population, which is difficult to explain in terms of access to suitable markets (Peacock, 1979, p. 5). Colchester, London, and Verulamium have produced small clusters of tile kilns, and some others are known to have been on local estates were supplying these urban centres. However, most major Roman towns have produced little evidence of brick-making from their immediate environs though many may have been destroyed by subsequent urban development. Peacock suggests that rural tile makers migrated to the town and fired bricks using clamp kilns, located outside of town walls which are areas traditionally under-investigated in Roman Britain (1979, p. 9). What is certain is that there must be many production sites yet undetected. The source of many tile fabrics in London, for example, is unknown (Betts, 1985, p. 15). Brick-making in Roman-Britain was a new activity to the heavy construction sector of the economy. It has been described as one of the least desirable activities that took place in the Romano-British countryside, with air pollution being a major consequence of the firing of a brick kiln (Darvill and McWhirr, 1982, p. 137).

With no tile production industry present in Britain before the Roman invasion, the first production centres were almost certainly military operations, until the skills had been disseminated to a civilian workforce. The requirements generated by the various building works in urban settlements across the province meant that tile production moved to civilian authorities, with varying demand dependent on, amongst other factors, the availability of good quality building stone. Holt provides the best example of the organisation of brick production under military control, with an arrangement of seven rectangular kilns and one circular kiln along with ancillary buildings, workshops, and drying sheds, located south-east of the barracks (Grimes, 1930).

Some attempts have been made to understand the modes of production and by doing so enable discussions of the economic and social conditions surrounding the manufacture and movement of the material to a wide range of consumers (Peacock, 1979, p. 6). The raw materials, techniques of production and the constraints, in terms of seasonality, have changed little between the Roman period and the 19th century (Darvill and McWhirr, 1984, p. 247). The study of medieval and post-medieval brickmaking in England provides valuable insights into the distribution and marketing of products, the ways in which the demands for bricks were met and the differences in technology and organisation required to meet these demands (Drury, 1981, p. 132). Peacock (1979, pp. 6–8) developed a series of models of production for Romano-British material, based on those he devised for Romano-British pottery production. They are focussed on the nature of the production centre and to a lesser extent on the distribution of the products themselves. He acknowledges, however, that this was an attempt to impose a conceptual framework upon a situation that in practice was almost infinitely variable (Peacock, 1982, p. 8). The proposed modes of production range from small scale household production to estate brickworks, through rural brickyards, nucleated brickyard complexes, to municipal controlled production. McWhirr's thesis (1984) proposes a six-fold division of the organisation of the Romano-British brick industry and later Darvill & McWhirr (1984) re-evaluated these models to consider all influences on the industry from political and social pressures to develop further insight into how the organisation of production and distribution of CBM took account of different levels of demand. McWhirr was explicit in stating that these modes of production were not evolutionary but demonstrably coeval (1984, p. 35) clearly adaptive and able to adjust to an ever-fluctuating demand with flexibility within the organisational structures of the industry thus emphasising the variabilities in demand. Conversely, clear differences in the patterning of demand led to the emergence of a greater variety of responses (Darvill and McWhirr, 1984, p.

256). High demand would be seen at large urban centres requiring, it was assumed, a fairly continuous demand for building materials (Darvill and McWhirr, 1982, p. 138) with fluctuations reflecting socio-economic development or regression (Darvill, 1979, p. 312). Medium demand centres are described as having quite high requirements overall but would experience more fluctuation in that demand with changing fortunes, and a higher degree of conservatism in re-building. Villa sites, following the initial high demand during the construction phase, would exhibit little demand for building materials, except for periodic restoration and repairs. Estate production would have served the demand of the associated estate with limited dispersal of products further afield when demand was low on the estate itself. The level of investment in capital equipment was relatively low, output small and geared towards the needs of the estate. In the 18th and 19th centuries most brick and tile was produced in rural brickyards employing a small workforce. Material was distributed to limited areas with rare specialist orders (Peacock, 1979, p. 6). A similar situation probably prevailed in the Roman period with small brickyards requiring limited amount of capital investment in plant and technology (Darvill and McWhirr, 1984, p. 249). The frequent presence of animal footprints on bricks and tiles is seen as evidence of the brickmaker carrying out his work in a domestic environment alongside animal husbandry practices. This is discussed in more detail in Chapter 10.

Archaeologically it is the correlation of tile fabrics bearing known stamps or dies connected exclusively with particular tileries and with local clays, which provides the evidence for peripatetic or itinerant tilemakers (Betts, 1985, p. 20). This implies the movement of equipment and craftsmen to sources of suitable raw materials or existing production centres in the vicinity of the demand centre (Darvill and McWhirr, 1984, p. 254), oriented towards meeting short-lived demands (McWhirr, 1984, p. 45) or for the manufacture of specialist products. This mode of production has been identified particularly in the production of relief-patterned flue tiles (Chapter 9) (Lowther 1948; Johnston & Williams 1979; Betts *et al.* 1994). The location of the demand centre and the scale, duration and stability of the demand would have been fundamental considerations for the establishment of a tilery alongside the access to the raw materials. It has been observed that brickyards at all periods are generally situated close to deposits of clay or brickearth from which the tile was made, and it seems that the distance, and therefore cost, of transport of the finished products was not necessarily a primary consideration (McWhirr, 1984). Since suitable brickmaking clay would be required in large quantities, even limited transportation of raw materials would be prohibitively expensive for the typical brickyard producing standard, unspecialised products (Peacock, 1982, p. 34). As clay is heavier, and thus more expensive to move than fired brick and tile, it is typically the latter that is moved to the market/consumer. Some poorer clay sources would require a higher level of investment in clay preparation, drying, and firing technology to produce bricks of sufficient quality and in these cases, the increased capital investment would suggest a degree of permanency of a production (Darvill and McWhirr, 1982, p. 139).

Clustered industries are thought to have developed where several producers worked together to exploit the local raw material resources. These are seen to be a response to the demand of large scale civil building products in the local area. This increased scale of production to meet a large demand meant that the production centre could be located further from the consumer, the resulting increased transportation costs being offset by the larger scale of production at reduced cost (Alonso, 1964, p. 103). Clustering in the pottery industry was common in Roman Britain, as illustrated by the production of New Forest Ware (Fulford, 1975) and Oxfordshire wares (Young, 1977). Continental pottery production at Scoppieto gives evidence for at least 27 potters working simultaneously in the workshop (Wilson, 2008, p. 400). The simplest explanation may be that, as competition for fuel supplies around many towns increased through depletion of nearby woodland, it became more economic to exploit fuels and clays beyond their immediate orbit. Economies of scale resulted from the organisation and supply of raw materials, sharing of common facilities, notably the kilns, and the marketing and distribution of the products*(idem*.). Flexibility is evident in the responses to differing types of demand with the adaptability in the modes of production and distribution patterns reflecting this variability (Darvill and McWhirr, 1984, p. 255). It would be unwise to attempt to synthesise the production and distribution of CBM in Roman Britain into a single provincial model. From the itinerant tile-maker to the nucleated industry, the management of the production and distribution of the finished product would have been on altogether different scales.

2.9 Economic models

Economic models are typically applied to Roman brick and tile in analyses mapping the movement of materials from the production centre to the demand loci. The distance and cost effects of arterial routeways are considered in terms of the movements of the bricks and brickmakers against expected patterns in the movement of heavy goods (Hodder and Orton, 1976, p. 184). Transport is the key to defining the physical limits to trade. Literary evidence for travel times and costs is important, and artistic representations are useful, but both sources are incomplete and geographically limited (Greene, 1986, p. 169). It is certain that Roman transport was equal to the demands placed upon it, and that it was not surpassed in scale or effectiveness until the advent of canal or railway network and steam-powered ships. The study of transportation, such as the distribution of materials, demands the existence of a successful transport system. It also suggests that the transport costs from the Roman literary sources may be inflated as they relate to the mountainous geography of the Mediterranean region, rather than the flatter fringes of the Empire. The ratio of costs for the differing transportation routes has been calculated as 1: 4.9:28-56 (inland waterway: sea: road) (Duncan-Jones, 1974, p. 368), based primarily on Diocletian's Edict which includes the cost of sea and road transport for grain, along with a papyrus from Egypt dated to A.D.42 which records inland water transport costs for wheat. Delaine (1997, pp. 210–11) divides the inland waterway transport between downstream and upstream resulting in ratios of 1:3.9:7.7:42). (sea: downstream: upstream: land). Neither of these models take account of price variations across the Empire and are most likely a snapshot of the prices at the time in the area from which the Edict originated (Duncan-Jones, 1974, p. 367). From a technical point of view, the scale and size of Roman transport seems to have been limited by demand, not technology (Greene, 1986, p. 169). The costs of movement of products are minimised along principal routeways allowing for comparatively cheaper movement of goods, based on the premise that transport costs increase with distance and terminal costs e.g. unloading and loading, do not vary. Locational models take irregular forms (Alonso, 1964, p. 98), (Fig.2.4) as shown A-A and B-B are roadways, and whilst point D is nearer than C to M it is more expensive to reach.

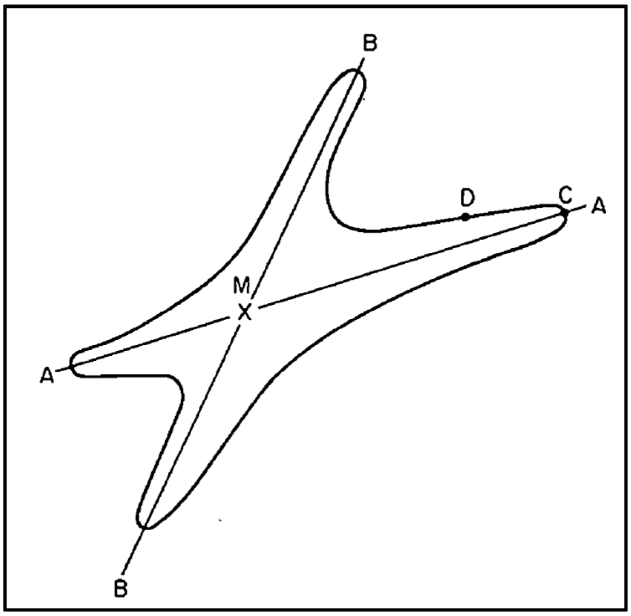


Figure 2.4: *Location theory isotim considering transport networks (After* (Alonso, 1964, p. 98 Fig.16.)

Gravity models rely on the identification of product from a known production centre and model their distribution in terms of the percentage of its assemblage against the distance from the tilery (Hodder and Orton, 1976, pp. 187–195). This model was used by Hodder (1972, p. 901, 1974, p. 42) when illustrating the distribution of stamped-tiles in the Cirencester region, resulting in what he called a 'local' marketing pattern from a single source. Darvill & McWhirr (1982, p. 147) point out that Hodder (1974) neither knew the full distribution of the material nor the homogeneity of the data set. The distribution has been shown to be a classic case of the ease of transport along arterial routeway, in this case Ermine Street, as modelled by Alonso (1964).

The consumer-city model explores the inter-relationships between town and country, based on the premise that cities are dependent on the exploitation of their hinterlands through rents and taxes for their sustenance (Mattingly, 1997, p. 210). Finley's (1985) approach is considered to have resulted in over-generalisations about the economy of the ancient world. His model has been described as minimalist or primitivist (Dark, 2001, p. 19; McComish, 2012, p. 32). He describes long distance trade as being restricted to luxury goods due to poor transportation systems and he views the ancient economy as having low-capital investment in productivity and a lack of technological and industrial specialisation (Mattingly and Salmon, 2001, p. 3; Mills, 2013a, p. 5). The development and characteristics of Romano-British urbanism reflect its liminality on the frontier of the province and models applied to Mediterranean counterparts are not going to fit (Mattingly, 1997, p. 213).

Several scholars propose the involvement of a middleman or builders-merchant who would perhaps have bid for the building projects, particularly at times of the large-scale development and then "sub-contracted" the production of the building materials to one or more tileries. Who was acting as the building merchant/middleman to meet the orders from the consumer centres in the area? The Procuratorial stamps found in London could, for example, be evidence of this co-ordination of production and acquisition of building materials for large-scale construction projects. Similarly, the signatures, relief-patterned designs and other markings could be the marks of the tilers to ensure payment at shared production centres where the work of several tilemakers was being co-ordinated for large-scale demands. These discussions of modes of production tend focus on the location and scale of the production from a tileworks, and the distribution of its products to building projects. Except for London, there are no examples of the study of the building material from the point of view of the consumer. Topics such as the sources of material for specific building projects, over the lifetime of the villa or town, or the different suppliers and production centres that were exploited to meet the demands of the evolving Roman infrastructures call for further research. The fabric series maintained by MOLA (Museum of London Archaeology) has been used very successfully to provide a narrative of the changing ceramic building material suppliers over the lifetime of the Roman provincial capital (Betts, 2017).

2.10 London CBM chronology

In London it is apparent that tile production began soon after the establishment of the Roman settlement in c.A.D.48, with CBM used mainly for roofing timber-and-daub constructed buildings and for the construction of hearths (Betts, 2017, p. 368). Most of the ceramic building materials are made with clays containing varying amounts of quartz, which fire to shades of red. On most central London sites, around 85-95% of the assemblage is locally-made, red and orange tile of 1st to mid-2nd century date (MOLA fabric group: 2815) which came from several kilns situated within 30km of London (Betts, 1987, pp. 27–8). Most of the known kiln sites of this date were situated along Watling Street between London and St Albans, these tileries used very similar clays and it is not possible to attribute these red tiles to specific production sites. The remaining 5-15% provide important evidence for the importation of tiles into Roman London from further afield (Betts, 2017, p. 371).

Several sites have produced early hypocaust tiles, as well of ceramic water pipes of 1st century date (Pringle, 2007, pp. 205–7). After A.D. 70 urban development expanded, with the construction of private buildings alongside an ambitious public building programme (Rowsome, 2008, p. 27). Amongst the public buildings dating to this period are the Huggin Hill baths, which are similar in plan to the public bathhouse at Silchester. This may imply the use of a 'pattern-book' of bath plans, or indeed the involvement of the same architect builder (Rowsome, 1999, p. 265).

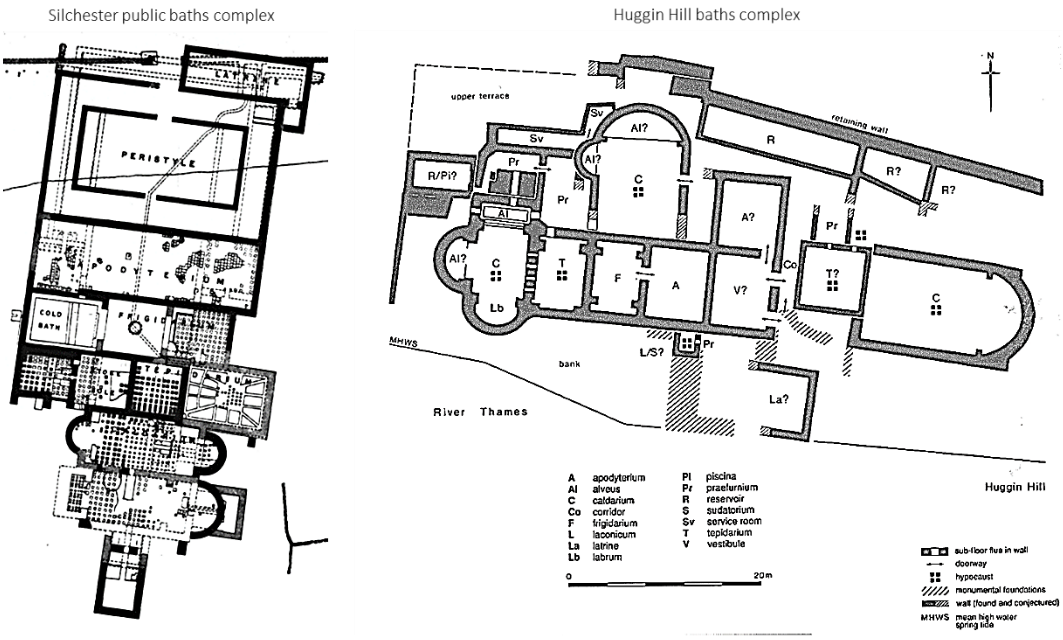


Figure 2.5: *Plans of the Silchester and Huggin Hill bath complexes (After* (Hope and Fox, 1905 Pl.LXXIII; Rowsome, 1999 Fig.2)

The recovery following the extensive fire in c.A.D. 125 may have been less vigorous than previous building programmes, resulting from changing economic circumstances and a decline in trade. The fabrics of CBM from London in the mid-2nd century suggests that a decline of kilns within a 30km radius of the capital may have allowed opportunities for new manufacturers to meet *Londinium's* needs (Unger, 2009, pp. 110–111) with new sources of brick and tile found. The change in CBM fabrics also coincides with local pottery kilns also ceasing production (Betts, 2017, p. 376). This could also reflect a downturn in demand, in London, as by this time most of public buildings had now been constructed. Even with a lower overall demand, construction projects in London would have to have sought new tile suppliers (Unger, 2009, p. 111), and this may have been the trigger for the importation of tiles from more distant tileries., including the production centre at Harrold, Bedfordshire (Late-2nd century and material sourced from Reigate, Surrey (Doods Farm A.D.140-230 (SAU 2015)), filling a gap in production until more local tileries reappeared in the later Roman period. These changes in supply of CBM also coincided with the re-use of brick obtained from the demolition of existing buildings. Shortly after cA.D.140 Huggin Hill bath was systematically stripped of its box-flue tiles, roofing tiles, and other salvageable items, when it was deliberately demolished (Bateman, 1998, p. 48).

It is understood that more local tile production may have temporarily restarted sometime around A.D. 190-220 (Milne, 1995, p. 77), the probable date of the 3km long Roman city wall which is in the main constructed of Kentish ragstone, used a considerable volume of tiles set in a horizontal string courses. It seems unlikely that there would have been sufficient existing brick and tile available to re-use for such a vast building project (Betts, 2017, p. 377). The 4th century saw a sudden increase in the use of fine sandstone and limestone as both roofing and paving. This switch strongly suggests that there were no readily available sources of ceramic tile available at this time, and where tiles were needed they had to be re-used. A tilery at St Martin-in-the-Fields was excavated in 2009 (Tefler, 2009) and based on the results of archaeo-magnetometry dating of the last firing of the kiln, is estimated to have been in use between A.D. 400-450. This suggests that after a prolonged hiatus, fresh supplies of ceramic tiles were needed for building construction or repair, with no awareness of the imminent collapse of the market for which it had been established (Betts, 2017, p. 381).

2.11 Conclusions

As stated in Chapter 1, the distribution of Roman brick and tile is most often studied from the starting point of the production centre, tracing the movement of the products, and using the results to map the distribution networks. The large assemblage of material from Silchester allows for the study of CBM from a different starting point. Here the collection includes a multitude of forms, with examples of stamped materials, relief-patterned tiles and numerous bricks and tiles which include footprints of animals and birds. All these features of the material are considered, along with a detailed characterisation of the fabrics of the collection, the geological situation of the Roman town and local brick and tile production centres to illustrate the supply networks of the brick and tile industry that supported the development of the Roman town.

3. Methods

The methodologies for this study are multi-disciplinary, combining the detailed recording and analysis of the bricks and tiles in the Silchester collections, with both non-destructive and destructive scientific analysis of their composition and mineralogy. As the elemental signatures of archaeological ceramics are a reflection of the clay, aplastic inclusions (natural or temper), water, and changes caused by use and/or diagenesis, the most reliable studies use a combination of chemical and petrographic techniques (Degryse and Braekmans, 2014, p. 196). The methodology for the recording of each item of CBM in the Silchester collections is described. This is followed by a discussion of the scientific techniques applied to the material: portable x-ray fluorescence (pXRF) and ceramic thin section preparation and analysis.

3.1 Recording of material

The details of each item of retained CBM has been entered individually into a MS Access database. All items were assigned a unique reference number, those from the Insula IX archive are prefixed with IX, forum-basilica records are prefixed FB and Reading Museum collection records RM - see Appendices I(IXDB), II (FBDB) & III (RMDB). Each entry includes the form and specific type of the pieces, along with its weight (g) and dimensions (mm). Any context information is recorded, and the context is assigned to a site period or phase according to the Integrated Archaeological Database (IADB) which is used to record all the data from the Insula IX excavations and the site records for the forum-basilica collection. The Reading Museum record includes the accession number and Silchester reference number where available. Any surface features including signatures, scoring and footprints are described along details of any use-wear identified. All items with footprints were also recorded on a separate MS Access database with the dimensions and characteristics of the impressions recorded (section 3.1.1). Forms are assigned per the typology discussed in detail in Brodribb's Roman Brick and Tile volume (1987). Flat pieces greater than 30mm thick and without distinguishing features have been classified as bricks. The typically fragmentary nature of the collection means it was not possible to distinguish between the different brick types, e.g. *Lydion, bessalis,* except where complete dimensions were present, which was rare. Flat pieces, measuring less than 30mm thickness, and without diagnostic features are recorded as tile. Some of the thinner tile fragments will undoubtedly be *opus spicatum*, *tegulae*, *imbrices,* and wall-bonding fragments. Flue-tile were recorded where distinctive scoring, combing, roller-, or relief-patterning is present. *Tegulae* were identified where a flange is present, there is clear evidence of a flange having been removed, or where a lower or upper cutaway can be identified. Upper and lower cutaways are recorded by type per Warry (2006). Bricks and tiles with the addition of clay lumps to the surface are recorded as *mammatae*. All examples are shallow in height and are unlikely to have been functional for the transfer of heat and probably served as spacers within the kiln to facilitate the movement of hot air between the bricks during firing.

All the items were inspected using a 10x binocular microscope and macroscopic descriptions of the fabrics were devised based on PCRG (2011) examining a fresh break where possible. The colours of the exterior, interior and core of each fabric are described with reference to Munsell Color Soil Chart. The colour of the artefact, however, did not influence its inclusion within a fabric group, which was based on mineralogical inclusions and up to 28 fabric groups were formed from the macroscopic analysis.

3.1.1 Footprint recording

The details of the footprints identified on bricks and tiles were recorded onto an MS access database (Appendix V-FOOTDB), using separate recording forms for the bird footprints, ungulate (hoofed) prints, and other mammal footprints, including human footprints both shod and bare-footed. These databases include the context information and reference number from the item record database. The forms record the metrics of the print, images, and identifications. It is acknowledged that all print measurements are approximately 10% smaller than when first impressed as a result of shrinkage during the drying process and firing (Brodribb, 1987, p. 4).

Birds

The bird footprints have been measured per Brown *et al.* (2003) and assigned to the relevant size category according to their length (enormous > 140mm; large – 100-140mm; medium – 75-99mm; small – 31-74mm; minute <30mm.) The measurement of the length of the first and third toes were recorded. Notes were made as to whether the print was symmetrical, and the toes segmented. The angle between the second and fourth toes was measured to assist with the identification of the species which was done using the criteria defined by Bang & Dahlstrom (1974).

Ungulates

The length and width of the hoofprints were recorded, along with a measurement of the gap between the toes (Fig.3.1a). A note was made as to whether the print was symmetrical, along with detail of any other diagnostic characteristics displayed in the print. In addition, ages of the sheep and cattle who made the footprints have been estimated following Barr & Bell (2017).

Other mammals

The length and width measurements of the pawprints were recorded (Fig.3.1b), alongside a note of the presence/absence of claw impressions and a record of the number of toes pads present. Brief descriptions of morphological features were also recorded.

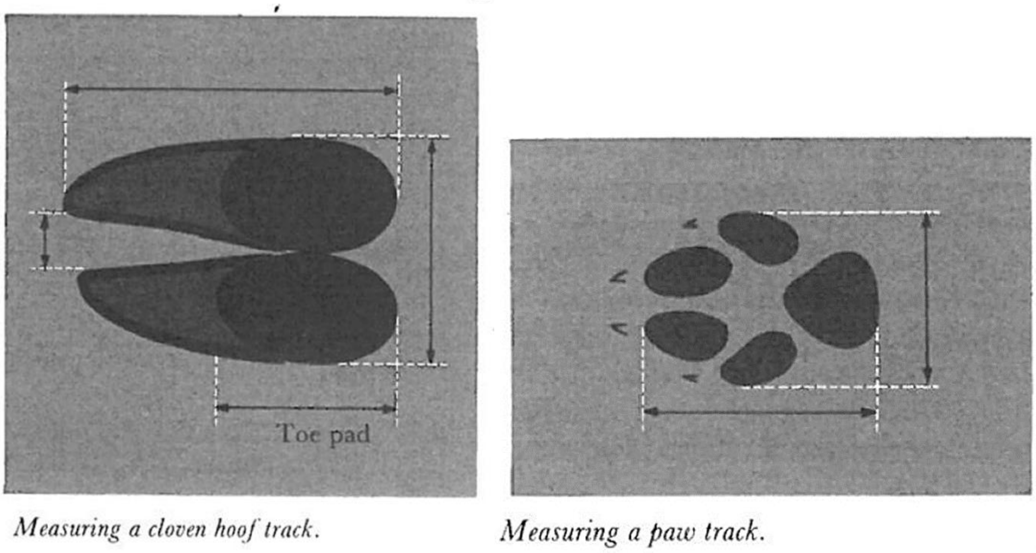


Figure 3.1: Location for measurements of hoof (a) and paw prints (b) (After (Bang and Dahlstrom, 1974)*)*

3.2 Provenance postulate

According to Harbottle (1990, p. 12), it was Jan Erazim Wocel, in the 1850s, who suggested that correlations in chemical composition could be used to provenance archaeological materials, and even to provide relative dates for their manufacture and use. French mineralogist Damour was one of the first to propose explicitly that the geographical source of archaeological artefacts could be determined scientifically "mineralogy and chemistry must make known the characteristics and composition of the artefacts unearthed" (Damour, 1865). The ability to ascertain the provenance of archaeological materials depends on a number of factors: the characterisation of the composition, the predictability of any anthropogenic alterations, and negligible post-depositional alteration (Wilson & Pollard 2001, pp.507--8; Pollard *et al.* 2007, p.7). The assumption of the provenance paradigm is that the chemistry of sediments approximately reflects the main characteristics and chemical composition of the rocks from which they were derived (Degryse and Braekmans, 2014, p. 195) and also assumes that the chemical variability among natural sources of raw materials exceeds the variability within a given source (Hein *et al.*, 2002, p. 542). It is a complex exercise to link ceramic artefacts directly to extant clay deposits as the chemical and mineralogical composition of the artefacts do not necessarily correspond in a simple way to any one distinct raw material, since a number of compositional changes may be introduced in the manipulation and mixing of the raw material, as well as through the use of the pottery, its subsequent burial and post-excavation curation (*ibid.* pp.357–358). Clays were almost always processed and refined to remove coarser particles which will alter the chemical composition in an unpredictable manner. Clays of differing mineral compositions are often mixed, and temper added to the clay to improve the forming and thermal properties. Material of 'assumed provenance' can be used, but kiln wasters are preferred for use as comparative material. These are items that have failed in the firing for some reasons and have been dumped close to the kiln; it is assumed that nobody would transport such useless material over any distance. Whilst ideal in terms of contextual security, wasters are, by definition, products that have failed in the kiln for some reason. Therefore they may be chemically atypical of the kiln's production if failure is related to faulty preparation, which introduces a further complexity into the chain of archaeological inference (Pollard *et al.*, 2007, pp. 15–16). Provenance studies of archaeological pottery by chemical or mineralogical analysis assume that ceramics of the same production series are chemically and mineralogically similar, while being distinguishable from the ceramics of other production series (Hein *et al.*, 2004, p. 357). Several producers may use the same or very similar clay sources in different ways, as for example, if an itinerant brick-caster periodically used the same clays exploited by a static user (Darvill and McWhirr, 1984, p. 243), their products would be geo-chemically and mineralogically the same as those of the permanent producer based at the production centre.

3.3 Clay sampling

Superficial brick clays and brick earths appear to have been the sole source of raw materials used on the brick industry throughout Roman, Medieval, Tudor and Jacobean times (Firman, 1975). Raw materials remain the primary source for interpreting the chemical and mineralogical diversity of pottery and ceramic artefacts, in order to differentiate production units and determine their location (Hein *et al.*, 2004, p. 358). Where kiln sites are lacking, collection and analysis of clay samples may determine the possible source of ceramic building material. Clay deposits are generally made up of a mixture of clay minerals, together with various non-clay inclusions, such as fragments of un-weathered rock, or other siliceous materials which may have become mixed in with the clay deposit. The exact composition will depend on the character, age, and weathering history of the parent rock, and for secondary deposits, on the nature of the transport phenomena involved. Most clay deposits are likely to undergo further weathering and biological modification as part of the normal soil-formation processes (Pollard and Heron, 2008, p. 122). Reference to geological maps and associated notes directed sampling for this thesis to the formations that were considered most suitable to produce brick and tiles, along with areas of known brick and pottery production both Roman and more recent. The locations were selected based on their geological stage and formation, the conditions and depth of the deposits and their location in relation to Silchester. A 5cm diameter auger was used to extract the clay and samples of 1-2 kg were extracted from each location at a depth of approximately 40-50cm. The samples were processed and formed into briquettes, which were then fired in an oxidising atmosphere in a muffle furnace at 800^{o}C for five hours. The samples were neither weathered nor ground before firing. The briquettes were analysed using the portable X-ray fluorescence, as per the methodology set out in section 3.4.1, and prepared into petrographic thin sections for mineralogy analysis (section 3.5).

3.4 Scientific analysis

Ceramics are difficult to provenance using a single analytical method. Brodribb's brief discussion of CBM fabrics highlights the complex nature of the heterogeneity of the material both within and between assemblages (Brodribb, 1987, p. 136). The inherent variability of clay, the additions of temper, along with the complex and subtle nature of the questions to be addressed demand a greater degree of flexibility of approach. As discussed above, a single analytical method is rarely sufficient to identify source materials for ceramics, but a dual approach offers the advantage of complementary results from two techniques providing discrimination based mainly upon the nature of aplastic inclusions using thin section petrography and upon variations within the clay matrix (Betts, Black and Gower, 1994, p. 17), in this case by portable X-ray fluorescence (pXRF).

There are few examples where scientific techniques have been applied to CBM. Petrological analysis has been used to establish the origins of the raw materials used in their production, for example, Peacock's (1977) work on the products of the Classis Britannica and Mills (2013a) study of the material from excavations at Carthage and Beirut. The application of other scientific methods on Roman buildings materials is uncommon, but examples include Francesco *at al*. using X-ray fluorescence (XRF) and X-ray diffraction (XRD) in their analysis of bricks and amphorae at Luzzi (2011) and Meloni *et al.* using neutron activation analysis (NAA) to provenance building material at Roman Pavia (2000). Finlay *et al.* (2012) successfully employed inductively-coupled-plasma-mass-spectrometry (ICPMS) to confirm the movement of brick and tile from York to the Roman fort at Carpow.

3.4.1 Portable X-ray fluorescence (pXRF)

Elemental analysis by pXRF is one of the most common and versatile, non-destructive analytical techniques used in geochemistry, and in archaeological studies, to characterise and provenance materials. It has been applied to archaeological materials from as early as the 1970s (Speakman *et al.*, 2011, p. 3483). The use of portable X-ray fluorescence (pXRF) in archaeological research has been widely discussed, highlighting the strengths and weaknesses of the technique (Potts, Williams-Thorpe and Webb, 1997; Williams-Thorpe, Potts and Webb, 1999; Papadopoulou *et al.*, 2004, 2006; Padilla, Van Espen and Godo Torres, 2006; Romano *et al.*, 2006; Speakman *et al.*, 2011; Frankel and Webb, 2012; Grave *et al.*, 2012; Frahm and Doonan, 2013; Wilke, Rauch and Rauch, 2016). XRF methods enable quantitative analysis of the geochemical composition of samples based on the principle that primary X-rays are incident upon a sample and create inner shell vacancies in the atoms of the surface layers. These vacancies de-excite by the production of a secondary (fluorescent) x-ray whose energy is characteristic of the elements present in the sample. Some of these characteristic X-rays escape from the sample and are counted and their energies measured (Fig. 3.2). Comparison of these energies with known values for each element allow elements present in the sample to be identified and quantified (Pollard *et al.*, 2007, p. 101).

The non-destructive capabilities of pXRF analysis, the portability of the equipment, and the rapidity of results have made this a popular technique in the analysis of archaeological materials. Portable analysers which use miniature X-ray tubes, can be handheld and were developed for use in the field. The following discussion of the use of pXRF in archaeological science highlights the perceived strengths, particularly its non-destructive method, and the limitations of this technique. The combination of conveniently portable, high-resolution instrumentation capable of non-destructive, multi-element analysis has underpinned the rapid growth in the application of pXRF analysis to archaeological materials (Forster *et al.*, 2011, p. 389). However, the benefits of the reduced analysis time needs to be offset against the lower sensitivity and reduced set of measurable elements in comparison to laboratory-based techniques (Craig *et al.*, 2007, p. 2013). For fully quantitative XRF analysis, ceramic samples would need to be homogenised into a powder to ensure that the specimen is representative of the sample bulk composition (Holmqvist, 2017). The use of pXRF on unprepared samples results in a reduction in the excitation volume which increases the susceptibility of sample heterogeneity and surface attenuation effects (Forster *et al.*, 2011, p. 389). Effective sample volume is also affected by variation in detection response across the analytic window and matrix attenuation of fluorescent x-rays. These factors influence the effective weighting of detected elements according to their distribution within the sample matrix (*ibid.* 2011, p.398). The method has been discussed and commented on by many papers, particularly in relation to its application and interpretation of the data returned from the analysis. Grave *et al.* (2012) state that archaeological applications of pXRF continue to be cautiously treated, principally due to a perceived lack of analytical rigour.

Frahm & Doonan (2013) conducted an extensive review of peer-reviewed literature which used pXRF as a method of analysis. They concluded that the technology is not being accompanied by a change in methodological or theoretical frameworks. The technique was used in isolation in only half of the cases reviewed, which was interpreted as an indication of the researchers awareness of the limitations of the method, with the second analytical technique chosen to corroborate their results and/or satisfy sceptical reviewers (2013, p. 1431). This, however, could be portrayed somewhat more positively: that the pXRF is used as a complementary method to supplement results from other analyses as part of a robust methodology, to fully characterise the material under analysis.

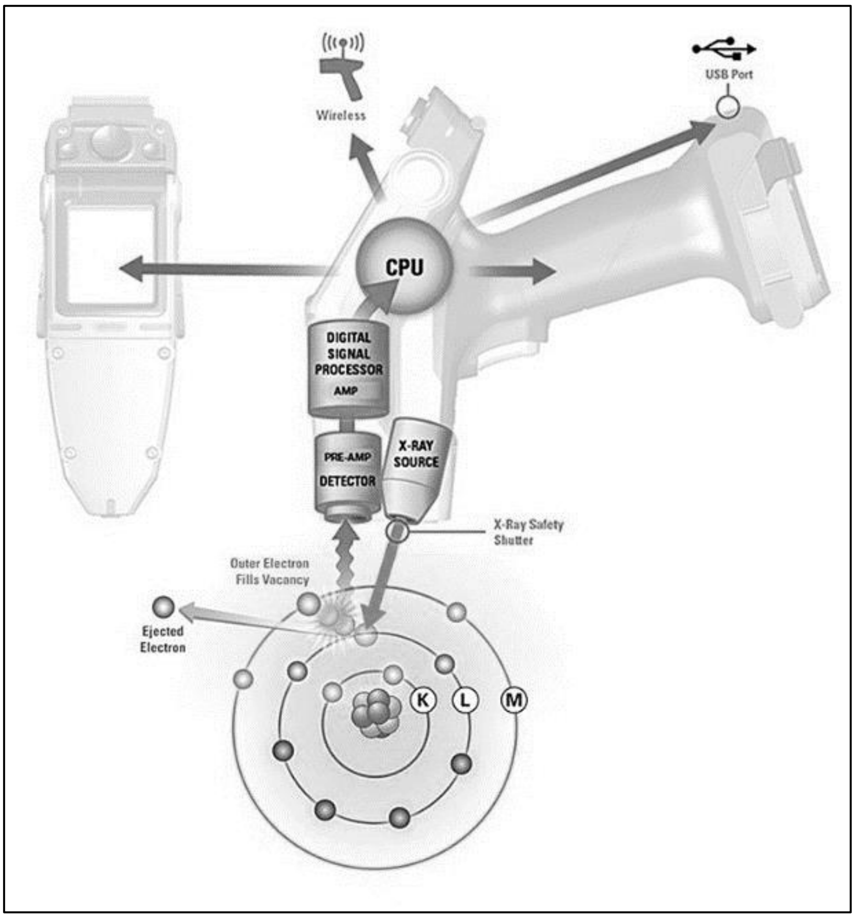


Figure 3.2: *Diagram of the portable XRF analysis process © Niton systems*

The non-destructive nature of the process is always considered an advantage, as destructive analyses are not always possible or permitted. Speakman *et al.* (2011) still claim that INAA or other destructive methods are more suitable as they homogenise the samples and remove the problem of heterogeneity of the material. This opinion is shared by a number of other authors, who assert that the method is only suitable for homogeneous materials, e.g. fine pottery (Romano *et al.*, 2006), citing that the method has been particularly successfully applied to the analysis and provenance of obsidian (Phillips and Speakman, 2009; Nazaroff, Prufer and Drake, 2010; Forster *et al.*, 2011). The problems inherent in using this method on heterogenous materials is readily acknowledged, and the analysis should not be undertaken without some knowledge of the chemical variability and the expected group structures so that meaningful compositional groups can be constructed (Speakman *et al.*, 2011, p. 3495). Ceramic fabrics are multicomponent systems, the abundance ratios of some elements can be altered as a result of mixing of several materials. Consideration of post-depositional changes have important implications in the interpretation of analytical data from archaeological ceramics, and highlight the importance of petrological and mineralogical analysis to support the chemical data (Pollard and Heron, 2008, p. 127). The difference between production centres' chemical signatures, particularly when they are geographically adjacent, can be minimal. In this context Wilke *et al*. discuss the use of artificially spiked fired clay samples to calibrate the pXRF analyser and thus refine distributions to account for small variations in composition where elemental patterns of ceramics overlap (2016, p. 142). It is believed that the analysis of unprepared or field samples can only be quantitative and reproducible (without the application of correction factors) if the sample has a flat surface. Any rough or irregular surface will not lie in the analytical reference plane of the instrument. In these circumstances, both the excitation and detection efficiency will be affected by the inverse square law, which reflects the fact that intensities from a point source vary in inverse proportion to the square of the X-ray path length (Williams-Thorpe, Potts and Webb, 1999, p. 217).

Portable XRF is thought to be best suited for chemical analysis of transition metal alloys with geological materials found to be more problematic because most are composed predominantly of elements of low atomic number (e.g. silicon, aluminium, magnesium, sodium, oxygen, carbon), all of which are excited/detected with very low efficiencies. Portable XRF is often used in a multi-disciplinary methodology to support manual groupings of materials and facilitate sample selection for other analytical methods. This method has proven to be useful in dividing up a rather unpromising bunch of sherds on a rational basis (Orton and Hughes, 2013, p. 169). Cairo *et al* (2002) successfully combine thin section petrology, XRF and NAA on artefacts and clay samples from the Po River delta to demonstrate that the raw material was modified in order to obtain a suitable mixture for brick production. The aim of this study is therefore to use the portable XRF as a semi-quantitative method to verify clusters or groups defined in hand specimen, alongside mineralogical analysis of thin section.

3.4.2 Machine specification and calibrations

Portable x-ray fluorescence analysis was conducted using a Niton XL3t GOLDD+ spectrometer. The analyser is calibrated to calculate the chemical composition for up to 32 elements, excluding the lightest elements (H-Na). The accuracy of the analyser has been demonstrated to be most effective for a suite of fourteen elements present in the clays (Al, Si, K, Ca, Ti, V, Cr, Mn, Fe, Zn, Rb, Sr, Nb and Zr). These commonly occurring elements have been found to vary as little as 15% across a heterogeneous set of clay artefacts, accurate to ten parts per million. For precision, comparability with data sets from other instruments, and to compensate for drift, the results are calibrated using NIST standard reference samples with published values: JB-1 – basalt (Myokanji-toge, Japan) JG-1 granite (Sori, Gumna-ken, Japan), FER-1 – iron formation sample (Bathurst, New Brunswick, Canada) (confirmed with additional testing on a conventional lab-based EDXRF analyser). These silicate rocks standards were chosen as they are similar in composition to ceramic artefacts.

3.4.3 Selection of elements & number of readings

The general advice when choosing which elements to include in any analysis is to analyse for everything, making no *a priori* assumptions about useful elements (Harbottle, 1982, p. 22). Most rock types and clays consist of heterogeneous mineral phases with mineral grains distributed randomly. The precision of determinations by pXRF is affected by grain size as there are statistical variations in the number of discrete mineral grains of a particular composition within the analysed volume (Williams-Thorpe, Potts and Webb, 1999, pp. 218–9). For non-destructive pXRF, to overcome the inherent heterogeneity in ceramic samples, the solution is to average multiple replicates for the same sample, with the number of replicates determined by the coarseness of the sample. Sampling precision will not affect all elements to the same extent, since magnitude of the element depends not only on variations in the mineral assemblage, but also on the way individual elements are partitioned between individual mineral phases. Grave *et al*. calculated an average of 3-5 replicates were required for medium-to-fine matrices of volcanic and metamorphic rocks, in order to allow, at best, a semi quantitative estimate of bulk composition (2012, p. 1677). Williams-Thorpe *et al.* calculated between one and five measurements are sufficient to give an average composition with a relative standard deviation of the mean better than 5% for Ca, Ti, Fe, Sr, Zr and Ba of a slightly coarser rock, but with 11 to over 300 measurements needed for very coarse-grained rocks (1999, p. 219).

To ascertain the number of replicate measurements needed on the Silchester CBM collection, the method outlined by Potts *et al.* was followed (1997). Ten points were analysed on a single sample of a heterogeneous fabric, at a minimum spacing of 30mm to avoid overlapping analysed volumes (Potts, Williams-Thorpe and Webb, 1997, p. 35). The results were used to calculate the number of replicate readings needed to achieve 10/5/2% standard error, in Potts' results, these ranged from 1-4 readings for a 10% standard error in a homogeneous ceramic and 1-42 readings in a heterogeneous granite. The results of the analysis on a sample of CBM from Silchester are shown in table 3.1.

The results show that two determinations (rounded up from 1.87) are required to achieve a relative standard deviation of the mean of 10%. Eight repetitions (rounded up from 7.49) would be required to achieve a relative standard deviation of the mean of 5%. However, as this project is not looking to measure a particular element to a stated precision, the <u>average</u> number of measurements needed to meet the standard deviations of mean criteria at 2%, 5%, 10%, and 20% are 12.51 (rounds up to 13), 2, 0.50 (rounded up to 1) and 0.13 (rounds up to 1) respectively. Based on the results of this analysis, the decision was taken to take three measurements on each sample in different positions.

	Reading	Al (ppm)	Si (ppm)	P (ppm)	K (ppm)	Ca (ppm)	Ti (ppm)	Fe (ppm)	V (ppm)	Cr (ppm)	Zn (ppm)	Rb (ppm)	Sr (ppm)	Zr (ppm)
	1	71952.96	239112.1	11588.53	11585.5	12942.08	3489.71	34904.02	489.38	137.37	135.85	54.47	217.73	151.72
	2	72031.41	220358.2	13573.86	11360.27	14045.42	3760.41	35511.15	494.45	153.96	137.54	53.03	207.87	168.68
	3	72508.59	228928.7	13292.76	11453.94	13700.55	3510.3	33992.07	457.48	138.58	116.07	53.24	199.86	165.5
	4	66119.91	224118.6	10989.39	11358.72	13218.79	3620.74	33869.97	495.33	163.66	132.65	51.95	210.55	154.21
	5	61573.27	218283	10157.94	11108.78	12231.14	3582.58	33933.09	424.29	144.67	131.84	53.05	203.47	172.81
	6	57505	218492	10053.38	11071.26	12192.48	3738.61	32847.33	392.69	151.16	148.9	55.73	228.9	163.47
	7	60819.89	211166.2	12437.86	10643.24	13807.16	3372.99	31635.59	425.78	139.15	127.61	52.51	219.6	174.26
	8	58835.67	207018.5	8927.17	11064.27	12716.37	3701.38	37256.32	407.74	173.23	145.86	58.93	215.36	164.6
	9	61471.52	207085.9	12217.03	10527.01	13613.54	3402.66	32929.84	418.42	151.63	126.75	56.72	225.98	141.9
	10	64304.32	214352	11895.92	11042.72	14617.9	3765.83	32661.36	422.24	136.02	147.35	54.9	232.72	154.29
Mean		63907.73	216644.79	11505.03	11070.02	13349.26	3606.17	33848.52	437.60	150.23	134.95	54.45	216.03	162.19
Standard Deviation (SD)		5392.82	7466.18	1574.77	315.09	829.38	150.68	1679.23	36.72	12.34	10.99	2.31	11.58	10.35
Relative SD as a percentage		8.44	3.45	13.69	2.85	6.21	4.18	4.96	8.39	8.21	8.15	4.23	5.36	6.38
Standard Deviation of Mean		1205.87	1669.49	352.13	70.46	185.45	33.69	375.49	8.21	2.76	2.46	0.52	2.59	2.31
As a %		1.89	0.77	3.06	0.64	1.39	0.93	1.11	1.88	1.84	1.82	0.95	1.20	1.43
n for 20% SD of mean		0.18	0.03	0.47	0.02	0.10	0.04	0.06	0.18	0.17	0.17	0.04	0.07	0.10
n for 10% SD of mean		0.71	0.12	1.87	0.08	0.39	0.17	0.25	0.70	0.67	0.66	0.18	0.29	0.41
n for 5% SD of mean		2.85	0.48	7.49	0.32	1.54	0.70	0.98	2.82	2.70	2.65	0.72	1.15	1.63
n for 2% SD of mean		17.80	2.97	46.84	2.03	9.65	4.36	6.15	17.61	16.86	16.59	4.48	7.18	10.18

Table 3.1: *Calculation of the number of determinations required to achieve 20%/10%/5% and 2% SD of the mean*

All analysis was conducted using the 8mm window, as opposed to the 3mm spot analysis, to account for variations in clay composition. Three readings were taken at three different locations across the surface of each sample. These readings have been averaged to reflect the overall clay composition at the surface of the artefact, consistent with the common sample size used for thin-section analysis of clays. The analyser was calibrated to mining mode and set to perform a complete analysis over the course of 150 seconds (30 seconds main filter, 30 seconds high filter, 30 seconds low filter and 60 second light filter). Each artefact was therefore analysed for a maximum total of seven-and-a-half minutes.

3.4.4 Statistical analysis of results

The results were reported in parts-per-million (ppm). Only the elements where a result was returned for every sample were included in the analysis. This negated the need to insert arbitrary values where the reading was below the limit of detection (Sanford, Pierson and Crovelli, 1993). The replicate analyses were averaged for each element for each sample. These results were then analysed using Principal Components Analysis (PCA) using SPSS to identify discrete compositional groups within the dataset or assess the coherence of hypothetical groups already established (Degryse and Braekmans, 2014, p. 195). The use of multivariate statistical processes allows for the definition of composition based on the raw analytical data without the need for arbitrary selection. Principal components analysis (PCA) is a multivariate ordination technique and is primarily used as a tool for exploratory data analysis in order to reveal the internal structure of the data responsible for its variance (Baxter, 1995). The method envisages the individual samples as points in geometrical space whose axes are defined by the variables, and which therefore have as many dimensions as there are variables.

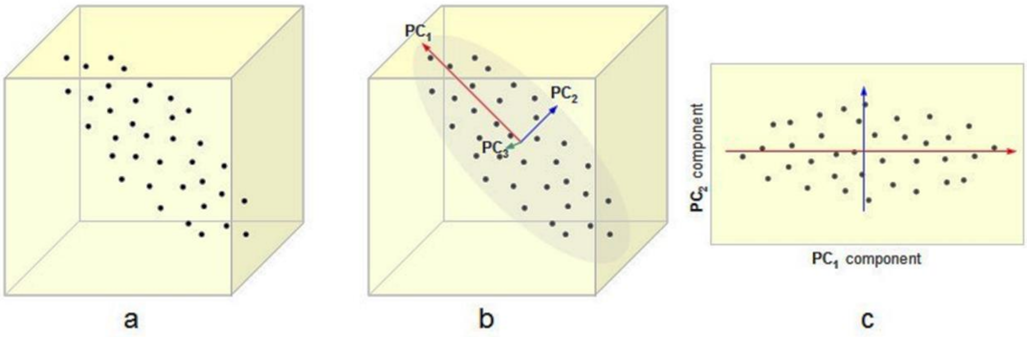


Figure 3.4: *An illustration of PCA. a) the data set plotted as 3-dimensional points. b) three Principal Components (PC1,2,&3) ordered by variance c) an example of a two dimensional projection of the data set into the first two PCs.*

The space is rotated to a new set of axes so that the observations are as spread out as possible (Fig.3.4). PCA is used to investigate chemical compositional structure in the data and whether or not archaeological types cluster together based on chemical data only (Baxter, 1995, p. 514). The aim is to obtain a low-dimensional representation of the data (usually two), while preserving as much as possible of the original structure of the data. Principal components analysis requires no prior information about the fabric groups to which each artefact is said to belong, so clustering of items from one fabric group confirms their common identity. With chemical analyses of ceramics, the program searches for those elements which show the greatest variability in the whole set of analyses and constructs from them a series of principal components carrying decreasing proportions of variability. The program devises a calculation for each component; for the first component the concentration of each element is multiplied by a 'weighting' factor (loading) calculated to reflect the variability of that element in the whole dataset (Orton and Hughes, 2013, p. 176). It is almost universal practice to take logarithms of the concentrations of all the elements before submitting the data to PCA (Baxter, 2003, p. 75). This serves to normalise element distributions and reduce the impact of differences in magnitude for some of the major elements (Bakraji, 2006, p. 191). For example iron (Fe) which is highly variable because of chemical action during weathering, erosion, sedimentation, and diagenesis (Degryse and Braekmans, 2014, p. 194).

An idealised plot would show each fabric group as a close cluster of points but separated from other groups of points representing other fabrics. Since one of the core aims of compositional analysis is to use the chemical grouping of fabrics of known provenance to compare with sherds of unknown provenance, any analysed artefacts which fall close to or within a recognised group on the plot suggests they are also members of that group. In an assemblage that has not been divided into fabric groups, the grouping of the results on PCA plots may suggest underlying fabric clusters or sub-groups. Variation in elemental concentrations may be due to variable tempering rather than to clay source distinctions and these temper-related effects are often revealed in the first Principal Component. The extreme dominance of silica in the samples means that variation in this compound, which is related to abundance of quartzose inclusions in the samples, is likely to exert a strong dilution effect on the relative proportion of the other elements (Baxter and Freestone, 2006, p. 524). Results of analyses on two known groups of ceramic building material were plotted, and the groups coalesced when principal components one and two were plotted, however, the separation was clear using components two and three. Therefore, principal components two and three are used in the scatterplots to eliminate this dilution effect of quartz-sand temper (Neff, Bishop and Sayre, 1988). In this project, the pXRF was primarily used to verify similarities between fabric groupings which had been assigned macroscopically. These groups were then investigated further with petrographic analysis.

3.5 Thin section petrography

Thin section analysis of archaeological ceramics first began to establish itself with the pioneering work of David Peacock (1969b, 1969a), who showed that the clay source used for the manufacture of pottery could be characterised by the presence of distinctive inclusions. Ceramics are fired sedimentary clay and as such can be treated as geological samples and subjected to thin section preparation and analysis. The contribution of ceramic petrography has been of paramount importance in understanding the processes of production techniques, and in relating the ethnographic and historical record of pottery production. It allows for the identification of rock and mineral inclusions within the clay matrix, and analysis of the size of certain types of grains present (Betts, 1985, p. 2). The method is most useful in characterising a broad range of ceramic materials by identifying the types of inclusions present, applying the techniques of optical mineralogy to archaeological materials (Quinn, 2013, p. 4). Whilst the technique is destructive, only a small sample is needed and the thin-section does preserve the detail of the sample in slide form for future reference or study (Rice, 1987, p. 382).

Provenance studies using thin-section petrology involve the geological characterisation of ceramic artefacts and the nature of their raw materials (Quinn, 2013, p. 117). Thin section petrology is of most benefit when distinctive mineral inclusions are present, when it focuses on non-plastic inclusions that retain the characteristics of their original clay or temper sources (Reedy, 2008, p. 151). Once identified, these can be used to establish the geological composition of the material. When compared with the local and regional geology, it may be possible to establish a probable source of the material. This is typically based on the assumption that ancient potters did not travel significant distances to obtain their raw materials (Quinn, 2013, p. 119). Petrographic provenance determination indicates if an ancient ceramic artefact or fabric was produced locally or not, whether the fabrics are from geologically separate groups, and potentially identifies the source area of the ceramics. The establishment of the source of a ceramic through the petrology of its fabric is dependent on variability in the local geology and the availability of sufficient comparative samples or literature (Vince, 1984, p. 33). Where distinctive minerals are absent, textural analysis of the quartz present can help group homogenous sherds or determine whether several centres were responsible for the production of pottery (Williams, 1983, p. 304). Any post-production movement is likely to be the result of one or more past cultural processes, such as trade, exchange, distribution, ceremonial offerings, migration and settlement shifts (Quinn, 2013, p. 142). The results of petrographic analysis can also be used to construct economic models of supply and trade (Barclay, 2001, p. 9).

There has been some discussion to determine whether a single thin-section is representative of the ceramic being analysed. Whilst homogenised samples are used for x-ray diffraction (XRD) analysis and inductively-coupled-plasma-mass-spectrometry (ICP-MS), it is not possible to homogenise a sample prior to thin section preparation. Darvill & Timby (1982) analysed a number of sections taken from the same pots and ceramic tiles, concluding that a single section was adequate to define the fabric of a single object, but, no attempt was made to measure the variability encountered between sections taken from the same ceramic. Betts tested this variability by making several sections from the same tile, for each of which grain size distribution was determined based on the measurement of 150 grains (1985, pp. 80–86). His results showed that at two kiln sites three thin-sections were a valid sample size to define the grain size of the kiln material.

There has been little use of ceramic petrography in the study of bricks and tile, it is more typically employed in pottery analyses. Kritsotakis (1995) successfully uses petrological analysis alongside inductively coupled plasma atomic emission spectroscopy (ICP-OES) to address several questions regarding the production of tiles at Mirebeau and surrounding sites. Tomber (1987) used petrological analysis to identify inter-provincial, long-distance movement of bricks and tiles through recognition of imported material at Carthage. Here, two categories of fabrics with metamorphic or volcanic inclusions could be identified as imports, those with inclusions of restricted occurrence which allow for potential source areas to be identified, and those with more generic inclusions where the source is more difficult to pin down. Petrological analysis might point to common origins in terms of clay sources, whilst a signature or stamp can be ambiguous as either the tile or tile-maker may have moved in geographical terms. Darvill has used petrological analysis and stamp typology together allowing for valid statements to be made about the production infrastructure, thus providing insights into the Romano-British brick and tile industry as a whole (1979, p. 311).

3.5.1 Sample selection and preparation

The recommendation is to include at least two samples of each macroscopically identified fabric (Quinn, 2013, p. 129) in the thin section samples. For the purposes of this project, at least three samples were taken from each of the fabrics identified macroscopically. Each thin section has been assigned a unique identification number prefixed TSID. Following petrographic analysis, several the macroscopic fabrics have been combined into groups for the final fabric series, resulting in at least six thin sections contributing to the petrographic descriptions of each of the SILCBM fabrics.

The samples were polished and mounted onto microscopic slides that had been frosted to provide a key to secure the sample. The samples were trimmed to approximately 2mm and then lapped to a thickness of 30µm using a Logitech LP30, before being cleaned and covered with a thin glass coverslip. The thin sections were analysed using a Leica DMEP polarising microscope at x25 – x100 magnification under plane polarised light (PPL) and crossed polars (XP). Digital microphotographs were taken using a Leica DFC420 camera attached to a Leica DMLP polarising microscope. Thin-section descriptions were recorded according to the criteria set out by Quinn (2013, pp. 79–102 Appendices A1-A3). Each sample is described in thin section according to the inclusions identified, both plastic and aplastic, followed by a description of the clay matrix and a characterisation of the voids within the fabric.

3.5.2 Textural and compositional analysis

Textural analysis involves the measurement of the longest dimension of a large number of randomly selected inclusions within a ceramic thin section. Measurements of the size and shape of the inclusions, usually quartz, has been successfully employed by many where distinctive mineral suites are lacking in the ceramic material, as is expected in a region of sedimentary geology (Darvill, 1979, p. 315). This method assumes that the thin section is representative of the ceramic under investigation, see above. Johnston and Williams (1979) used textural analysis on the fabrics of relief-pattern flue-tiles; this suggested that the tiles were moved over a considerable distance. Darvill's study of TPF- and LHS-stamped tiles (1979) also used textural analysis. This revealed that one fabric group could be linked to the kiln material from Minety, Wiltshire, whilst the other matched samples of *Lower Lias* clay in the vicinity of the villa at Hucclecote some 40km away.

The number of grains required for textural analysis depends on the fabric of the material under investigation. According to Shackley (1975, p. 136) the number of grains that need to be measured depends on the size range present, but should be at least 300-500, preferably more. Wandibba (1982) recorded 50, 100 and 200 grains from nine thin sections, and compared the mean grain size for each count. He found that the results from measuring 50 and 100 grains was not significantly different to that obtained for the measurement of 200 grains. This suggests that an adequate mean grain size can be obtained from just 50 grain size measurements, provided the grains are well dispersed across the section. Streeten (1982, p. 128) showed a larger standard deviation when 25 and 50 grains were measured, which narrowed when the grain count was increased to 100. Between 150 and 200 grains there is relatively little difference. Based on these results, Streeten recommended a minimum sample of 150 grains to ensure an adequate representation of sparse larger grains. Betts used the Kolmogorov-Smirnoff test to establish whether two independent samples were drawn from the same population and assessed the required grain count needed for textural analysis. He concluded that a 150-grain sample is clearly adequate for his material, but that this may not always be the case. This is dependent on the size range of the inclusions present and their frequency (Betts, 1985, p. 79).

Point-counting and compositional analysis software, Petrog, was used to record the textural and compositional data using with an automated stepping stage to move the slide being the point being recorded. This facilitated the recording of 300 points per sample, providing a large data set for each sample. Using the software, an area of interest was assigned to the slide to accommodate 300 points to be recorded and ensure that the spacing between the points, step-size, was consistent and greater than the mean diameter of the particles being measured (Freestone, 1991, p. 403). A step-size of approximately 0.75mm was maintained for each sample, large enough to ensure the smallest inclusion size was exceeded. Every point was assigned to a category: matrix, void, or inclusion; measurements were taken of the longest axis of all inclusions. Textural and compositional analysis was carried out on at least three thin sections for each fabric to determine similarities and differences between fabrics where no distinctive inclusions were present.

The maximum, mode, and mean size of the aplastic inclusions within an archaeological ceramic thin section, as well as the standard deviation, can provide simple textural criteria that are characteristic of the samples and may therefore be used to compare one artefact to another (Quinn, 2013, p. 103). Of these, the most valuable parameters are perhaps the mean and mode, which are related to the overall grain-size of the sample. However, the textural complexity of ceramic pastes, especially those which have been intentionally modified, means that the mean and the modal values may oversimplify the grain-size characteristics of a sample and thus fail to record certain valuable information. A better approach is to use textural data to examine in detail the grain size distribution of the aplastic inclusions. The grain size distribution can be presented visually in a frequency distribution chart, where inclusion size categories are expressed in millimetres (*idem*.). The size of the categories strongly influences the shape of the histograms with large categories masking detail in the grain-size distribution and very small categories over emphasising minor differences that may not be of importance. The histogram plots for the Silchester material have been set to intervals of 0.025mm.

Most naturally occurring sediments have a unimodal grain size distribution composed of a single dominant grain-size forming a peak in the histogram and lesser quantities of inclusions with larger or smaller grain sizes. The inclusions in archaeological ceramics can also have a unimodal grain size distribution, especially where a single source of clay has been used in their manufacture. The prominence of the mode and the spread of the histogram are related to the degree of sorting, with better sorted unimodal grain-size distribution having a narrower range of grain sizes and a sharper peak. The process of sieving and levigation of clay produces a refined paste, removing larger inclusions. This may produce a truncated unimodal grain size distributed, with a mode that is skewed to the right. The addition of particulate temper and the additional mixing of two texturally different clay sources affects the grain size distribution of archaeological ceramics and may produce a polymodal distribution. In the case of tempering, aplastic particles with a grain size greater than the naturally occurring inclusions in the base clay are normally added (*idem.*). The grain-size distribution patterns of archaeological ceramics can be used as a provenance tool for matching non-local artefacts to their sources. The specific mix of clay and temper used by potters for the manufacture of certain fabrics at different production sites can result in ceramics with characteristically shaped distributions. If sufficient numbers of samples from a range of possible kiln sites are subjected to textural analysis, it may be possible to provenance ceramics of unknown source based on the visual appearance of their histograms.

Thin section petrography and textural analysis can reveal relatively minor variations in grain size and frequency but tell us little about the ceramic clay matrix. Geo-chemical analyses can reveal variations in the composition of the clay matrix but cannot easily identify differences in fabric caused by differences in quartz grain size. The use of two complementary techniques provides a more complete description of the material under study.

Chapter 4. Reading Museum CBM collections

4.1 Introduction

This chapter looks at the CBM collections held in the Reading Museum collection, which mostly comprises that material recovered and retained from the Antiquarian excavations at Silchester. Initially, there is a short discussion about the retention policies applied to the material and therefore the composition of the retained assemblages. A review of the reports of the excavations by the Society of Antiquaries is used to record all references to ceramic building materials across the town. These data are analysed to establish if any of the material in the Reading Museum collection can be assigned to the *Insulae*, buildings or features described in the excavations reports. Other particular items of note in the collections are also discussed. All descriptions of hypocaust systems recorded by the Society of Antiquaries are collated and discussed in terms of the type and details of their construction.

The history of excavations at Silchester is summarised by Creighton with Fry (2016, pp. 10–36 Table 3.1). The material recovered by excavations prior to the 1970s makes up the Silchester collection housed in the Reading Museum archive and Silchester gallery within the museum. There are no specific references within the Antiquarian reports to the recording, retention, and disposal of CBM. The published excavation reports are characteristically narrative in nature, describing the layout of the buildings and focussing on their structural composition. Brick and tile are typically referred to in the reports in relation to their use in the structure of a building with only exceptional or unusual items described in any detail. One particular example of the lack of attention to CBM is seen in Joyce's 1881 report of his excavations of the forum-basilica which makes no mention of ceramic building materials in any form (Joyce, 1881). It was not until excavations of the 1970s onwards that an increased awareness of the value of archaeological remains led to increased retention of materials, including CBM, animal bones assemblages, and plant macrofossils (M. Fulford, *pers comm.*). The report on the tiles in the Silchester defences volume (Green 1984, pp.196–199) states that a random sample of 57 reasonably large pieces was extracted from many hundreds of tile-fragments in one layer. Another 168 fragments were examined from the filling of F7 (?grave) in the centre of the southern gateway (Fulford, 1984 Fig.15), whilst the remainder of the report focusses on the recorded dimensions and characteristics of bricks measured in-situ. The report on the brick and tile recovered during the 1977-80 excavation of the forum-basilica describes a total of 23,620 fragments recorded, with an approximate weight of 3413.5kg. Fragments of intrinsic interest and most of the material from the pre-conquest levels were retained for further work. This amounted to approximately 4% by weight (Timby, 2000, p. 116). The Silchester Town Life project, investigating the life of the Roman town in an area of Insula IX, recorded approximately 13.2 tonnes of CBM over the 18 years of excavation. Of this, less than one tonne, approximately 882.151kg has been retained, equating to approximately 6.68% of the CBM bulk finds recorded in the IADB (Integrated Archaeological database). As the discarded material is recorded only by weight, it is impossible to ascertain the number of discarded pieces.

4.2 Society of Antiquaries excavation reports

The Silchester CBM collections housed at Reading Museum comprise material retained from the excavations at the Roman town prior to the 1970s. The most extensive investigation of the town was conducted by the Society of Antiquaries between 1890 and 1909. This project resulted in the drawing of the town plan of Silchester which is still the most complete there is of a Romano-British town (Wacher, 1995, p. 255) (Fig.4.1).

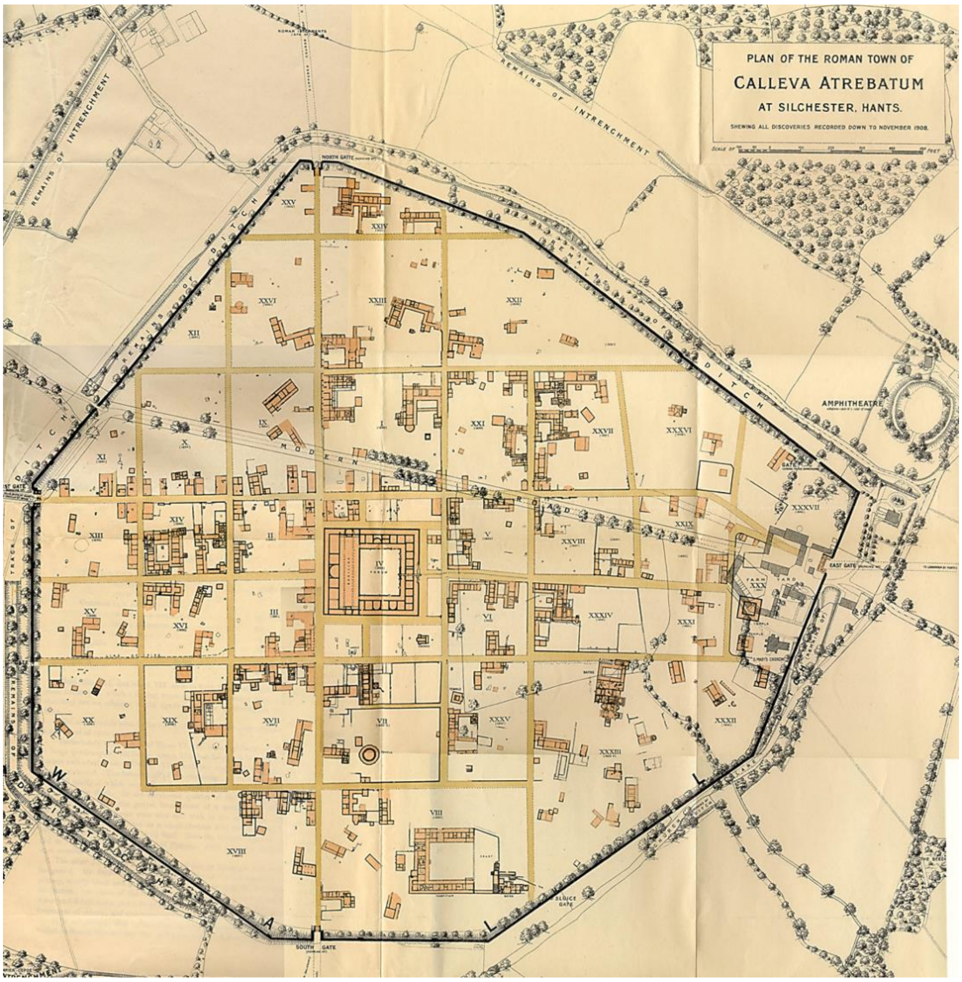


Figure 4.1: *Antiquarian town plan of Calleva Atrebatum*

The techniques of the early excavators were not as thorough compared with modern standards lacking attention to sequencing and stratigraphy. At Silchester, the Society of Antiquaries' primary objective was to recover the complete plan of the Roman town and did so by revealing stone walls and other solid structural remains. Artefacts were recovered with no relation to the stratigraphic sequence (Clarke and Fulford, 2002). The Reading Museum collection includes many complete examples of bricks and tiles, along with a large number with animal, human, or bird footprints. A total of 489 items of CBM have been recorded from the collections of which 267 (54.6%) are complete examples. This is a relatively small collection of CBM when it is considered that the archive includes material from the twenty-years of excavations by the Society of Antiquaries along with that from some more recent work.

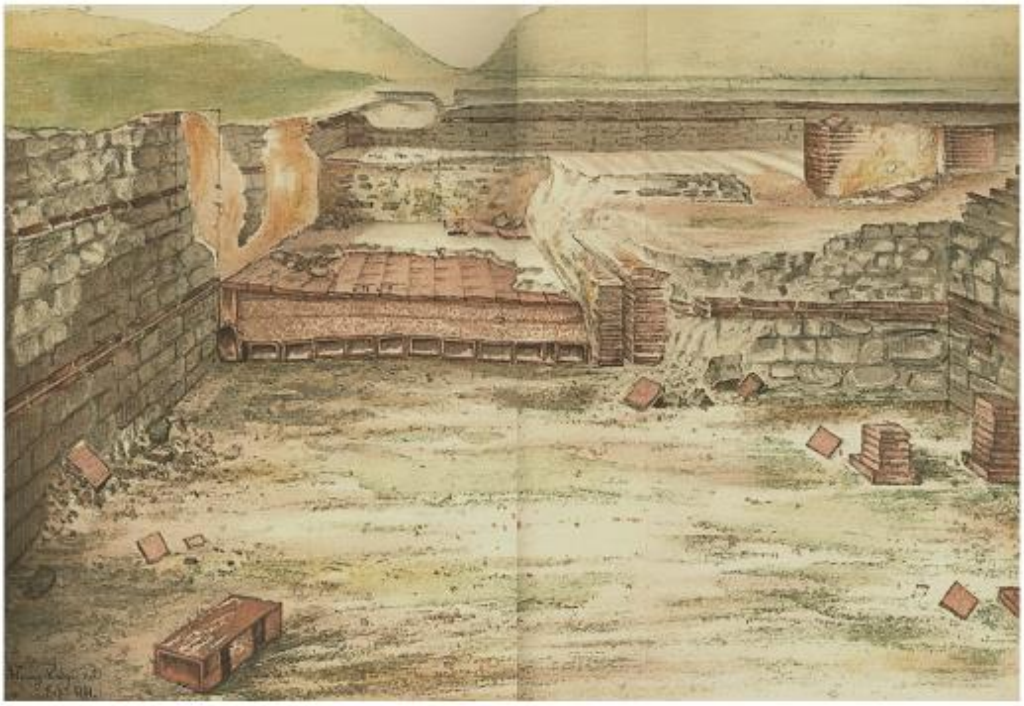


***Figure 4.2**: Illustration of hypocausts construction from the baths, block IX, chamber 8 (Insula VIII).* (Hilton Price, 1887 Plate XIX)

Appendix (I) provides details of all 181 references to CBM recorded from the reports of the 19th - century excavations and the reports from the 20 years of investigation by the Society of Antiquaries. This includes a record of all direct references and descriptions of CBM items included in the text along with reference to illustrations of buildings and structures within the reports, for example, the watercolour images of the excavation of the bathhouse (Fig. 4.2), which shows CBM in-situ such as *pilae*, box-flue tiles, and bonding courses. Figure 4.3 summarises these references in terms of their form. The data include the context of the material (including *Insula*, building and room where reported), the type of CBM and the description of the use of the material in the context. This information has then been compared with the Reading Museum (RM) database of the material recorded in the Silchester collections to establish whether it is possible to assign context information to any items in the museum archive. There is a total of 47 references to CBM used in wall construction and a further 49 descriptions of CBM in heating and hypocaust systems.

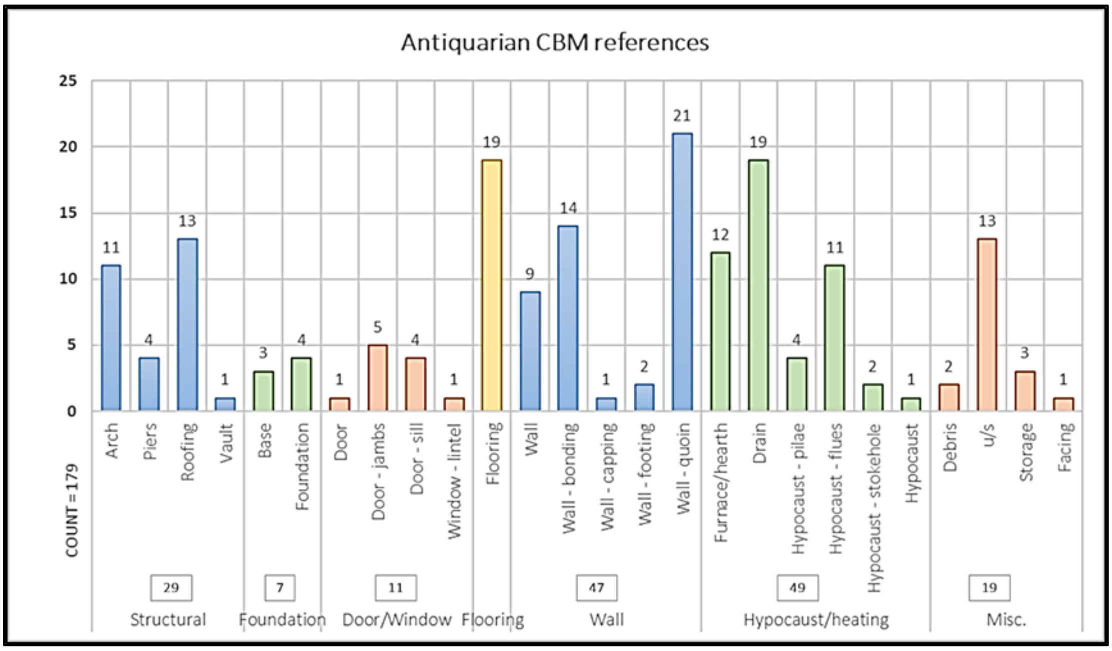


Figure 4.3: *Summary of CBM references in Antiquarian excavation reports*

There are 11 references to the construction of archways across the town, including archways from stoke holes for hypocaust systems and arches at the South and West gates. The construction of the archways at the gates is described in some detail in the report of their excavation in 1889 (Fox and Hope, 1890, p. 753) including the use of solid voussoirs in the construction. There are three solid voussoirs (RM162;173;182) held in the Reading Museum archive, though none include any record as to their provenance. Solid voussoirs or *Cuneatus* are a form of tapering brick used in the construction of arches (Brodribb, 1987, p. 43). One example is described in the antiquarian report of the excavations of the city gates (Fig. 4.4-4.6). At the South gate a complete tile was found, described as having been made to serve as a *voussoir* of an arch. It is recorded as being 17 inches long and 6 inches wide, with a tapering thickness of 1 ¾ inches to 1 ⅜ inches (Fox and Hope, 1890, p. 753). These dimensions broadly correspond with those recorded for one example in Reading Museum (RM162: 1995.85.373; 253mm long, 195mm wide, 43-24mm thickness). It was assumed from its width that this was a half-tile, and a diagram of the arrangements of whole and half tiles was included in the report (Fox and Hope, 1890, p. 753), reproduced in figure 4.5. At the West gate, there was no evidence of vaulting of the passages and guardhouse, but the discovery of another fragment of *voussoir* was assumed to indicate that the gates here were arched back and front. As the arches of the gate were not as thick as those of the South gate, the tiles forming the *voussoirs* would probably have been arranged differently (Fox and Hope, 1890, p. 755). In the report on the tiles from the

South gate, Green confirms that the example from the West gate was correctly assumed to be a half tile with complete tile widths recorded during the 1975 investigations (Green, 1984, pp. 197–8).

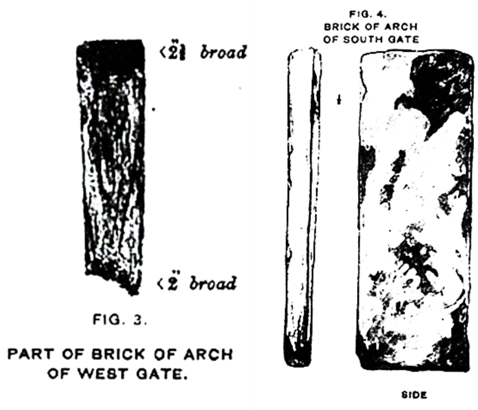


Figure 4.4: *Antiquarian illustrations of solid voussoirs from the West and South gates. (After, Fox & St John Hope 1890 Plate XXXII, Fig. 4., Plate XXXIII, Fig.3.)*

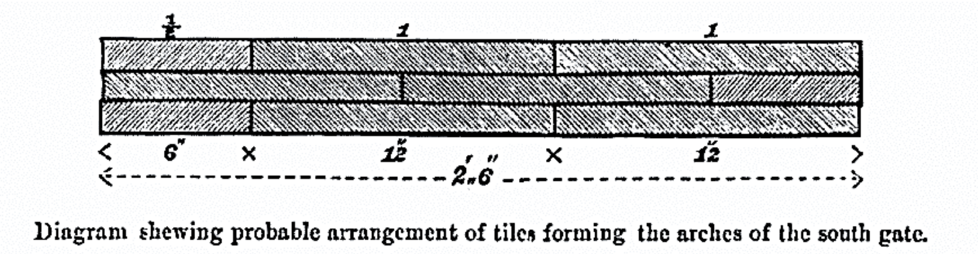


Figure 4.5*: Diagram illustrating the construction of the arches at the south gate, formed of voussoirs* (After Fox and Hope, 1890, p. 753)

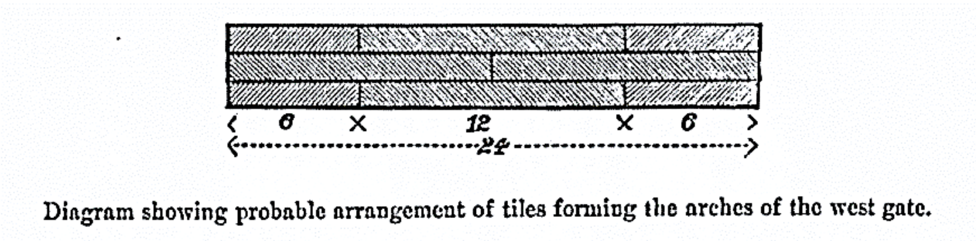


Figure 4.6: *Diagrams illustrating the construction of the arches at the south and west gates, formed using solid voussoirs (After Fox & Hope 1890, p.753).*

There is a single reference to the discovery of hollow *voussoirs* in the Society of Antiquaries reports. The report of the 1906 excavations describes hollow *voussoirs* recovered from Room 27, House 1, Insula XXXIV, "a chamber of remarkable character" (Hope, 1907, p. 444). Hollow voussoirs are box-tiles with a taper on two edges and were used to form arches whilst providing an airspace for insulation or the flow of heated air (Brodribb, 1987, p. 79). The image included in the report shows the sides of the *voussoir* were combed, with two sets of five diagonal lines forming a cross pattern (*ibid.* Fig.5.) (Fig.4.7). The tiles are described as arranged in bands, each tile fitting closely to the other with thick mortar joints, whilst the underside of the tiles was plastered with two coats to form the ceiling. There are three examples of hollow voussoirs in the Reading Museum archive one of which shows the same combed design (**RM281**: 1995.85. B36 – labelled: "from 1334"). A calcium carbonate deposit noted by Brodribb on the bottom half only suggests that hot air within the *voussoir* condensed and dripped towards the bottom, thus preventing condensation on the underside of the arch which would have dripped into the room (Brodribb, 1987, p. 81). *Voussoirs* of this type were used in the construction of the vault over the great *caldarium* at the public baths of *Aquae Sulis*, Bath (Cunliffe, 1969, p. 119 Fig.37; Brodribb, 1987, p. 80).

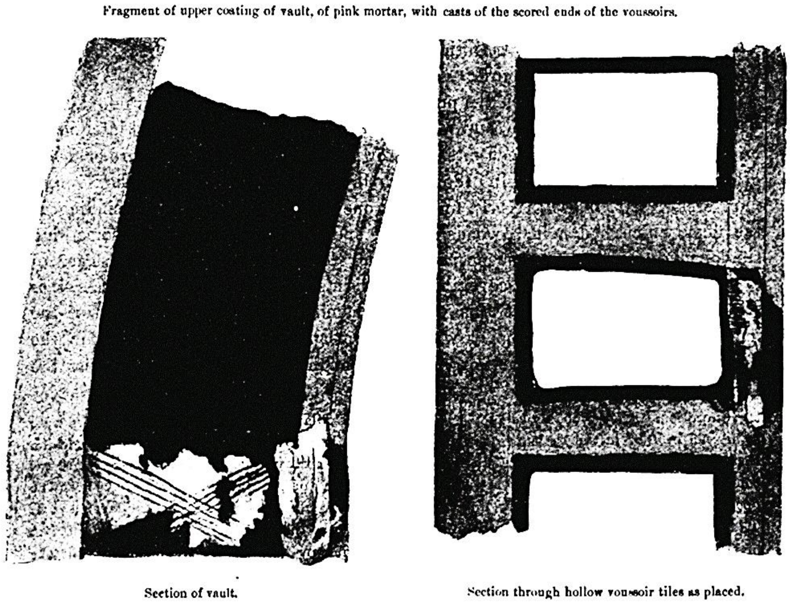


Figure 4.7: *Illustration of hollow voussoirs recovered from Room 27, House 1, Insula XXXIV* (After Hope, 1907 Fig.5.).

There are 13 references to roofing material in the Society of Antiquaries excavation reports. Many are references to assemblages of roofing tiles, found in the vicinity of buildings, and assumed to be collapsed roofs. There is a large collection of roofing material in the Reading Museum collection (108 items = 22%), few can be directly matched to references in the excavation reports. There are four fragments of antefix held in the Reading Museum collection, two are on display in the museum in the Silchester gallery, and two are held in the archive. One example is described in the report of the investigations into the environs of the forum-basilica, in Insula IV, as "part of an antefix with a crudely executed face, which evidently belonged to a building of some importance" (Hope 1893, p.561; **RM262**) (Fig.4.8). Another fragment of antefix is described by Cotton in the report of her excavations of the town rampart between the North gate and the amphitheatre (**RM263**: 1995.85. B34: From Y.C. 201 SIL RMAG) (Fig. 4.9). The report describes the discovery of a single antefix in an occupation layer, dated to c.A.D.100-120. The antefix is described as having been made in a local mould (Cotton, 1947, p. 127) as it is identical to the three other examples previously recorded. The other two antefixes are more complete and are on display in the museum but do not appear to be referenced in any of the excavation reports (Fig. 4.10). All the antefixes in the Reading museum collections are of the same fabric (SILCBM3A – Chapter 6.2.4). The face is male, beardless, and has hair surmounted by wings or horns. A similar example is known from Dorchester, Oxon (Boon, 1974, p. 169). The antefixes were interpreted as having belonged to building(s) of some importance (Hope, 1893, p. 561) and were understood, by Cotton, to be evidence of an ambitious roof-structure for the building, which was demolished for the construction of a road (Cotton, 1947, p. 127). They have been described as apotropaic and are thought to depict a local deity (Boon, 1974, pp. 169–170) or to be a representation of Mercury (Cotton, 1947, p. 147).

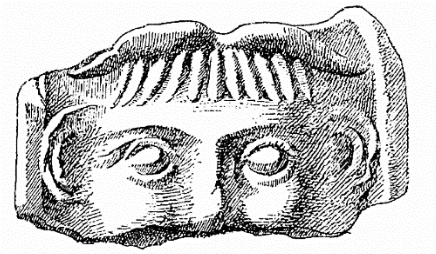


Figure 4.8: *Antefix recovered in 1892 from Insula IV (After* (Hope, 1893 Fig.3.)*)*

Figure 4.9: *Antefix recovered by Cotton in 1939 (After Cotton 1947 Plate XXXVII c.)*

Figure 4.10*: Image of near-complete example of Silchester antefix (After Boon 1974, p.169 Fig 27)*

There are 19 descriptions of the use of brick and tile as flooring; this does not include references to mosaics or tessellated pavements. There are octagonal *pilae* illustrated in the drawing of the floor in Block III , Insula XXIII, excavated in 1864 (Joyce, 1866) (Fig.4.11). The description in the text refers to octagonal *pilae* having been re-used for the flooring, whilst the illustration includes both hexagonal and octagonal tiles.

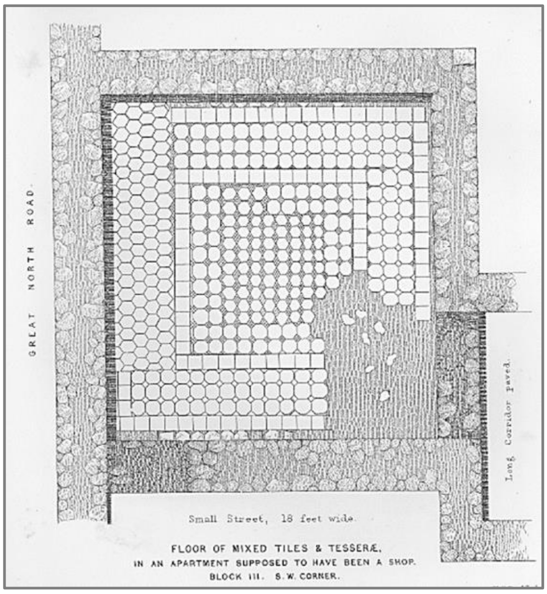


Figure 4.11: *Plan of the floor of mixed tiles and tesserae in block III* (After Joyce, 1866 Plate XXIV)

Boon comments that floors of this type are uncommon in Roman Britain, and are more commonly found in the Danube region (Boon, 1974, p. 209). The origin of this type of flooring is believed to be in the tradition of *Opus Sectile* flooring. There is a single octagonal *pila* in the collection (**RM293**) and three hexagonal tiles (**RM99; 173; 182**). While these could have been part of the floor described, it is unlikely, if tiles were removed from the floor for retention, that so few would have been retained. Hexagonal *pilæ* are described from *Insula* I near the westernmost hypocaust (Fox, 1892, p. 268).

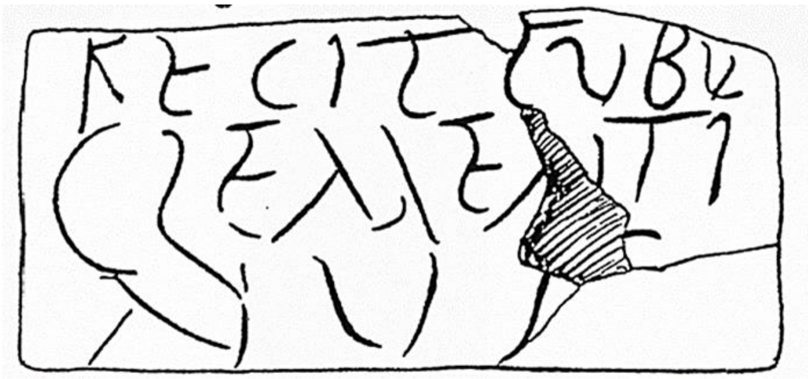
There is a total of 45 references to the use of brick and tile in the construction of walls. Of these, nearly half, (21), refer to quoins at the corner of walls and are found mainly in private dwellings e.g. houses. A total of 14 references relate to descriptions of ceramic brick-bonding courses. Interestingly these predominately occur in public buildings, including the temple and temple enclosure wall, the West gate, the *mansio* baths (Fig.4.2) and the forum-basilica. This is perhaps a reflection of different building contractors used for the different building projects or is an indication of the scale of the building projects being undertaken.

4.2.1 Inscriptions

There are several examples of CBM in the Reading Museum collection that bear inscriptions, stamps, or include literate graffiti marked upon the surface of the tile before it is dry enough to be loaded into the kiln for firing. Many are recorded in the Society of Antiquaries reports without specific reference to the context of their discovery.

One example of a roof tile that is referenced in the excavation reports and currently on display in Reading Museum bears an inscription **[…] SFECITI | […] RIONVS** (RIB2491.5; **RM483**). Here *fecit* and *onus* are clear; the other letters probably give the name of the inscriber, of which *unus* (or *onus*) formed part (Frere and Tomlin, 1993, p. 95 RIB2491.5). This item is described in the report of the 1897 excavations with no reference as to its provenance.

A further example of an inscription bearing the name of the tile maker was found in *Insula* XXVII during the 1901 excavation season. This writing was found on a box-flue tile (RM470-Fig.4.12), the inscription scratched onto one side read:



Fecit tubu(lum) Clementinus

(Clementinus made (this)box flue-tile)

Figure 4.12*: Image of box-flue tile from Insula XXVII (After Frere & Tomlin 1993, p.93 RIB 2491.1)*

In the report of the excavations conducted in 1880, Joyce describes a brick on which the word ***PUELLAM*** has been inscribed:

> "…a word written with great freedom and clearness with some sharp-pointed tool whilst the clay was moist. Some Roman lover was thinking of the maid he worshipped whilst preparing his tiles for the kiln, and with a lover's ardour he scribbled on one of them some sentence about the maiden, more indelible than the passion it expressed, of which the last word "puellam", along is left to record to a distant age the Roman's love." (Joyce, 1866, p. 341)

A sketch of the fragment of brick was recorded in Joyce's diary and included in the report (Fig.4.13; RM462: 1995.1.29). This brick is currently on display in the Reading Museum, Silchester gallery. The *Roman Inscriptions of Britain* (Frere and Tomlin, 1993) has a record of another example of a tile with an inscription of the word *Puellam*, found during excavations at Caerleon, the inscription reads:

[…]SIRICΛ VIDVΛ […] | […] PVELLΛM

Sirica…the widow…the girl

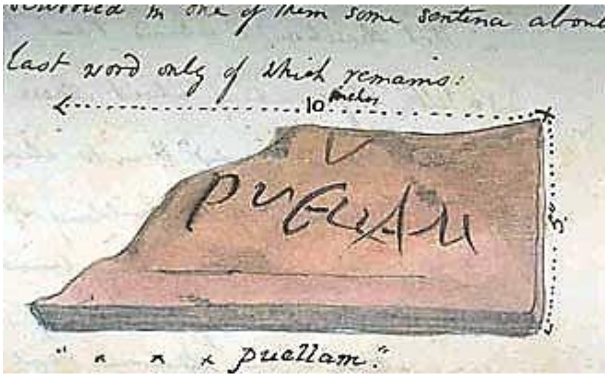


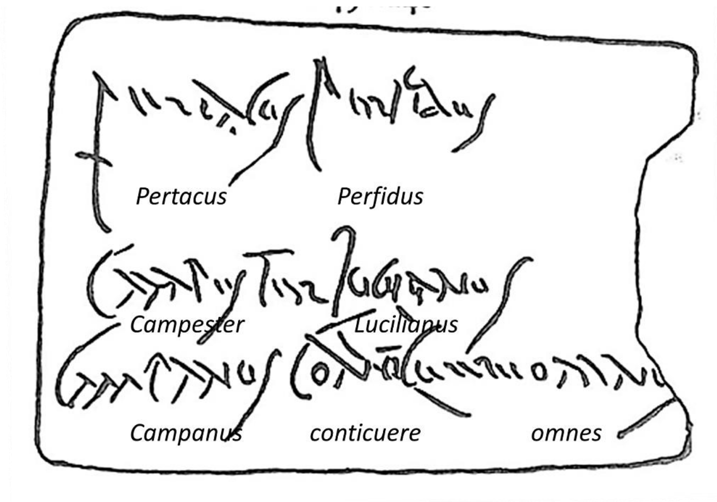
Figure: 4.13: *Sketch of puellam inscribed tile from Silchester (© Reading Museum)*

Figure 4.14: *Puellam inscribed tile from Caerleon (After* (Frere and Tomlin, 1993, p. 130 RIB: 2491.122)

Figure 4.15: *Brick in Reading Museum collection with sketch of Bos Longifrons or 'shaggy ox' (© Reading Museum)*

Figure 4.16: *Box-flue tile from Dover with bull inscription (After Frere & Tomlin 1993, p.131 RIB 2491.124))*

In the report of the excavations in 1893, Hope describes a tile on which has been sketched a rude figure of a native ox (Fox & Hope 1894, p.238; (RM471- Fig. 4.15)). This item is recorded in the Reading collection as bearing the image of a 'shaggy coated ox' (Boon, 1974, p. 158 Fig.7.5). The only comparable example found elsewhere a box flue-tile from Dover which features a sketch of a bull beneath the word 'TAURI' (Frere and Tomlin, 1993, p. 131 RIB2491.124) (Fig.4.16).



pertacus perfidus | campester Lucilianus | campanus conticuere omnes
(Untrustworthy Pertacus, Campester, Lucilianus, Campanus, all fell silent)

Figure 4.17: *Tile in Reading Museum collection bearing graffito referencing Virgil's Aeneid (Frere & Tomlin 1993, p.138 RIB 2491.148* **RM461***)*

These tiles bearing graffiti have been taken as evidence of the need for tilemakers to be literate in order to record their production. One example in the Reading museum collection bears a reference to a quotation from Vergil's Aeneid (Fig.4.17). This has been interpreted as a writing lesson that was meant to be copied, as it includes fifteen letters of the alphabet and is written with a stylus by a practised hand (Frere and Tomlin, 1993, p. 138 RIB2491.148). That the tile was returned to the stock, fired and sold suggesting that the lesson took place at the tilery (Boon, 1974, p. 64). Though the phrase 'conticuere omnes' is common in graffiti and Virgil being the most quoted poet means this graffito is unlikely to have been a literacy lesson (Benefiel, 2011, p. 39).

A fragment of *tegula* found in a cesspit to the east of the latrine near the bathhouse in Insula XXXIII, included a circular stamp (RM281: Fig.4.18). It has in the middle what looks like a rose, circumscribed: NER·CL·CÆ·AVG·GER. i.e. Nero Claudius Cæsar Augustus Germanicus. These tiles are discussed in more detail in chapter 6.2.4. The morphology of the stamp is unusual in Roman Britain where the stamps found on brick and tile are typically rectangular. The Nero-stamped tiles are similar in form to some examples of the stamps found on CBM made by the Classis Britannica (Fig.4.19) which feature a circular stamp with a central 'wheel' motif, somewhat akin to the floral emblem included in the centre of the Nero-stamped examples from Silchester. These circular examples of stamping of tiles by the Classis Britannica date to no earlier than the 2nd century (Frere and Tomlin, 1993, pp. 1–4), while the Nero-stamped are the earliest examples of tile-stamps in Roman Britain (*ibid*, p.26) with a *terminus post quem* of A.D. 54.

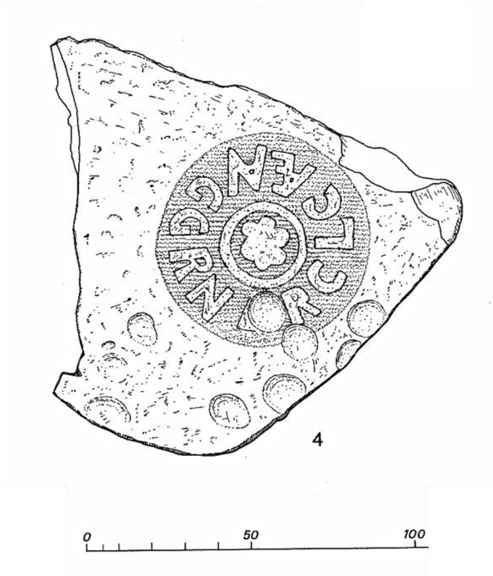


Figure 4.18: Neronian stamped tile recovered from the baths in Insula XXX (After Fulford & Timby 2000 Figure 95.4)

Figure 4.19: Example of round Classis Britannica stamp (After Frere & Tomlin 1993 RIB 2481.99)

There is also a record in *The Roman Inscriptions of Britain* (Volume II Fascicule 4) of another stamped tile recorded as recovered from the site of the Roman church at Silchester and was understood to be in private possession (Frere and Tomlin, 1992, p. 181 RIB 2463.23). This tile bears the stamp of Legion XX, which arrived in Britain in A.D.43 and is believed to have begun stamping their tile output after their arrival at Chester c.A.D.87 (Grimes, 1930). The provenance of this tile is disputed and its Silchester origin has been called into question, as with the LHS-stamped-tile held in the Reading Museum archive (Chapter 7.11).

Another stamped-tile held in the Reading Museum collection bears the letters DIGNI (Fig.4.20; RM481). This tile is recorded as having been found during field-walking over Insula XXXIV, approximately opposite the public baths in Insula XXIIIA, in 1973 (Wright, Hassall and Tomlin, 1976, p. 384). The stamp is incomplete, the complete stamp would have read IVC DIGNI and is interpreted as *Iuc (undus Digni*, which translates as '*Iucundus*, slave of *Digni'*. There are seven examples of this die recorded in The Roman Inscriptions of Britain (Frere and Tomlin, 1993, pp. 62–3). The distribution of these stamped tiles was investigated in 1978, the results showing that these stamped-tiles were probably manufactured at Minety, though no examples were recovered during the limited excavation (Scammell, no date, p. 13) and are mainly distributed in the Wanborough area, with the exception of the Silchester example which called into question the provenance of the tile (McWhirr and Viner, 1978, p. 369).

Figure 4.20: *Image of DIGNI stamped tile from Silchester (After: Frere & Tomlin 1993, Plate III)*

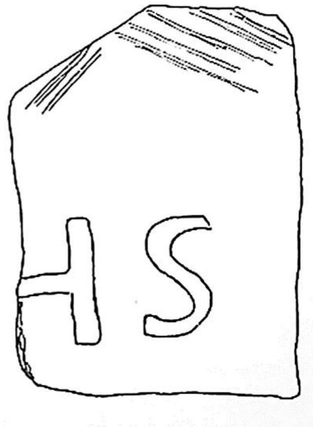


Figure 4.21: *Sketch of LHS stamped tile from Silchester (After Frere & Tomlin 1993, p.64 RIB2489.21C(ii))*

There is, however, another tile in the Reading Museum Silchester collection, the provenance of which has been doubted. A flue-tile stamped **LHS** (RM42: Fig. 4.21) is one of three tiles donated to the museum by Stuart G Davis in 1910. The museum record card describes it as "suspect" and correspondence between Mr Francis Haverfield and a Mr Colver asserts that Mr Davis' collection was clearly not restricted to the Silchester area (Original Record Card: 00131; 1995.1.144). The production of these **LHS** stamped tiles at Minety is associated with other tiles stamped **TPF**. Fabric analysis has shown that the majority, over 95%, of the **TPF**-stamped tile are of one fabric, which has been identified as originating from the tileworks at Minety. The other examples found at Hucclecote villa are in a fabric derived from the *Lower Lias* clay found in the vicinity of the villa (McWhirr, 1984, p. 78) though with matching stamp, suggesting an itinerant tiler or movement of the stamp die. This also means that some of the tiles were moved up to 40km from the production centre to the villa at Hucclecote (Darvill, 1979, p. 319). The discovery of the **IVC DIGNI** stamped tile in the Silchester collection made it more likely that the **LHS** stamp was a genuine Silchester antiquity (McWhirr and Viner, 1978, p. 369). Both the **LHS**- and **DIGNI**- stamped tiles have been assigned to the **SILCBM2** fabric group (see Chapter 6.2.3).

4.2.2 Hypocausts and heating

Almost 40% of the CBM references throughout the reports relate to items used in the construction of hypocaust heating systems and hearths. A number of these references are derived from the watercolour illustrations of the hypocausts during excavation, including the illustration of the excavation of Block III, Insula XXIII (Fig.4.22). This shows the composition of the hypocaust systems within the building, including the use of combed box-flue tiles and *pilæ*.

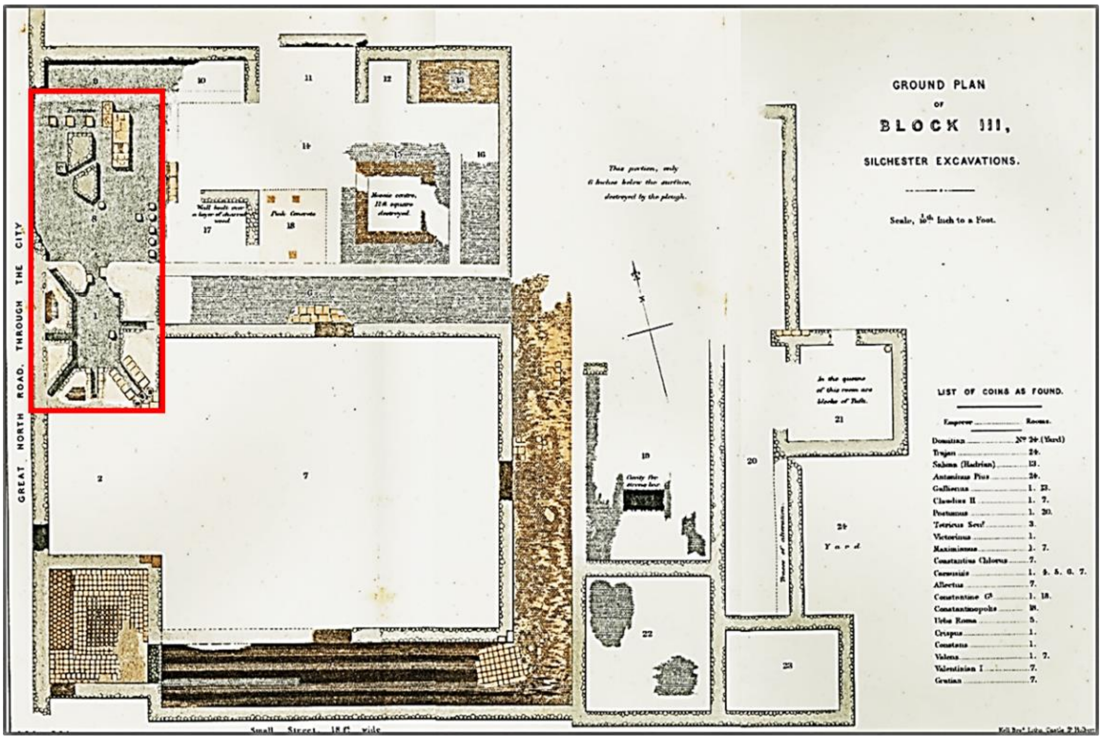


Figure 4.22: *Plan of Block III, Insula XXIII* (After Joyce, 1866 Plate XXIV)

There is a total of 149 hypocausts described in the Antiquarian reports. The three main forms of hypocausts found in the town are channelled/radiating (n=22), pillared (n=28), and composite (n=28). Over one-third of the hypocausts are not described in detail (n=54) and certainly in the early years of the Society of Antiquaries excavations there are examples of the mis-identification of features as hypocausts. One example noted during the Society of Antiquaries excavations at Insula IX (Fox, 1895), was found to be a hearth (1433) located within of ERTB1 (Fulford and Clarke, 2011, p. 25). Excavations in 2015 in the north-west corner of Insula III investigated a feature identified as a hypocaust (hyp) during the 1891 excavations (Fox, 1892); upon excavation this was revealed to be an oven with its flue oriented towards the north-south street (Clarke *et al.*, 2015, p. 14). There are approximately the same number of channelled and pillared hypocausts (22 and 28 respectively) across the town with a larger number (35) of composite systems.

Channelled/radiating hypocausts are constructed with radiating channels dug into the ground on which the floor of the chamber is laid. The channels connect to the flues in the walls of the room. These channelled hypocausts were also more common in the later Roman period (Williams, 1971, p. 183) and potentially show the later construction projects or renovations across the town. The examples of channelled hypocaust systems are all located to the north and west of the forum-basilica (Fig. 4.23),

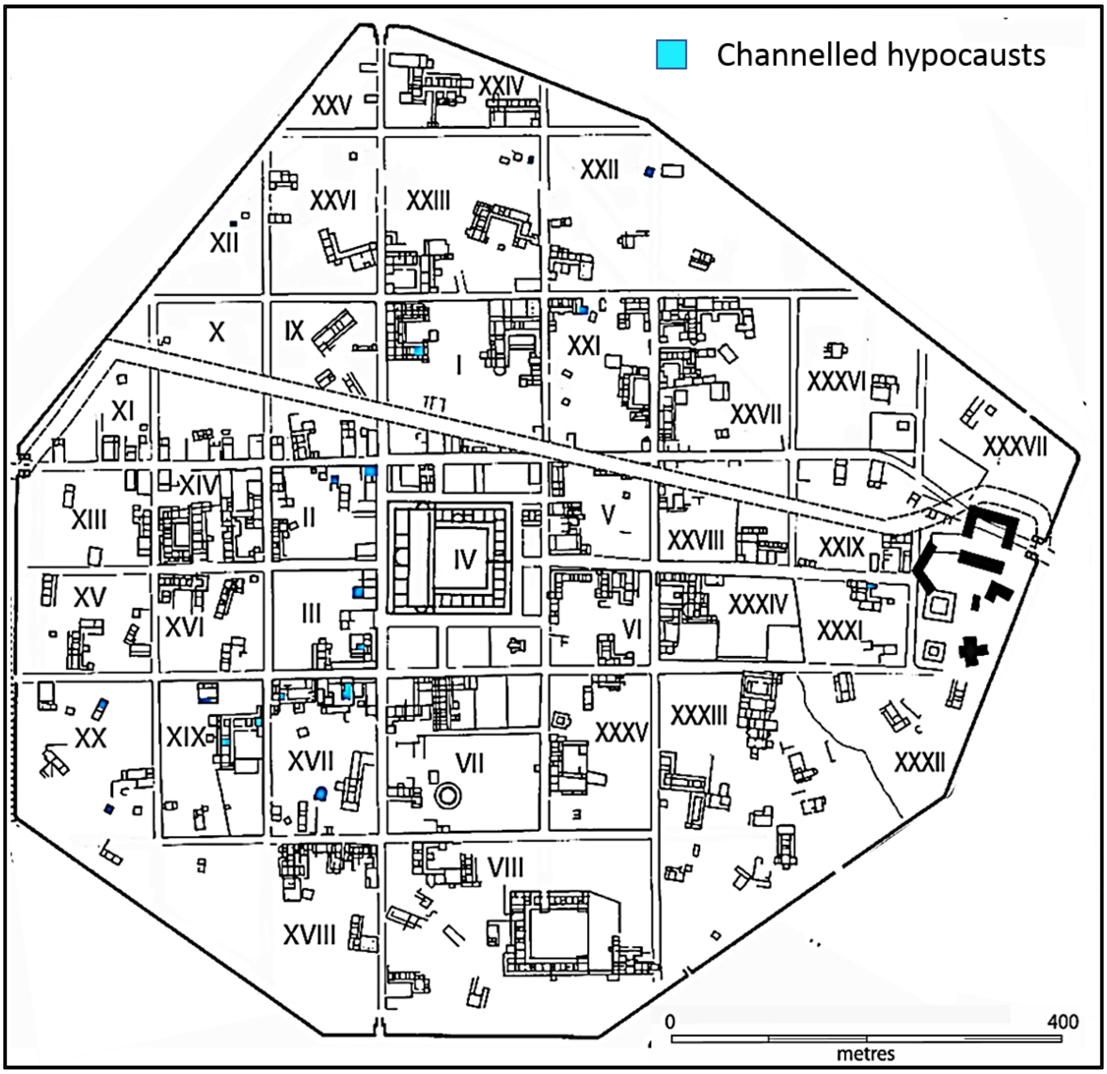


Figure 4.24: Distribution of channelled/radiating hypocaust systems

Pillared hypocausts are those constructed with *pilæ* to support the floor whilst composite systems are a combination of these two systems, with radiating channels and used in conjunction with *pilæ*. The pillared examples are found to both the north and south of the town, with seven examples described within the public baths complex in Insula XXXIII (Fig. 4.24).

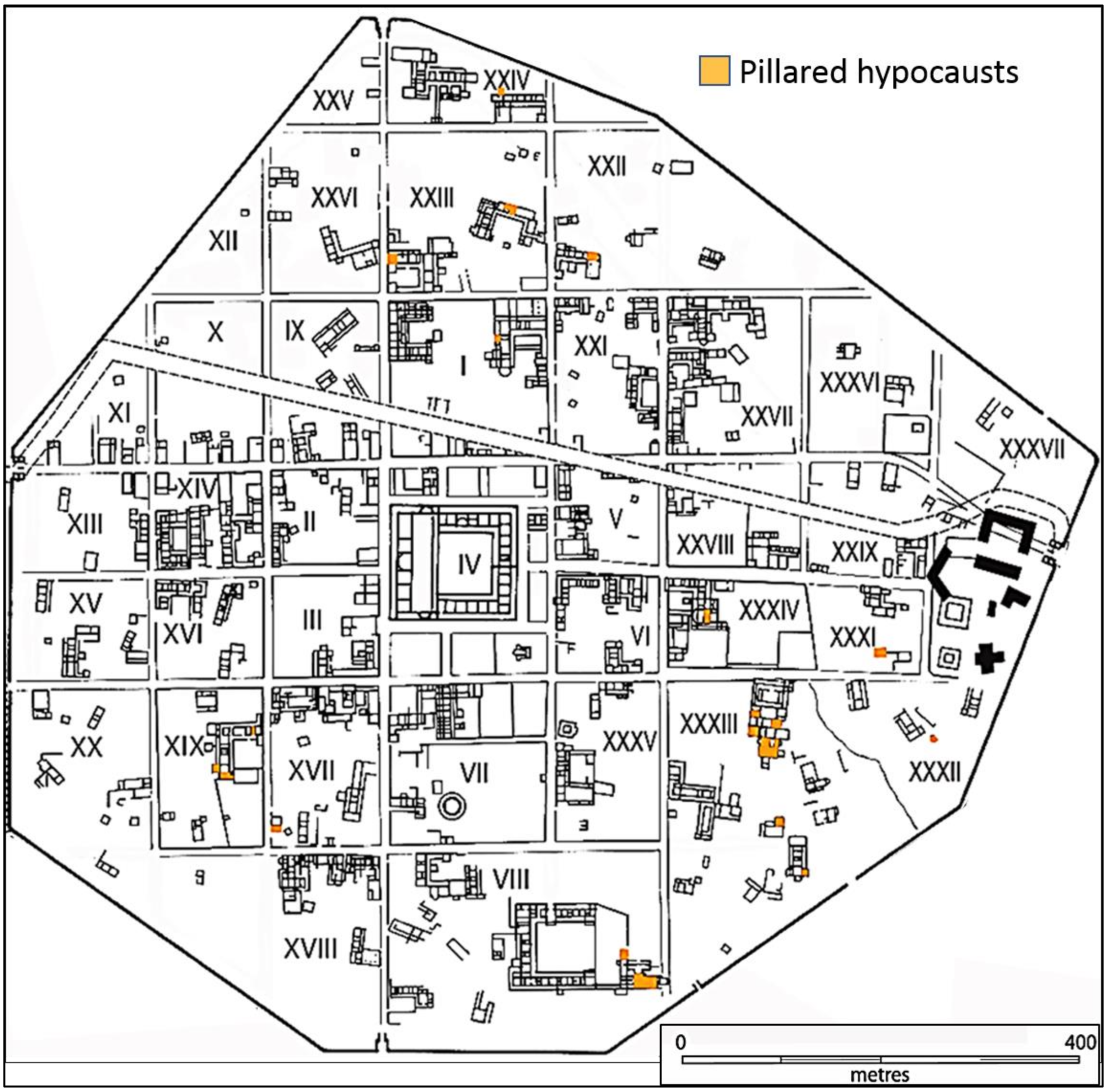


Figure 4.25: Distribution of pillared hypocaust systems

The composite examples, combining both construction methods are found throughout the town with a single example within the public baths (Fig. 4.25).

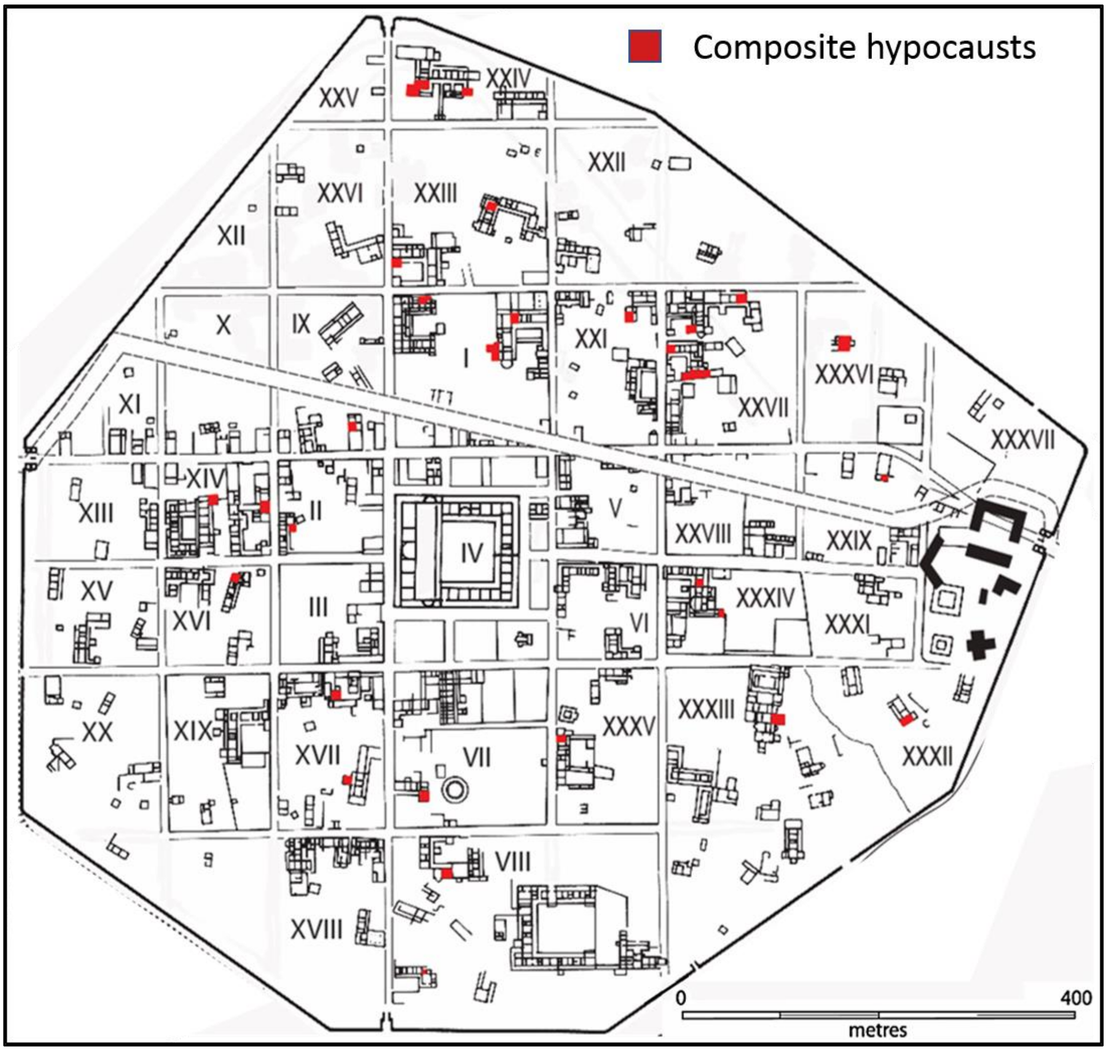


Figure 4.25: *Distribution of composite hypocaust systems*

There is also a single example of what is described as a 'new' type of hypocaust system, heating chambers 18 and 19 of house II, Insula XIV, where the construction is described as different to any type yet found (Hope and Fox, 1896, p. 244). The stokehole opens via an arch into a diagonal passage leading to a narrow compartment parallel with the wall containing two *pilae*. At the north and south, short triangular passages lead to a flue traversing the length of the walls. Wall flues open out of these compartments with a further branch flue of triangular section starting at a higher level passing diagonally down the room to a flue in the east wall. Square and triangular flues were constructed of large tiles (Fig.4.26).

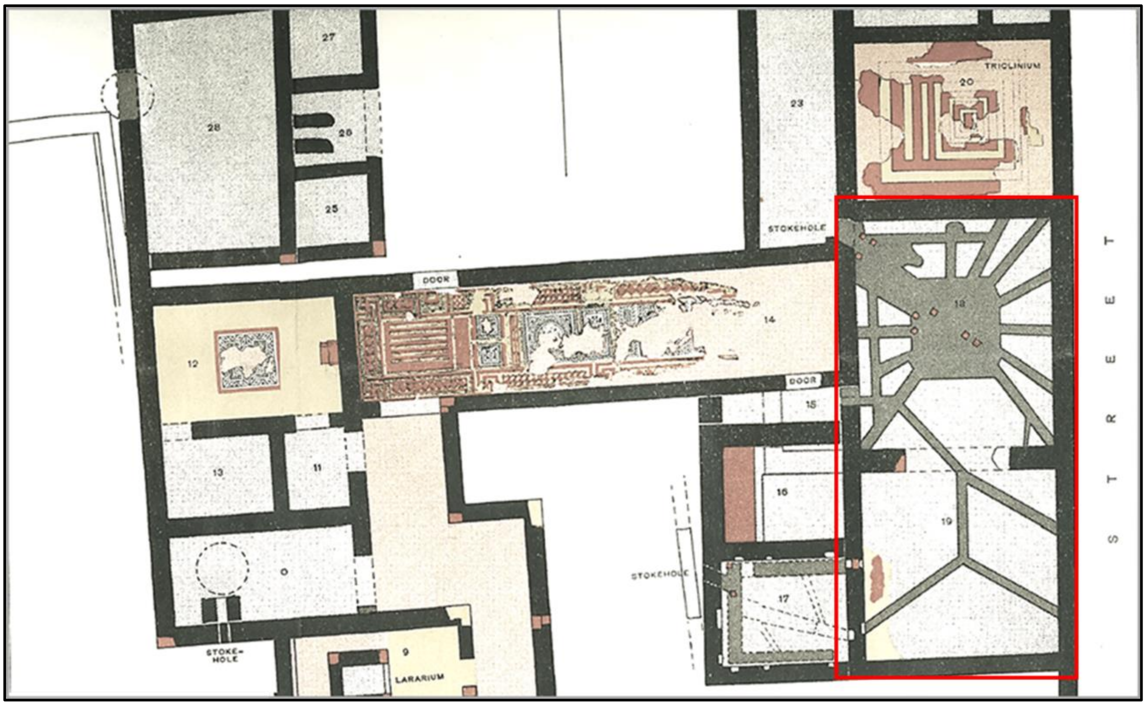


Figure 4.26: Extract of plan of House II, Insula XIV, including diagram of the plan of the 'new' hypocaust in chamber 17 (After Hope and Fox, 1896 Plate XV).

The remainder have been recorded as 'Type not described' where there is certain mention of a hypocaust without further description. 'Possible' refers to those which are described as evidence of hypocausts, usually in the form of areas of burnt tile and as discussed previously are probably mis-identified as hypocausts.

4.3 Summary

Of the 179 references to CBM recorded from the Society of Antiquaries reports, only 14 can be matched to artefacts in the Reading Museum collections. Of these, two with graffiti, have no reference to their provenance. The Reading Museum collection, however, has still been included in this study because it adds details to the narrative of the supply and consumption of CBM in the Roman town. The fabrics of the items in the collection, along with the forms contribute to the corpus of material manufactured at the respective production centres (Chapter 6) whilst the footprints illustrate aspects of the life and work at the tileries (Chapter 8). The corpus of bricks and tiles featuring graffiti also provide evidence of literacy within the workforce.

Chapter 5. Geology and clay sampling

5.1 Introduction

This chapter provides an overview of the geology of the area around the Roman town at Silchester, with reference to suitable brick-making resources. These clay resources have been sampled and petrographic descriptions of the clay samples are given. These clay samples have been also analysed using pXRF for comparison with the fabric series, and to establish if potential raw material sources can be identified for the fabrics.

5.2 Clay Sampling

Geological mapping showing bedrock and superficial deposits show that suitable brick-making clays appear throughout the area surrounding the Roman town (BGS Sheet 286). Brick-making sites were typically located at a distance from the town and no evidence has yet been uncovered for brick making in the immediate vicinity of *Calleva Atrebatum*. As well as suitable clay resources, the industry also needed to be close to other raw materials such as water, and perhaps most importantly, a large supply of fuel for firing the kiln. Most brick-clays are of sedimentary deposits and thus contain a variety of minerals, of differing origins, and in different proportions (Prentice, 1990). Table 5.1 provides a summary of the geological sequence in the Reading district.

Clay sampling was carried out to characterise the composition of the clays in the area in terms of their mineralogy and allow for direct comparison with the ceramic building materials. Table 5.2 details of the location of the sampling sites and the geological units included which are plotted on figure 5.1.

						Thickness
Quaternary		Flandrian	Artifical man-made deposits			
			Alluvium		Mass-movement deposits; Head; Head gravel; Clay-with-Flints;	
		Post-Anglian to Devensian	Brickearth; Langley Silt; River Terrace Deposits (fifth to first)			
	Ma	Pre-Anglian to Anglian	River Terrace deposits (tenth to sixth)			
Palaeogene	44.0		Bracklesham Group	Camberley Sand Formation	sand, fine grained, locally glauonitic, yellow-brown, with thin clay lenses and flint pebbles near base	20 m
				Windlesham Formation	sand and clay, highly glauconitic, dark green to brown, with discontinuous flint pebble bed at base	20 m
				Bagshot Formation	sand, fine-to-medium grained, yellow-brown, with thin silt and clay laminae, flint pebble bed at base	20-25 m
			Thames Group	London Clay Formation	clay and silty clay, grey-blue, with sunordinate sands, silts and flint pebble beds, variably glauconitic and shelly	55-100 m
	54.8			Harwich Formation	sand and clay, glauconitic and shelly, pebbly at base	3-6 m
	Palaeocene		Lambeth Group	Reading Formation	clay, colour-mottled red, grey, orange and brown with sand beds	118-27 m
				Upnor Formation	sand and clay, highly glauconitic, locally shelly, nodular glauconite-coated flints at base	1-6 m
Cretaceous	65.0		Chalk Group	Upper Chalk	white nodular chalk with flints (Lewes Chalk) overlain by white soft and nodular chalk with flint seams	60-100 m
	Upper Cretaceous			Middle Chalk	white, soft and nodular chalk, rare flint seams at top	65 m
				Lower Chalk	grey marly chalk	50-80 m

Table 5.1: Summary of the Geological Sequence

Reference	Site name	Grid Reference	Geology
CS-M	Southfield Pightle, Kiln Lane	SU489724	Reading Formation
CS-K	Sulham's Copse (Pot Kiln)	SU552731	Reading Formation
CS-B	Kiln Pond (1)	SU628633	London Clay Formation - sand
CS-C	Kiln Pond (2)	SU630632	London Clay Formation - clay, silt & sand
CS-N	Lower Eversley Copse	SE792792	Bagshot Formation
CS-O	Parsonage Copse	SU778522	Bagshot Formation
CS-E	Little London - North	SU623598	Windlesham Formation - sand, silt and clay
CS-H	Hazeley Heath	SU755578	Windlesham Formation - sand, silt and clay
CS-I	Nippers Grove	SU677813	Clay-with-flints
CS-Q	Back Lane, Southrope	SU678445	Clay-with-flints

Table 5.2: Clay sample locations

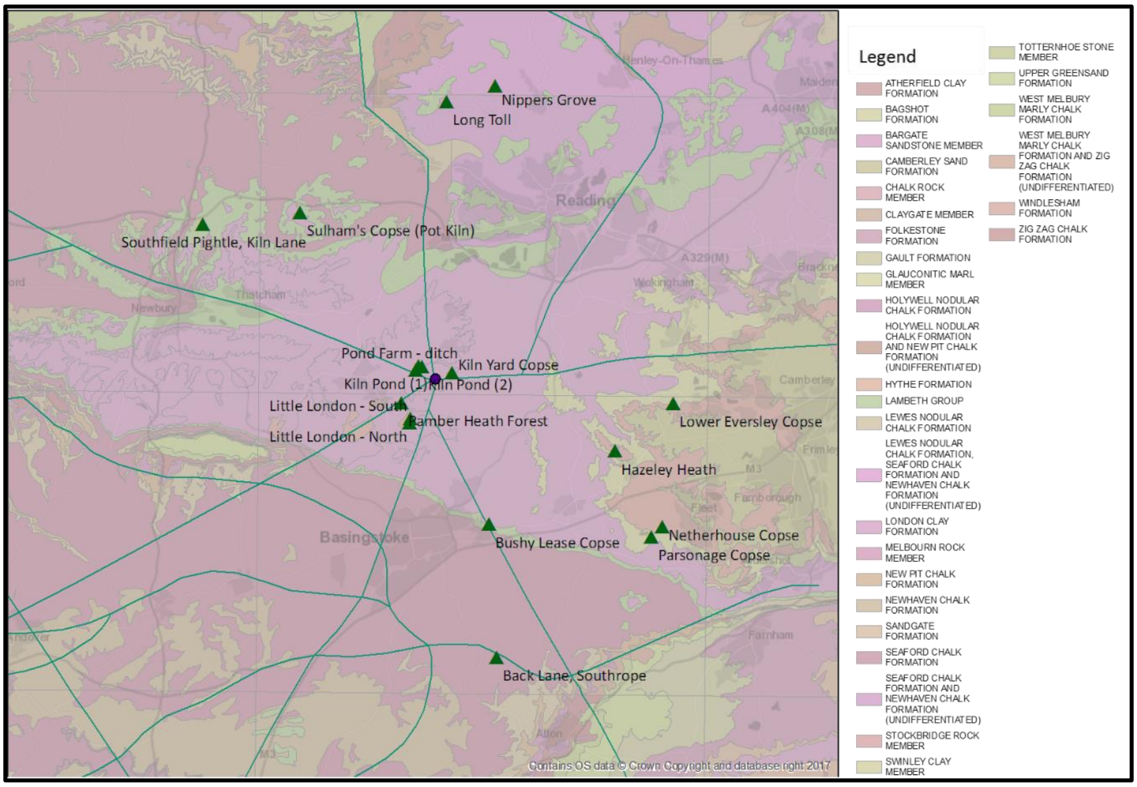


Figure 5.1: *Map of the bedrock geology around the Roman town of Silchester and clay sampling locations*

In the Berkshire chalklands, the early Tertiary silts and clays, *Reading Formation*, *London Clay* and *Bagshot Formations*, together with the closely associated *Clay-with-Flints*, were the basis of a major building-ceramic industry in the later nineteenth century (Allen, 2017, p. 67). The digging of brick clay was once commonplace from large pits of mottled clays of the *Reading Formation*, situated mainly near Reading and Tilehurst (Mathers and Smith, 2000, p. 23). There are several potential local sources of building clay in the area around Silchester Roman town, which include the *London Clay Formation* and the *Bagshot Formation* which outcrop in the vicinity of the Roman amphitheatre, nonetheless the sediments may vary in their appropriateness for use as building materials and manipulation into artefacts (Banerjea, 2001, p. 88).

5.2.1 Lambeth Group

The **Lambeth Group** is made up of the Reading formation (formerly Reading Beds) and the *Upnor Formation*. The *Upnor Formation* comprises highly glauconitic, green, blue, and grey sands and clays. This marine sequence is commonly fossiliferous, it is usually less than 1m thickness, and exceeds 2m only in the Brampton area (Mathers and Smith, 2000, p. 10). The restricted thickness of this unit makes it an unlikely choice for brick and tile production.

The overlying *Reading formation* is the oldest tertiary deposit in the region, with a fairly consistent thickness of c.15-20m increasing to c.30m southward (Allen, 2017, p. 74). It consists chiefly of plastic mottled grey clays or light yellow and grey sands, with a wide variety of colours common in deep exposures but not as soil parent materials (Jarvis, 1968, p. 6). The mass of mottled clays with soil-like features above would seem to represent estuarine and coastal mudflats and marshes (Allen, 2017, p. 75). Beds of fine- to medium-grained sands, commonly up to 2m thick but locally reaching 7m, occur at all levels of the formation, these are most common at or near the base, but their spatial distribution is very variable and unpredictable (Mathers and Smith, 2000, p. 10).   In the nineteenth century, the chief use *of Reading formation* was for making bricks, tiles, and other building ceramics, with their sands also excellent for building purposes, being mainly loose, clean and chiefly fine grained (Allen, 2017, p. 75).

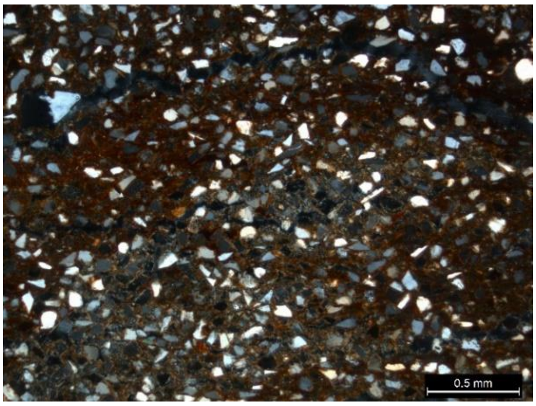


Figure 5.2: *Photomicrograph of Reading Formation sample - CS-K (XP; x40 magnification)*

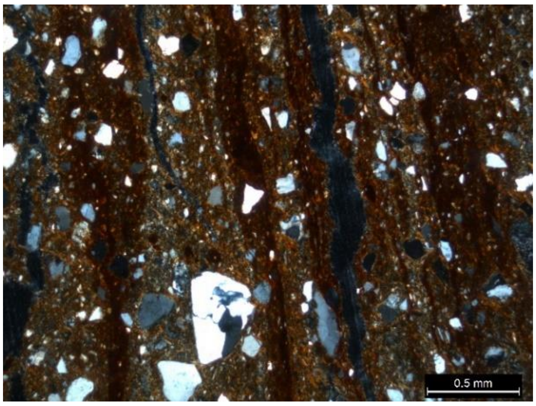
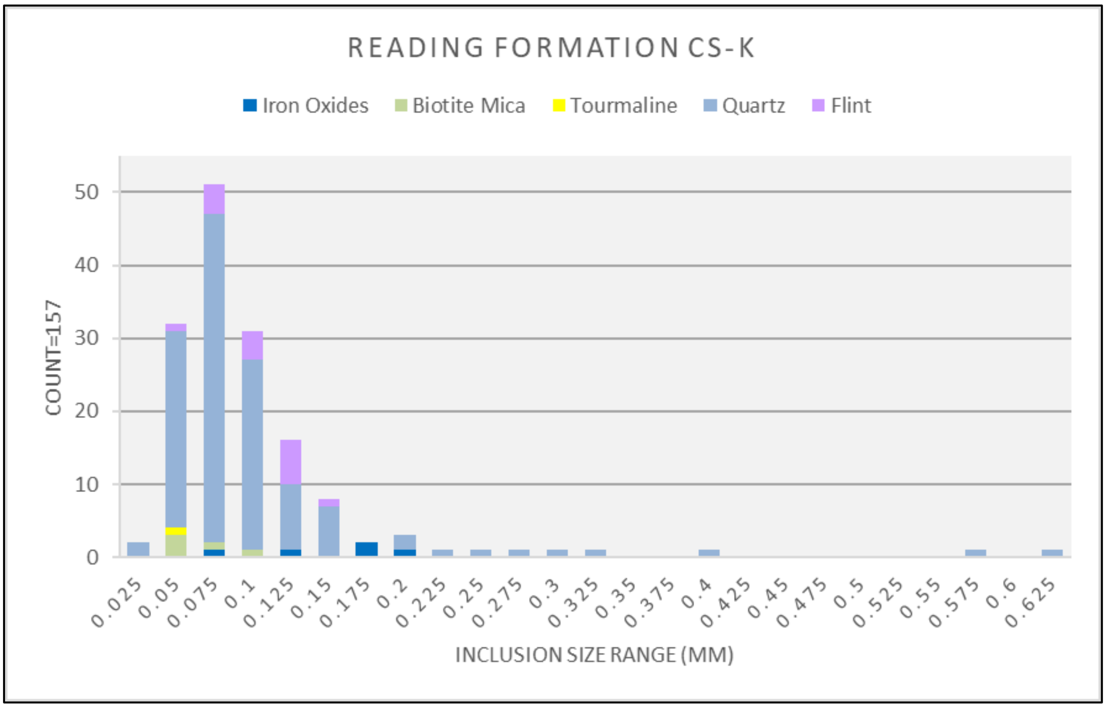


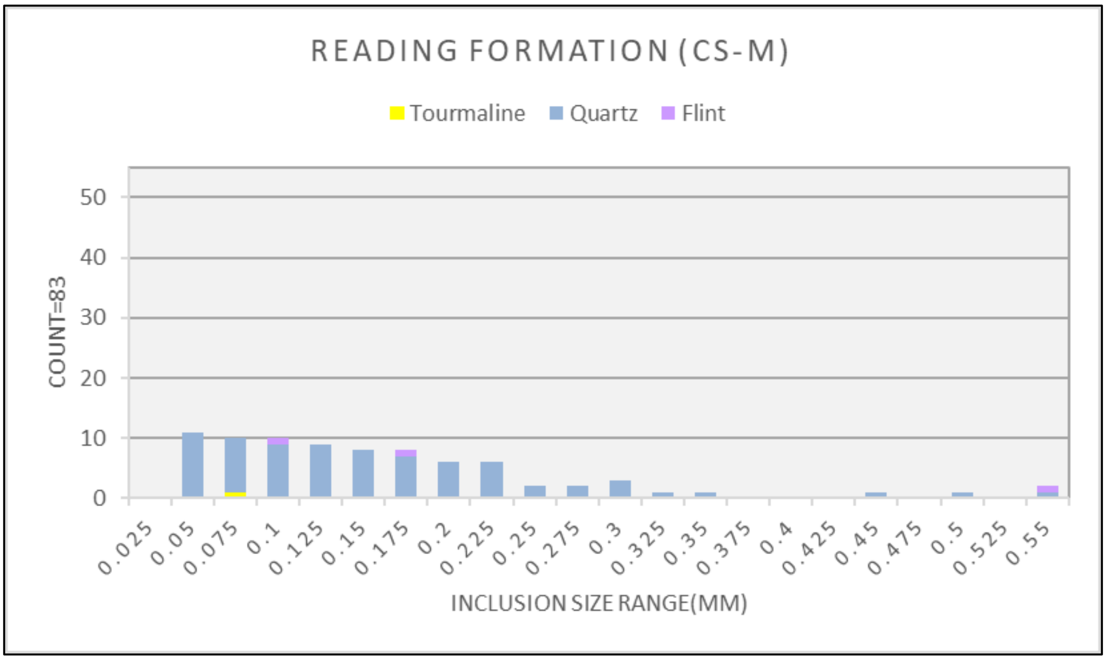
Figure 5.3: *Photomicrograph of Reading Formation sample - CS-M (XP; x40 magnification)*

The Photomicrographs above (Figs: 5.2 & 5.3) clearly illustrate the variation within the Reading formation. Both samples were subjected to the same processing before being formed in bricks and fired. Whilst both samples are non-calcareous, sample CS-M (Fig: 5.3) is highly heterogeneous with laminae of iron-rich and iron-poor clay clearly visible, whilst the sample CS-K (Fig: 5.2) has a more homogeneous appearance. Sample CS-K has a much higher proportion of well-sorted quartz sand visible when compared with CS-M, where the quartz is much less abundant and poorly sorted.



Min = 0.0212mm	Max = 0.6054mm	Mean = 0.0915mm	Mode = 0.0332mm	StdDev= 0.0789mm

Figure 5.4: *Grain-size distribution of textural data from Reading Formation sample (CS-K)*



Min = 0.0259mm	Max = 0.542mm	Mean = 0.1546mm	Mode = 0.0457mm	StdDev = 0.1138mm

Figure 5.5: *Grain-size distribution of textural data from Reading Formation sample (CS-M)*

The inclusions within both samples are dominated by coarse silt to medium quartz sand, with low mean grains sizes for both samples, but with a much higher volume of quartz present in the CS-K sample, with 157 recorded points compared to 83 points for CS-M. Both samples are relatively fine-grained, with maximum grains sizes less than 0.07mm. There are occasional flint fragments within the CS-M sample, with more frequent flint in the CS-K sample. While the samples are the same in terms of mineral composition, it is the textural composition, the proportions of inclusions, that differs, thus demonstrating the variability present within the same formation.

5.2.2 Thames Group

Overlying the **Lambeth Group** is the **Thames Group**, which includes the *Harwich* and *London Clay* formations, the *Harwich Formation* is not mapped separately and has been recorded in numerous old brick pits in and around Reading and Tilehurst (Mathers and Smith, 2000, p. 11).

The *London Clay Formation* comprises mottled, non-calcareous fine sandy and silty clays (Jarvis, 1968, p. 6) with subordinate thin glauconitic sands and pebble beds. It is a fossiliferous unit, of shallow-marine origin, with extensive outcrop, especially in the east of Berkshire. The formation varies in thickness from less than 60 metres to c.90 metres at Wokingham (Allen, 2017, p. 76). At its outcrop there is generally a brown weathered zone several feet thick, probably coloured as a result of the oxidisation of iron pyrites in the original deposit. Sulphuric acid produced by the oxidisation is neutralised by reaction with calcium carbonate to produce crystals of selenite (gypsum) (Jarvis, 1968, p. 6). Locally, there are sandy seams, with the lower sandier beds preferred for exploitation in the nineteenth century, with production focussing on bricks, and to a lesser extent tiles (Allen, 2017, p. 76).

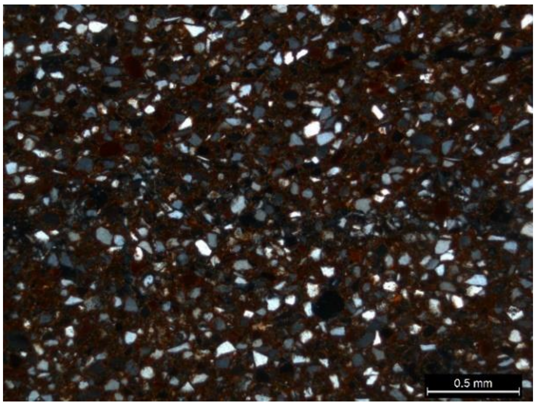


Figure 5.6: *Photomicrograph of London Clay (sand) Formation (CS-B) (XP; x40 magnification)*

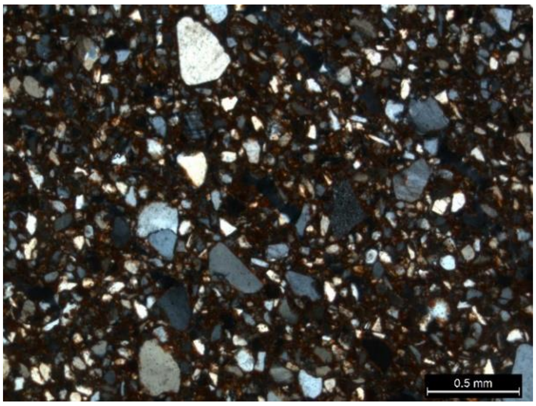
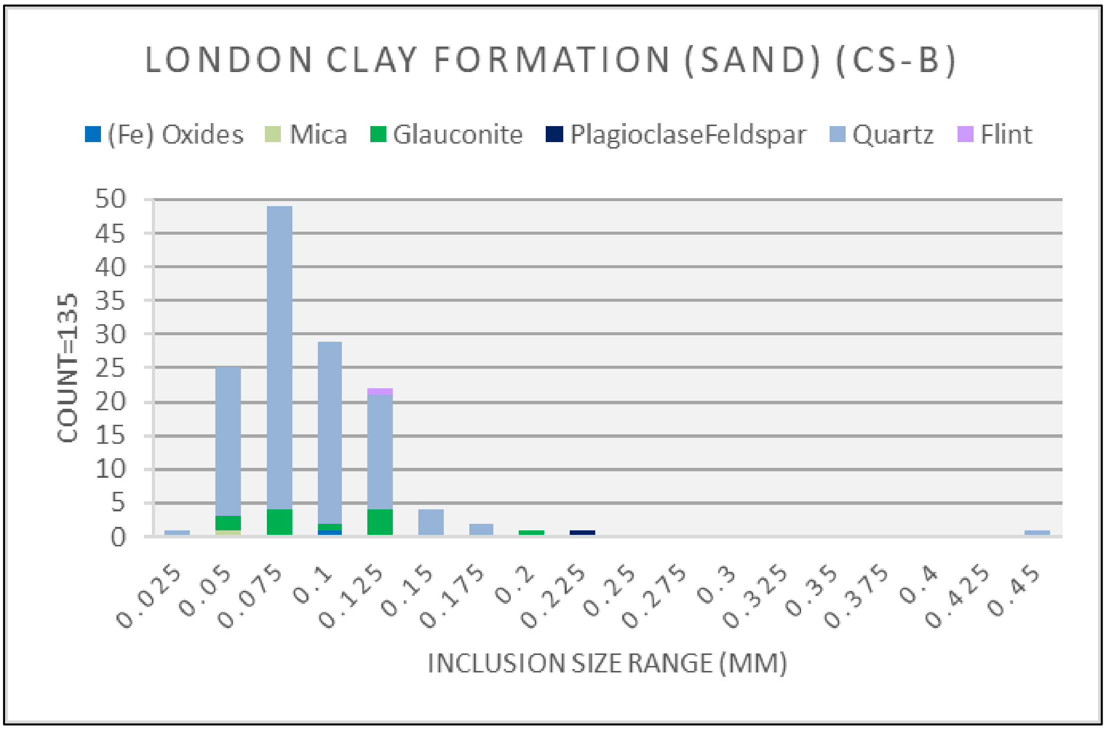


Figure 5.7: *Photomicrograph of London Clay (clay, silt, and sand) Formation (CS-C) (XP; x40 magnification)*

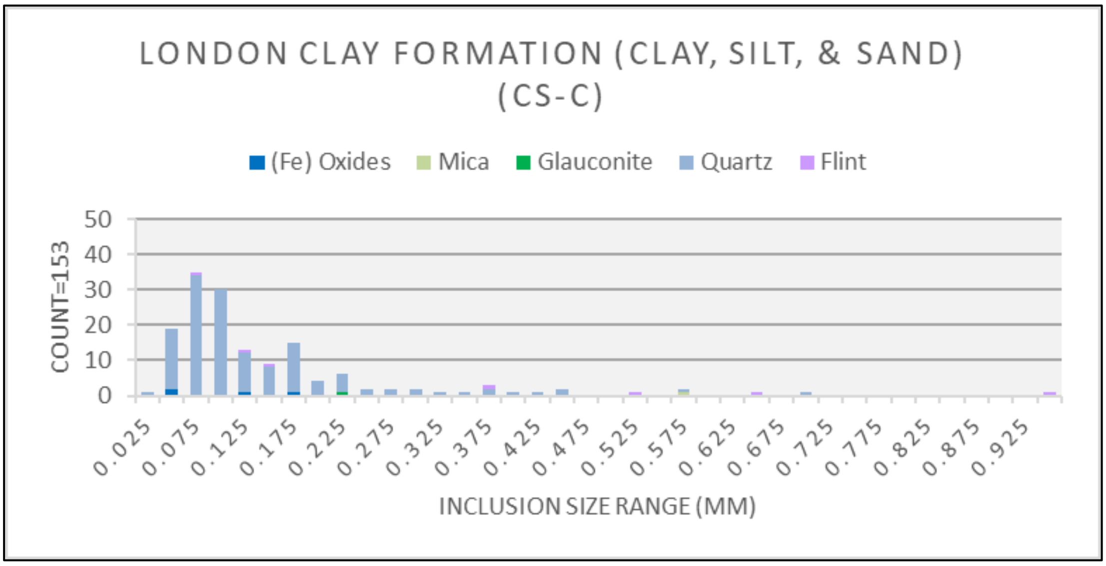
The Photomicrographs above (Figs: 5.6 & 5.7) again show the variability within the same formation. These two samples were selected from different sub-groups of London Clay Formation. Sample CS-

B (London Clay-Sand) has a finer texture, with well-sorted quartz sand throughout, whilst, sample CS-C (London Clay-clay, silt, and sand) is also dominated by inclusions of quartz, but these are more poorly sorted. Both samples are iron-rich and non-calcareous.



Min = 0.0244mm	Max = 0.428mm	Mean = 0.0801mm	Mode = 0.0443mm	StdDev = 0.04330mm

Figure 5.8: *Grain-size distribution of textural data from London Clay (sand) Formation (CS-B)*



Min = 0.0221mm	Max = 0. 9411mm	Mean = 0.1411mm	Mode = 0.054mm	StdDev = 0.1373mm

Figure 5.9: *Grain-size distribution of textural data from London Clay (clay, silt, and sand) Formation sample (CS-C)*

Both samples again are comparable in terms of mineral composition, being dominated by coarse silt to medium quartz sand. Both samples are micaceous, with iron oxides and glauconite present with a small proportion of flint fragments. The mean and standard deviation for sample CS-C are inflated due to the presence of a proportion of larger quartz grains and fragments of flint, this is reflected in the maximum grain size of almost 1mm, compared to 0.428mm for sample CS-B.

5.2.3 Bracklesham Group

Above the *London Clay Formation* lie the early to middle Eocence sediments of the predominantly sandy **Bracklesham Group**, which incorporates the *Bagshot Formation, Windlesham Formation* and *Camberley Sand formation* (Jarvis, 1968, p. 12; Mathers and Smith, 2000).

The *Bagshot Formation* are mainly pale grey or yellow sands, about 20-25m in depth, with seams of mottled grey plastic clay and mottled fine sandy clays these are mostly glauconitic sandy clays, bottle-green, yellow, and strong brown in colour, with occasional seams of sand. The sand component mainly comprises quartz and some mica, with scarce feldspar and flint grains (Jarvis, 1968, pp. 6–7), locally glauconitic, with subordinate thin clay lenses (Mathers and Smith, 2000, p. 13). Thin beds and lenses of laminated pale grey to white sandy or silty clay or clay occur sporadically, becoming thicker towards the top of the formation (Curry, 1958). To the south-west of Reading, up to 15m of interbedded sands, silts, and clays here are assigned to the *Bagshot Formation*. The sands are finer than the *Reading Formation* sands. Of mixed shallow-marine and freshwater origin, the sandier nature of these deposits makes them less suitable for making bricks and tiles than the *Reading* and *London Clay* Formations (Allen, 2017, p. 77).

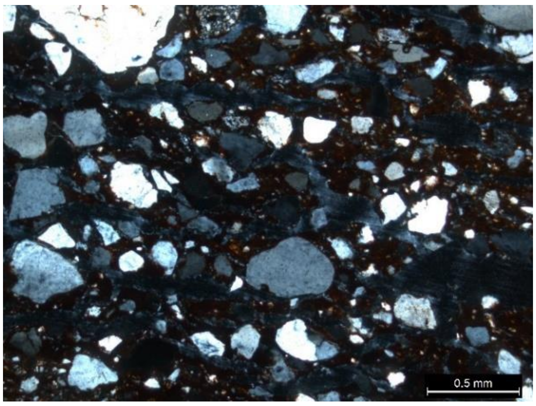


Figure 5.10: *Photomicrograph of Bagshot Formation sample (CS-N) (XP; x40 magnification)*

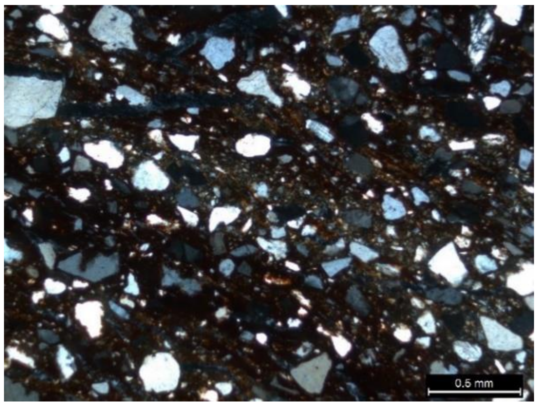
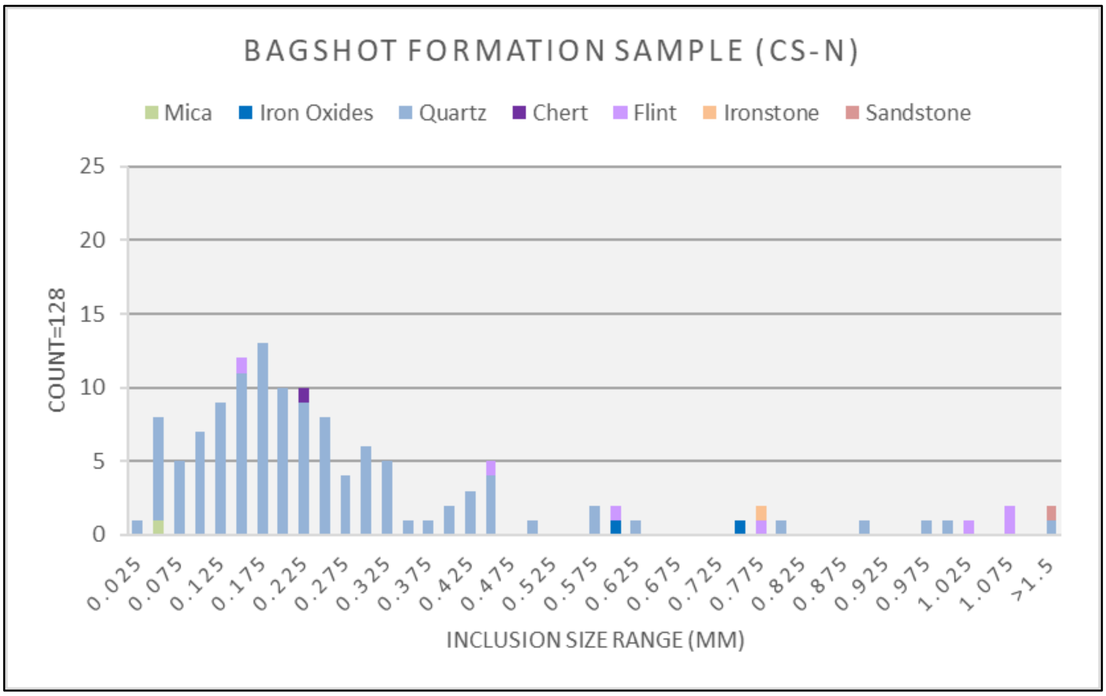


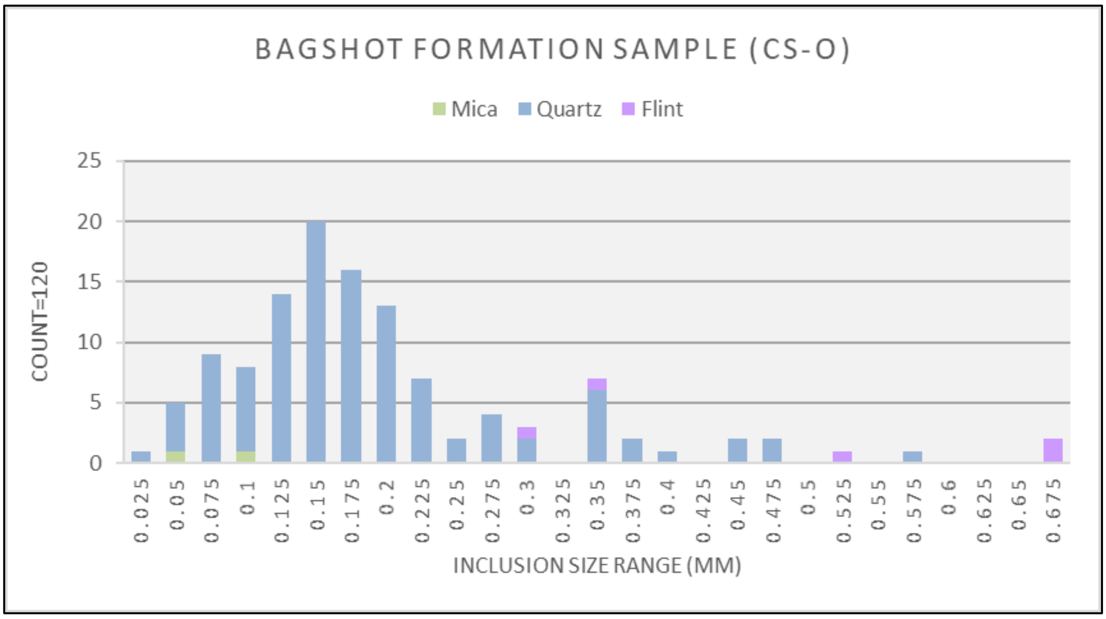
Figure 5.11: *Photomicrograph of Bagshot Formation sample (CS-O) (XP; x40 magnification)*

The photomicrographs clearly show the similarities between these two samples, they are both iron-rich, non-calcareous clays. Sample CS-O (Fig: 5.11) shows a greater degree of heterogeneity, with laminae of different coloured clays visible, when compared to the more homogeneous sample, CS-N (Fig: 5.10). The quartz in both samples is poorly sorted, with angular-to-rounded quartz grains present, sample CS-N appears to have a larger mean grain-size.



Min = 0.0201mm	Max = 1.8266mm	Mean = 0.2883mm	Mode = 0.2299mm	StdDev = 0.2870mm

Figure 5.12: *Grain-size distribution of textural data from Bagshot Formation sample (CS-N)*



Min = 0.0183mm	Max = 0.6607mm	Mean = 0.1862mm	Mode = 0.1182mm	StdDev = 0.1223mm

Figure 5.13: *Grain-size distribution of textural data from Bagshot Formation sample (CS-O)*

The inclusions within both samples are dominated by coarse-silt to medium-sand sized quartz. Alongside the quartz, both samples contain mica and flint. In addition, sample CS-N includes a wider variety of rock fragments, in the form of chert, flint and ironstone. The mean and standard deviation for sample CS-N are inflated due to the presence of these larger rock fragments and quartz grains, this is reflected in the maximum grain size of almost 2mm, compared to 0.4661mm for sample CS-N.

The *Windlesham formation* outcrops on the high ground between Wokingham and Finchampstead, with restricted outcrops to the south-east, Hazeley Heath, and south-west, Little London, of Silchester. It comprises up to 20m of dark green to brown, highly glauconitic, bioturbated sand and clay (Mathers and Smith, 2000, p. 13).

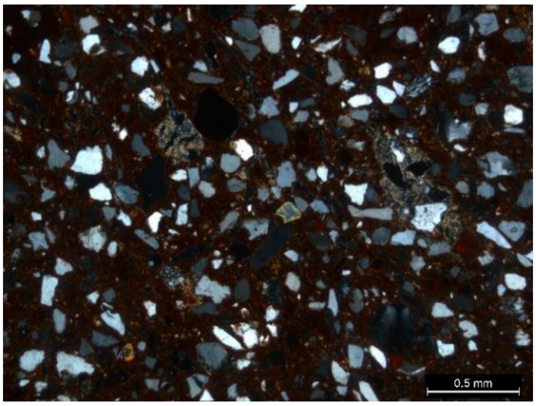


***Figure 5.14**: Photomicrograph of Windlesham Formation sample (CS-E) (XP; x40 magnification)*

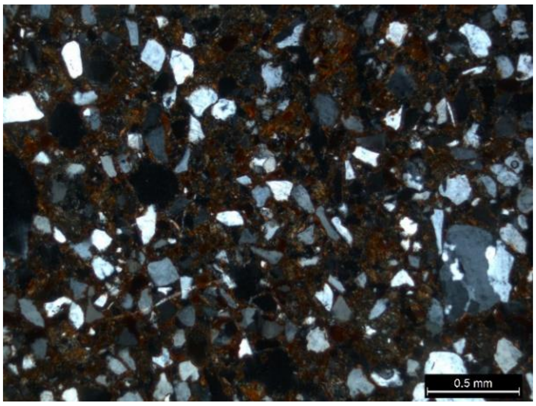
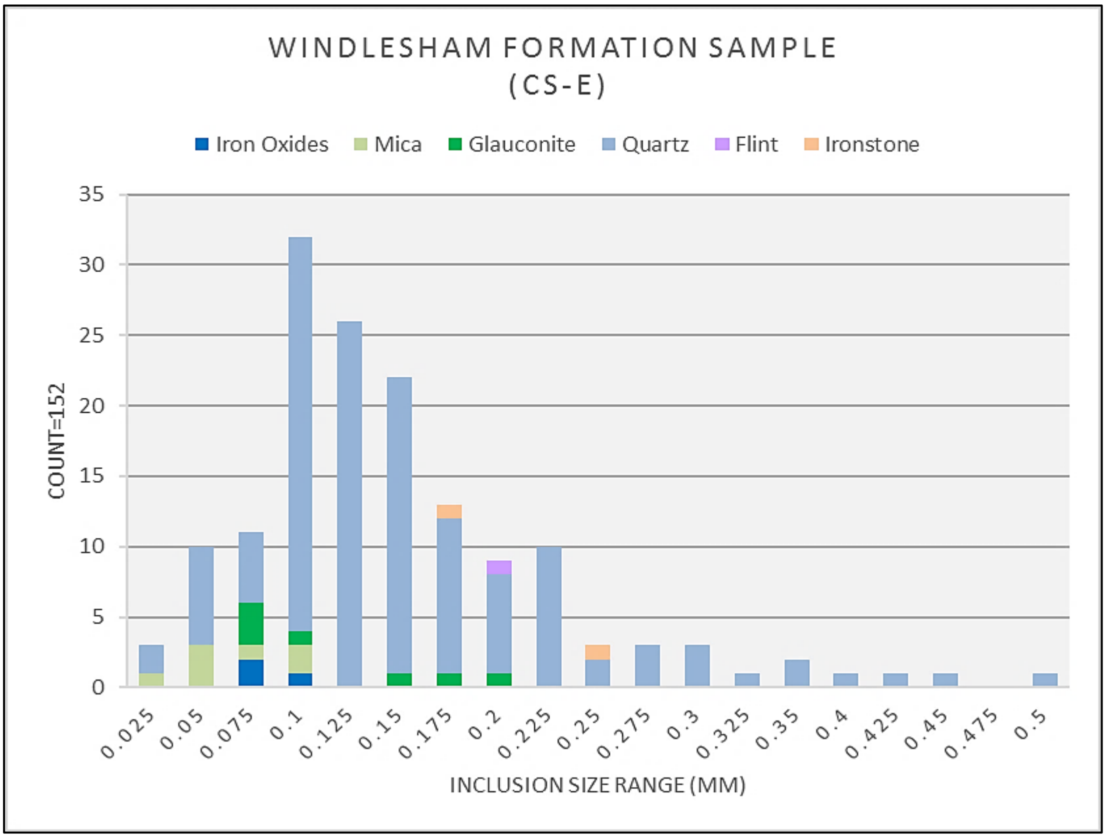


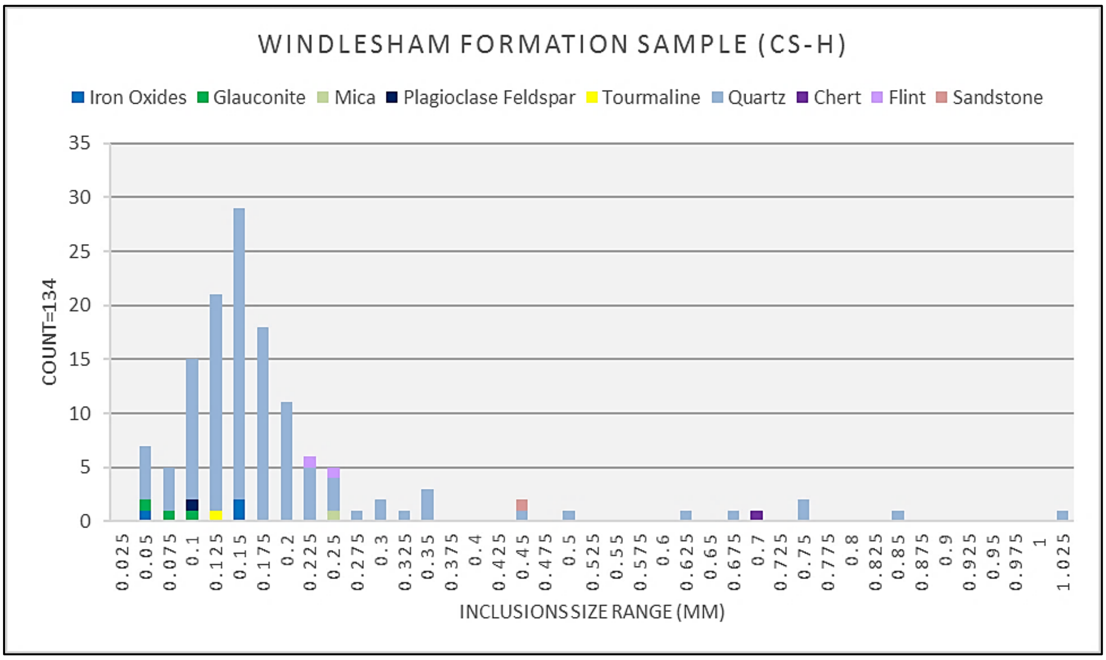
***Figure 5.15**: Photomicrograph of Windlesham Formation sample (CS-H) (XP; x40 magnification)*

The photomicrographs (Figs. 5.14 & 5.15) clearly show similarities between these two samples, they are both iron-rich, non-calcareous clays. They both have similar proportions of moderately sorted angular quartz. A small number of clay pellets can be seen in sample CS-E (Fig.5.14), these exhibit diffuse-to-merging boundaries and are distorted in shape.



Min = 0.0195mm	Max = 0.4=847m	Mean = 0.1410mm	Mode = 0.0406mm	StdDev = 0.0852mm

***Figure 5.16**: Grain-size distribution of textural data from Windlesham Formation sample (CS-E)*



Min = 0.0309mm	Max = 1.0232mm	Mean = 0.1821mm	Mode = 0.0869mm	StdDev = 0.1558mm

***Figure 5.17:** Grain-size distribution of textural data from Windlesham Formation sample (CS-H)*

The similarities between the samples are also reflected in the results of the textural analysis. Sample CS-H (Figure 5.17) show more variety in the range of inclusions that were recorded. Most of the quartz grains are less than 0.35mm in size in both samples. Both samples are micaceous, with iron oxides and glauconite present with a small proportion of flint fragments. In addition, sample CS-H includes a wider variety of rock fragments, in the form of chert, flint and sandstone. The mean and standard deviation for sample CS-H are inflated due to the presence of a proportion of larger quartz grains, this is reflected in the maximum grain size of over 1mm, compared to 0.485mm for sample CS-E.

5.2.4 Clay-with-Flints

Clay-with-flints or Plateau drift, is a superficial post-Cretaceous material that varies in thickness from a metre to a few metres in most places. The *Clay-with-Flint* is a dark brown or reddish tenacious clay, containing flints as unbroken nodules or large angular fragments (Jarvis, 1968, p. 12). The deposits on the Chalk in the north-west of the area covered by British Geological Survey Sheet 268 are believed to result from both the reworking of small outliers of the Lambeth group (Mathers and Smith, 2000, p. 21). Compositionally, both the *Clay-with-Flints* and the *Langley Silts* (formerly mapped as Brickearth) are related to the *Reading Formation* and associated early Tertiary deposits. *Clay-with-Flints* has been exploited to a limited extent in the nineteenth century for brick and tile production (Allen, 2017, p. 78).

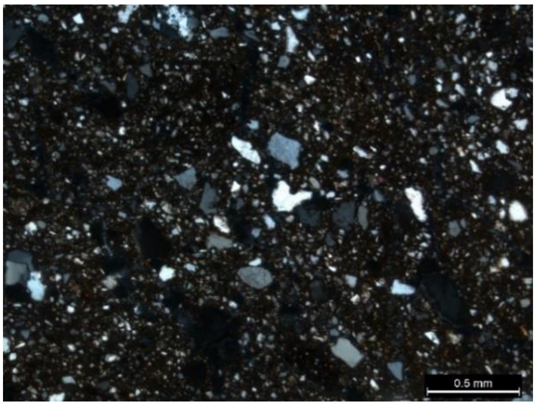


Figure 5.18: *Photomicrograph of Clay-with-Flints (CS-I) (XP; x40 magnification)*

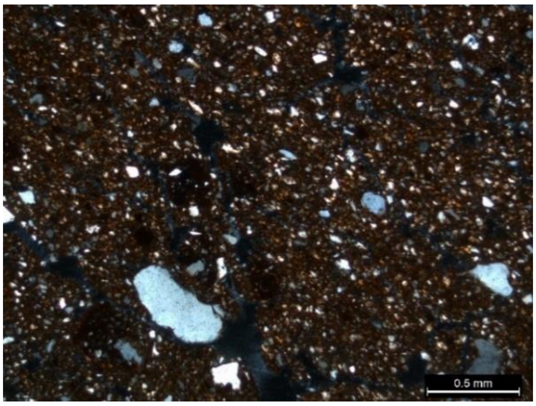
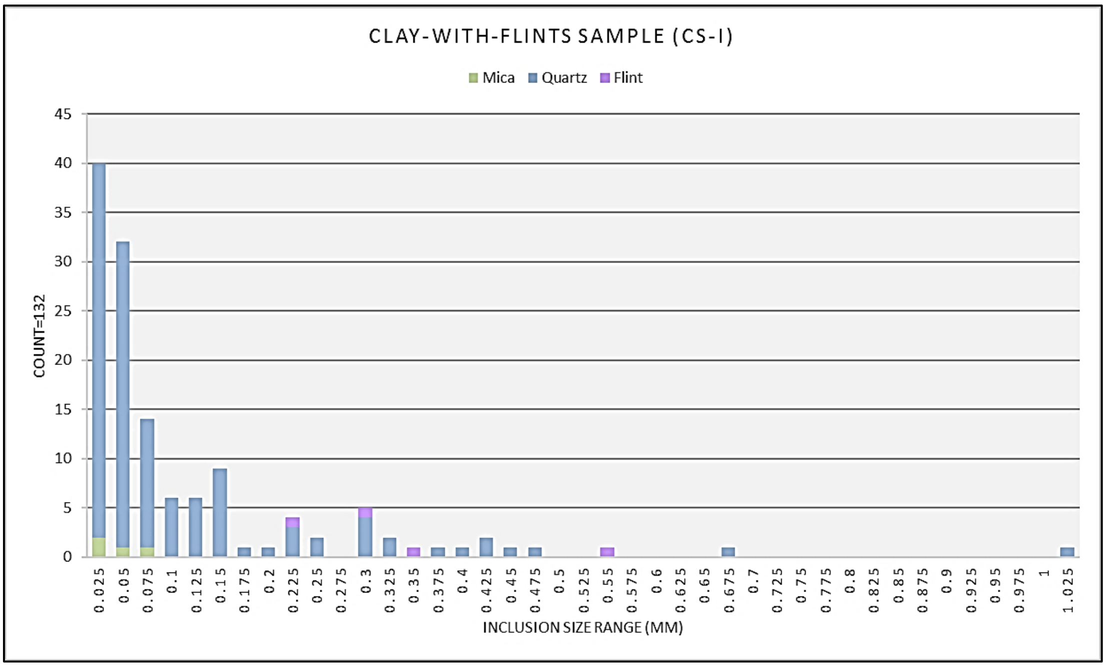


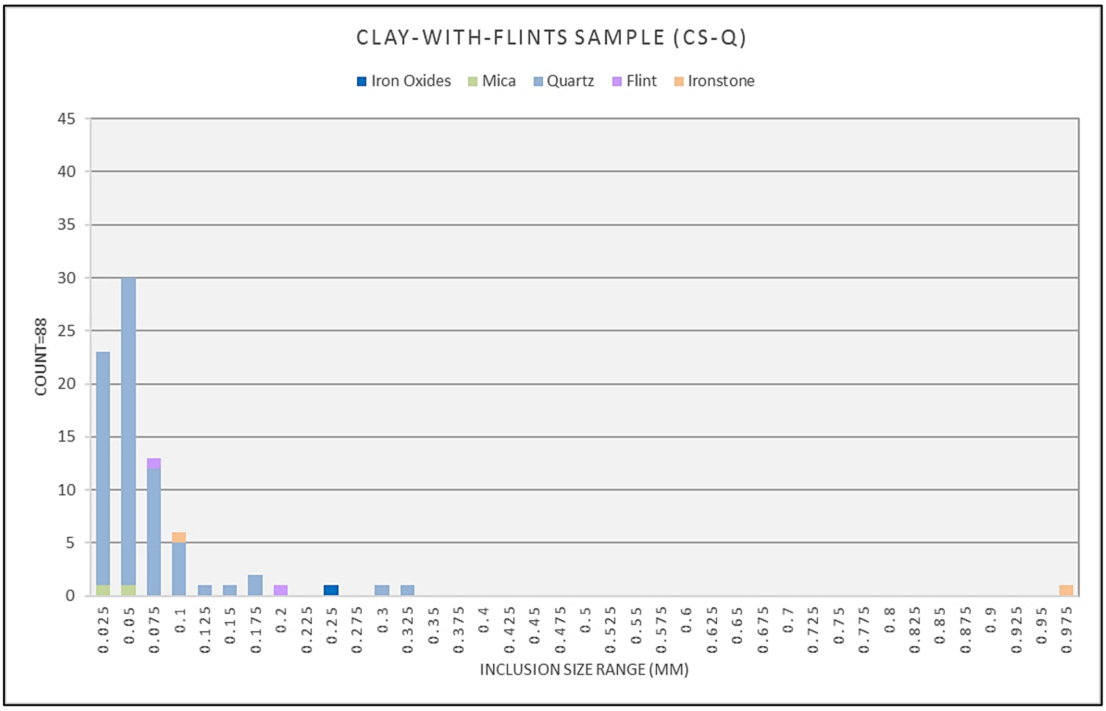
Figure 5.19*: Photomicrograph of Clay-with-Flints sample (CS-Q) (XP; x40 magnification)*

The photomicrographs show clear similarities between these two samples, they are both homogeneous iron-rich, non-calcareous clays. They have a body of fine angular-to-subangular quartz sand throughout, with a scatter of larger quartz grains present.



Min = 0.008mm	Max = 1.0113mm	Mean = 0.1057mm	Mode = 0.0144mm	StdDev = 0.1453mm

***Figure 5.20**: Results of compositional and textural analysis of Clay-with-Flints sample (CS-I)*



Min = 0.0091mm	Max = 0.9767mm	Mean = 0.0763mm	Mode= 0.0207mm	StdDev= 0.1539mm

***Figure 5.21:** Results of compositional and textural analysis of Clay-with-Flints sample (CS-Q)*

The similarities between the samples are again reflected in the results of the textural analysis. Both samples are composed of quartz, flint, and mica, with sample CS-Q also having iron oxides and fragments of ironstone. Most of the quartz grains are of fine quartz sand, typically less than 0.15mm in size in both samples. The mean grain size for samples CS-I, 0.106mm, is higher due to the small proportion of larger quartz grains present. The standard deviations for the two samples are very similar.

5.3 Summary

This chapter has defined the geology in the area around Silchester and the resources available to the Romano-British brick and tile producers. The following chapter defines the Silchester CBM fabric series and compares each fabric with the geological results in order to identify potential raw material source.

Chapter 6. Silchester CBM fabric series

6.1 Introduction

This chapter presents the results of macroscopic and petrological analysis of the fabrics of the ceramic building material assemblage from Silchester. These are compared with the resulted of the analysis on the clay samples (chapter 5).

Fabrics groupings were assigned following macroscopic examination under a x10 binocular microscope or using a x10 hand lens. This involved the analysis of the retained ceramic building material assemblages from the Insula IX archive (IX - n=1231), the forum-basilica archive (FB - n=329), and the material held in the Reading Museum collection (RM – n=489). Portable X-ray fluorescence analysis was used to verify fabric groupings and confirm relationships where destructive sampling was not permissible. Several samples from each fabric group, a minimum of three, were selected for thin section preparation and analysis. Initial petrographic analysis sought to confirm if the group divisions in hand specimen were valid. After the identification of obvious compositional differences, these groups were then further scrutinised to detect more subtle differences between samples.

The following section begins with detailed macroscopic and petrographic descriptions of the main fabrics from the Silchester assemblage, those which make up the largest proportions of the retained assemblage. Any fabric groups which make up less than 5% each of the retained are described in summary. This is based on the fabric description methodology outlined in Quinn (2013, p. 73–102; Appendices A1-A3), adapted from the Whitbread Descriptive System (Whitbread, 1989). Each inclusion is described with an indication of its relative proportion within the sample of which it is part. These indicate a percentage range, rather than an actual number, and are used as semi-quantitative frequency labels (Quinn, 2013, p. 90). Photomicrographs of a typical example of each fabric, at x40 magnification, are included as an illustration of the fabric composition in plain polarised light (PPL) and crossed-polars (XP). This same thin section was used for compositional and textural analysis (as per methodology section 3.5.2), and these results are included within each fabric description.

The range of forms present in each of the fabric groups is described, along with detailed descriptions of any unusual forms or groups of material. These fabric groupings are then compared with the geological clay samples to look for connections to potential raw material sources.

6.2 Silchester Ceramic Building Material Fabric series

This section defines the fabric series derived from the ceramic building materials held in the archives from the Insula IX and forum-basilica excavations and the Reading Museum collections. A total of 13 fabrics have been identified in the Roman ceramic building materials, which belong to nine fabric groups. These have been assigned sequential fabrics codes e.g. **SILCBM1**, **SILCBM2**. In addition, there are three fabrics that have been described separately. These represent ceramic artefacts that do not comprise the usual Roman building materials corpus, these have been labelled **SILOCA1**, **SILOCA2** & **SILOCA3** (OCA=Other ceramic artefacts). The fabrics are described in the order of the proportion of the retained assemblage that they represent, starting with the largest proportion.

6.2.1 **SILCBM1A**: Micaceous

Fabric as a proportion of the retained assemblage: 34.82%

Macroscopic description: This is a hard, homogeneous fabric, with sandy texture and irregular fracture. It is typically oxidised throughout with red (2.5YR5/8) surfaces, margins, and core. There are a few examples where the fabric has been reduced to a greyish-brown (10YR 5/2) throughout. The matrix has fine quartz sand throughout with varying proportions of coarse- to very coarse- quartz sand. The fabric is highly micaceous with occasional large flint inclusions, up to 2cm. Figure 6.1 shows the fabric in hand specimen. Moulding sand, where present, is typically medium quartz sand. The inner surfaces of flue-tiles show evidence of gypsum precipitate.

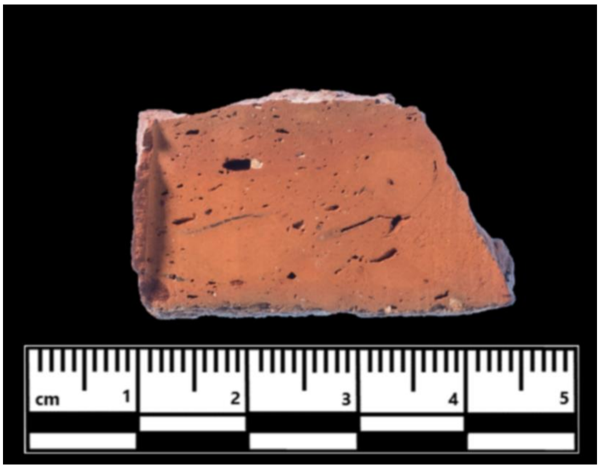


Figure 6.1: *Example of* ***SILCBM1A*** *- London Clay-Mica fabric in hand specimen*

Thin section references: TSID060; 098; 108; 112; 113; 121; 123; 126; 142; 168; 172; 177; 178; 179; 219; 221; 222; 259; 301; 303; 304; 314;

Petrographic description

Inclusions: 39-43%; equant and elongate, angular to subrounded, <0.6mm; moderately sorted. Double-spaced. Weak to moderate alignment. Weakly bi-modal.

Dominant: **Monocrystalline quartz**; equant, angular-to-sub-rounded. <0.15mm, mode=0.05mm. Silt to very fine sand throughout the matrix.

Common: **Biotite Mica;** equant and prolate, angular. <0.25mm, mode=0.1mm. Elongate needle-like grains, bright 1st to 2nd order colours, pleochroic in PPL.

Few: **Iron oxides;** equant, subrounded. <0.15mm, mode = 0.05mm. Discrete iron-rich grains, deep red and opaque, derived from iron-rich pedogenic nodules.

Few: **Flint;** equant & prolate, angular-to-subangular. <0.5mm, mode=0.25mm. The proportion of flint ranges from 3-5%.

Few-very few: **Monocrystalline quartz**; equant, sub-rounded. <0.5mm, mode = 0.4mm. Small fraction of medium quartz sand ranging in proportion from 1-4%. The samples with a higher proportion of this larger quartz component are described as Mica+med.

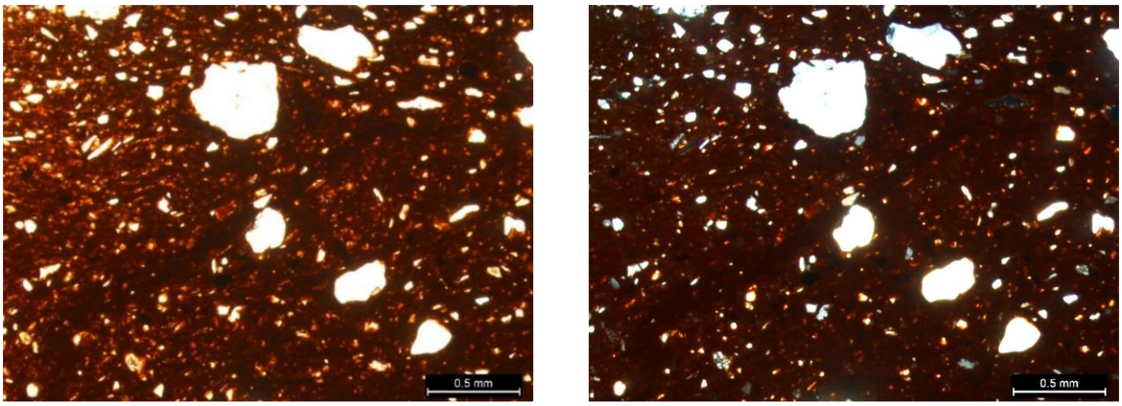
Rare/absent: **Glauconite**; equant, rounded. <0.25mm, mode=0.2mm. Heat-altered glauconite grains naturally occurring within the clay matrix; transformed from their natural pale green colour, to semi-opaque grains of a mid-orange in colour due to the oxidation of divalent iron. The colour changes from green to red or black depends on the firing temperature and oxidising conditions within the kiln (Basso *et al.*, 2008, p. 95). See figure 6.4 & 6.5, below which shows both an unfired sample and fired sample of Lower Greensand clay, from Marden (Grid Reference: SU092579).

Rare/absent: **Ironstone**; equant. Sub-rounded. <1mm, mode = 0.5mm. Nodules commonly dark reddish-brown in colour, often opaque with inclusions of monocrystalline quartz within.

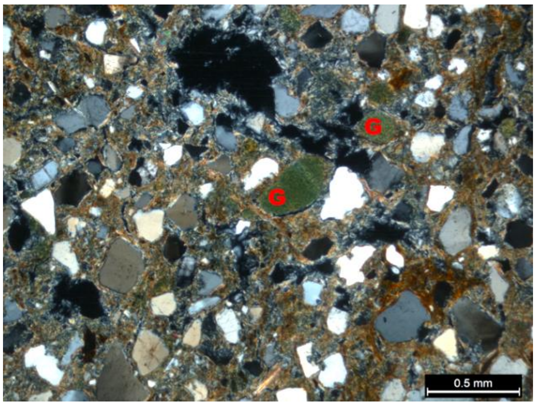
Rare/absent: **Gypsum**; prolate, elongate and angular. This is a pseudomorph after gypsum (selenite), with crystal faces evident and pyramidal terminations. Selenite crystals form when the oxidisation of iron pyrites releases sulphate ions which are neutralised by a reaction with calcium carbonate (Jarvis, 1968, p. 6)6.6 & 6.7).

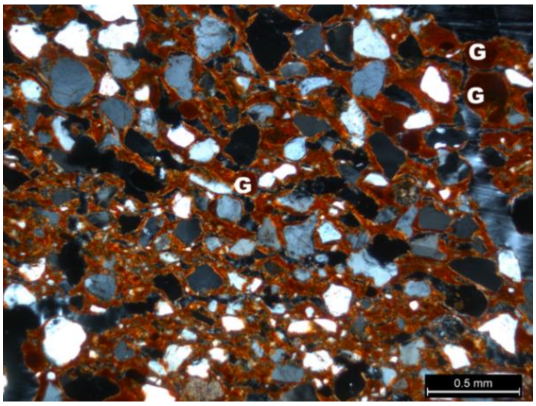
Voids: 2-4% comprising of meso-vesicles. There is no preferred orientation or alignment exhibited.

Matrix: 53-60%. Homogenous. Iron-rich; non-calcareous. The fabric is dark yellow-orange in both PPL and XP. The matrix is only slightly optically active, with no clay pellets or streaks present.

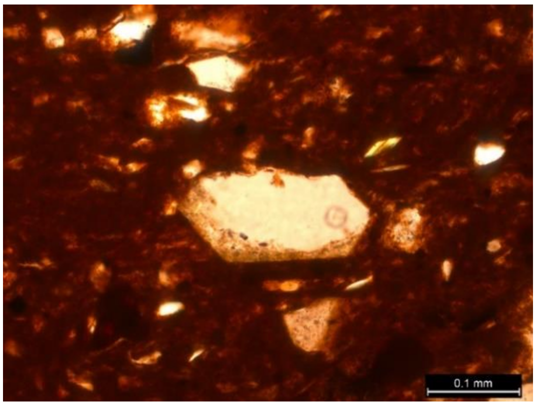


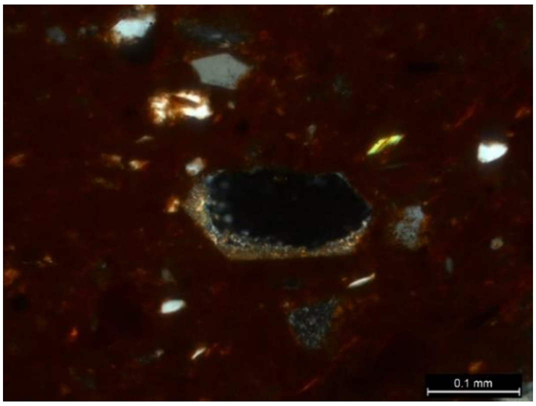
***Figures 6.2 & 6.3**: **SILCBM1A** - London Clay – Mica (TSID178) in PPL (left) and XP (right) (x40 magnification)*





Figures 6.4 & 6.5: *Glauconite grains (G) in unfired Lower Greensand clay sample (left) and clay sample fired at 800 degrees for 6 hours (right). (XP; x40 magnification)*





Figures 6.6 & 6.7*: Example of gypsum formation in clay matrix (TISD178), shown in PPL (left) and XP (right) (x40 magnification)*

Comments: This homogeneous fabric is highly micaceous, with fine silt-sized quartz throughout, and a small proportion of larger quartz present. The fabric would appear to be in its natural state with no anthropogenic additions of temper during processing. There are few voids present making it a dense, hard fabric. The reduction in optical activity is probably the result of a high firing temperature. There are several examples where selenite (gypsum) crystals have also been noted on the inner surface of relief-patterned tiles, keyed with die 27. Selenite can form through post-depositional processes in archaeological deposits. Though typically observed in arid regions (Courty, Goldberg and MacPhail, 1989, pp. 171–172), gypsum precipitation is often observed on ancient and modern clay building materials (McGee and Mossotti, 1992; Brocken and Nijland, 2004) and in the case of these box-flue tiles, could be a result of the use of these tiles in the warm and damp environment of a hypocaust system.

Compositional and textural analysis: The overall composition of the fabric is shown in figure 6.8, illustrating that in this sample two-thirds of the fabric is made up of the clay matrix.

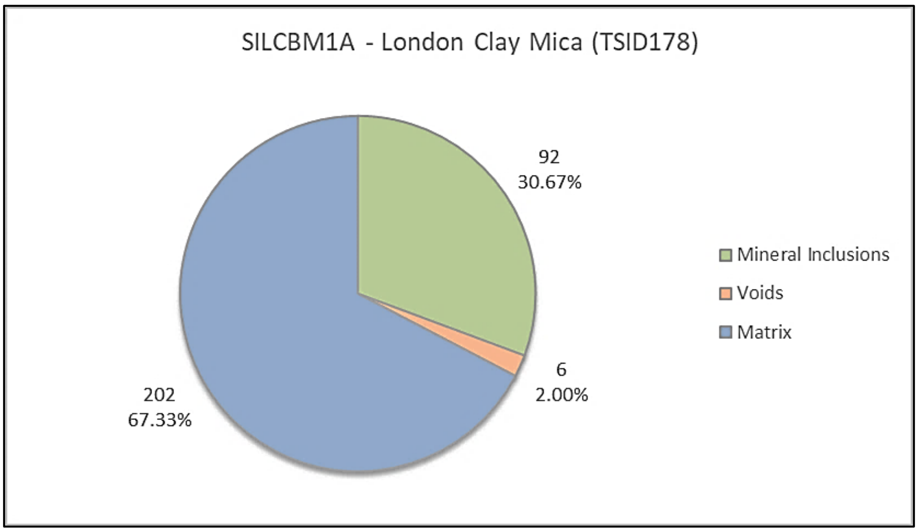
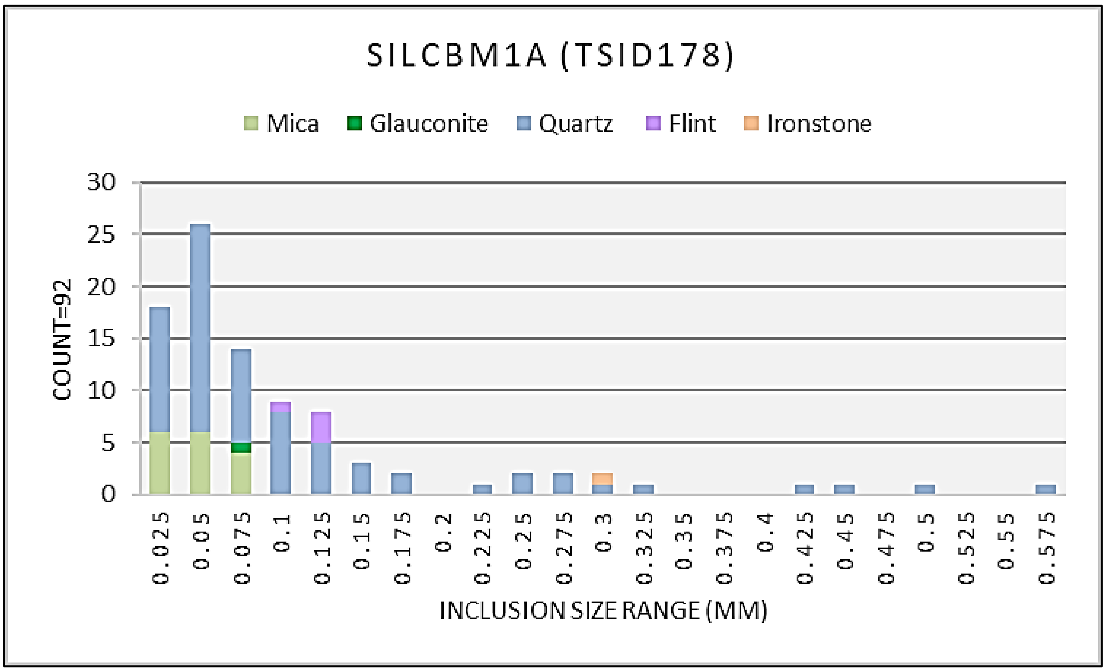


Figure 6.8: Composition of ***SILCBM1A*** *- London Clay – Mica sample (TSID178)*

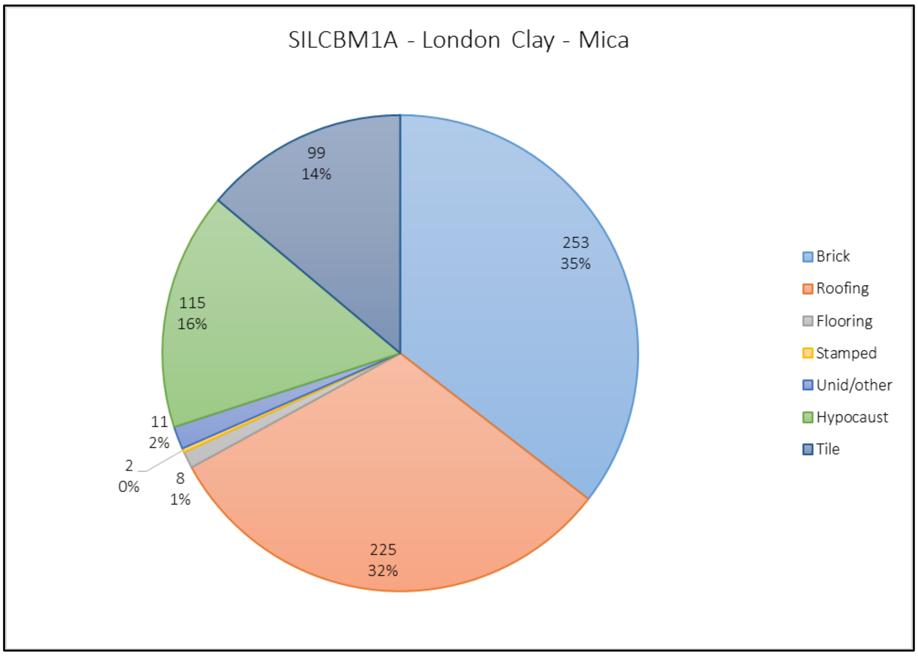
The grain-size distribution chart, figure 6.9, illustrates the weakly bimodal distribution of grain size within the fabric. Most of the inclusions are within the 0.025-0.2mm range size, comprising very fine-to-fine grained quartz sand and mica. All inclusions are less than 0.6mm in size with a scatter of fine-medium quartz sand grains accounting for the larger sized inclusions. The mean grain size and standard deviation are inflated by the presence of these larger inclusions in the sample.

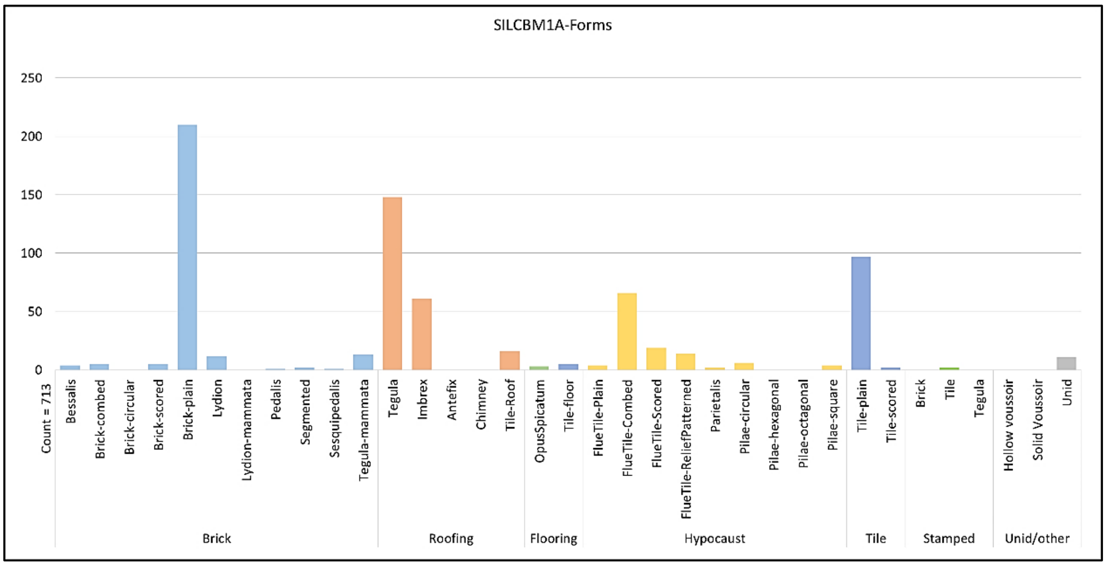


Min = 0.139mm	Max = 0.5648mm	Mean = 0.0928mm	Mode = 0.0219 mm	StdDev = 0.1071mm

Figure 6.9: Grain-size distribution from textural analysis of ***SILCBM1A*** *- London Clay-Mica sample (TSID178)*

Forms: There is a wide range of forms in this fabric. There is a large proportion of roofing materials with *tegulae* and *imbrices* making up 20.90% and 8.62% respectively. Bricks account for nearly 36% of the fabric with a further 14.69% made up of tile forms, figure 6.10.





***Figures 6.10 & 6.11**: Range of forms in **SILCBM1A** - London Clay – Mica fabric*

The forms in this fabric are dominated by plain bricks, with a large proportion of *imbrices* and *tegulae* making up the assemblage, along with plain tiles. There is a very small proportion of floor tile present. There are 16 examples of relief-patterned tiles of die 27, along with the one example of the new relief-patterned die (Wilson, 2017) in this fabric. These are discussed in more detail in chapter 9.

There is a single example of a stamped tile, figure 6.12. This was recovered from the backfill of a well in Insula IX during the 2000 excavation season, it has a partial stamp which has been interpreted as being the stamp of a private tilemaker, AR FLO, *Aur(elius) Flo…* with the cognomen being *Florus* or *Florentinus* (Tomlin, 2012, p. 401).

Figure 6.12: *Illustration of AR FLO stamped-tile (After Tomlin 2012 Fig.9)*

6.2.2. **SILCBM1B**: Fine Quartz

Fabric as proportion of retained assemblage: 14.86%

Macroscopic description: This is a moderately micaceous homogeneous fabric with a high proportion of fine quartz sand present, up to 30%. The samples are typically red (2.5YR 5/8) and oxidised throughout. There are several examples with cores reduced to a strong brown colour (7.5YR 4/6). This is a hard, very sandy fabric with irregular fracture. There is a small proportion of red iron-oxide grains visible along with occasional flint fragments. Figure 6.13 shows the fabric in hand specimen. Moulding sand is typically fine-to-medium quartz sand.

Figure 6.13: *Example of* ***SILCBM1B*** *- London Clay – Fine Quartz in hand specimen*

Thin section references: TSID124; 129; 130; 224; 226; 240; 289; 290; 312;

Petrographic description

Inclusions: 30-40%; equant and elongate, angular-to-rounded, <0.3mm; moderately sorted. Single spaced. Moderate alignment and unimodal.

Predominant: **Monocrystalline quartz;** primarily equant, subangular-to-angular. <0.25mm, mode = 0.1mm. Very fine quartz sand throughout, with no proportion of larger quartz grains present.

Few: **Biotite mica;** equant and prolate, angular. <0.25mm, mode = 0.15mm. Elongate needle-like grains, bright 2nd order colours in XP, pleochroic in PPL.

Very few: **Glauconite**; equant, rounded. <0.15mm, mode=0.15mm. Heat-altered glauconite grains naturally occurring within the clay matrix.

Very few: **Iron oxides;** equant, sub-rounded. <0.15mm, mode = 0.05mm. Discrete iron-rich grains, deep red and opaque, derived from iron-rich pedogenic nodules.

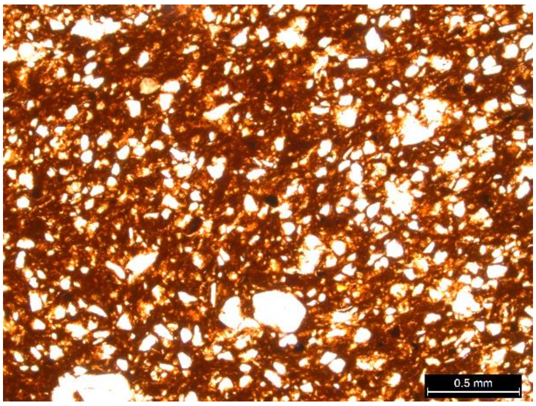
Very few: **Flint;** equant and prolate, angular-to-subangular. <0.20mm, mode=0.15mm. The proportion of flint ranges from 2-5%.

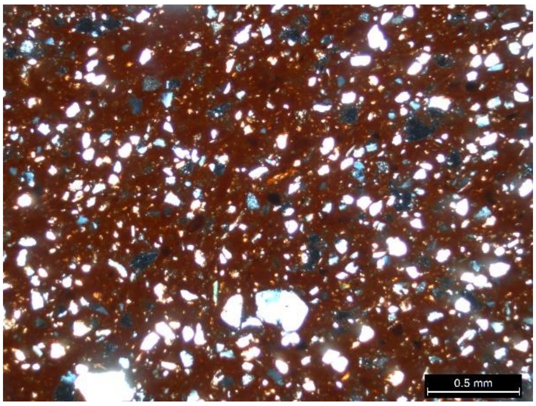
Rare/absent: **Plagioclase feldspar**; equant and prolate. <0.1mm, mode = 0.075mm. Occasional grains of plagioclase feldspar exhibiting albite twinning.

Voids: 2-5% comprising meso-vesicles. There is no preferred orientation or alignment exhibited.

Matrix: 55-68%. Homogeneous. Iron-rich; non-calcareous. The fabric is mid-orange-brown in both PPL and XP. The matrix has low optical activity.

Comments: This homogeneous fabric is moderately micaceous, with very fine quartz sand throughout. The fabric would appear to be in its natural state with no anthropogenic additions of temper during processing. The reduction in optical activity is resulting from a high firing temperature.





***Figures 6.14 & 6.15**: **SILCBM1B** - London Clay - Fine Quartz (TSID130) in PPL (left) & XP (right) (x40 magnification)*

Compositional and textural analysis:

Figure 6.16 shows the overall composition of this fabric example, showing a slightly higher proportion of voids (5%) than the **SILCBM1B** - London Clay-Mica example (TSID178). The textural analysis clearly illustrates the unimodal nature of the fabric with a fine matrix of fine quartz sand inclusions. The low value of the standard deviation reflects the small size range of the inclusions. There is a small proportion of small flint fragments throughout the matrix.

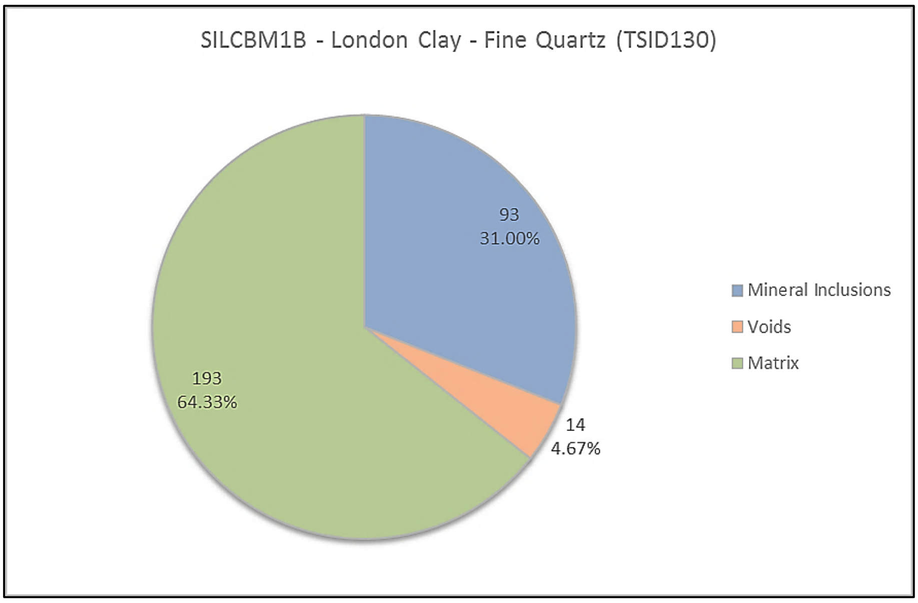
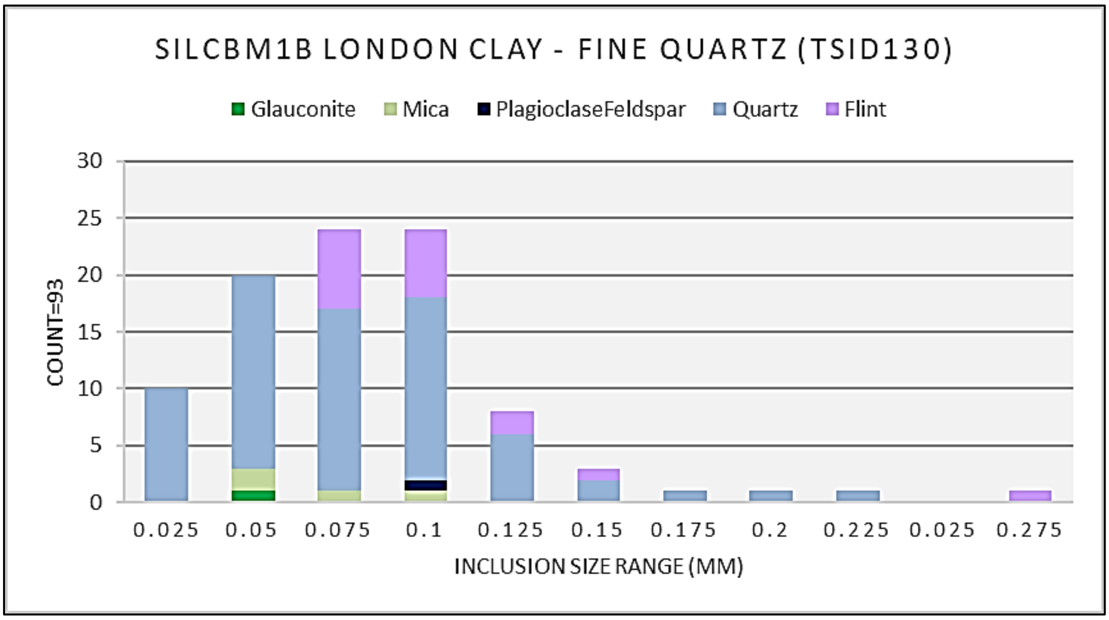


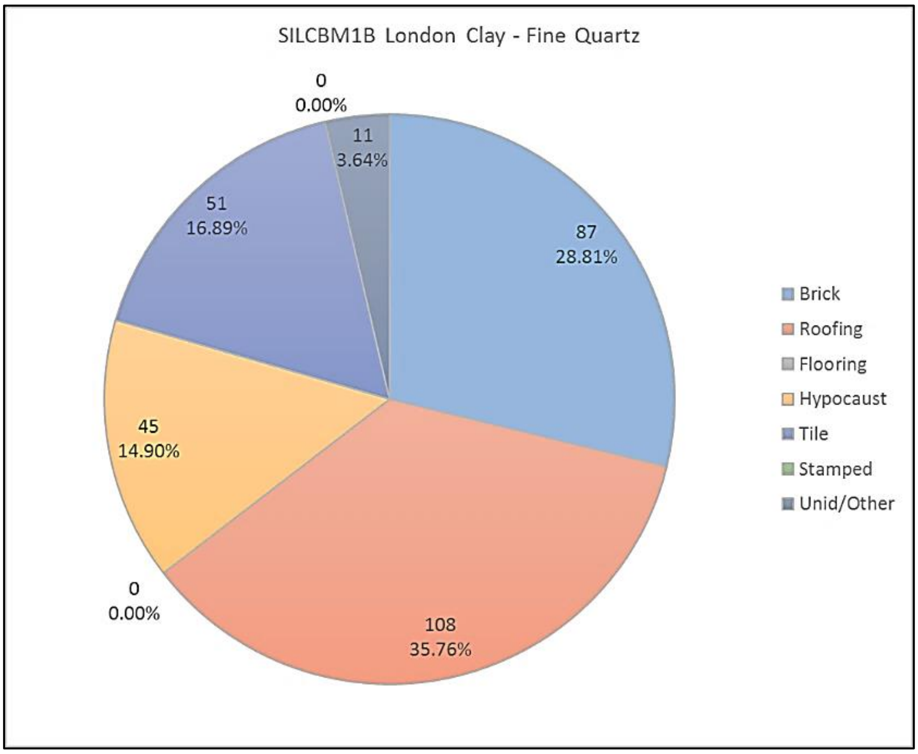
Figure 6.16: Composition of ***SILCBM1B*** *- London Clay – Fine Quartz (TSID130)*



Min = 0.011mm	Max = 0.2587mm	Mean = 0.0701mm	Mode = 0.0475mm	StdDev = 0.0415mm

Figure 6.17: Grain-size distribution of textural data from ***SILCBM1B*** *London Clay – Fine Quartz sample (TSID130)*

Forms:



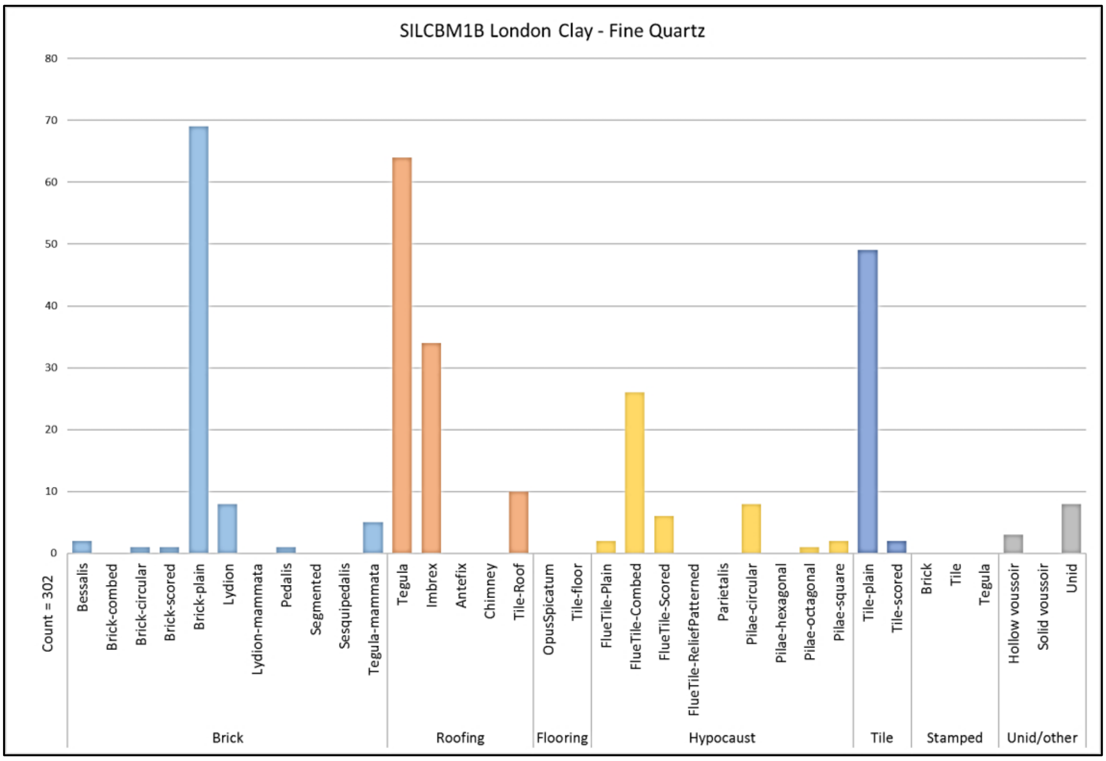


Figure 6.18 & 6.19: Range of forms in London Clay – Fine quartz

There is a wide range for forms in this fabric, as with the London Clay-Mica fabric, figure 6.18. There is a large proportion of roofing material with *tegulae* and *imbrices*, making up 21.14% and 11.41% respectively. Bricks account for 28.86%, with a further 17.11% made up of tile forms. One of the most unusual forms in the fabric is the hollow *voussoir* or *Tubulus Cuneatus.*

Figure 6.20 shows the results of the portable X-ray fluorescence analysis on these samples along with the results of the analysis of the London Clay formation clay samples. The fabric samples all group around the clay samples which would confirm geochemical similarities.

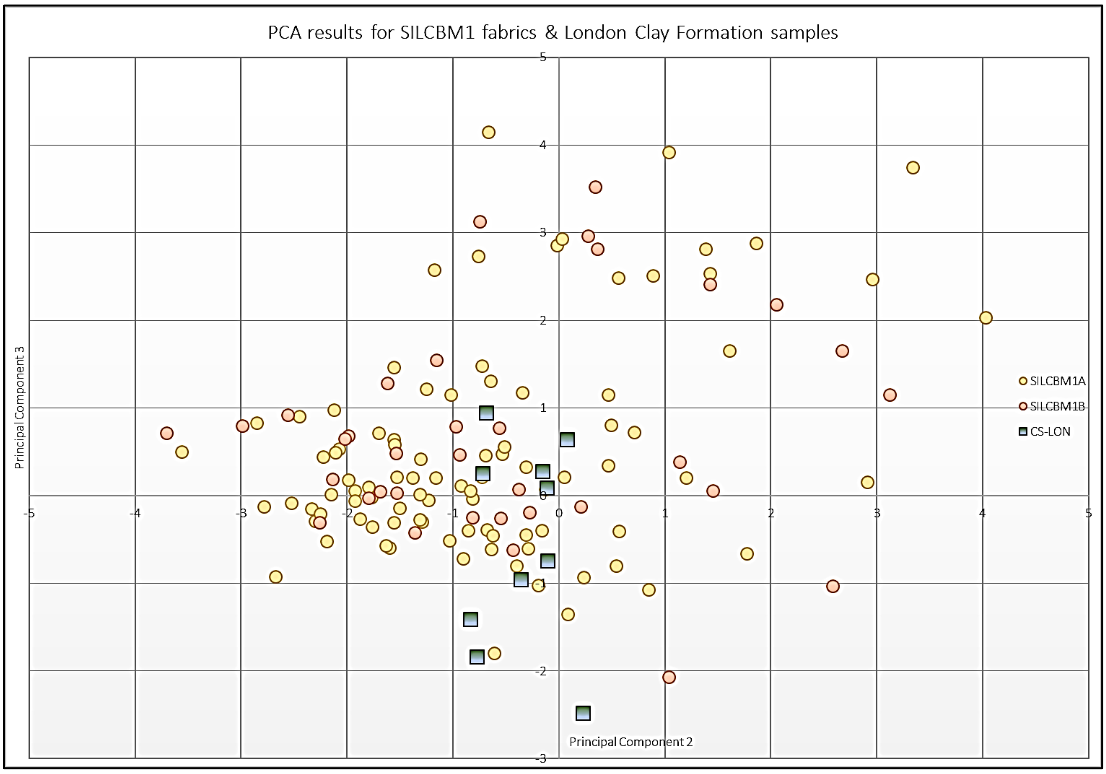


Figure 6.20*: Results of PCA classification of the London Clay fabrics and London Clay samples analysed, based on the normalised abundance of 13 elements*

Summary: These two fabrics demonstrate affinities with the London Clay formations of the area around Silchester. The mineralogy of the samples is comparable, with the main variation being the proportion of fine quartz sand. The *London Clay Formation* has variability in terms of its lithology and quartz sand components, with the upper beds comprising of mottled, non-calcareous fine sandy or silty clays (Jarvis, 1968, p. 6) with localised sandy seams (Allen, 2017, p. 75). There is also the potential for the variation to be due to the addition of quartz sand during the manufacturing process. There are also examples of the formation of gypsum on the CBM samples, which is entirely consistent with a *London Clay Formation* source. The portable X-ray fluorescence analysis results has also confirmed geo-chemical similarities.

6.2.3 SILCBM2

Macroscopic description: a slightly heterogeneous orange fabric with few inclusions. There is coarse silt-sand throughout along with varying proportions of fine quartz sand. Surface colours vary from red (2.5YR 5/6) to light red (2.5YR 6/8). Large red opaque iron oxides are visible with occasional sedimentary rock fragments and flint grains. Red and cream clay pellets are also visible in hand specimen. This is a hard, sandy fabric with irregular fracture, generally oxidised throughout. Figure 6.21 Shows the fabric in hand specimen.

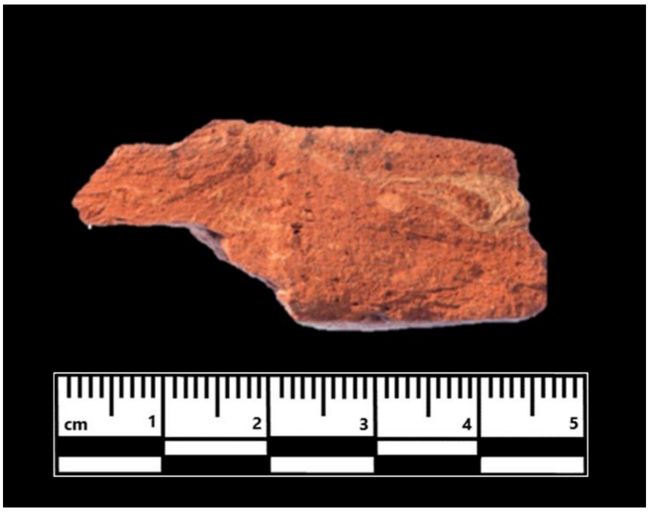


Figure 6.21: *Example of **SILCBM2** in hand specimen*

Fabric as a proportion of the retained assemblage: 18.33%

Thin section references: TSID057; 063; 064; 065; 089; 105; 111; 114; 118; 122; 133; 137; 165; 173, 176; 310;

Petrographic description:

Inclusions: 15-32%; equant and prolate, sub-rounded to rounded, <1.15mm; moderately-to-poorly sorted. Open-spaced. Weak alignment and uni-modal.

Common: **Monocrystalline quartz;** equant, subrounded; mode = 0.05mm. Fine silt-sized quartz sand.

Common: **Monocrystalline quartz**; equant, subrounded; <0.5mm, mode = 0.35mm. Coarser component of fine quartz sand.

Few: **Iron Oxides**; equant, subrounded; <1mm, mode = 0.75mm. Discrete iron-rich grains, deep red and opaque, derived from iron-rich pedogenic nodules.

Few: **Glauconite**. Equant, rounded; <0.25mm. Heat-altered glauconite grains, semi-opaque grains of a mid-orange in colour.

Very few: **Hornblende**; prolate, elongate; Mode = 0.1mm. Occasional grains with bladed form.

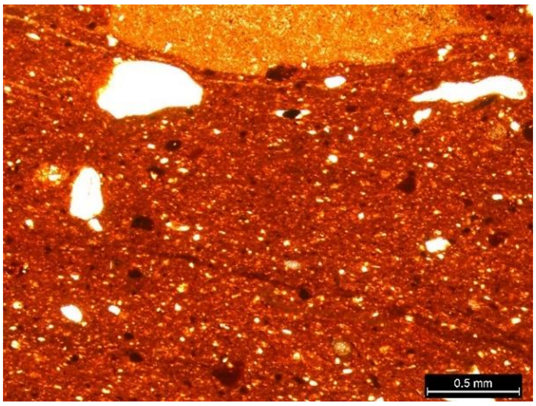
Very few: **Muscovite mica;** equant and prolate, angular. <0.05mm, mode = 0.04mm. Elongate needle-like grains, high 3rd order colours and non-pleochroic in PPL.

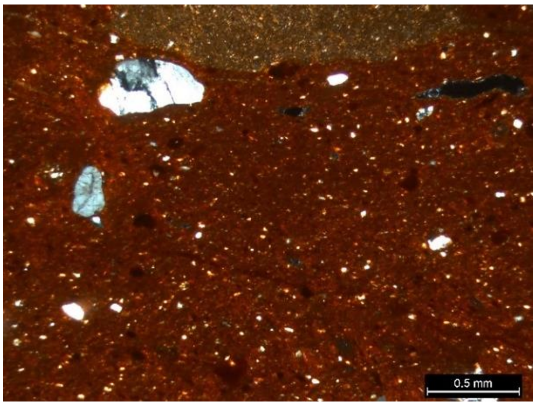
Very few/few: **Flint**; equant. Subrounded-to-rounded. <0.75mm, mode = 0.5mm. The proportion of flint ranges from 1-2%,

<u>Voids</u>: 5% comprising meso-macro planar channels. They are primarily parallel to the surfaces though exhibiting no preferred alignment.

<u>Matrix</u>: 63-80%. Slightly heterogeneous; fine-grained iron-rich, non-calcareous matrix. The fabric is mid-brown in PPL and mid orange-brown in XP. There are rare clay phenomena throughout, identified as clay pellets per Whitbread (1986). These are very pale brown, highly birefringent pellets, with merging-to-diffuse boundaries, rounded and equant, with neutral optical density and concordance with the surrounding matrix. There are also rare mid red-brown pellets with merging boundaries, rounded and equant with high optical density and concordance with the surrounding matrix.

Comments: The inclusions in this fabric are dominated by coarse silt-sized quartz grains, with a proportion of larger fine quartz-sand. There are few other diagnostic inclusions present.





***Figs. 6.22 & 6.23: SILCBM2** (TSID178) in PPL (left) and XP (right) (x40 magnification)*

Compositional and textural analysis: Figure 6.24 Shows the overall composition of this fabric, with inclusions typically representing one third of the composition, with around 5% voids. The compositional and textural analysis highlights the high proportion of very fine quartz sand in the fabric, with the scatter of larger quartz grains along with clay pellets which increase the mean grain size.

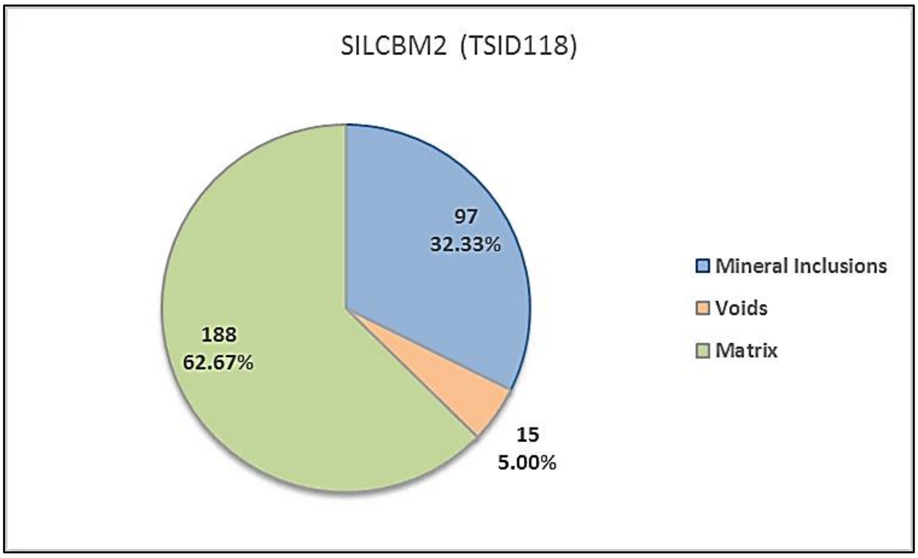
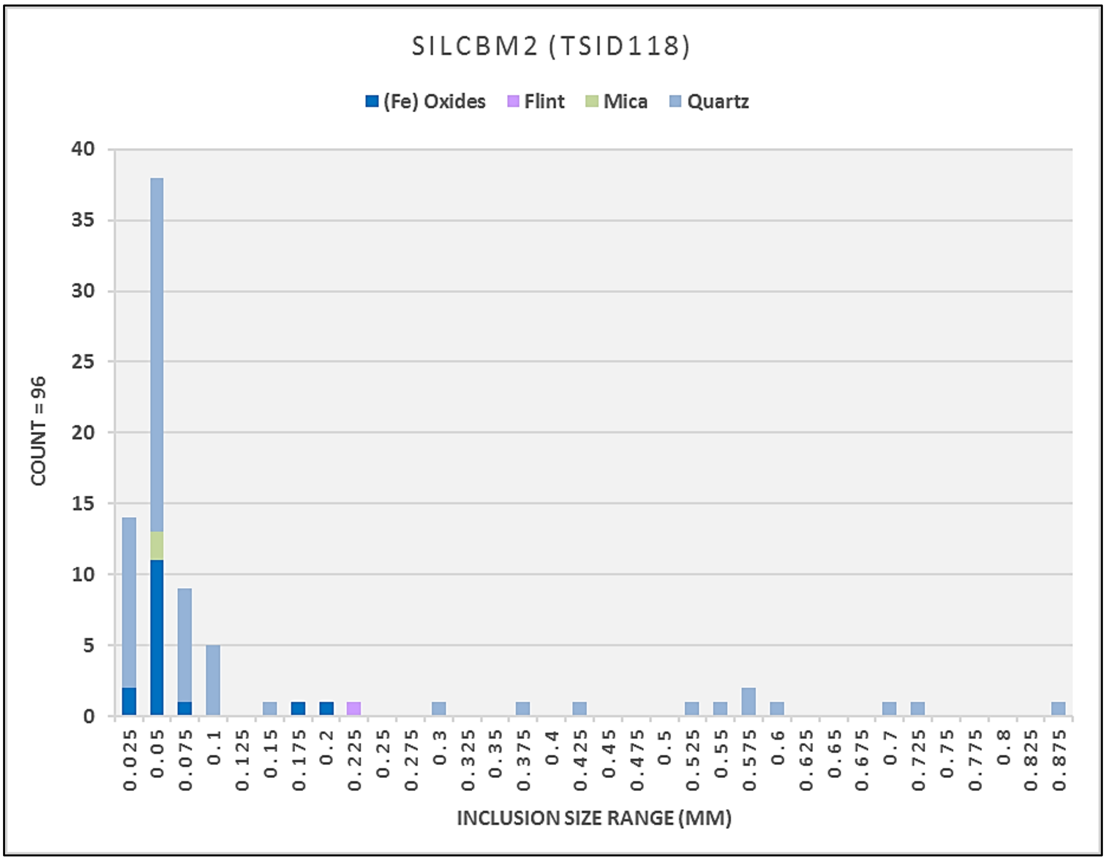


*Figure 6.24: Overall composition of **SILCBM2***



Min = 0.0132mm	Max = 0.8634mm	Mean = 0.1208mm	Mode = 0.0138mm	StdDev = 0.1842mm

***Figure 6.25**: Grain-size distribution of textural data from **SILCBM2** sample (TSID118)*

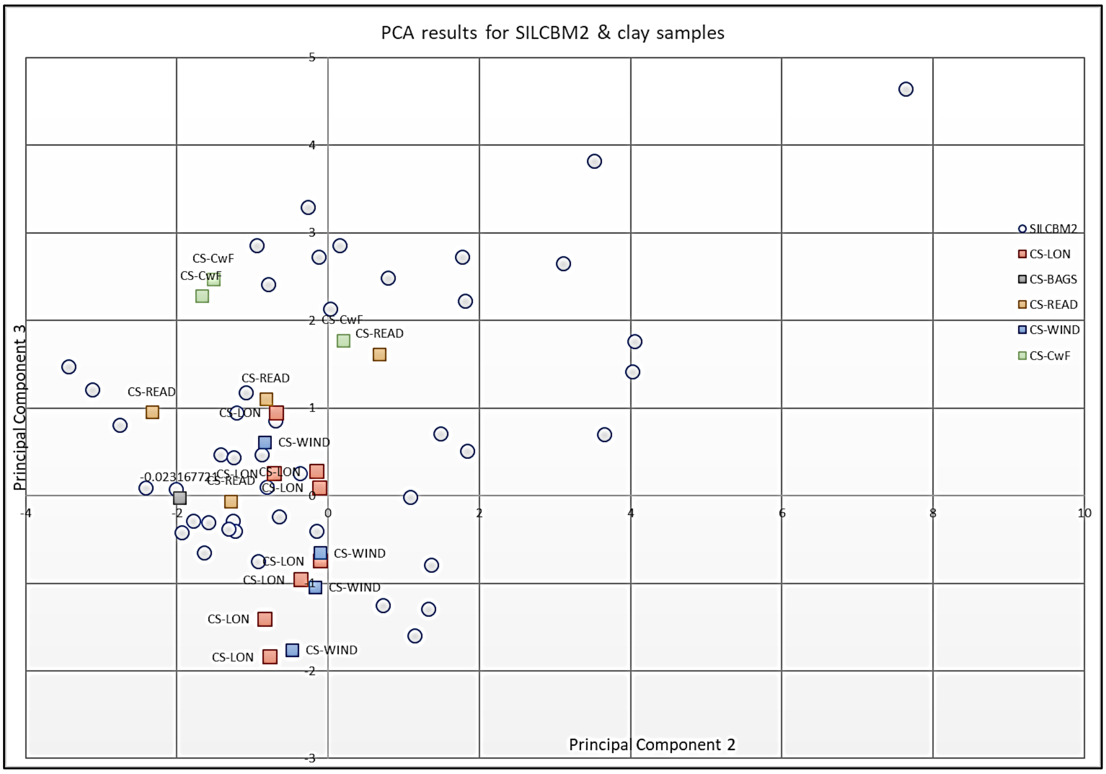
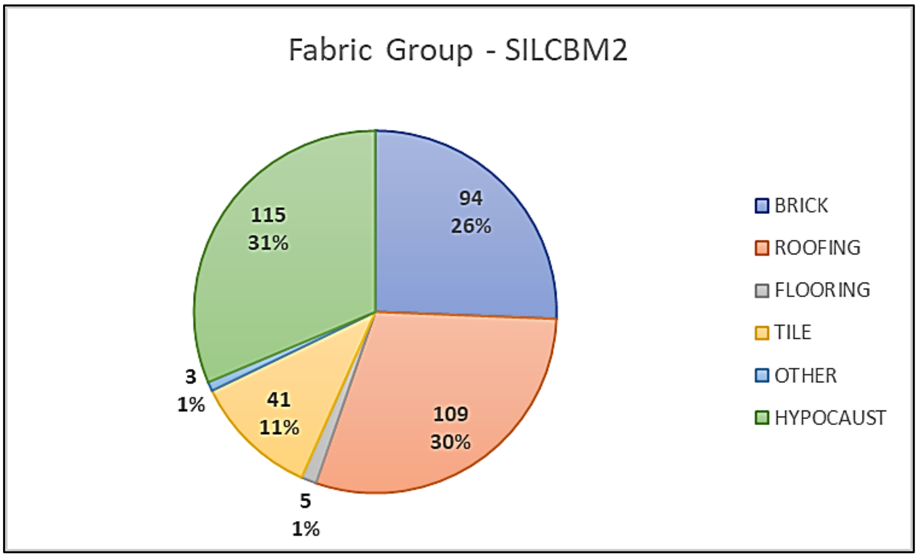


*Figure 6.26: Results of PCA classification of the **SILCBM2** samples and clay samples analysed, based on the normalised abundance of 13 elements*

The portable XRF results reflect the heterogeneity in the fabric with a wide scatter of the fabric samples across the plot. The XRF results from analysis of the clay samples are included on the plot. There is no correlation between any of the clay samples and the SILCBM2 samples.

Forms:



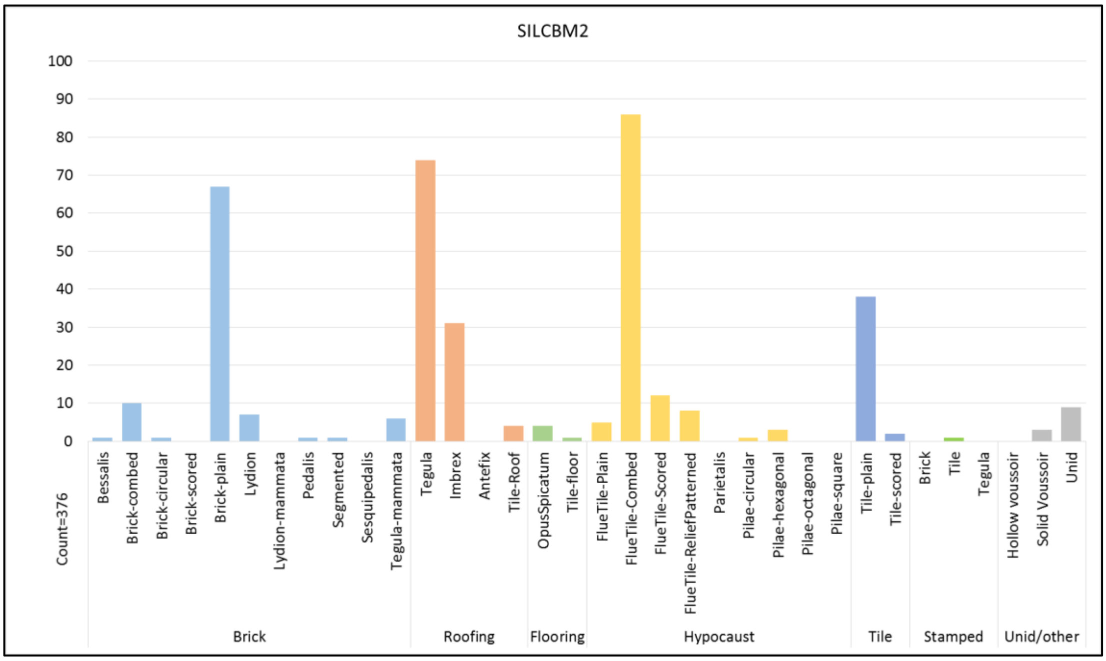


***Figure 6.27 & 6.28**: Composition of SILCBM2 assemblage by form*

This fabric includes the widest range of forms of all the fabric groups. Hypocaust components make up 38.59% of the group, dominated by 86 examples of combed flue-tiles. Roofing materials account for 36.58%, comprising 24.83% *tegulae* and 10.40% *imbrices*, whilst bricks account for 31.54% of the group. The relief-patterned tiles are keyed with a diamond-and-lattice design (die 38), these are discussed in more detail in chapter 9.

Stamped tile: There is a single example of a stamped- tile in this fabric. The tile is stamped with **DIGNI** and is currently held in the Reading museum collection (Frere & Tomlin 1993, p.63).

Solid voussoirs (*cuneatus*): There are three solid voussoirs in the Reading museum collection in this fabric (RM162: 1995.85.373; RM173:1995.85.384; RM182:1995.82.393). *Cuneatus* is a type of tapering brick used in the construction of arches (Brodribb, 1987, p. 43). In his corpus of brick and tile, Brodribb describes five size categories of this form incorporating measurements of 1 foot 6 inches, 1 foot, and six inches (Brodribb, 1987, p. 44).

Summary: The composition of this fabric is typical of many of the clay sources in the area, dominated by quartz, with inclusions of mica, glauconite, and flint. There are fewer coarse inclusions in this fabric than in some of the other fabric groups. The fabric is heterogenous and pXRF results reflect the variability within the fabric and show no correlation with clay samples.

6.2.4 SILCBM3

Macroscopic description: A typically heterogeneous matrix with ferruginous bands and clay streaks visible. Surface colours vary from very pale brown (10YR 7/3), to pink (7.5YR 7/4 pink) and yellowish-brown (10YR 5/4). This fabric is generally oxidised with examples of reduced cores (2.5Y 5/1 grey) and rare examples of reduction to surfaces, resulting in a greyish-brown colour (10YR 5/2). Most examples show evidence of being poorly worked with folds visible. There is little evidence of the use of moulding sand though, where present, it is a fine sand, <0.25mm. Quartz is present in the form of fine grains within the matrix and a scatter of larger grains is visible throughout. Red iron oxides can also be identified along with the occasional flint inclusion. Figures 6.29 & 6.30 shows fabric variants **SILCBM3A** & **SILCBM3B** in hand specimen.

*Figure 6.29: Fabric **SILCBM3A** in hand specimen*

*Figure 6.30: Fabric **SILCBM3B** in hand specimen*

Fabric as proportion of total assemblage: 15.05%

Thin section references A: TSID77; 79; 84; 86; 87; 88; 90; 91; 92; 167; 169; 171; 291; 292; 315; B: TSID85; 93; 94; 95; 175; 183; 241; 287; 288; 316;

Petrographic description

Inclusions: 28-30%; equant and elongate; angular to rounded; <4mm; Moderate-to-well sorted. Single-to-double spaced; Weak alignment; Moderately bi-modal;

Dominant: **Monocrystalline quartz**; primarily equant, sub-angular-to-angular, <0.5mm, mode = 0.25mm. This is the fine fraction of quartz present within the fabric of the matrix.

Common: **Monocrystalline quartz:** equant, sub-rounded-to-sub-angular, <1mm, mode = 0.75mm. This fraction of larger quartz grains could possibly have been an anthropogenic addition, although the source material is a naturally heterogonous clay and it could therefore be a natural phenomenon. The quartz components range in size from silt to medium sand.

Few: Flint/chert: equant and elongate, angular-to-subangular. <4mm, mode = 0.5mm. Rare examples of larger fragments of flint, size typically in the range of 0.25-2mm. Some examples have a higher proportion of flint inclusions, visible to the surface where spalling has occurred. The proportion of flint ranges from 1-2%.

Few: Clay pellets: equant and distorted, rounded-to-well-rounded. <2mm, mode = 0.5mm. These comprise of rounded argillaceous inclusions identified as clay pellets based on their morphology and the criteria set out by Whitbread (1986) (*see methodology).* They are typically concordant with the matrix and exhibit high optical activity. The pellets have diffuse-to-merging boundaries and are distorted in shape which indicates that they were plastic when the clay was processed and fired. There are two types of clay pellet identified within the fabric.

1. Pale yellow-brown in colour, highly optically active fine-grained pellets of purely crystalline clay.

2. Darker reddish-brown pellets with quartz inclusions indicating a higher iron content in these. These are of high optical density in relation to the surrounding matrix.

Very few: Red opaque grains: equant, rounded to sub-rounded. <0.1mm, mode = 0.1mm. Discrete iron-rich grains usually mid yellowish-orange in colour, derived from iron-rich pedogenic nodules.

Very Few: Ironstone: equant, subrounded. <1mm, mode = 0.5mm. These nodules commonly dark reddish-brown in colour, often opaque with inclusions of monocrystalline quartz within. These iron-rich pedogenic inclusions are likely naturally occurring inclusions, commonly found in soils or residual clay deposits (Quinn, 2013, p. 63) formed as ferruginous elements in the weathering zones of the clays.

Rare: Biotite mica: equant & prolate, angular. <0.35mm, mode = 0.25mm. Elongate needle-like grains, bright 2nd order colours in XP, pleochroic in PPL.

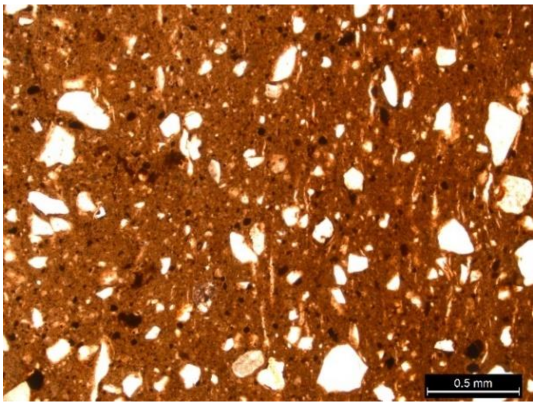
Rare/absent: Grog: equant and prolate, angular-to-subangular. <4mm. Angular inclusions of previously fired clay. These are typically optically inactive and of high optical density in relation to the matrix, examples exhibit clear boundaries and are discordant with the matrix. Alignment of inclusions within the grog can be identified in some examples. There are a variety of colours and compositions present within the examples of grog in this fabric.

<u>Voids</u>: 10% comprising of meso-to-mega planar voids. These exhibit preferred alignment, primarily parallel to the surfaces.

<u>Matrix</u>: 60-62%. Typically, highly heterogeneous. Iron-poor; non-calcareous; The fabric is mid orange-brown in both PPL and XP. The matrix is generally moderately optically active with iron-rich streaks and indistinct clay phenomena in the form of pellets and bands of fine-grained purely

crystalline clay, which is highly birefringent, pale yellowish-brown in PPL and very pale brownish-yellow in XP.

Variants: In thin section the group can be divided into two fabrics. Those assigned to fabric (A) are highly heterogeneous, whilst those of fabric (B) are more homogeneous, probably because of more thorough processing of the raw materials during manufacture. The composition of the inclusions within both fabrics are comparable, indicative of a single raw material source.



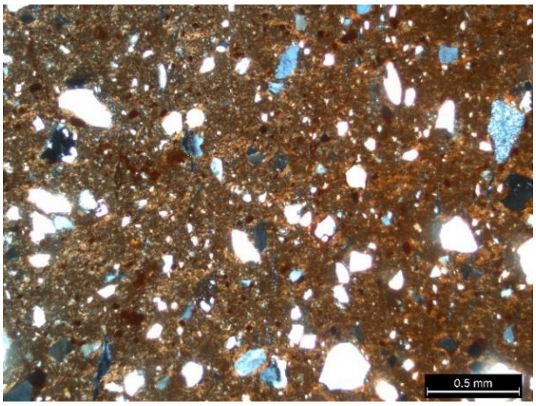
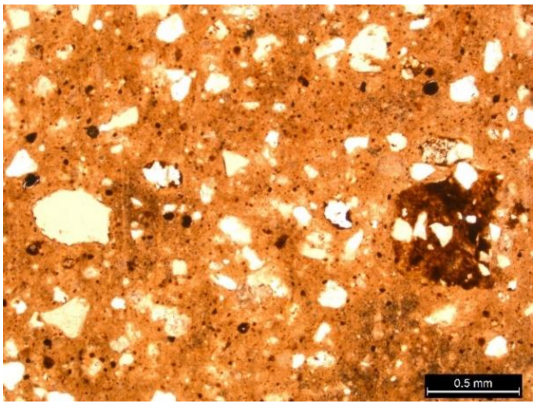


Figure 6.31 & 6.32: SILCBM3A *in PPL (left) and XP (right) (x40 magnification)*



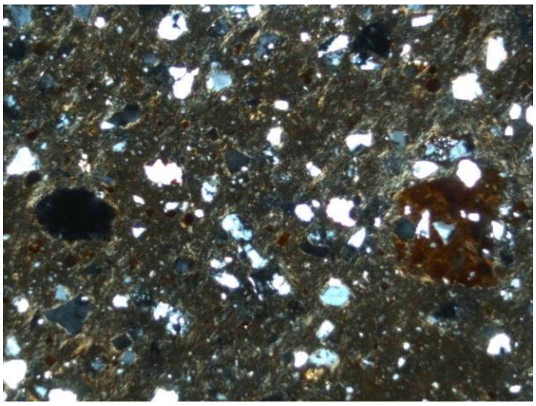
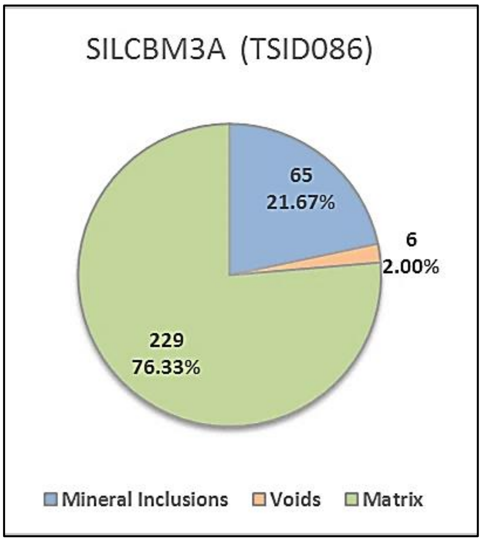


Figure 6.33 & 6.34**: **SILCBM3B *in PPL (left) and XP (right) (x40 magnification)*

Comments: This highly heterogeneous fabric exhibits a wide range of inclusions, all within a common mixed base clay. It is evident through the variety within this fabric group that the raw material was subjected to different amounts of processing before the products were formed and fired, with some examples showing a higher degree of heterogeneity with highly ptygmatic regions visible.

This fabric is an example of the imperfect mixing of a naturally variegated clay defined by the zones of iron-rich and pure crystalline clay, rather than anthropogenic heterogeneity introduced as a result of the mixing of two different raw materials (Quinn, 2013, p. 42). The raw clay has been insufficiently processed and worked to produce a homogeneous fabric.

Compositional and textural analysis: Textural and compositional analysis was carried out on an example of (A) and (B) variants. Figures 6.35 & 6.36 clearly show the similarity in composition based on the proportions of matrix, inclusions, and voids.



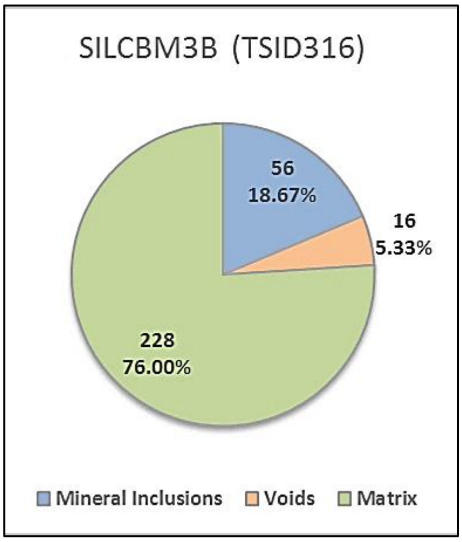
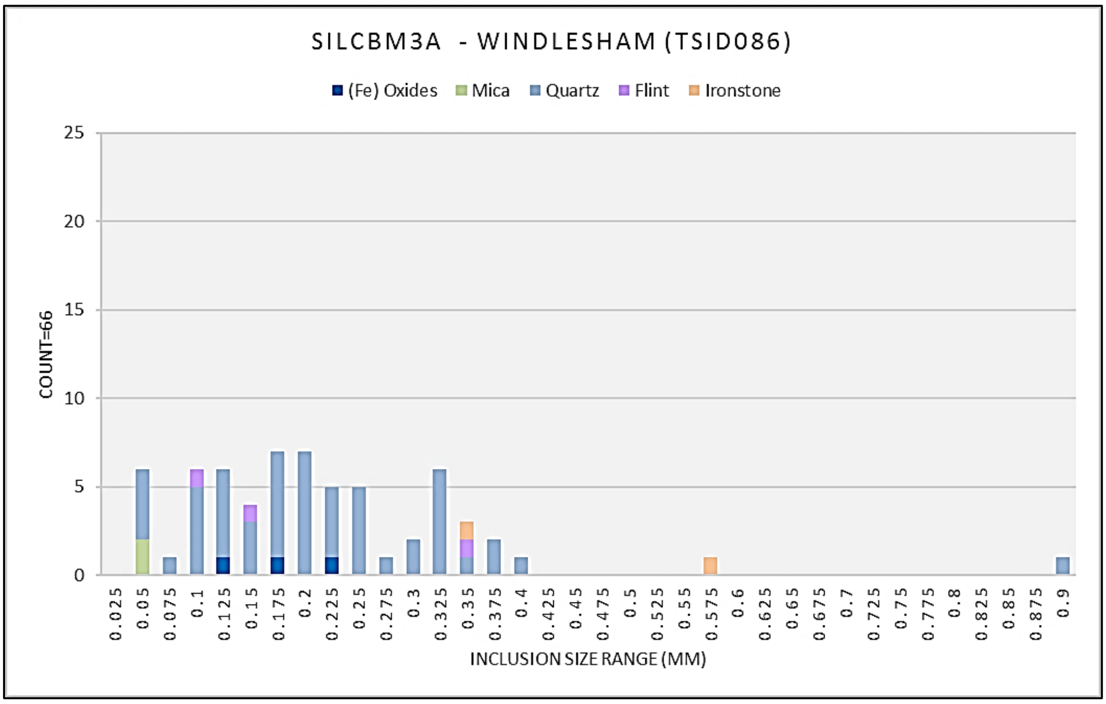
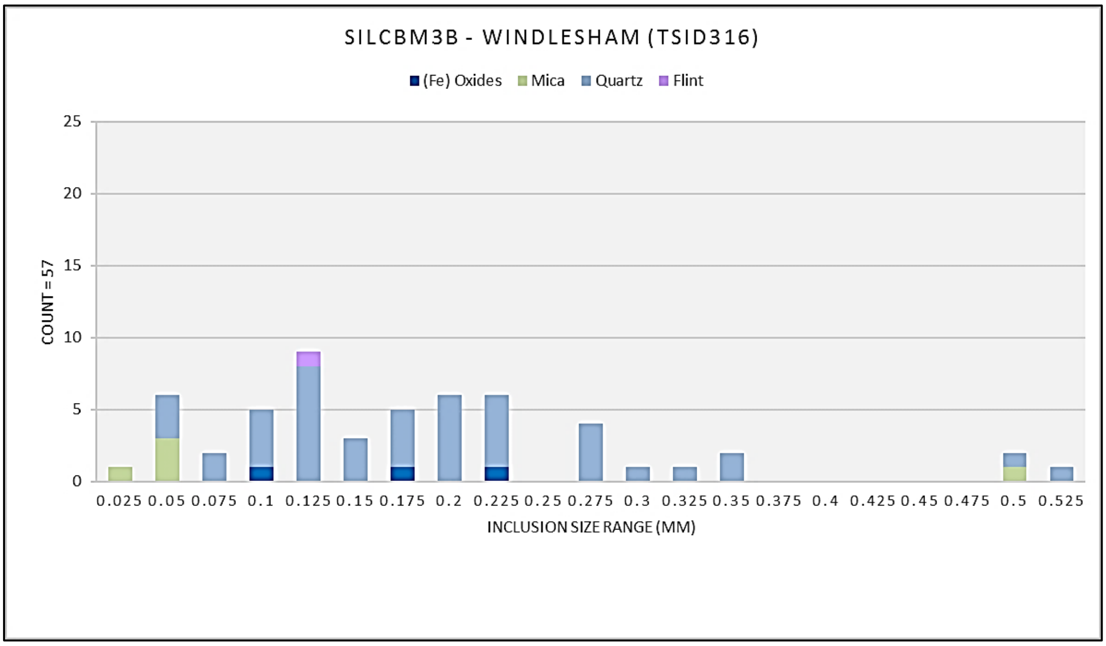


***Figure 6.35 & 6.36**: Composition of Windlesham Nero fabrics (A) & (B)*



Min = 0.031mm	Max = 0.880mm	Mean = 0.203mm	Mode = n/a	StdDev = 0.137mm

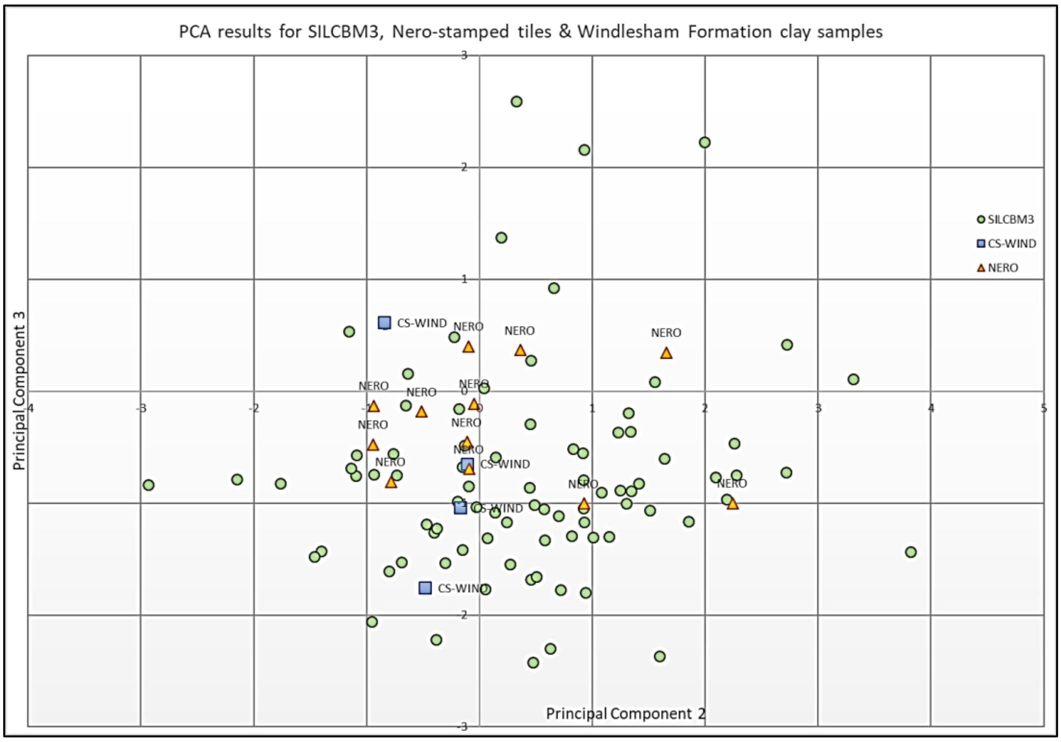
***Figure 6.37:** Grain-size distribution of textural data from **SILCBM3A** - Windlesham (TSID086)*



Min =	0.167mm	Max =	0.506mm	Mean =	0.179mm	Mode =	n/a	StdDev =	0.114mm

Figure 6.38: *Grain-size distribution of textural data from* ***SILCBM3B*** *- Windlesham (TSID316)*

The textural analysis clearly illustrates similarities in composition between the A & B variants of the fabric, figure 6.37 and 6.38. The small size range of the inclusions in fabric B is reflected by the low value of the standard deviation, whereas, these are higher for the fabric A sample due to the large quartz and ironstone fragments recorded.

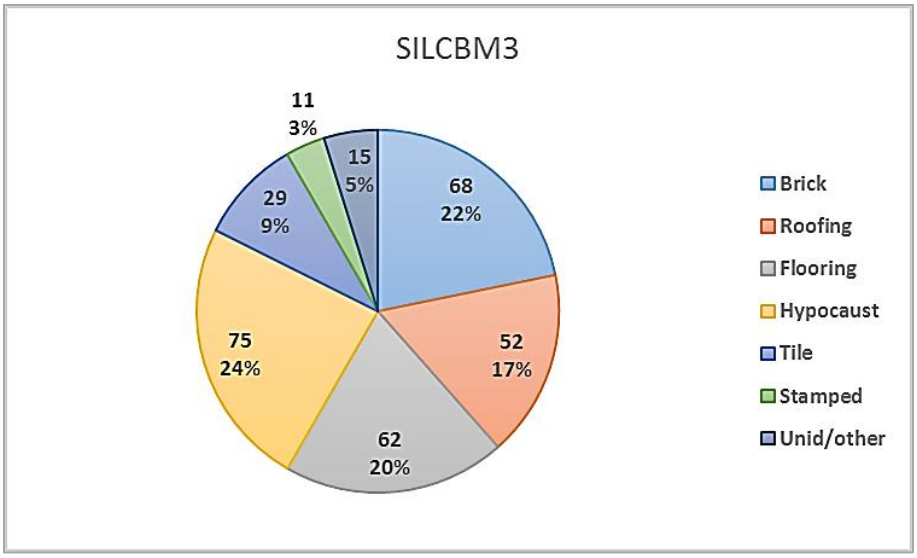


5

Figure 6.39*: Results of PCA classification of the* ***SILCBM3*** *- Windlesham, Nero-stamped tiles, and clay samples analysed, based on the normalised abundance of 13 elements*

Figure 6.39 shows the portable XRF results from the *Windlesham Formation* clay samples plotted alongside the **SILCBM3A** & **SILCBM3B** samples and the analysis of the Nero-stamped tiles. The twelve points that represent the Nero-stamped tiles overlap some of the fabric A examples, confirming their inclusion within the same fabric grouping. The *Windlesham Formation* clay sample results all lie within the main group of the **SILCBM3A** and **SILCBM3B** fabric samples, and Nero-stamped tiles. This confirms that the Nero-stamped tiles, and fabrics **SILCBM3A** and **SILCBM3B** are made of *Windlesham Formation* clay, and the tilery at Little London is the potential production centre for this material. This will be tested in chapter 7 when these fabrics are compared with samples from known production centres.

Forms:



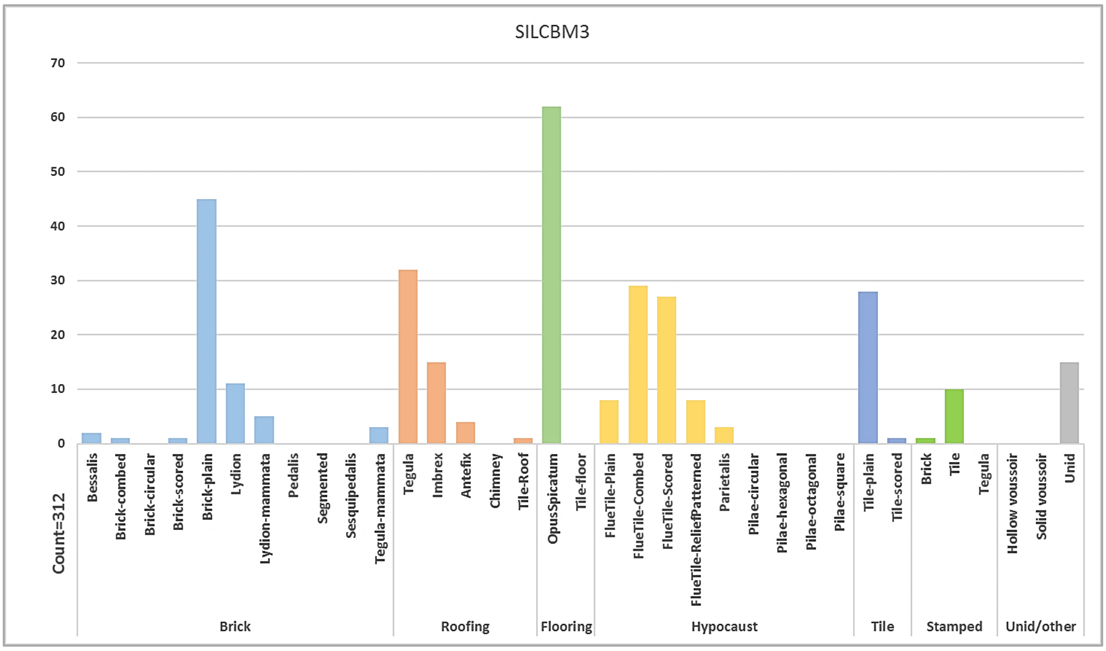


Figure 6.40 & 6.41: Range of forms in SILCBM3 fabrics

There is a wide variety of forms present in this fabric, figure 6.40. There is a relatively small proportion of roofing materials, only 17% of the assemblage (10.26% *tegulae* and 4.81% *imbrices*), figure 6.41. Bricks, of a variety of types, make up 21.79% of the assemblage. These have an average thickness of 43.55mm.

Floor tiles make up 19.2% of the forms in this fabric, exclusively in the form of *Opus Spicatum*. This proportion is dominated by the large number bricks retained from the Antiquarian excavation of the public bathhouse in Insula XXXIII, excavated in 1904 (Hope and Fox, 1905). The Reading museum archive includes 43 complete *Opus Spicatum* bricks in the Windlesham Nero fabric, all of which show evidence of wear with one edge worn smooth. They are between 144-158mm in length, 78-87mm wide and 43-57mm thick. These were used to pave the central division (E) of the *frigidarium*, where bricks measuring six inches by three inches by two inches were found to be set on edge and arranged herring-bone wise on a bed of red cement, the cold bath (G) was also floored in a similar way *ibid.*, p.344). There were a further 30 *Opus Spicatum* in the Reading museum collection which are made of **SILCBM4**.

A further 23.9% of the material consists of brick and tile forms used in the construction of hypocausts, including seven examples of relief-patterned flue tiles, die 39. These will be discussed in more details in Chapter 9.

There are three examples of *parietalis*, two in the (B) variant and one example of type (A). Two *parietalis* were recovered during the Insula IX excavations and one is held in the Reading Museum collection (RM314: 195.85. B43). *Parietalis* are wall-lining tiles, typically scored with a lattice-design and generally thicker than usual box-flue tiles. The tiles were attached to walls vertically using pegs or cramps in notches along the edges, providing a space through which the hot air from a hypocaust could be conducted (Brodribb, 1987, p. 59). The example in fabric type (B) is typical of the type described above.

There are four antefixes in the Reading museum archive, all of which are made of the **SILCBM3** fabric and are very pale brown in colour. One of the antefixes was recovered during the Antiquarian investigations in 1892 and was found in the vicinity of the forum-basilica (Hope, 1893, p. 561). The Antiquarian investigations recovered a further two examples housed in the Reading museum collection, though there is no record of the provenance of these. A further antefix was recovered by Cotton during her investigations in 1938-1939, see chapter 4.2

All the tiles and bricks stamped with the title of the Emperor Nero are made from the Windlesham Nero group fabric. *Windlesham Formation* clay sample, CS-E, was extracted from Little London, on the northern boundary of the field which is the site of the Romano-British tilery that produced the

Neronian-stamped tiles, see map (Figure 6.1). The Nero-Stamps are all found on *tegulae* (*contra.* Warry 2012, p.51), located to the lower edge and would have been visible when the tile was in-situ.

Summary: The analysis has confirmed the similarities between the fabric **SILCBM3A** & **SILCBM3B** samples, along with the Nero-stamped tiles. Geo-chemical analysis and comparison with the clay samples would appear to confirm a *Windlesham Formation* clay source.

6.2.5 SILCBM4

Thin section references: SILCBM4: TSID096; 100; 119; 135; 140; 201; 226; 229; 256; 313; **SILCBM4**-Clay Pellets: TSID099; 102; 109; 120; 170; 231.

Macroscopic description**:** A homogeneous iron-poor fabric with a high proportion of quartz and occasional fine pale cream clay lenses, see figure 6.42. The surface colour varies from a very pale brown (10YR 7/4) to pink (7.5YR 7/4). The fabric is generally oxidised throughout, though reduced examples are consistently mid grey on all surfaces and throughout the body of the samples. Some samples of SILCBM4A have a higher proportion of iron-rich inclusions. It is a hard-sandy fabric with irregular fracture. The moulding sand is generally of medium-to-coarse quartz sand.

Variant: SILCBM4B - Clay Pellets – This variant has the same composition in terms of mineral inclusions, it is however, a highly heterogeneous fabric, with a large number of iron-poor clay pellets present throughout the matrix, and clearly visible in hand-specimen. (Figure 6.42).

Fabric as a proportion of retained assemblage: 5.86% (**SILCBM4A** = 3.22%; **SILCBM4B** = 2.64%)

Figure 6.42: *Sample of* ***SILCBM4A*** *fabric in hand specimen*

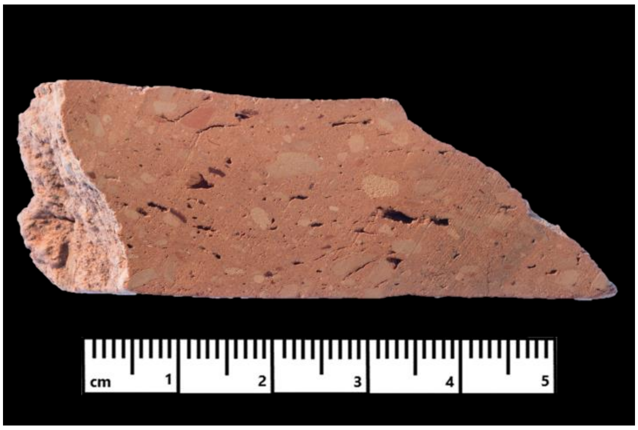


Figure 6.43: *Sample of* ***SILCBM4B*** *fabric in hand specimen*

Thin section references: SILCBM4A: TSID096; 100; 119; 135; 140; 201; 226; 229; 256; 313; **SILCBM4B**: TSID099; 102; 109; 120; 170; 231.

Petrographic description**:**

Inclusions**:** 32-51%; equant and prolate, angular to rounded; <2mm; moderately sorted. Single spaced, moderate orientation; Uni-modal.

Dominant/frequent: **Monocrystalline quartz**: equant, well sorted. Rounded-to-sub-rounded; <0.25mm, mode = 0.1mm; Fine quartz sand. This is the coarser quartz component and is possibly an anthropogenic addition to the fabric.

Frequent: **Monocrystalline quartz**: equant, well-sorted; Subangular-to-subrounded. <0.05mm, mode = 0.05mm. Fine quartz sand naturally present in the clay matrix.

Common/few: **Iron oxides**: equant, rounded-to-subrounded. <0.5mm, mode = 0.15mm. Discrete iron-rich grains, opaque and mid yellowish-orange in colour, probably derived from iron-rich pedogenic nodules.

Few: **Clay pellets**: equant and distorted, rounded. <2.5mm, mode = 1.75mm. These inclusions have been identified as clay pellets per Whitbread (1986), they are typically mid-orange brown in colour and moderately optically active. They are of high optical density when compared with the surrounding matrix and discordant with the matrix.

Few/very few: **Muscovite mica**; equant and prolate, angular; <0.3mm, mode = 0.15mm. Elongate needle-like grains, bright 2nd order colours in XP, pleochroic in PPL.

Few/very few: **Ironstone**: equant, subrounded. <3.5mm, mode = 1.0mm. These nodules commonly dark reddish-brown in colour, generally opaque with inclusions of monocrystalline quartz within. The proportion of ironstone grains ranges from 1-5%.

Very few: **Polycrystalline quartz**: equant and subrounded. <0.25mm, mode = 0.1mm.

Very few: **Flint**: prolate; moderately sorted, angular. <0.75mm, mode = 0.25mm. Small proportion of angular flint throughout.

Very few/Rare: **Tourmaline**: equant, rounded-to-subrounded. <0.15mm, mode = 0.1mm. Occasional grains scattered throughout the matrix.

Very few/rare: **Plagioclase feldspar**: equant and prolate; subrounded. <0.25mm, mode = 0.2mm. Occasional grains of plagioclase feldspar exhibiting albite twinning.

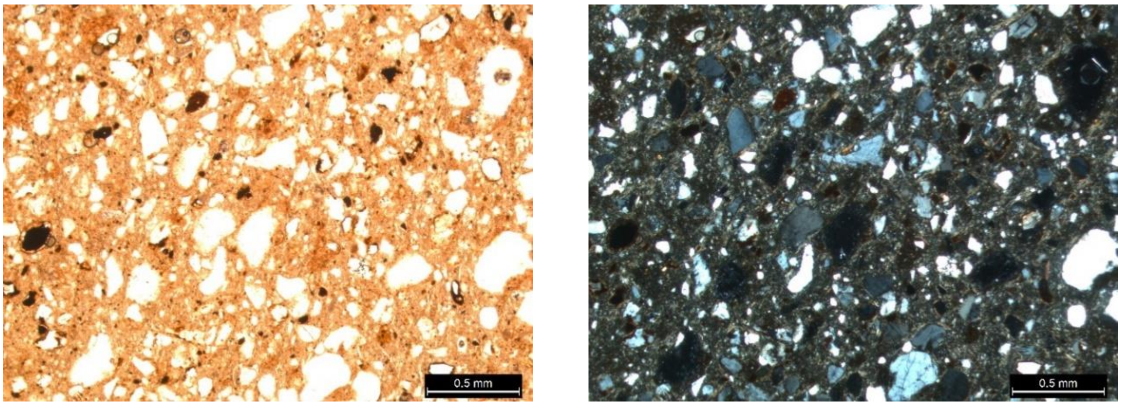
Rare: **Glauconite**: equant, rounded. <0.15mm, mode = 0.1mm. Heat-altered glauconite grains naturally occurring within the clay matrix, transformed from its natural pale green colour, to semi-opaque grains of a mid-orange in colour.

Rare: **Hornblende**: prolate, elongate. <0.15mm, mode = 0.1mm. Occasional grains with bladed form.

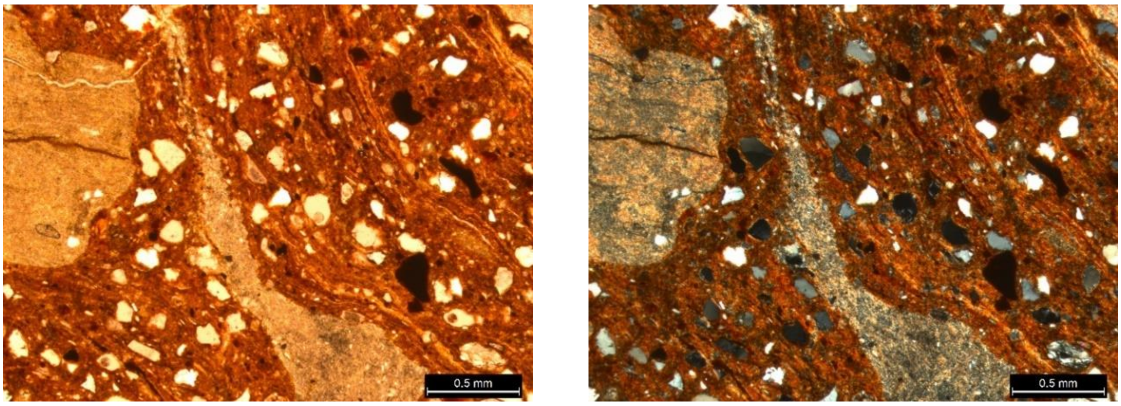
Voids: 3-5% comprising of macro planar voids. These exhibit preferred alignment primarily parallel to surface.

Matrix: 44-65%. Slightly heterogeneous. Iron-poor; non-calcareous. The fabric is light brown/beige in PPL and mid brown in XP. The matrix is moderately optically active with iron-poor cream-coloured streaks of fine, highly birefringent clay. The variant, Clay Pellets, has streaks and pellets of this fine birefringent clay throughout. These clay phenomena have clear to merging boundaries, taking the form of equant, typically rounded pellets, with some evidence of distortion, indicating they were plastic at the time of processing and firing. The pellets have a low optical density in relation to the surrounding matrix and some examples exhibit banding of quartz-rich seams. The pellets exhibit strial optical activity, going in-and-out of extinction as a whole. There are occasional iron-rich pellets, described above in inclusions.

The matrix demonstrates moderate optical activity, going in and out of extinction in randomly oriented domains. The coarser quartz component may to be anthropogenically added. The compositional and textural analysis, see below, does not demonstrate a bi-modal fabric, due to the relatively small size difference between the two quartz components.



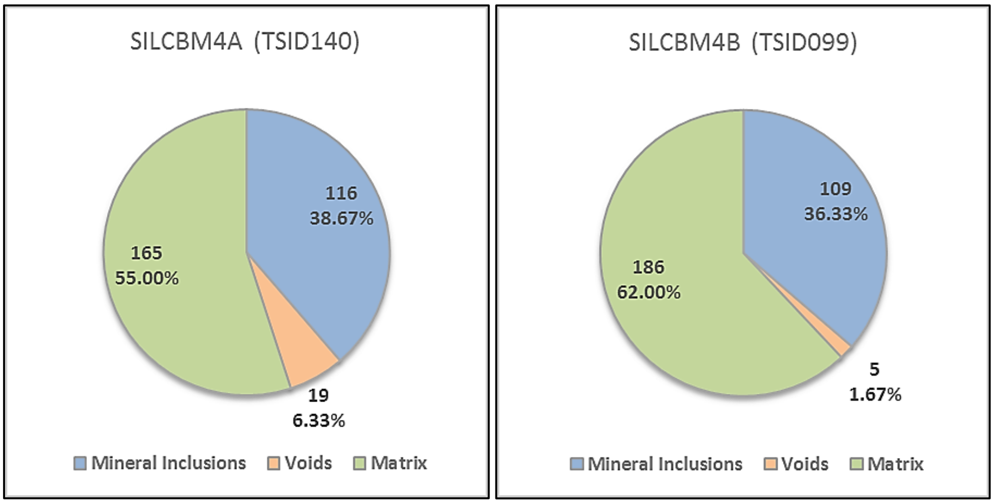
***Figures 6.44 & 6.45: SILCBM4A** sample (TSID140) in PPL (left) and XP (right) (x40 magnification)*



***Figures 6.46 & 6.47: SILCBM4B** - Clay Pellets sample (TSID099) in PPL (left) and XP (right) (x49 magnification)*

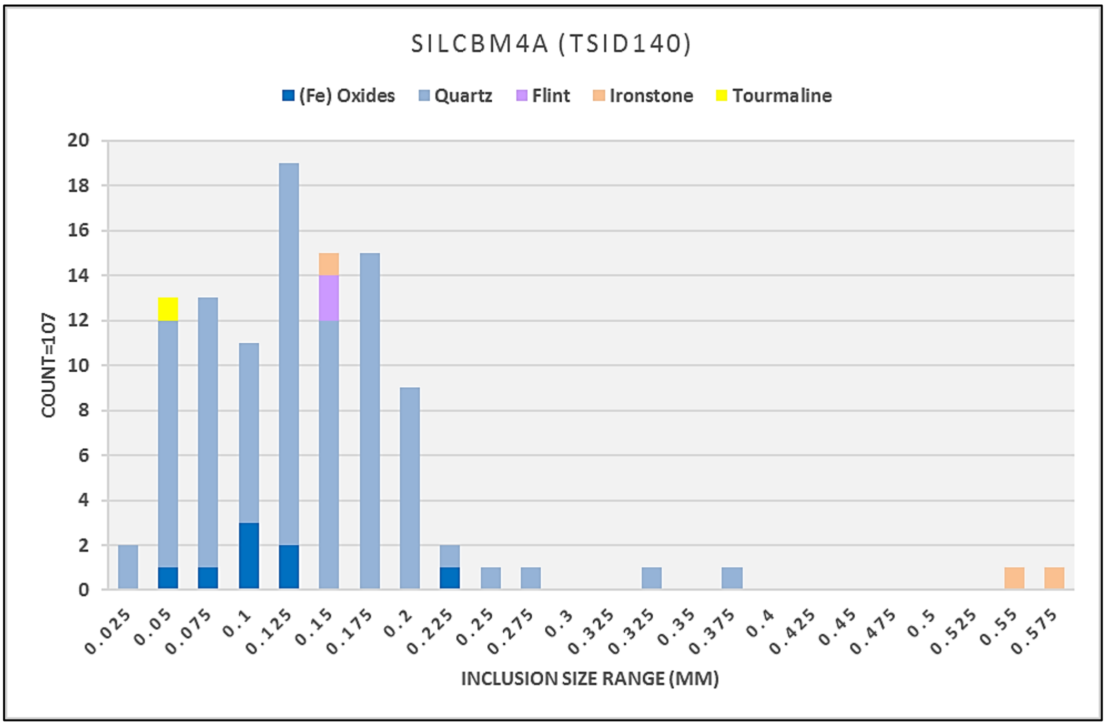
Comments: This fabric has a high proportion of quartz along with small iron-rich grains. The samples are pale in colour and very sandy in texture. The matrix is iron-poor and the **SILCBM4A** samples are generally homogeneous whereas the **SILCBM4B** variant is heterogeneous with a large number of pale cream clay pellets. This heterogeneity is probably a result of a lesser degree of weathering and processing of a naturally variegated clay, rather than the mixing of two different source clays. The composition of both sub-groups confirms a similar source for the two fabrics.

Compositional and textural analysis



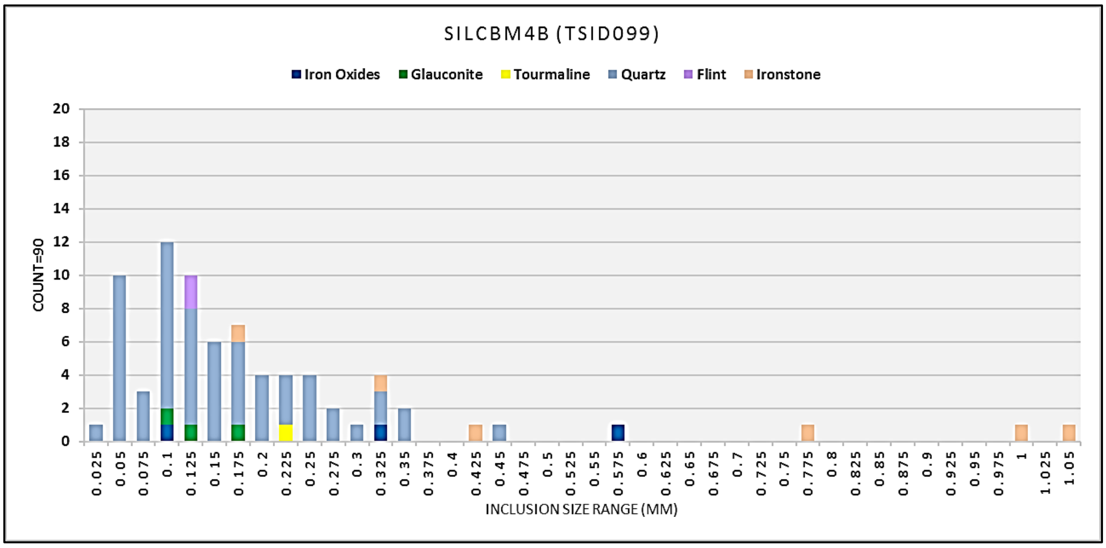
*Figures 6.48 & 6.49: Composition of **SILCBM4** fabrics*

The textural analysis illustrates the fine-grained quartz that dominates, reflected in the mean grain size of 0.1253mm for the **SILCBM4A** fabric, figure 6.50. The **SILCBM4B** variant has a larger mean grain size of 0.1848mm, a result of the presence of ironstone rock fragments within the fabric, figure 6.51. Despite the difference in appearance in both hand specimen and thin section, the similarity in composition between fabrics warrants their inclusion within the same group.



Min = 0.0149mm	Max = 0.5712mm	Mean = 0.1254mm	Mode= 0.031mm	StdDev= 0.0840mm

Figure: 6.50 Results of compositional and textural analysis of ***SILCBM4A*** *sample (TSID140)*



Min = 0.0187mm	Max = 1.0381mm	Mean = 0.1848mm	Mode = 0.0397mm	StdDev = 0.1859mm

Figure:6.51 Results of compositional and textural analysis of ***SILCBM4B*** *sample (TSID099)*

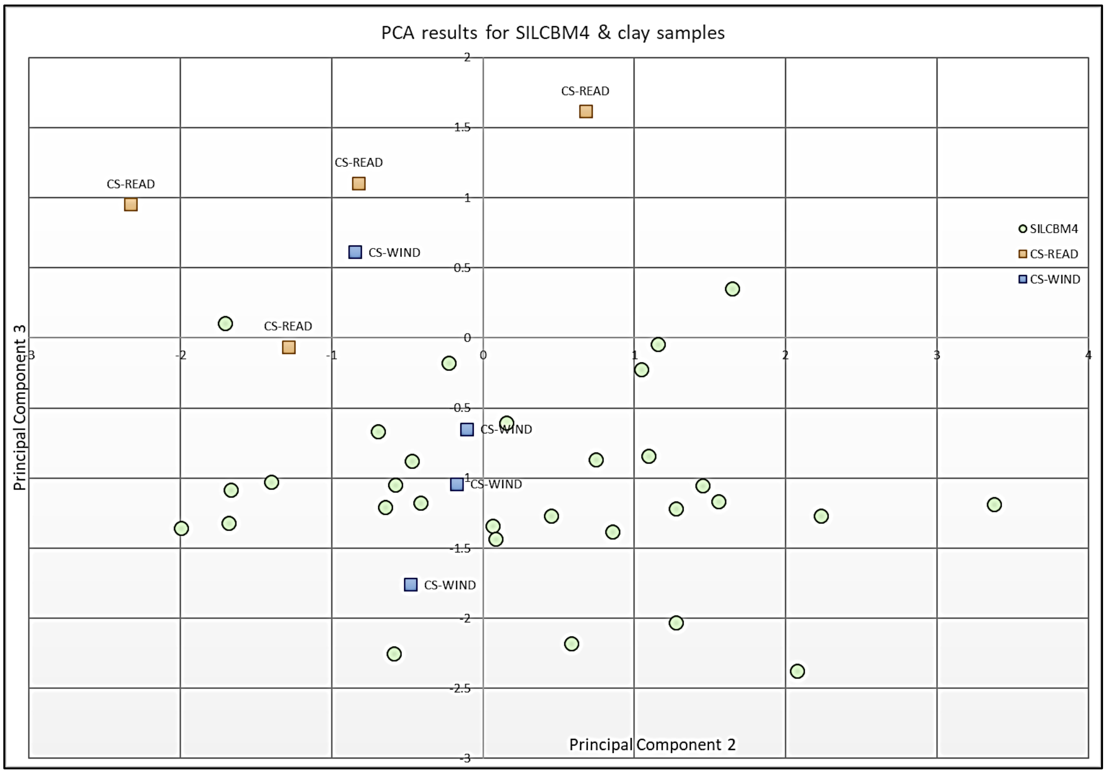


***Figure 6.52**: Results of PCA classification of the **SILCBM4** fabrics and clay samples analysed, based on the normalised abundance of 13 elements;*

Figure 6.52 shows the plot of portable XRF results of the **SILCBM4** fabrics along with the *Windlesham* and *Reading Formation* samples. The *Reading Formation* consist chiefly of plastic mottled grey clays, with a wide variety of colours common in deep exposures (Jarvis, 1968, p. 6) and has sand beds within which could account for the higher sand component in the Reading beds clay sample. The similarities in composition would suggest this to be the source of the raw materials (J.R.L. Allen, *pers.com*.). The heterogeneity of the fabric causes a widespread distribution across the plot whilst the two groups of clay samples cluster. There is very little overlap of the **SILCBM4** samples with the Reading Formation clay samples. However, the **SILCBM4** samples do correlate with the *Windlesham Formation* clay samples, this would appear to demonstrate the **SILCBM4** fabric is a further variation of **SILCBM3** originating from a *Windlesham Formation* source.

Forms:

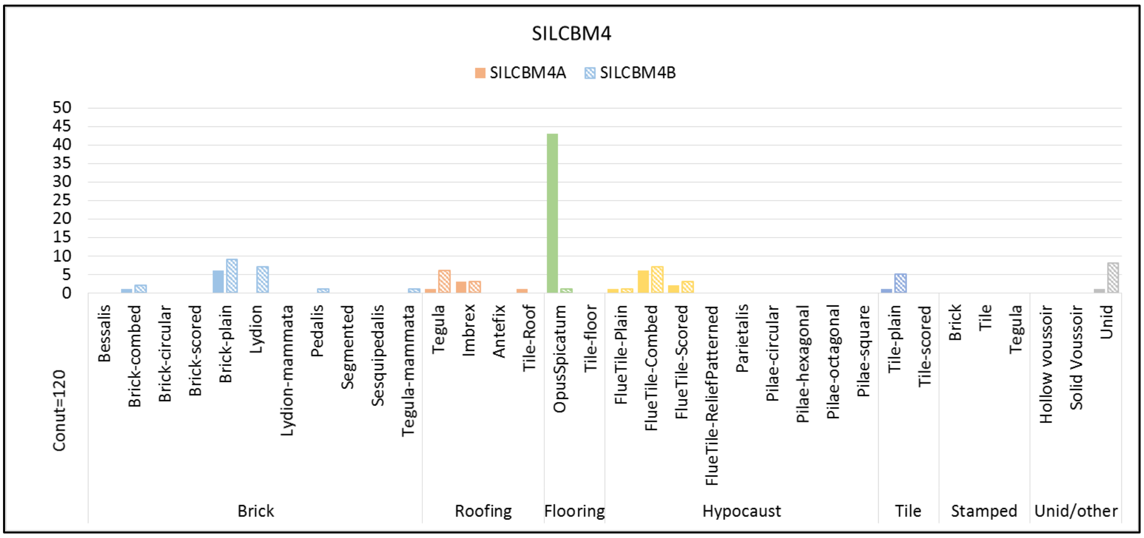


*Figure 6.53: Range of forms in **SILCBM4A** & **SILCBM4B** fabrics*

There is a more limited range of forms in this fabric group compared with the other larger groups. There is a marked similarity in the forms present in these two fabrics which would again confirm the single source for the fabrics. Bricks make up 22.50% of the assemblage, with an average thickness of 47.54mm. There are relatively few examples of roofing materials with only seven *tegulae* and six *imbrices* identified in this fabric. Hypocaust material in **SILCBM4** fabric consists only of box-flue tiles, with 20 examples, accounting for 16.67% of the fabric assemblage.

The largest proportion of the assemblage comprises flooring, exclusively *Opus Spicatum* bricks, which make up 36.67% of the fabric assemblage. There are 30 in the Reading Museum archive, again recorded as having been recovered from the bathhouse excavations, in Insula XXXIII in 1904 (Hope and Fox, 1905). There are also 11 *Opus Spicatum* from the Insula IX excavations in these fabrics which share similar dimensions to those in the Reading museum collection. There are no examples from securely dated contexts, most having been recovered from the fills of pits or the backfill of Victorian trenches. Many of the *Opus Spicatum* bricks from both the Reading museum and Insula IX archives are reduced throughout and are a uniform grey colour, in contrast to the very pale brown colour of the oxidised version of the fabric.

Summary: The geo-chemical results show an affinity with the *Windlesham Formation* clay source. This would therefore show that the **SILCBM3** and **SILCBM4** are all variants of the same fabric group and would appear to have a source in the *Windlesham Formation*. The combining of these two fabrics would account for 20.92% of the retained assemblage as whole and therefore become the second most dominate fabric in the assemblage. The range of forms for the two combined fabrics is shown in figure 6.54.

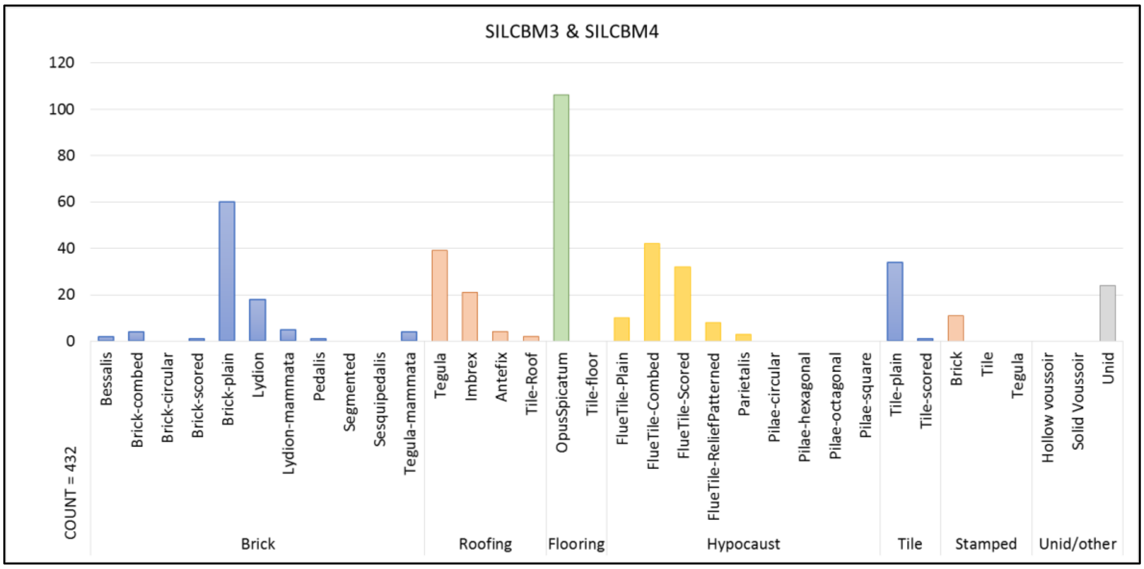


***Figure 6.54**: Range of forms in **SILCBM3** & **SILCBM4** fabrics*

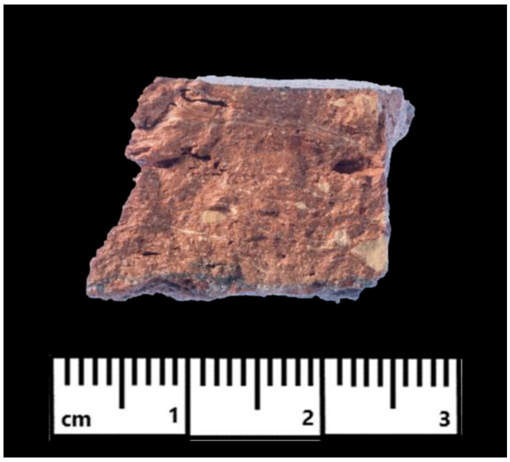
The combined assemblage is dominated by *Opus Spicatum* accounting for almost 25% of the material, these 110 examples represent nearly 90% of the total *Opus Spicatum* on the Reading Museum collection. This would suggest a specialist production centre for the manufacture of these flooring bricks along with the Nero-stamped bricks and tiles. Bricks and hypocaust material both account for 22% of the combined fabrics.

6.2.6 SILCBM5

Thin Section references: TSID061; 097; 101; 104; 106; 107; 117; 128; 132; 134; 136; 144; 180; 227; 255; 257; 261; 302;

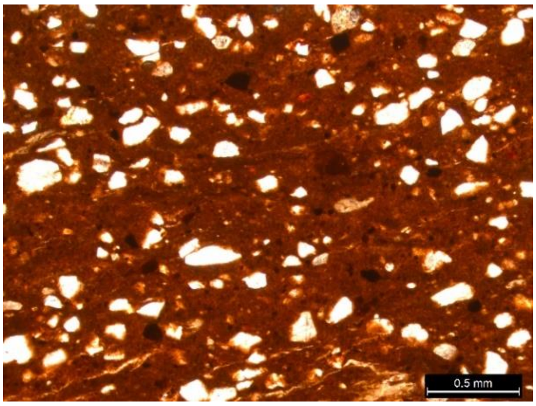
Fabric as a proportion of the retained assemblage: 4.35%

Macroscopic description: This is an iron-rich, non-calcareous mainly homogeneous fabric, typically oxidised throughout with some examples of reduced cores (**SILCBM5A**). Surface colours vary between red (2.5YR 5/6) and light red (2.5YR 6/6). Examples of sub-group **SILCBM5B** are brown (7.5YR 5/3) in colour. Both include very pale brown (10YR 7/3) clay pellets and streaks. These are harder in hand-specimen and shows signs of sintering, figures 6.55 and 6.56.



Figures 6.55 & 6.56*: Fabric* ***SILCBM5A*** *(Chimney fragment) and* ***SILCBM5B*** *in hand specimen.*

<u>Petrographic summary</u>: the fabric comprises a very fine-grained matrix, with very little quartz silt present. It is slightly micaceous, typically mid brown-orange in colour in XP and PPL. There is a proportion of well-rounded fine quartz sand, which may be an anthropogenic addition. The fabric has moderate optical activity, with reduced activity noted in the **SILCBM5B** sub-group. The pale cream pellets are rounded, equant clay pellets of a highly birefringent clay, with sharp to merging boundaries. Also present are angular-to-subangular flint fragments, probably added along with the coarser quartz component. The other mineral inclusions comprise heat-altered glauconite grains and plagioclase feldspar. Inclusions are unimodal, single-to-double spaced, exhibiting weak orientation.



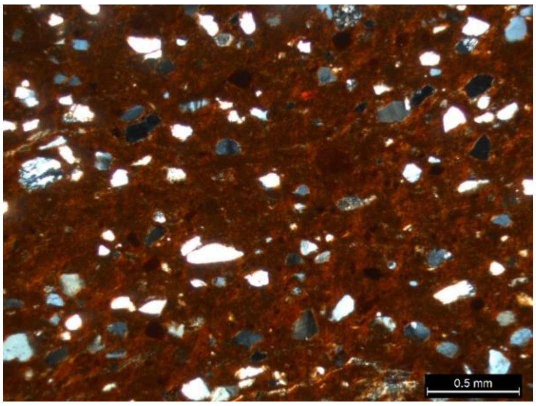


Figure 6.57 & 6.58: *Photomicrograph of Fabric* ***SILCBM5A*** *in PPL (left) and XP (right) (x40 magnification)*

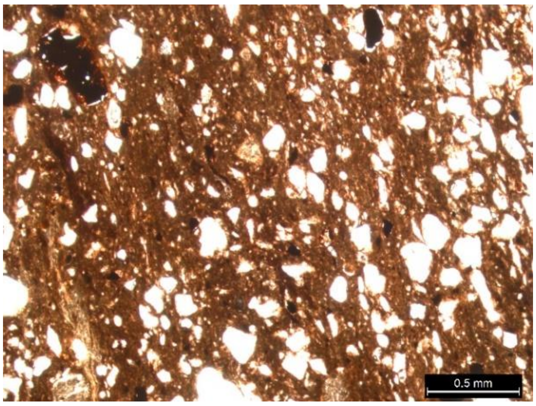
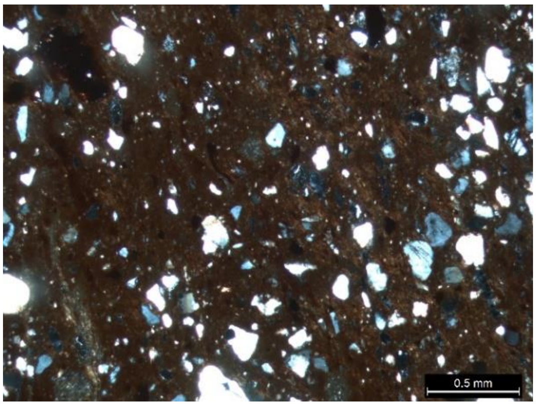
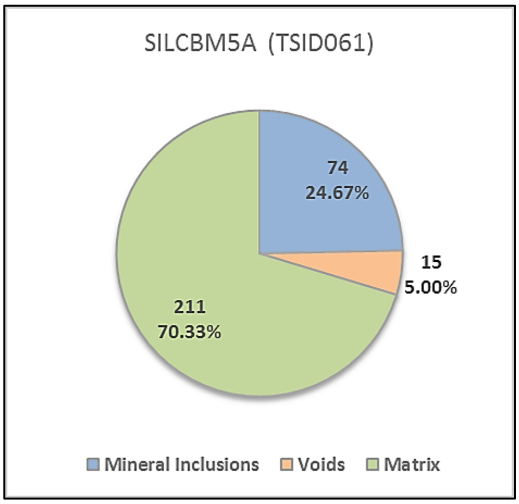
 

Figure 6.59 & 6.60: Photomicrographs of Fabric ***SILCBM5B*** *in PPL (left) and XP (right) (x40 magnification)*

Compositional and textural analysis: The diagrams below confirm the similar composition of the **SILCBM5A/B** samples.



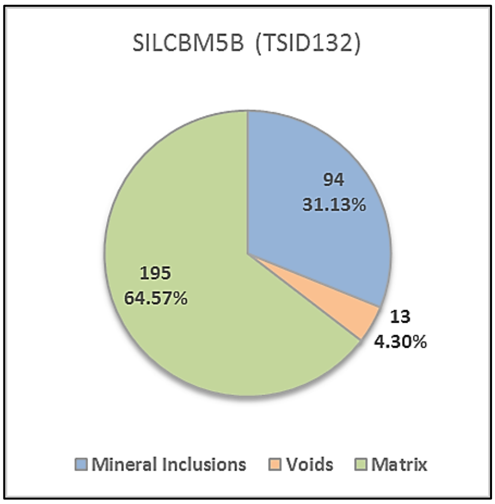
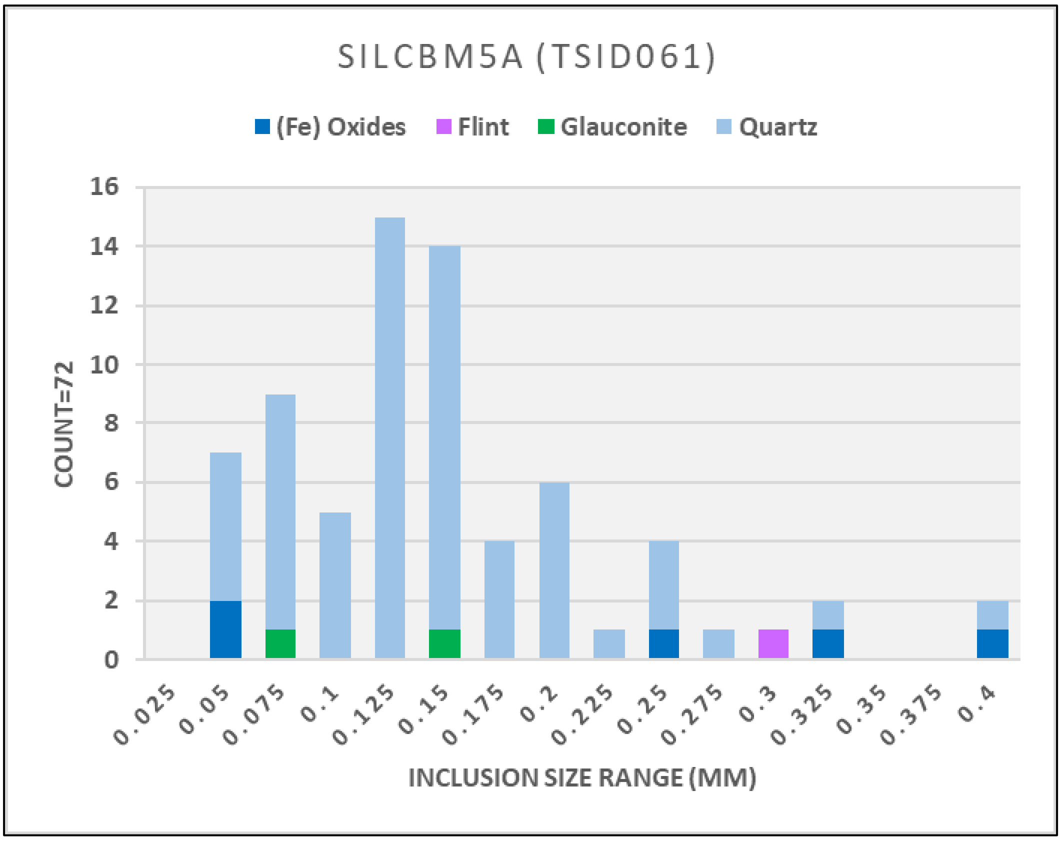
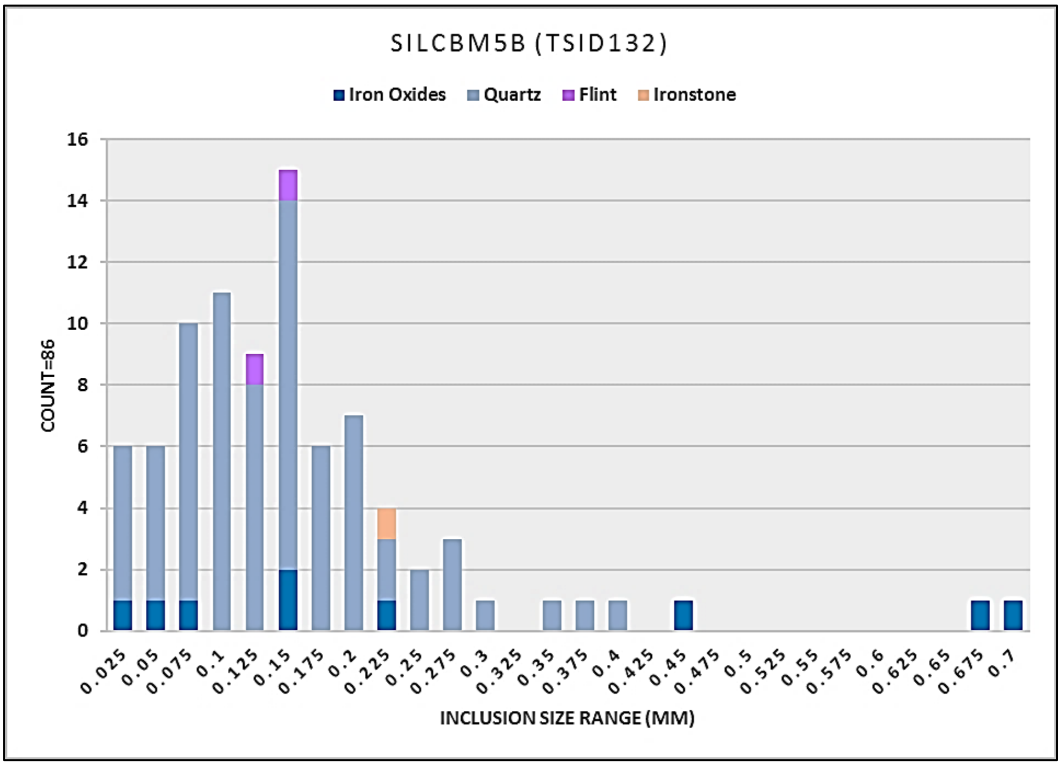


Figure 6.61 & 6.62: Composition of fabrics ***SILCBM5****A&B*



Min = 0.0256 mm	Max = 0.3931mm	Mean = 0.1382mm	Mode= 0.1351mm	StdDev= 0.07742mm

Figure 6.63: *Grain-size distribution of textural data from* ***SILCBM5A*** *sample (TSID061)*



Min = 0.109mm	Max = 0.6961mm	Mean = 0.1467mm	Mode = 0.091mm	StdDev = 0.1184mm

Figure 6.64: *Grain-size distribution of textural data from fabric* ***SILCBM5B*** *(TSID132)*

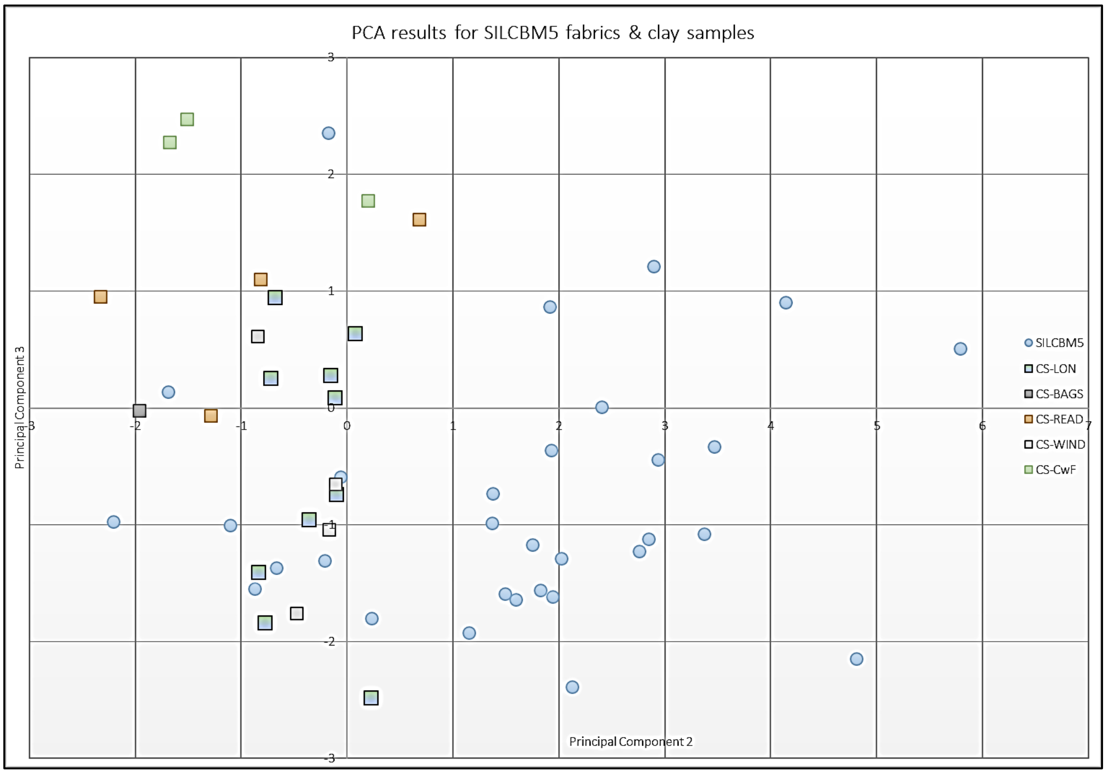
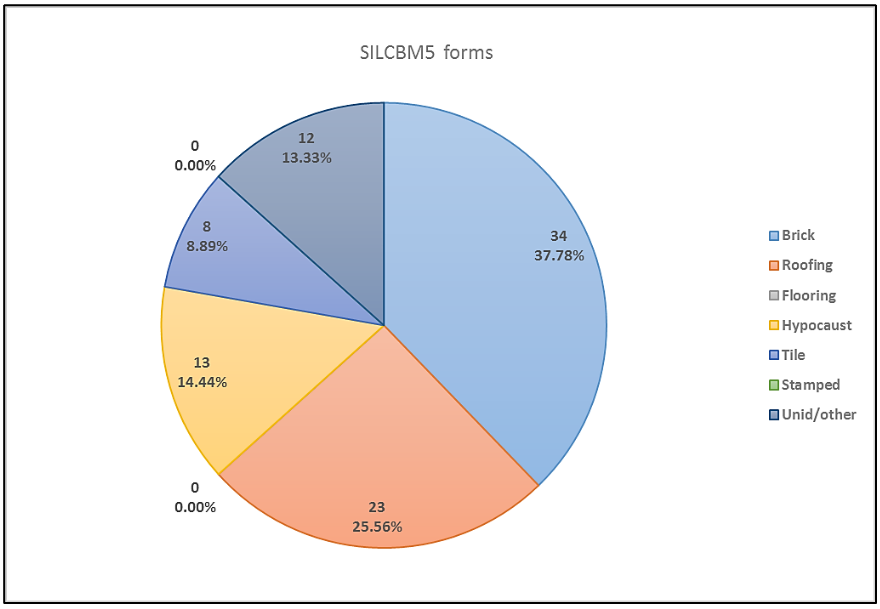


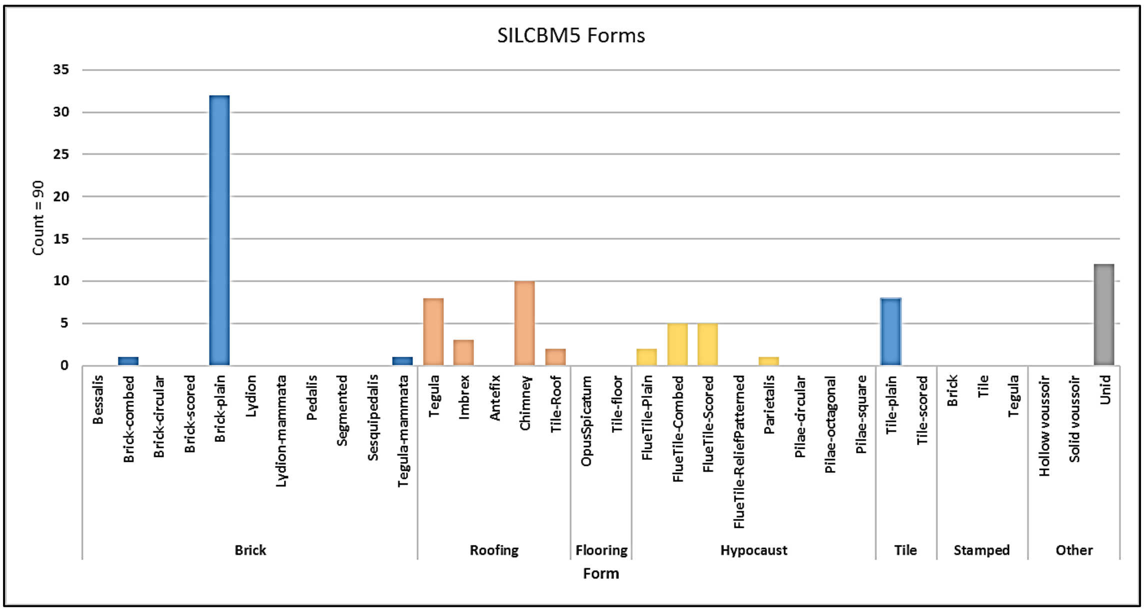
*Figure 6.65: Results of PCA classification of the **SILCBM5** fabrics and clay samples analysed, based on the normalised abundance of 13 elements;*

The textural analysis illustrates that fine-grained quartz dominates, reflected in the mean grain size of 0.1382mm and 01467mm for SILCBM5A and B respectively. The SILCBM5B fabric variant has a larger mean grain size and standard deviation as a result of the presence of ironstone rock fragments within the fabric.

Figure 6.65 Shows the plot of the results from the portable x-ray fluorescence analysis of the fabric samples, and the clay samples. There is very little correlation between the two.

Forms:





***Figures 6.66 & 6.67**: Range of forms in **SILCBM5** fabrics*

Bricks dominate this fabric group 37.78%, figures 6.66 and 6.67, with roofing material comprising 25.56% and hypocaust components 14.44% of the assemblage. There are 8 tiles in the fabric (8.89%) and 12 unidentified fragments. There are no examples of flooring or stamped tiles. The only examples of chimney in the retained assemblage, 10 fragments, are made of fabric **SILCBM5**. The chimney fragments have pinched decoration and triangular apertures. There is one complete circumference of what is probably the base of the chimney.

Figure 6.68: *Fragments of chimney from Insula IX assemblage in **SILCBM5** fabric (IX591, IX592 & IX593)*

Figure 6.69: *Image of reconstructed Roman chimney from Ashtead, Surrey (© British Museum)*

Summary: There is nothing particularly diagnostic in the samples to identify potential clay sources, and the geochemical analysis was inconclusive. There are no inclusions that show links between clay samples and the fabric series. The matrix is much finer grained than the London Clay samples.

The manufacture of a ceramic chimney would be a specialist activity and is unlikely to have been carried out by the same tiler that was producing the typical corpus of bricks and tiles. There is evidence from analysing the chimney that parts of it were wheel-thrown. It compares stylistically to the chimney recovered from Ashtead, which is held in the British Museum collection (Fig:6.69), which has been heavily reconstructed but is in excess of 60cm in height. The triangular-shaped apertures to the third tier are similar to those that can be identified on the fragments from the Silchester example, as is the pinched decoration which would have continued around the circumference of the chimney. The chimney is perhaps the work of a potter, rather than a tile maker. It is therefore not surprising that the fabric is not of local origin. There are also similarities with the examples recovered from the pottery and tiles production centre at Berkeley Street, Gloucester (Timby, 1991). Based on their rarity, the production of chimneys would have been small scale and highly specialised, and so it is therefore reasonable to assume that the manufacture was restricted to a small number of production centres. It is therefore likely that the artefacts moved a longer distance than the large-scale supplies of bricks and tiles needed in an urban centre. In his 1934 paper, Lowther changes his interpretation from chimneys or ventilation cowls, to votive or religious artefacts, based on comparable examples from the continent. He argues that if they were chimneys, they would be found in far greater number, and in association with box-flue tiles of hypocausts systems. There are very few examples found that show evidence of use i.e. sooting. Lowther suggested a 3rd to 4th century date for these objects, and noting the similarity between them and the stone finials, and the lack of smoke-staining favoured their interpretation as decorative finials, rather than chimneys (Lowther, 1976, p. 41).

6.2.7 SILCBM6

Thin Section references: TSID110; 220; 233; 225; 237; 239;

Fabric as a proportion of the retained assemblage: 0.64%

Macroscopic description: This is an iron-rich, non-calcareous homogeneous fabric, typically oxidised throughout with some examples of reduced cores. Surface are generally light red (2.5YR 6/6). It is a hard-sandy fabric, with an irregular fracture. The fabric is characterised by a moderate proportion of well-sorted quartz, iron oxides and small metamorphic rock fragments. Clay pellets are present both in a pale cream fabric, and in a light red colour, both of which are highly micaceous, figure 6.70.

Figure 6.70: *Example of **SILCBM6** in hand specimen (IX151)*

<u>Petrographic summary</u>: The fabric comprises a moderately heterogeneous fine-grained matrix, mid yellow-orange in XP and PPL. There is a small proportion (5%) of quartz silt, with a similar proportion of subrounded fine quartz sand component. The fabric has very limited optical activity. The pale cream pellets are rounded, equant clay pellets of a highly birefringent clay, with merging to diffuse boundaries. The pellets have limited optical activity, are optically neutral and generally concordant with the matrix. There are also laminae of this same highly birefringent clay through the sample. These are likely to be naturally occurring in the raw material as weathering over the winter would not necessarily disrupt the lamination completely. Weathering firstly results in moister clay and frost action will break the clay down somewhat, but this is going to be relatively superficial (J. Allen, *pers comm.*). Also present are a small proportion of angular-to-subangular flint fragments. There are a number of rock fragments present, these are a fine-grade metamorphic rock, exhibiting foliate banding of minerals. The other mineral inclusions comprise of heat-altered glauconite grains, a limited amount of muscovite mica and tourmaline. This fabric has affinities with **SILCBM5** fabric, lacking the metamorphic rocks present in the **SILCBM5** samples and containing a smaller proportion of quartz sand in **SILCBM6**.

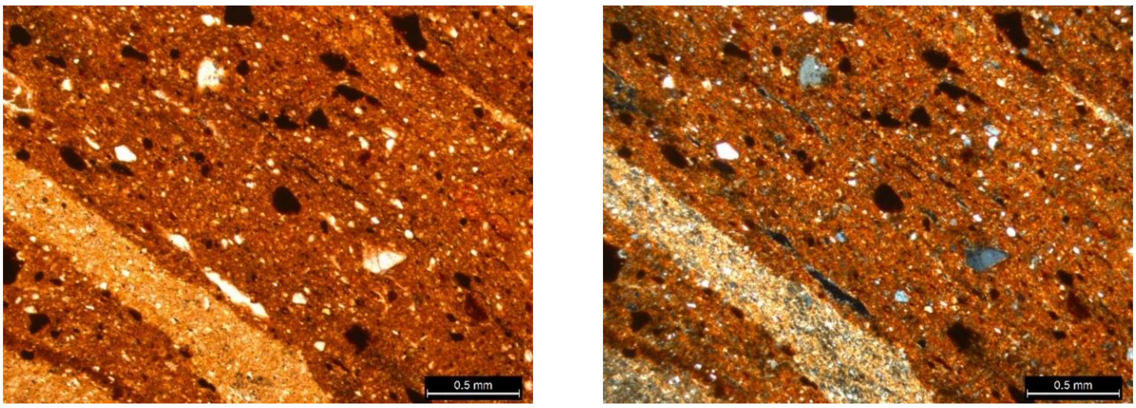


Figure 6.71 & 6.72*: Photomicrograph of **SILCBM6** in PL (left) and XP (right) (x40 magnification)*

Compositional and textural analysis:

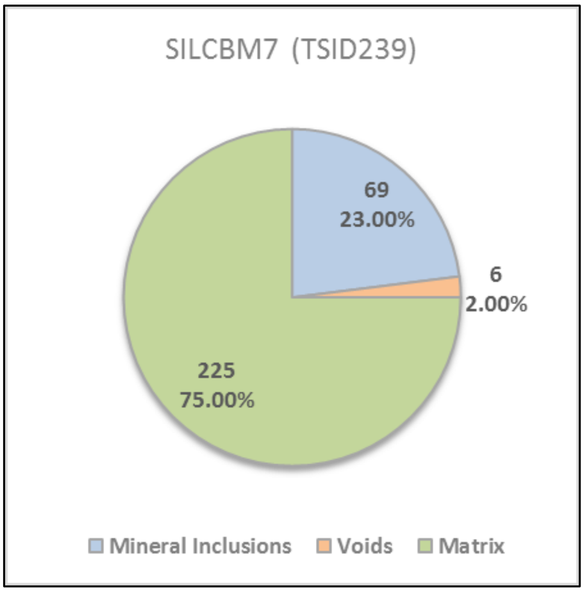
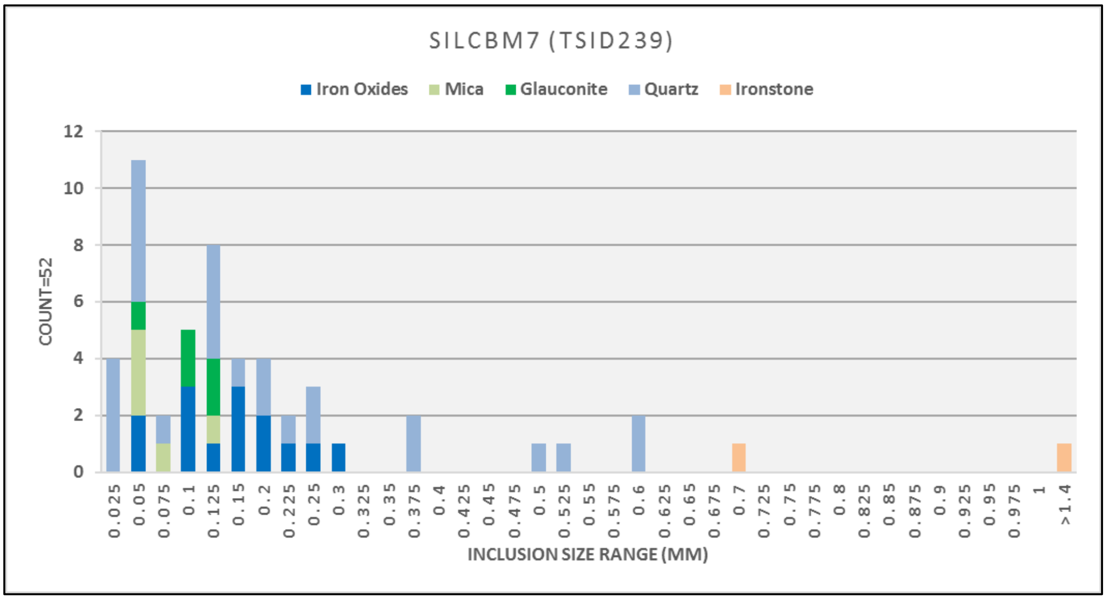


*Figure 6.73: Composition of **SILCBM6** (TSID239)*



Min = 0.0138mm	Max = 1.4946mm	Mean = 0.1871mm	Mode = 0.0316mm	StdDev = 0.2446mm

*Figure 6.74: Grain-size distribution of textural data from fabric **SILCBM7** (TSID132)*

The composition shows that the fabric is three-quarters matrix, with a very small proportion (2%) voids and 23% inclusions. The majority of quartz grains are of a fine quartz-sand, typically less than 0.3mm in size. The mean and standard deviations are inflated due to the ironstone inclusions in the sample.

There are only two samples of **SILCBM6** included in plot of portable XRF results. One of the examples plots to the group of clay samples from the *London Clay Formation* and the other close to the sample of clay from the *Bagshot Formation*. The *Bagshot Formation* can include laminae of pale grey or white silty clay or clay (Curry, 1958), although this is not exclusive to the *Bagshot Formation*.

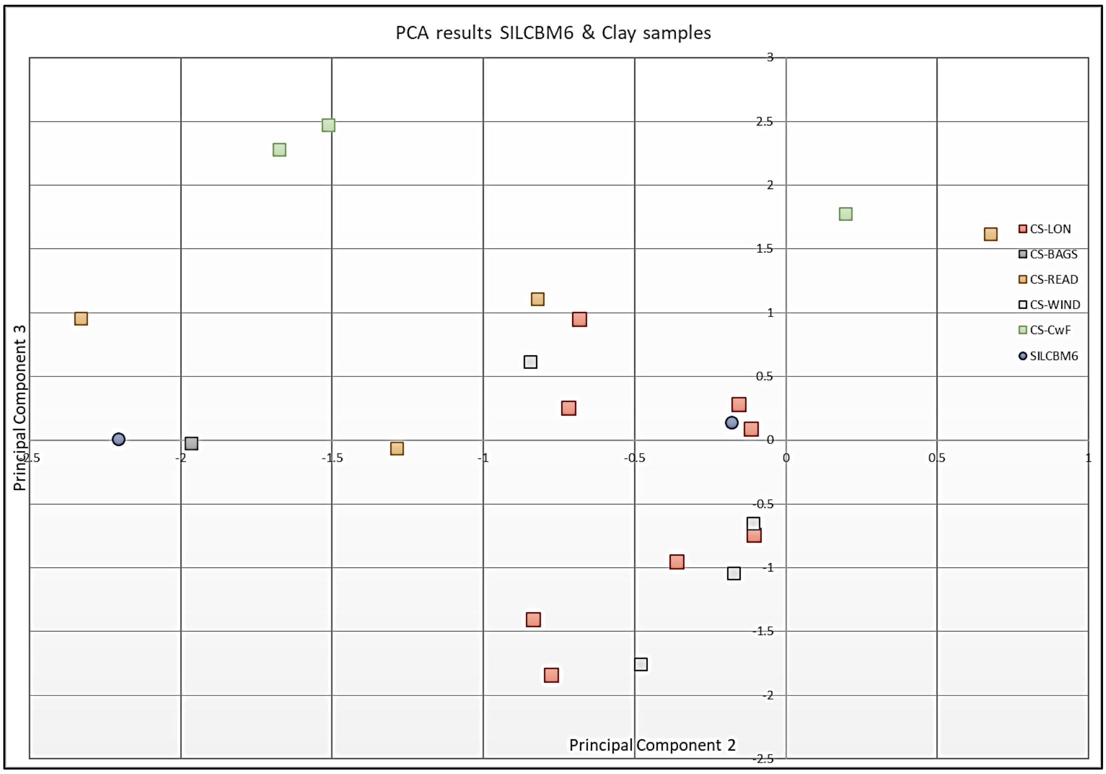


***Figure 6.75**: Results of PCA classification of **SILCBM6** fabric samples analysed, based on the normalised abundance of 13 elements;*

Forms: There are only 13 examples of this fabric (IX(3) and RM (10)). These are three plain bricks, single examples of a *tegula* and *imbrex*, five combed flue-tiles and three plain tiles. The combed flue tiles have different combed designs, two using a comb with six teeth, and one example each of designs made with four-, seven- and nine-tooth combs.

***Figure 6.76**: Examples of combed flue-tiles in **SILCBM6** fabric*

Summary: There are no particularly characteristic mineralogical inclusions within the fabric to tie it to a clay source. There is only a small number of examples in the assemblage.

6.2.8 SILCBM7

Thin section references: TSID067; 109; 115; 116; 143; 174; 181; 182; 199;

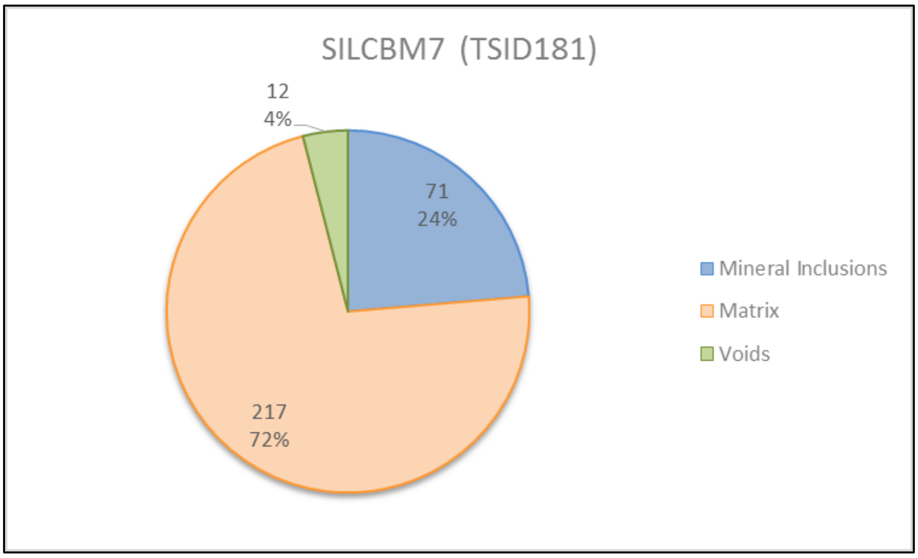
Fabric as a proportion of the retained assemblage: 0.59%.

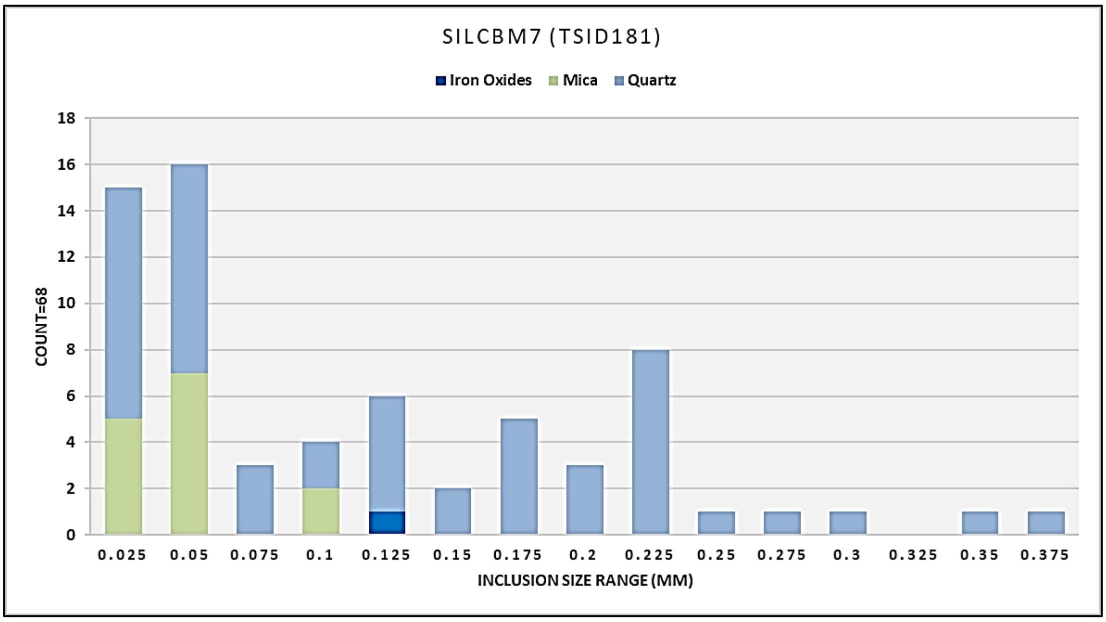
Macroscopic description: This generally homogenous fabric is characterised by the presence of well-sorted, subangular-to-angular, very fine-to-fine quartz sand in a micaceous dark greyish-brown (10YR 4/2) fabric. In addition, there is a component of medium sand, along with fragments of ironstone.

Figure 6.77: *Example of* ***SILCBM7*** *in hand specimen (FB207)*

Petrographic summary: The matrix is uniform with little evidence for lithological variation in the source material and just a few lighter quartzose bands visible (J.R.L. Allen *pers. comm*.). There is the occasional inclusion of grog, identified by sharp boundaries, prolate shape with high optical density, discordance and reduced optical activity. There is a lack of glauconite identified when compared with the rest of the assemblage. There is a small proportion of rounded clay pellets present, with diffuse boundaries, neutral optical density and concordant with the matrix. They are pale cream in colour and exhibit moderate optical activity. TSID174 shows a higher proportion of flint fragments when compared to the other samples, the flint present in this example is also calcined. Inclusions are unimodal, open-spaced, with weak orientation.

Compositional and textural analysis:





Min = 0.0106mm	Max = 0.369mm	Mean = 0.1028mm	Mode = 0.0275mm	StdDev = 0.0894mm

***Figures 6.78 & 6.79**: Grain-size distribution of textural data from fabric **SILCBM7** (TSID181)*

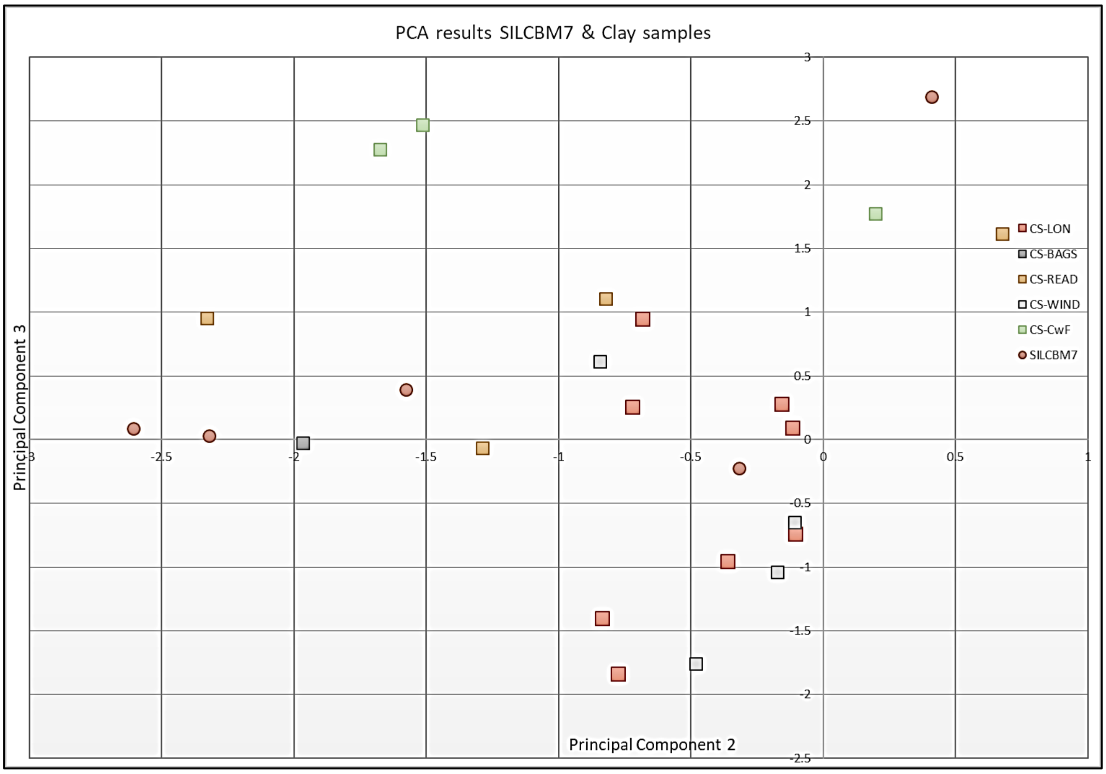


Figure 6.80: *Results of PCA classification of **SILCBM7** samples analysed, based on the normalised abundance of 13 elements;*

The **SILCBM7** fabric samples plot to the top of the chart, with one exception, figure 6.80. They do not show any correlation with any of the clay samples. They are clearly different to the rest of the assemblage both in hand specimen and thin section.

Forms: There are a small number of forms in this fabric. These are detailed in the table below:

Form	Count
Brick	1
Tegula	2
Tegula Mammata	1
Tile	4
Tile floor	3
Unidentified	1
TOTAL	12

Table 6.1 *Forms in **SILCBM7** assemblage*

6.2.9 SILCBM8

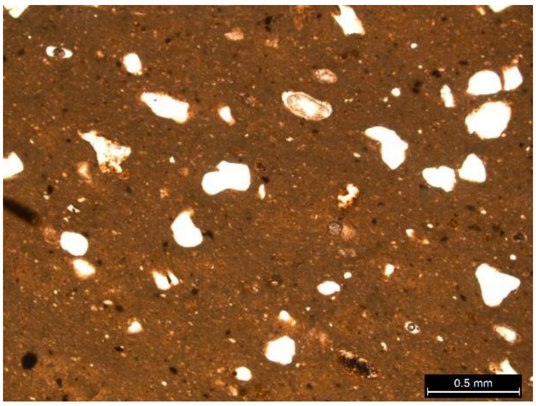
Thin Section references: TSID141; 198; 232; 263;

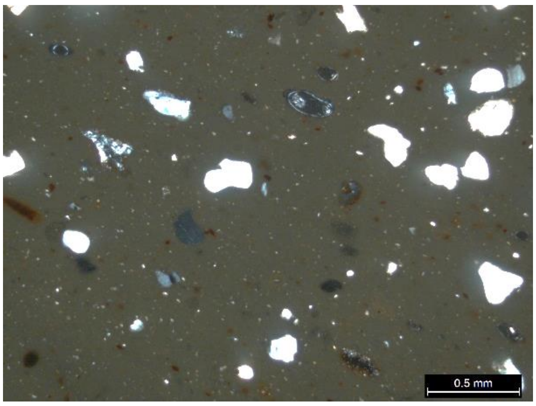
Fabric as a proportion of the retained assemblage: 0.29%

Macroscopic description: This is an iron-poor, non-calcareous, highly homogeneous fabric. It is typically evenly fired throughout, with surface and core colours of pale brown (2.5Y 8/2). It is a hard smooth-sandy fabric, with an irregular fracture. The fabric is initially identified by its unusually pale colour in relation to the rest of the assemblage, and is characterised by having very few visible inclusions, with only a small scatter of quartz grains present.

***Figure 6.81**: Example of Eccles fabric in hand specimen (IX938)*

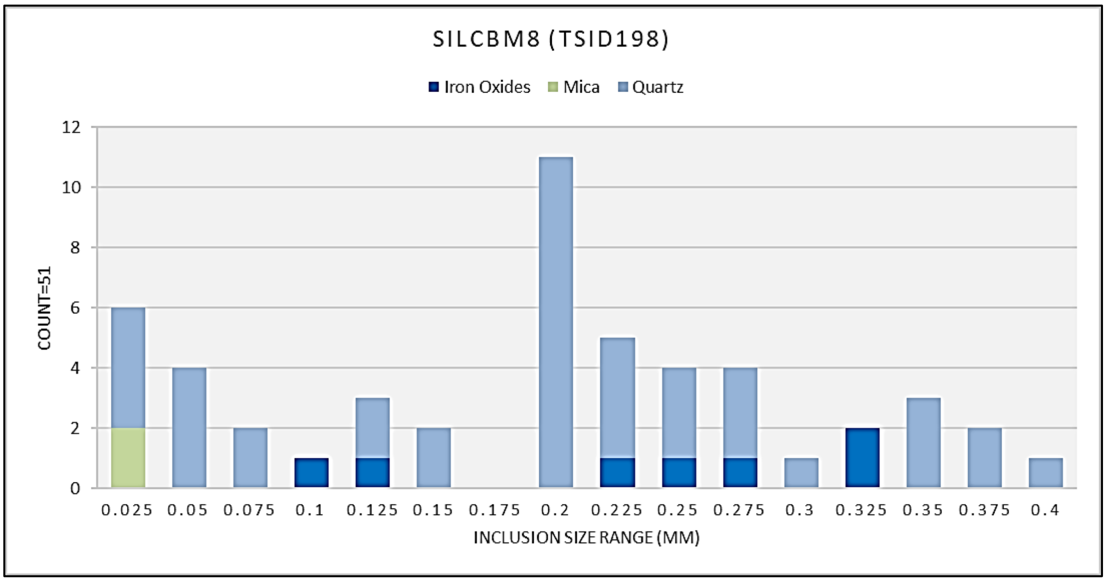
Petrographic summary: The fabric comprises a highly homogeneous micaceous, very fine-grained matrix, very pale brown in PPL and very pale yellow-brown in XP. There is a small proportion (5-10%) of well-rounded quartz silt, with a similar proportion of well-rounded fine quartz sand component, resulting in a bi-modal grain-size distribution. The fabric is optically inactive. There are small iron-rich grains present along with larger grains of ironstone, with small quartz grains visible within.





***Figures 6.82 & 6.83**: Eccles fabric (TSID198) in PPL (left) and XP (right) (x40 magnification)*

Compositional and textural analysis:



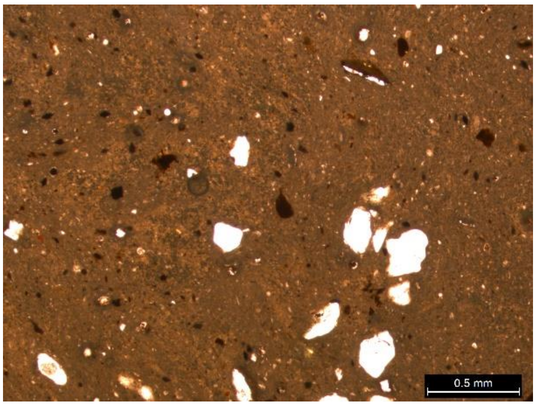
Min = 0.0058mm	Max = 0.3789mm	Mean = 0.1805mm	Mode = 0.0232mm	StdDev = 0.10623mm

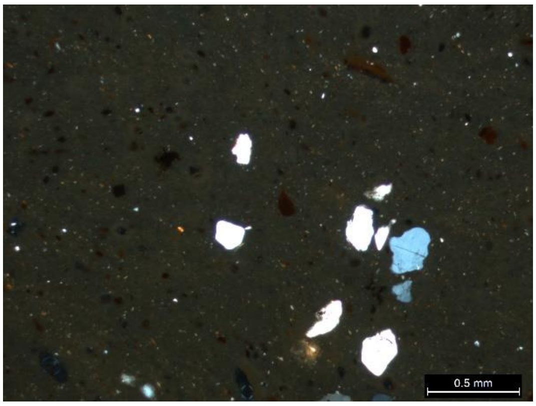
Figure 6.84*: Grain-size distribution from textural analysis of Eccles fabric (TSID198)*

The above figure, 6.84, confirms the bi-modal grain-size distribution, based on the quartz-sand inclusions. All measured inclusions are below 0.4mm in size, with a low value for the standard deviation reflecting the small size range.

Forms: There are only 12 examples of this fabric. These comprise four *tegula* and three *imbrices*, along with three tiles, one brick and one fragment where the form could not be identified. The report of the 1906 excavations at Silchester describe the quoin of a wall formed of white tiles, an uncommon variety at *Calleva* (Hope, 1907, p. 437), this is probably an example of Eccles fabric.

Summary: Yellow, white, and cream tiles are found on various sites in London, Essex, and north Kent. These are believed to have been produced at the estate tileworks at the villa in Eccles, Kent. The villa was producing tiles in the late 2nd century as a kiln of this date has been found 450m to the south-west of the villa complex (Detsicas, 1967; McWhirr, 1979c, p. 158). However, the tiles recovered in London are from an earlier phase of production dating to around AD50-80/100 (Betts, 2017, p. 371).





Figures 6.85 & 6.86: *Eccles fabric from London (MOLA fabric 2454) in PPL (left) and XP (right) (x40 magnification)*

The above figures are from a thin section of a sample of MOLA fabric 2454 which has been identified as a product of the tileworks at Eccles. It is clear that these are the same in terms of composition and character as the few examples of pale brown fabric recovered from the Silchester excavations (J.R.L. Allen, *pers. comm.*).

6.2.10 SILCBM9

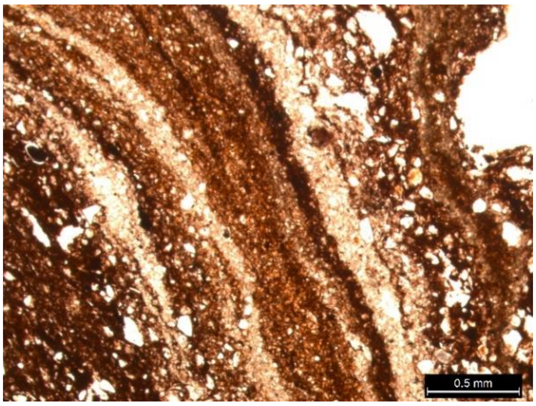
Fabric Summary

Thin Section references: TSID230; 234; 258; 306.

Fabric as a proportion of the total assemblage: 0.15%

This is a highly heterogeneous fine-grained fabric, characterised by the presence of bands of iron-rich and iron-poor matrix, resulting in a highly ptygmatic fabric. It contains a high proportion of silt-sized subangular-to-subrounded quartz, single-spaced or greater, all mineral inclusions are <0.375mm in size. The other mineral inclusions include muscovite mica, tourmaline and red opaque iron oxides, plus angular fragments of flint and distorted pellets of clay, with neutral optical density. The angularity of the flint suggests that the clay was residual in origin, or minimally transported. The matrix and clay phenomena within have relatively low optical activity which is indicative of a high firing temperature. The heterogeneity in the fabric is likely to be due to natural variegation within the source clay, rather than the result of the mixing of separate clay sources. The fabric is distinguished by its highly ptygmatic appearance, along with high proportion of quartz present.

***Figure 6.87**: Examples of **SILCBM9** fabric Alpha in hand specimen.*



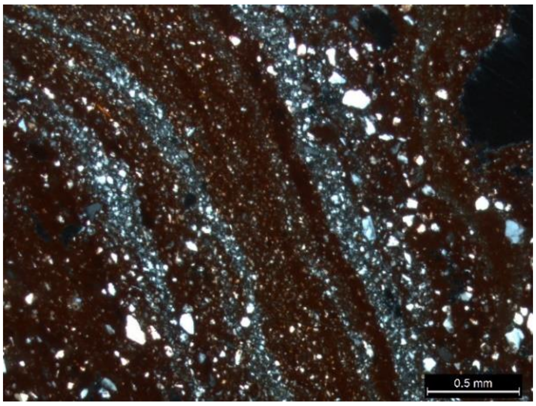
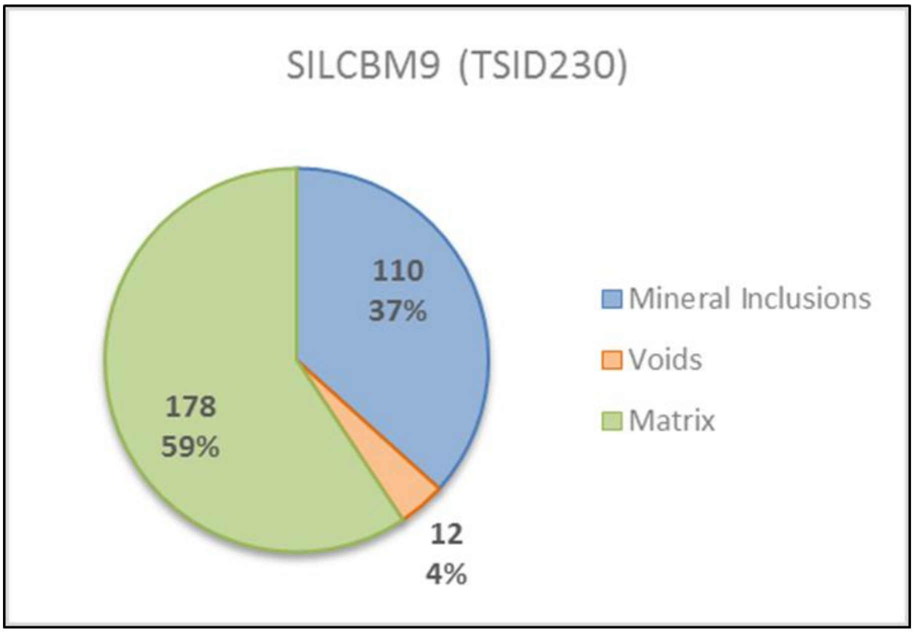
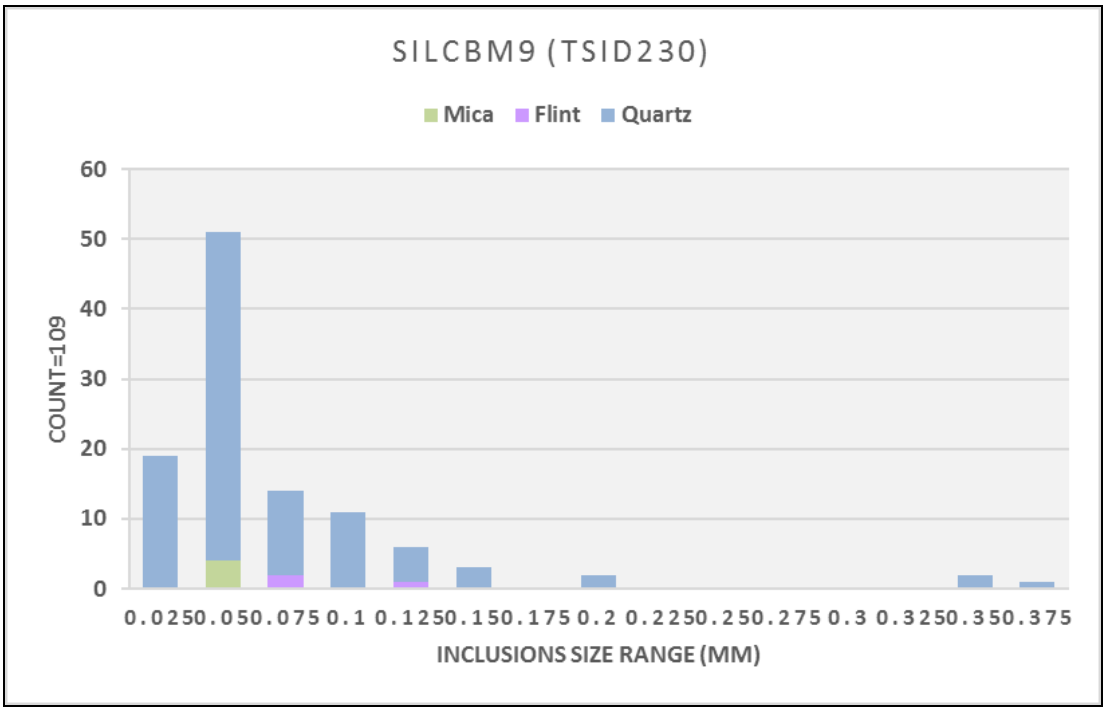


***Figure 6.88 & 6.89:** Photomicrographs of **SILCBM9** in PPL (left) and XP (right) (x40 magnification)*

Compositional and textural analysis:





Min= 0.0099mm	Max= 0.3632mm	Mean= 0.0579mm	Mode= 0.0218mm	StdDev= 0.0612mm

Figure 6.91 & 6.92**: Grain-size distribution of textural data from fabric **SILCBM9

The fine fabric is demonstrated through the compositional analysis, which shows the high proportion of silt-sized quartz, with a mean grain size for the sample of 0.0579mm, and a maximum size of only 0.3632mm.

Forms: There are only three samples in this fabric. One brick from the forum basilica archive and a brick and roof-tile from the Insula IX assemblage.

6.3 Pre-Roman building materials

The next three fabrics are not within the Roman ceramic building material corpus.

6.3.1 SILOCA1 - Early fabric

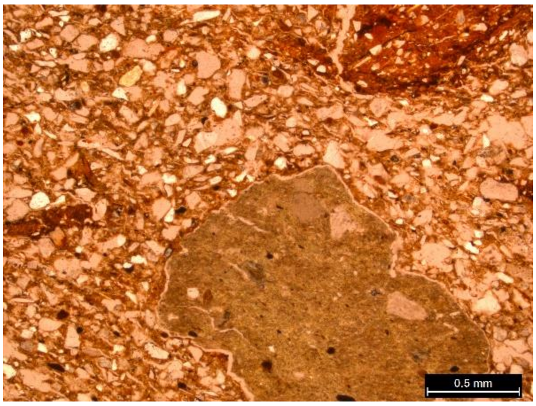
Thin Section references: TSID125; 262; 305;

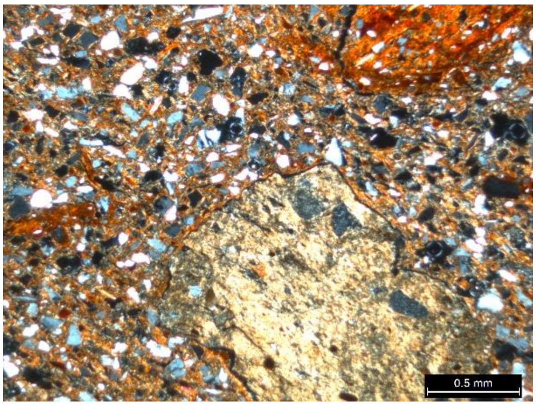
Fabric as a proportion of the retained assemblage: 0.34%

Macroscopic description: This is an iron-rich, non-calcareous slightly heterogeneous fabric, typically oxidised throughout. Surfaces are generally red (2.5YR 5/6), with a yellowish-red core (5YR 2/6). It is a coarse fabric, with an irregular fracture and often crumbly texture. The fabric is characterised by a high proportion of moderately-sorted quartz and visible flint fragments to the hand specimen. Red iron oxides and fragments of grog are visible in a fresh break.

Figure 6.93: *Example of fabric SILOCA1 in hand specimen (FB239)*

Petrographic summary: The fabric comprises a slightly heterogeneous fine-grained matrix, mid yellow-orange in XP and PPL. There is a large proportion (35%) of medium quartz sand. Inclusions are single-spaced with weak orientation and unimodal. The matrix exhibits moderate, speckled optical activity. There are pellets of grog mixed into the clay, these are in two distinct types. One is of a pottery fabric that has been tempered with calcined flint, of a similar composition to Silchester Ware, a locally made coarse ware. The other grog component is a fine brown sandy ware. Both are angular in form, with limited optical activity in relation to the matrix and typically discordant. There is a small proportion (5%) of flint in the fabric, these fragments are calcined and are probably derived from the flint-tempered grog component. The other mineral inclusions comprise heat-altered glauconite grains, a moderate amount of biotite mica along with discrete grains of plagioclase feldspar and hornblende.





Figures 6.94 & 6.95: Photomicrographs of fabric SILOCA1 in PPL (left) and XP (right) (x40 magnification)

Compositional and textural analysis:

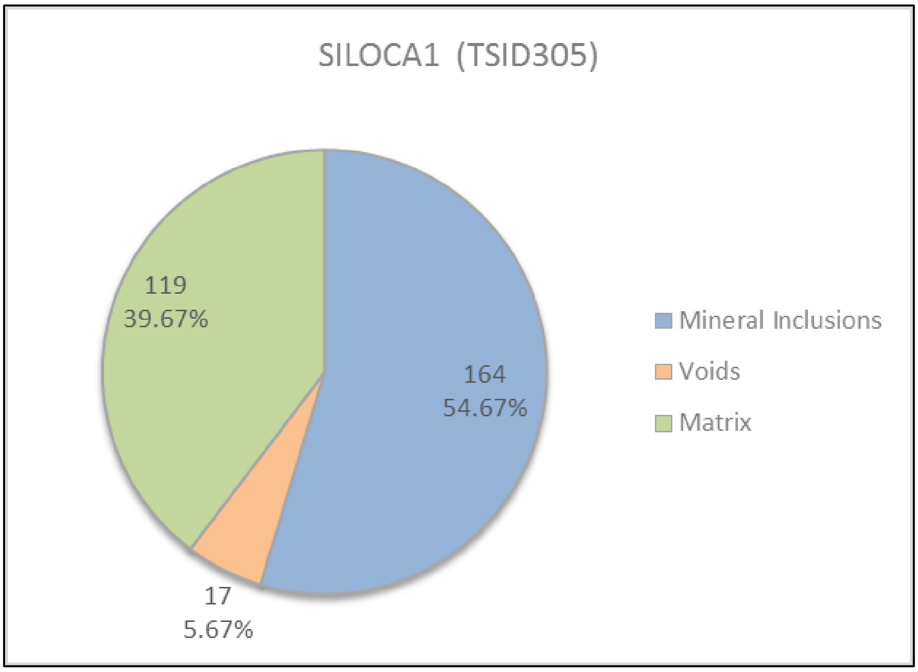
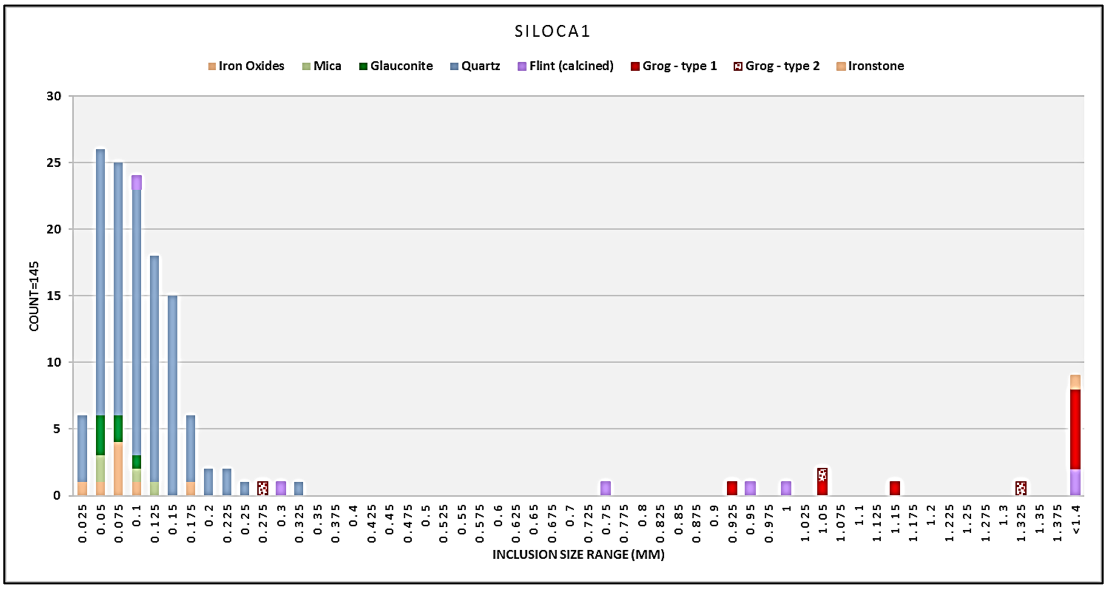


Figure 6.96: Composition of fabric SILOCA1 (TSID305)



Min = 0.0049mm	Max = 2.0641mm	Mean = 0.2443mm	Mode = 0.0418mm	StdDev = 0.4456mm

Figure 6.97: *Grain-size distribution of textural data from Early fabric sample (TSID305)*

Figure 6.97 Shows that the fabric is composed of almost 40% inclusions. The inclusions are dominated by fine quartz-sand, less than 03mm in size. The larger inclusions of grog and flint inflate the mean and standard deviation.

Forms: There are seven examples of this fabric. Two from the Insula IX archive and five from the forum-basilica collection. All are fragmentary. They have been categorised as tiles, of no particular form. The follow the tradition of mixed-grit fabrics often found in late Iron Age ceramics (J. Timby, *pers comm*.).

6.3.2 SILOCA2 - Mudbrick

Thin Section references: TSID307; 309;

Fabric as a proportion of the retained assemblage: 0.10%

Macroscopic description: This is an iron-rich, non-calcareous moderately heterogeneous fabric, typically oxidised throughout. Surfaces are generally reddish-yellow (7.5YR 6/6) with a brownish-yellow (10YR 6/8) core. It is a coarse fabric, with an irregular fracture and crumbly texture, suggesting that the tile may be considerably underfired or not-fired. The fabric is characterised by a moderate proportion of poorly sorted subangular-to-subrounded quartz. Flint fragments, and red iron oxides are visible in a fresh break.

Figure 6.98: *Example of SILOCA2 - mudbrick in hand specimen (FB79)*

<u>Petrographic summary</u>: The fabric comprises a moderately heterogeneous iron-rich, non-calcareous matrix which is light brown in PPL and light yellow-brown in XP. This fabric is characterised by the high proportion of voids visible, up to 15%, which are meso-to-macro in size and planar in shape. These are typically characteristic of the voids where a fabric has been tempered with grass or other organic material that has burnt out or leached from the fabric. There are no remnants in these voids. The voids show strong preferred alignment with moderate orientation in relation to the surfaces of the tile. There is a moderate proportion (20%) of poorly sorted medium quartz sand up to 0.5mm. Inclusions are open-to-single spaced with weak orientation and unimodal. The matrix exhibits slight optical activity, which is inconsistent across the section. This may be a result of the possible use of these as oven bottoms, and having been subjected to heat when in use. There are a small number of fragments of grog mixed into the clay. These are of a fine-grained sandy pottery, which also exhibits high optical density, low optical activity, and has sharp boundaries with shrinkage voids around. There is evidence of alignment of inclusions within the grog fragments. There is a small proportion 1-2%) of flint in the fabric, these fragments are non-calcined and naturally occurring within the clay matrix. The other mineral inclusions are red opaque iron oxides grains and orange heat-altered glauconite grains.

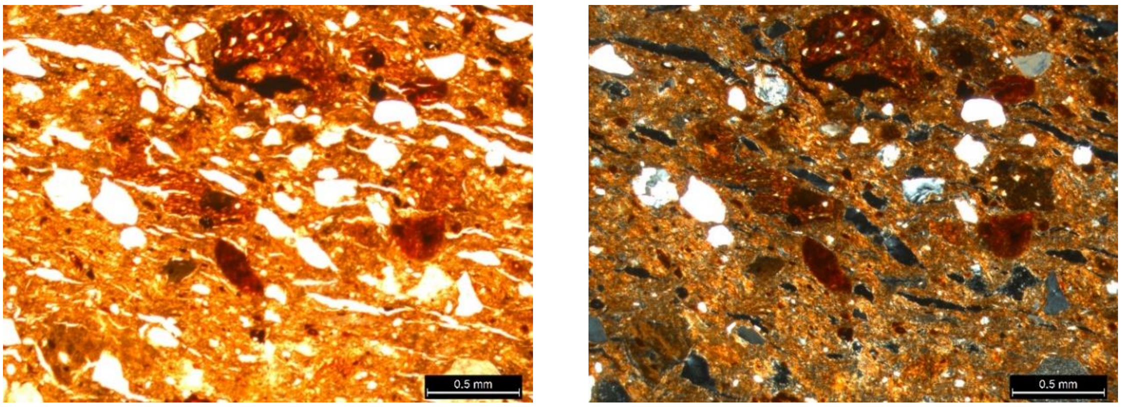


Figure 6.99*: Photomicrographs of SILOCA2 - mudbrick in PPL (left) and XP (right) (x40 magnification)*

Compositional and textural analysis: The compositional analysis is summarised in figure 6.100, this clearly shows the high proportion of voids (14.67%), when compared with other fabrics in the series.

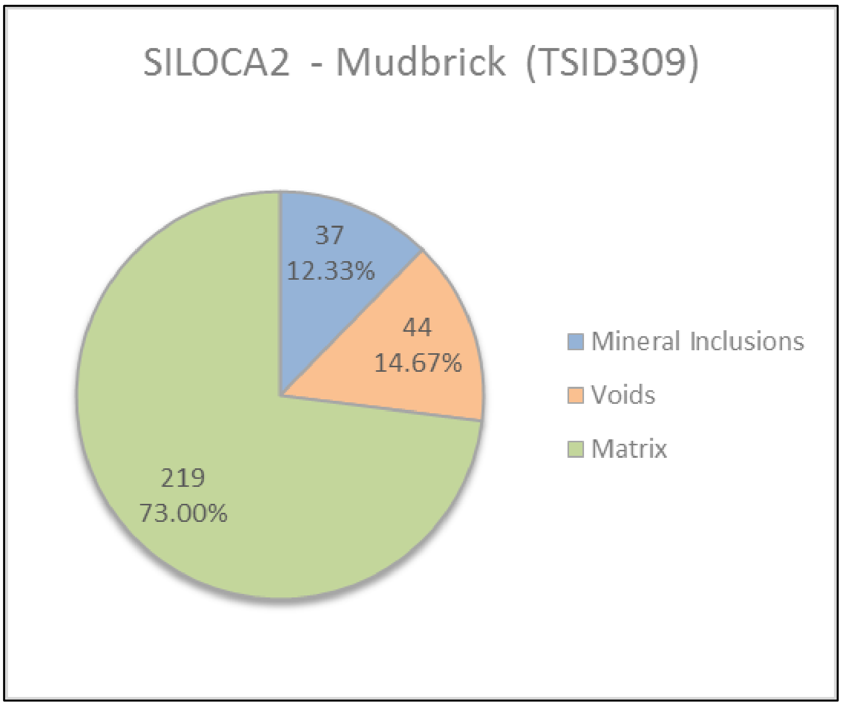
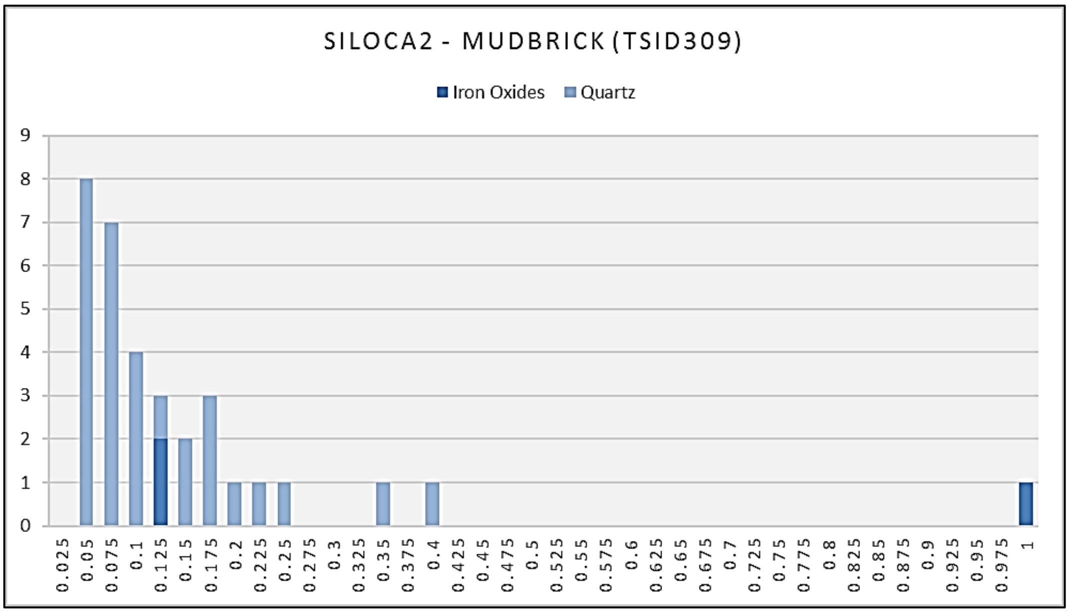


Figure 6.100: Composition of mudbrick fabric (TSID309)

The textural and compositional analysis only recorded inclusions on 37 of the 300 points counted. These are dominated by the poorly sorted quartz grains.



Min = 0.0268mm	Max = 0.9779mm	Mean = 0.1377mm	Mode = 0.0334mm	StdDev = 0.1729mm

***Figure: 6.101** Grain-size distribution of textural data from SILOCA2 - mudbrick sample (TSID309)*

Forms: There are only two examples of this fabric. They are both from the forum-basilica archive. One was recovered from a phase 6.13 context, where it was almost certainly residual and the other from a well, dated to phase 3.6 (c.A.D. 40-c.50-60). They are typically low-fired, and formed into non-uniform shapes.

6.3.3 SILOCA3 – Oven furniture

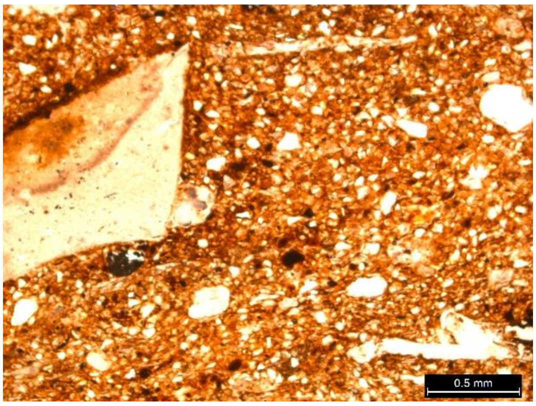
Thin Section references: TSID236;

Fabric as a proportion of the retained assemblage: 0.05%

Macroscopic description: This is an iron-rich, non-calcareous moderately heterogeneous fabric. It is underfired, oxidised throughout and yellowish-red (5YR 5/6) in colour. It is a soft, granular fabric, which exhibits an irregular fracture. The fabric is characterised by a moderate proportion of poorly-sorted medium to coarse quartz sand and flint fragments.

***Figure 6.102**: Oven furniture SILOCA3 –late Iron Age.*

Petrographic summary: The fabric comprises a moderately heterogeneous, sandy matrix which is mid orange-brown in XP and PPL, with pale cream laminae (Fig 6.102). The matrix exhibits moderate optical activity and inclusions are single-spaced with no preferred orientation and unimodal. There is a moderate (20%) fine quartz sand and a proportion (10%) of coarse quartz sand. The matrix exhibits moderate-speckled optical activity, going in and out of extinction in random zones. There is a small proportion of flint in the fabric, these fragments are non-calcined and are naturally occurring in the clay. The other mineral inclusions are orange heat-altered glauconite grains with occasional grains of tourmaline. There is a high proportion of voids within the clay matrix. These comprise of macro- channels and vesicles, some with evidence of organic remnants.



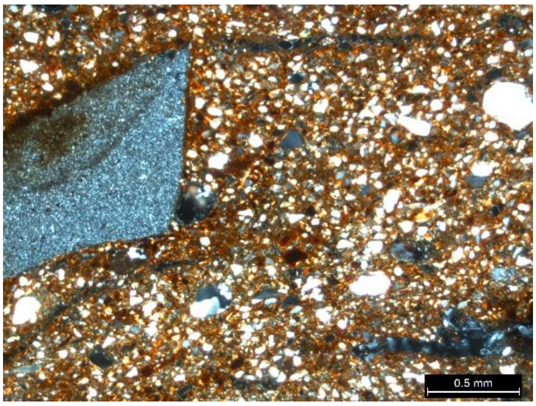
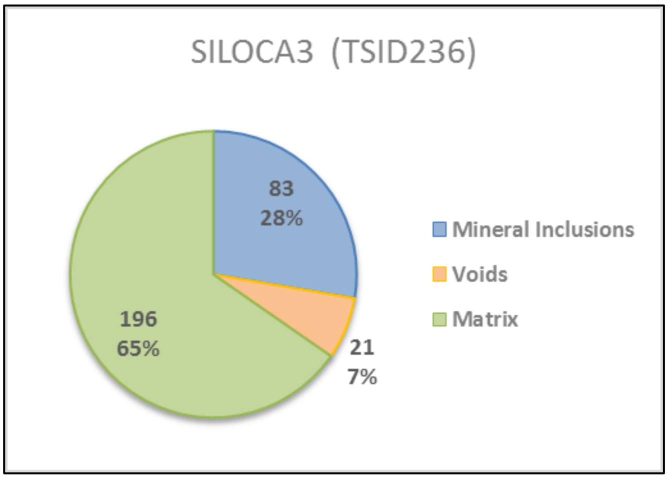
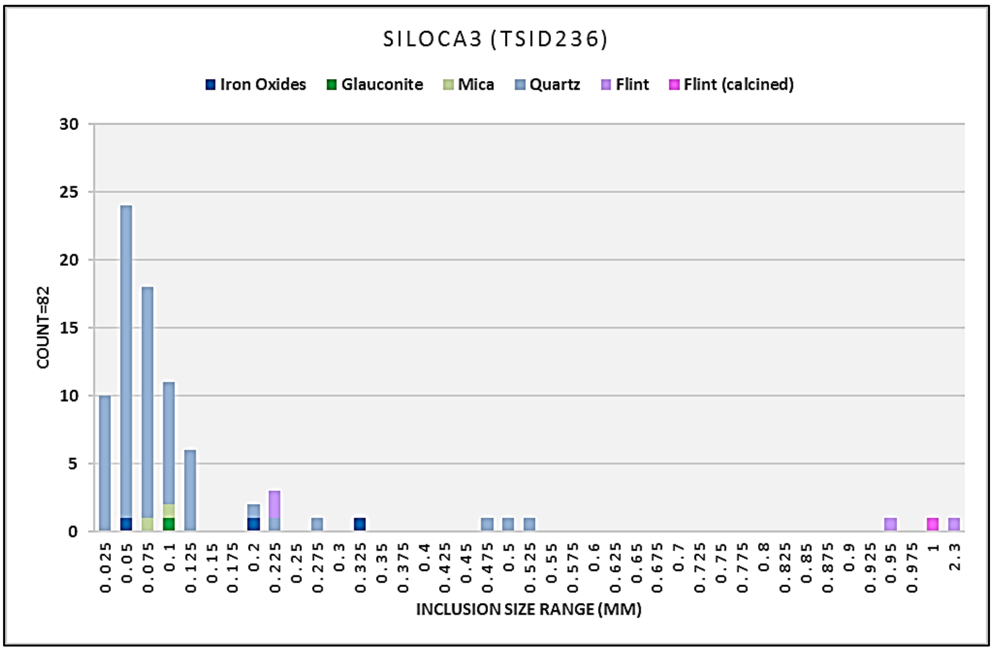


***Figure 6.103 & 6.104**: Photomicrograph of SILOCA3 – oven furniture in PPL (left) and XP (right) (x40 magnification)*

<u>Compositional and textural analysis:</u>





Min = 0.0146mm	Max = 2.2831mm	Mean = 0.1334mm	Mode = 0.0757mm	StdDev = 0.2914mm

***Figure 6.105 & 6.106**: Grain-size distribution of textural data from fabric SILOCA3 (TSID236)*

<u>Forms:</u> There are two re-fitting curved sections of a possible Iron Age floor tile, identified by C. Ball and M. Fulford per IADB records. There are impressions on base indicating the tiles were plastic when placed on a ridged surface. The tiles have been interpreted as oven furniture or for use in small hearths as their composition would negate their use as flooring material (Timby, 2000, p. 120).

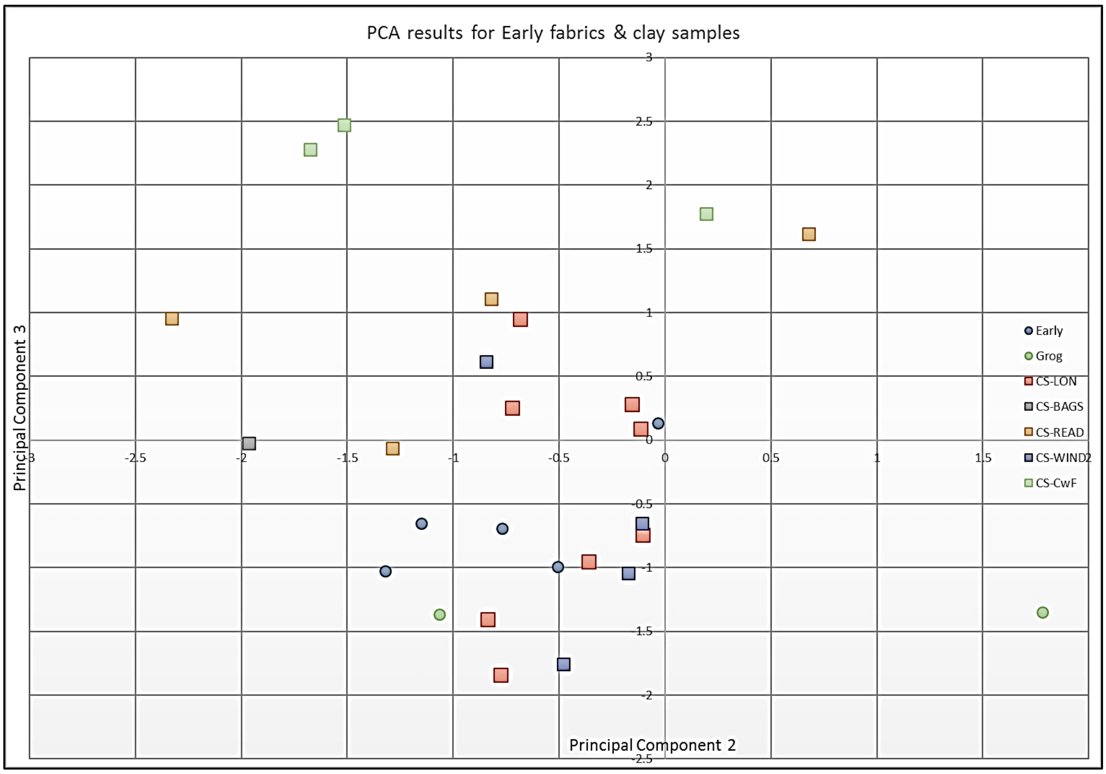


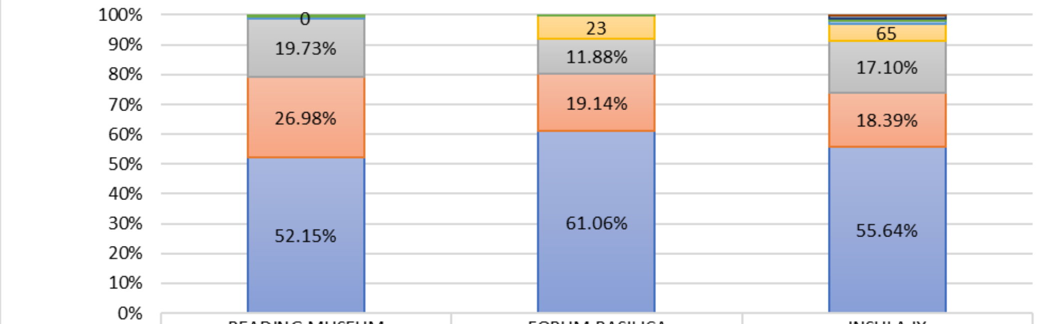
Figure 6.107*: Results of PCA classification of 'Early' samples analysed, based on the normalised abundance of 13 elements;*

Figure 6.107 show a plot of the portable XRF results from the Early fabrics along with those from the clay samples. The graph shows the 'Early' fabrics, with one exception, plot amongst the *London Clay formation* samples. These fabrics all represent very small proportions of the assemblages, and the forms are such that they are not typical of the Roman ceramic building material types. They are items that would have been made locally as when required, rather than to meet a large-scale demand for bulk building materials.

6.4 Discussions

The assemblages from Reading Museum, the forum-basilica, and Insula IX are considered in terms of the proportions of fabrics in each assemblage (Fig.6.108). All three assemblages are dominated by **SILCBM1** fabrics, representing 52.15%, 61.06%, and 55.64% respectively. Material in **SILCBM2** makes up the next largest proportion of all three assemblages followed by the combined **SILCBM3** & **SILCBM4** fabrics. Only the Insula IX assemblage includes material from all 9 fabric groups, with no examples of **SILCBM8** and **SILCBM9** in the forum-basilica or Reading museum assemblages and

SILCBM6 absent from the forum-basilica material and **SILCBM5** absent from the Reading museum collection.

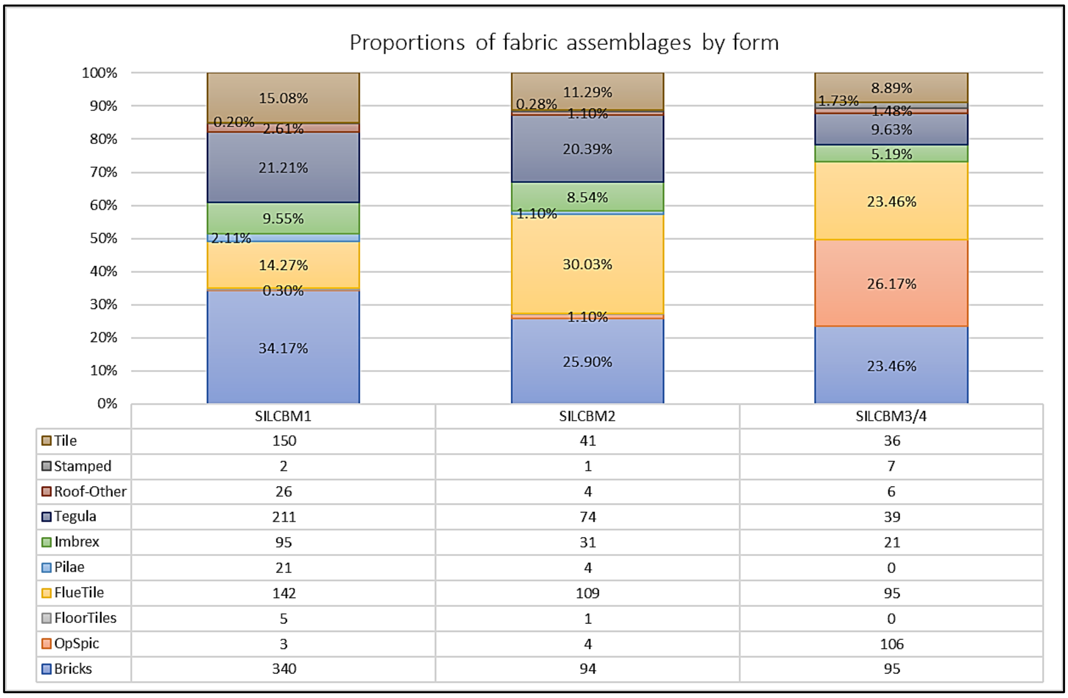


	READING MUSEUM	FORUM BASILICA	INSULA IX
SILCBM9	0	0	2
SILCBM8	0	0	10
SILCBM7	2	1	9
SILCBM6	3	0	10
SILCBM5	0	23	65
SILCBM3&4	87	36	185
SILCBM2	119	58	199
SILCBM1	230	185	602

Figure 6.108*: Proportions of collections represented by each* ***SILCBM*** *fabric group*

6.4.1 Fabric and forms

The data relating to the form of the material and its fabric is summarised in figure 6.109. This serves to emphasise the dominance of **SILCBM3/4** in the production of Opus Spicatum. SILCBM3/4 is made from *Windlesham Formation* clay as found at Little London. Vitruvius (7.1.7) recommends the use of Opus Spicatum bricks, laid in a herringbone pattern, for covering floors open to the elements. The assemblage in the Reading Museum collection were recovered from the Antiquarian excavations of the public baths in Insula XXXIII.



	SILCBM1	SILCBM2	SILCBM3/4
Tile	150	41	36
Stamped	2	1	7
Roof-Other	26	4	6
Tegula	211	74	39
Imbrex	95	31	21
Pilae	21	4	0
FlueTile	142	109	95
FloorTiles	5	1	0
OpSpic	3	4	106
Bricks	340	94	95

Figure 6.109: *Analysis of the forms present in each of the key fabric groups*

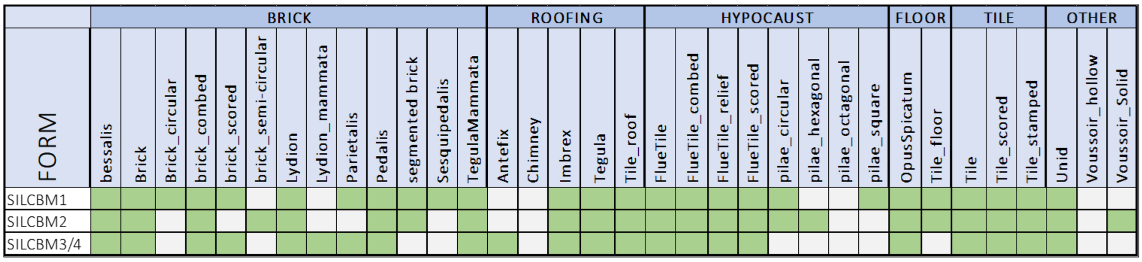


Figure 6.110: *Presence/absence data for forms by key fabric groups*

Figure 6.109 also highlights the large proportion of flue-tile that is represented in **SILCBM2** (30.03%) representing almost a third of the fabric group, this is discussed further in chapter 11. The presence and absence data show that many of the forms are manufactured in all the key fabric groups. However, it does highlight the presence of potential specialised production of some forms of CBM. For example, semi-circular and hexagonal *pilae*, along with solid voussoirs are found in **SILCBM2** only. Whilst **SILCBM1** sources were only used for the manufacture of circular bricks, sesquipedalis, and square *pilae*, and all examples of antefixes are in **SILCBM3/4**.

6.4.2 Tally marks

Tally marks or batch marks appear on the edges of some forms of CBM, these are thought to be a record of output (Chapter 2.5). There are 42 examples of tally marks recorded on Silchester CBM examples, these are exclusively found on the edges of bricks. There are seven varieties of tally marks used and three fabrics represented in the collection (Fig 6.111). It has previously been suggested that the flat bricks found at Silchester were probably produced by a different, perhaps military or at least official manufacturer based on the presence of tally marks (Warry, 2012, p. 50). Of the 42 tally marks recorded, 23 (54.8%) were found on bricks from the forum-basilica. Most of these examples were recovered from Period 5 contexts (Flavian timber basilica – see Chapter 8.4.) along with two examples from the corresponding phase in Insula IX. The tally marks may be part of the public building programme involved in the construction of the forum-basilica with the small number of examples found elsewhere throughout the town being the result of the re-use of building materials or excess stock. Only a very small proportion of the brick assemblage bears tally marks, less than 10%, seeming to confirm that tally marks were only applied to a proportion of the bricks produced.

14.5

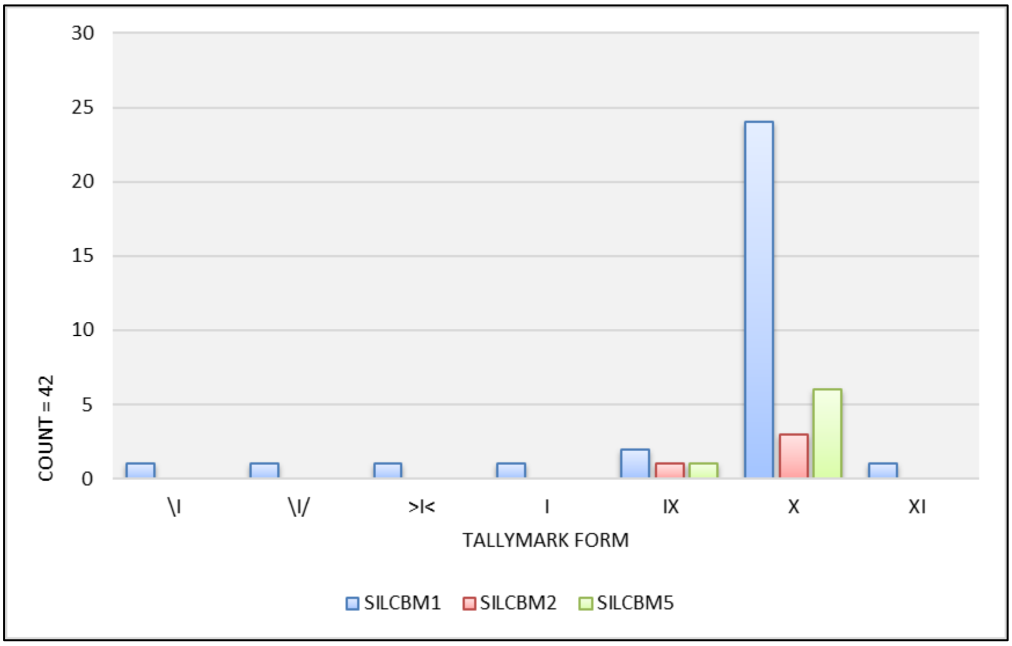


Figure 6.111: *Form and count of tally marks to brick by fabric*

6.4.3 Signatures

Other marks found applied to the surface of tiles are signatures (Chapter 2.5), these take a variety of forms and have been recorded per the typology devised by Warry (2006 Appendix 3 - *Tegulae* signature descriptors). A total of 189 signature were recorded in the collection, of these 154 were type S, taking the form of semi-circles, with a numeric descriptor added based on the number of fingers used to apply the design. As before, the four main fabric groups have been plotted along with the signature variants present (Fig 6.112).

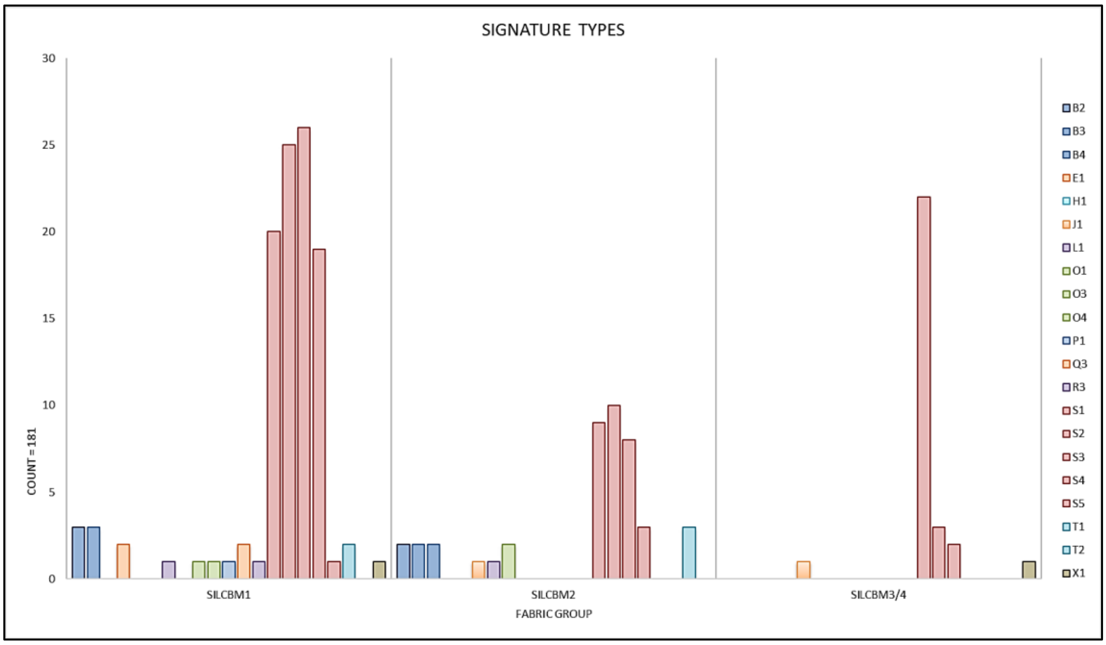


Figure 6.112: Signature types and fabric groups

6.5 Conclusions

This chapter has demonstrated the range of fabrics present in the Silchester material and the corpus of forms present in each of these fabrics. It has shown that the common forms of CBM, roofing material, brick and tile, are found in all the fabrics along with other more 'specialist' CBM forms. The composition of the repertoire in each of the fabrics gives an insight into the concept of specialist production centres which is explored further in Chapter 11.4. The comparison with clay samples has given an insight in to the origins of the material which is explored further in the following chapter which compares this fabric series with samples collected from known brick and tile production centres in the area. These sites are described in terms of their geographical and geological location, details of any kiln structures excavated and any dating evidence that has enabled a production date-range to be estimated. All samples from the productions centres have also been analysed using the portable X-ray fluorescence and in petrographic thin section to allow direct comparison with the Silchester material. Any differences between the public and private assemblages of the FB and Insula IX are discussed in detail in chapter 8 when the fabric series is applied to the assemblages in details and considered alongside the chronology of the two sites.

Chapter 7: Production Centres

7.1 Introduction

This chapter focusses on tile production centres that potentially supplied the Roman town at Silchester and the range of products manufactured. I will briefly review the corpus of tile production centres collated using published site information, grey literature, and data from the Roman Rural Settlement Project:

(http://archaeologydataservice.ac.uk/archives/view/romangl/map.html).

These sites divide into two groups those that have been confirmed as tileries with the excavation of a kiln structure and those sites that are believed to be a tilery based on artefactual or other evidence.

Sites have been selected for sampling based on their proximity to the town of Silchester and, in the case of large-scale production centres, where their distributions are known to have been widespread and may have reached Silchester. The sites sampled are described in terms of the nature of the site and its location in relation to Silchester, the structure of any excavated kilns, its geological situation, and the corpus of products manufactured. Where it has been established, the date range for the period of production is also included. All samples have been examined macroscopically, in thin section and using portable X-ray fluorescence analysis. Summary fabric descriptions characterise the material from each site, along with photomicrographs and textural/compositional data.

All the results are compared with the Silchester CBM fabric series to identify any similarities between the fabric groups and thereby identify potential production centres.

7.2 Catalogue of tile production sites.

The map below (Figure 7.1) shows all the known tile-production sites. Data relating to these sites are included in appendix 5: production centres, including the site names and locations, references and dating where available. There are a total of 80 confirmed brick and tile production centres and a further 71 possible/potential sites.

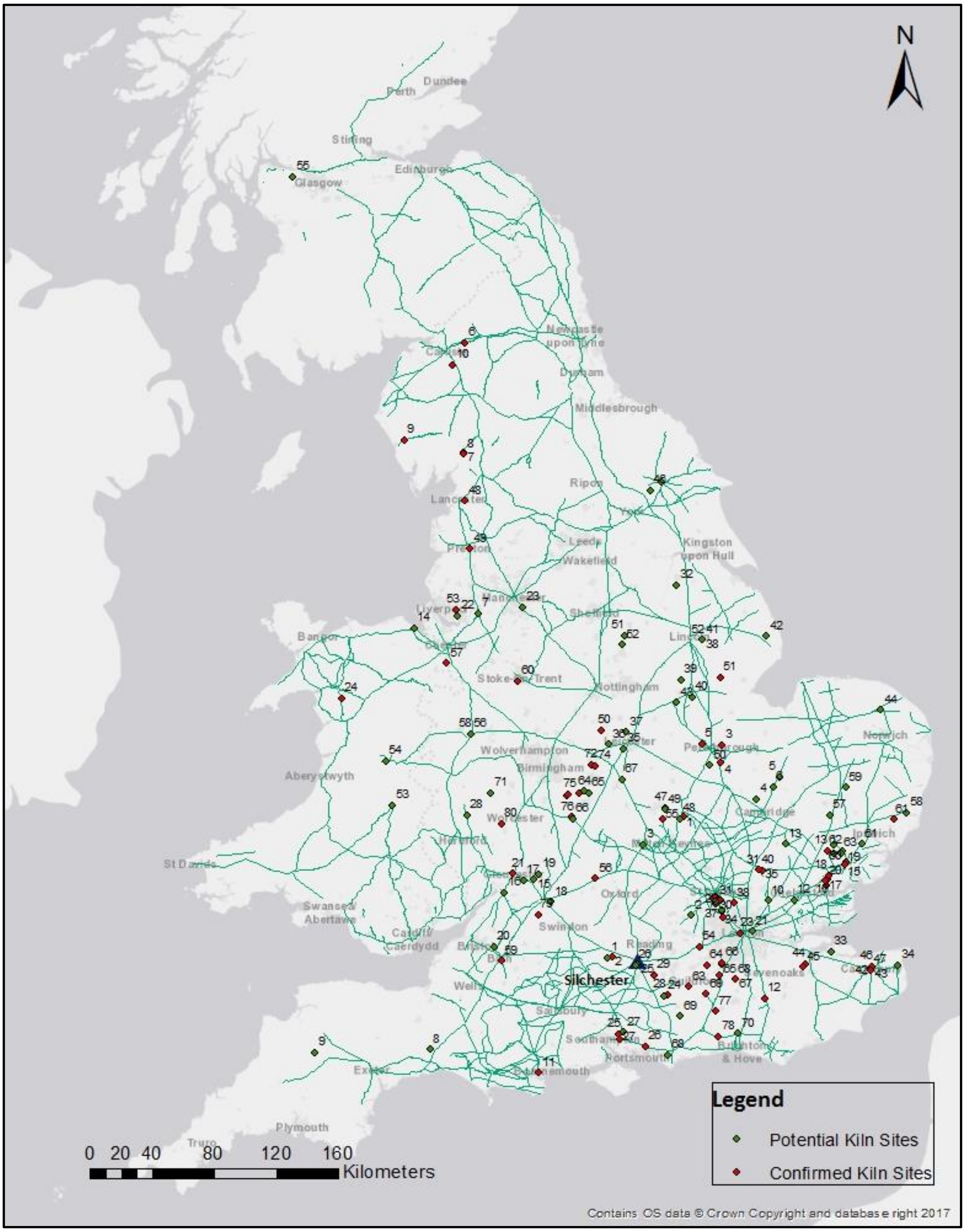


Figure 7.1: *Map of confirmed and potential brick and tile production sites in the UK. (See appendix 5)*

The map shows the distribution of sites is in the south-east of England. There is a concentration to the north-west of London which includes the tileries located along Watling Street, running north from *Londinium* to *Verulamium*. There is also a cluster to the east of London in Essex, around Colchester. There are a small number in the north-west of England associated with the military sites in the area with two sites near Hadrian's Wall. There is a sole potential tile production site in Scotland.

7.2.3 Sampled tile production centres

Figure 7.2 shows the sites from which samples have been taken, along with the geology of the area. The sites were selected based on the location of the tilery in relation to Silchester and their proximity to transport networks. The idea of more distant tileries supplying building materials to the town was tested with the inclusion of material from Ashtead, Reigate, and Minety. Both Ashtead and Reigate are known to have supplied material into London. The production centre at Minety, Wiltshire (see section 7.9) has been included as it is understood to be a large-scale tile-production site using up to ten kilns to produce pottery and ceramic building materials, with a wide-ranging distribution. The site at Eccles, Kent is included on the map as it has already been identified as a production site for part of the Silchester assemblage and is discussed in detail in section 6.3.9 as part of the **SILCBM** fabric series.

Potential brick and tile production was identified immediately adjacent to the town on the north-east side where wasters were discovered during the installation of a water main. A mass of poorly-fired tiles was found above a charcoal layer and interpreted as the remains of a tile clamp (Fulford *et al.*, 1997, p. 161) . A search of the archive at Hampshire Cultural trust (Accession no: A.1991.33) found there to be no retained material from the contexts referred to in the report and the archive contained no material that could be identified as wasters. The results of geophysical survey in the area has suggested the presence of a tile production centre in the vicinity of Kiln Yard Copse (Creighton with Fry 2016, p.421), whilst no excavation could be carried out to verify this, clay samples from this location were included in the analysis (Chapter 5.1).

Straight-line distances have been measured as a guide to the distance from each site to Silchester. Any potential movement of material identified is discussed in more detail within the description of each site. The sites are described in order of the distance from Silchester, starting with the nearest site.

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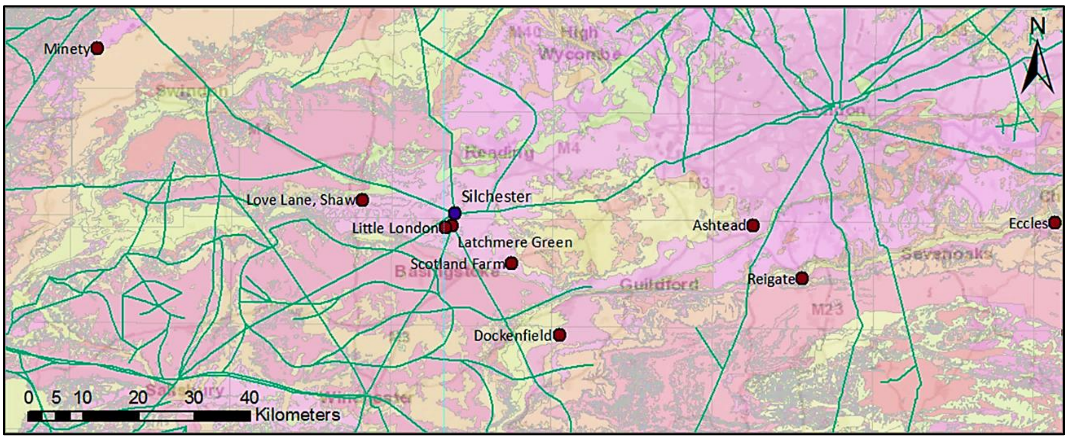


Figure 7.2: *Map of sampled production centres, with geology.*

7.3 Latchmere Green

Site Description: This site was identified during a watching brief by Southern Archaeological Services (SAS) for the installation of an electricity cable across northern Hampshire. Figure 7.3, shows the map of the route of the pipeline and its location in relation to *Calleva*. The watching brief was written up by SAS as grey literature, then subsequently published by Thames Valley Archaeological Services (Brading, 2011). The trench revealed a possible roadside settlement, south of the town of Silchester, at the junction of the Roman road from Silchester to, respectively, Winchester and Chichester. The site lies 1.5km south of *Calleva Atrebatum* (*ibid*. p.121). There is some evidence from the presence of over- and under-fired material, that pottery and tile production took place at the site. There are 34 contexts along the route which contained only Roman building materials, of which 32 are from the Latchmere Green area (*bid.* p.148), figure 7.4 shows the section of the cable route at Latchmere Green. (Accession number: A.1994.4).

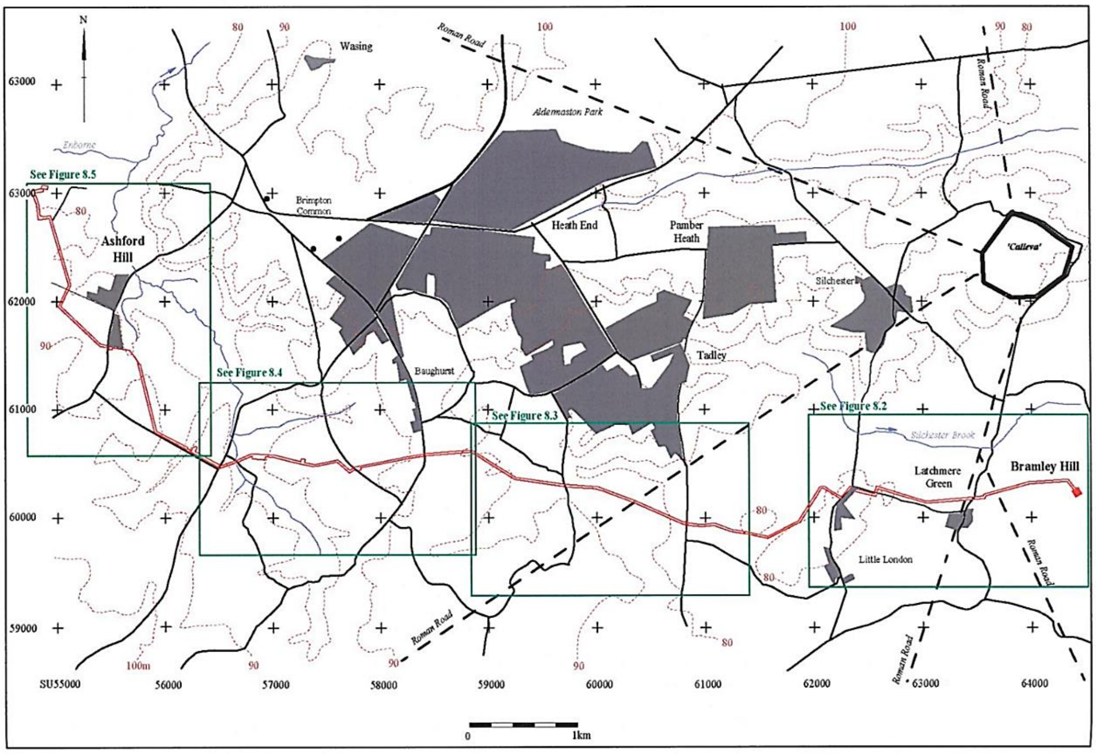


Figure 7.3: Map of cable route trench (After Brading 2011, Figure 8.1)

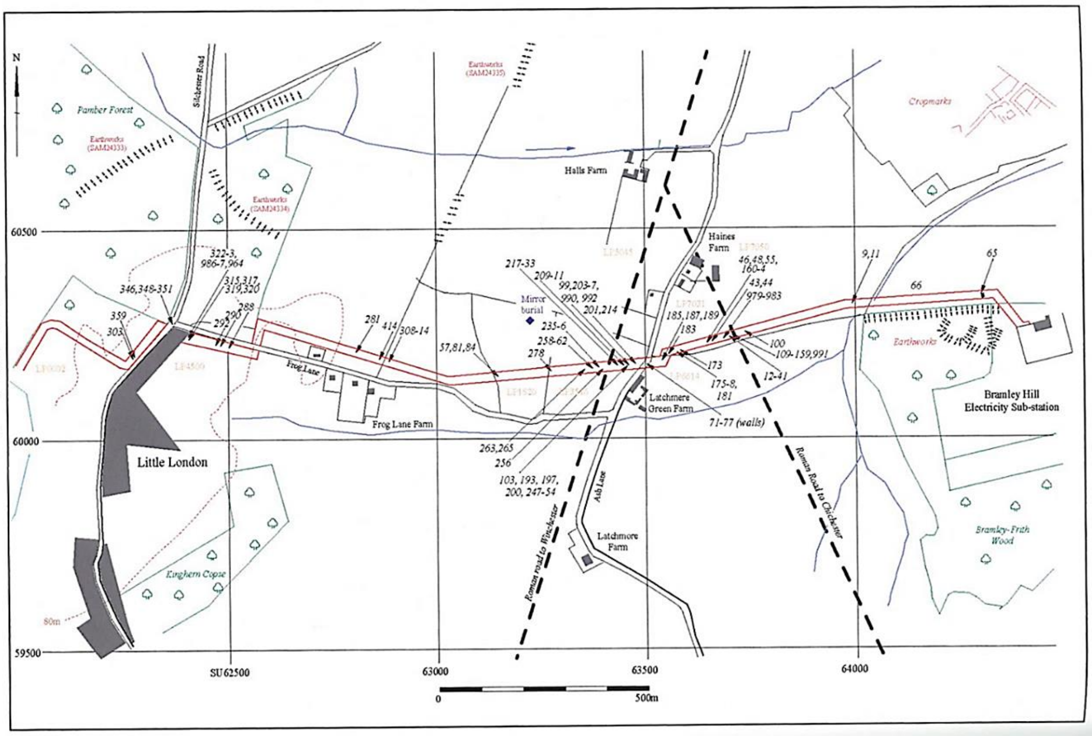


Figure 7.4: Detail of the cable route in the Latchmere Green area (After Brading 2011, Figure 8.2)

Grid Reference: SU634601

Kiln structure: No kiln structure has been excavated. There was a significant proportion of ceramic building material that was either under- or over-fired (301 fragments from 1214 total = 25%) and this along with the scarcity of mortar adhering to the material has been taken as an indication of a tile kiln operating in the vicinity, probably serving the local settlement/area (*ibid*, p.149).

Products: 23% of *tegulae* and 32% of *bessales* recovered were over-fired. As no kiln structure has been excavated, it has not been possible to establish the corpus of products of this potential tilery.

Dating: The occupation of the roadside settlement has been dated by the pottery assemblage. Whilst there is some late Iron Age/early Roman, flint-tempered Silchester Ware, there is no other, potential, pre-conquest pottery. There is evidence of occupation to at least the 4th century A.D., though activity seems to have been most intensive by the late 2nd and 3rd centuries A.D. (*ibid.*, p.57).

Geology: The site lies on a boundary between *London Clay Formation (Sand)* and *London Clay Formation (Clay, silt and sand)*, with gravel to the high ground to the north (*ibid.*, p.121).

Samples: samples were taken from contexts which were recorded to have included under- or over-fired CBM. These contexts are: 096, 106, 344 and 356.

Fabric Description: First, figure 7.5 shows an example of an iron-poor, non-calcareous fabric with a very high proportion of silt-sized quartz grains throughout. The fabric is very pale brown in colour in both PPL and XP, it exhibits high-strial optical activity. The fabric is glauconitic with dark brown clay pellets present, which are distorted with merging boundaries and reduced optical activity when compared with the surrounding matrix. These samples (LG1, LG4, LG8) have affinities with the Silchester CBM fabric **SILCBM7**, which is thought to derive from the *Clay-with-Flints Formation,* though the *London Clay Formation* (clay, sand & silt) is highly variable and includes lenses of silt-sized quartz in places. The differences in colour of CBM after firing should not be taken as indicative of different raw material sources.

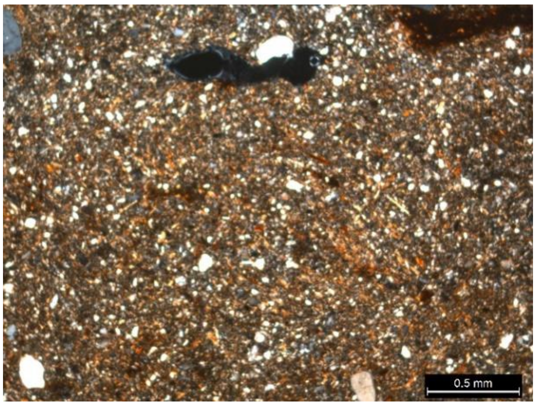


Figure 7.5: *Photomicrograph of LG1 (TSID245) (XP, x40 magnification)*

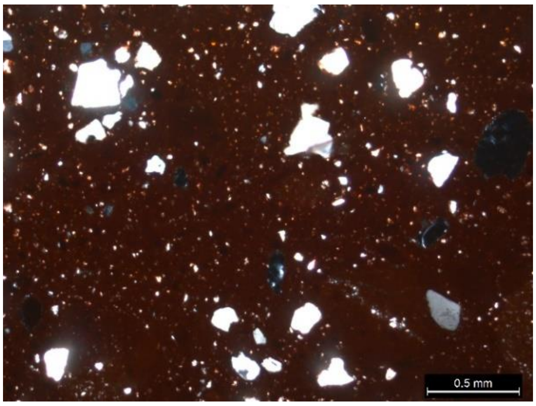


Figure 7.6: *Photomicrograph of LG3 (TSID247) (XP, x40 magnification)*

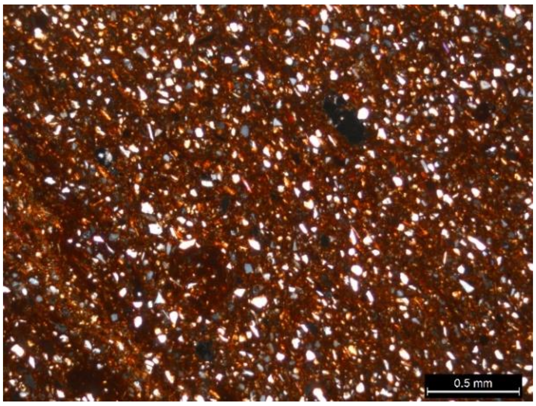
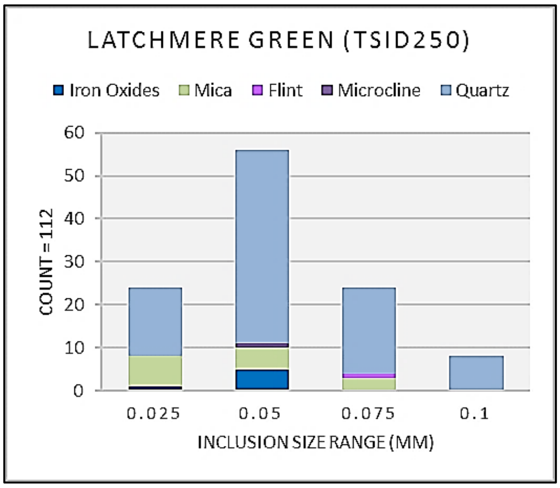


Figure 7.7: *Photomicrograph of Latchmere Green sample LG6 (TSID250) (XP, x40 magnification)*



Min =	Max =	Mean =	Mode =	StdDev =
0.0098mm	0.0942mm	0.04150mm	0.0324mm	0.01847mm

Figure7.8: *Grain-size distribution of Latchmere Green sample LG6 (TSID250)*

Second, figures 7.6 & 7.7, show iron-rich, highly micaceous fabrics. Sample LG3 (TSID247) is akin to **SILCBM1A** (London Clay – Micaceous) with a proportion of medium quartz sand added to a fine-grained micaceous matrix.

Third, sample LG6 (TSID250), along with samples LG2, LG5, & LG7, has affinities with **SILCBM1B** (London Clay – Fine Quartz), where an iron-rich micaceous matrix contains a very high proportion of silt-sized quartz sand throughout. This is reflected in the grain-size distribution results (Figure 7.8) with a very low value for the mean and standard deviations and a low maximum grain size of less than 0.1mm.

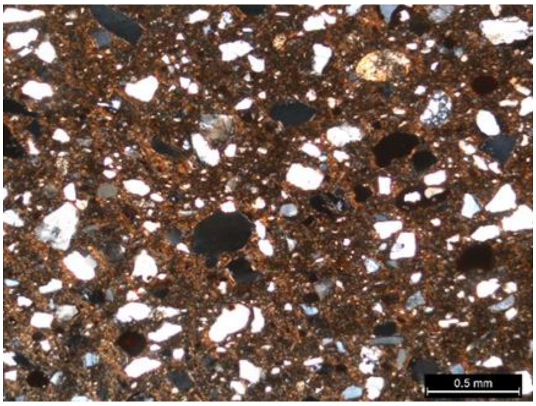


Figure 7.9: *Photomicrograph of LG9 (TSID253) (XP, x40 magnification)*

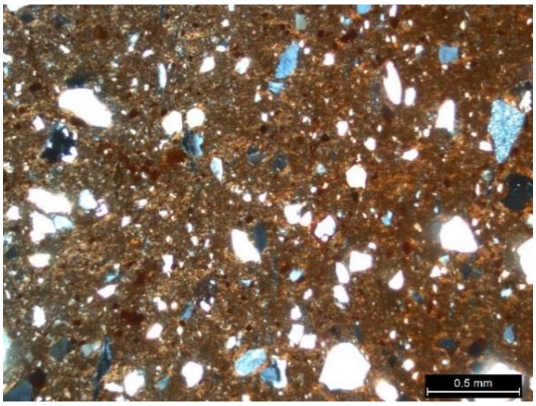


Figure 7.10: *Photomicrograph of* ***SILCBM3A*** *(TSID086) (XP, x40 magnification)*

Finally, sample LG9 (TSID253) is a heterogeneous sample, with pale cream streaks and pellets throughout (Figure 7.9). The matrix is iron-poor, in contrast to the **SILCBM1** examples, and is non-calcareous. There is a moderate proportion of quartz present, with occasional flint fragments and iron-oxides. This fabric compares with **SILCBM3A** (Figure 7.10), which has been provenanced to the *Windlesham Formation*.

Figure 7.11, illustrates the geo-chemical similarities between many of the Latchmere Green samples, when compared to the *London Clay Formation* clay samples (CS-LON) and Silchester fabric **SILCBM1**, derived from the *London Clay Formation*.

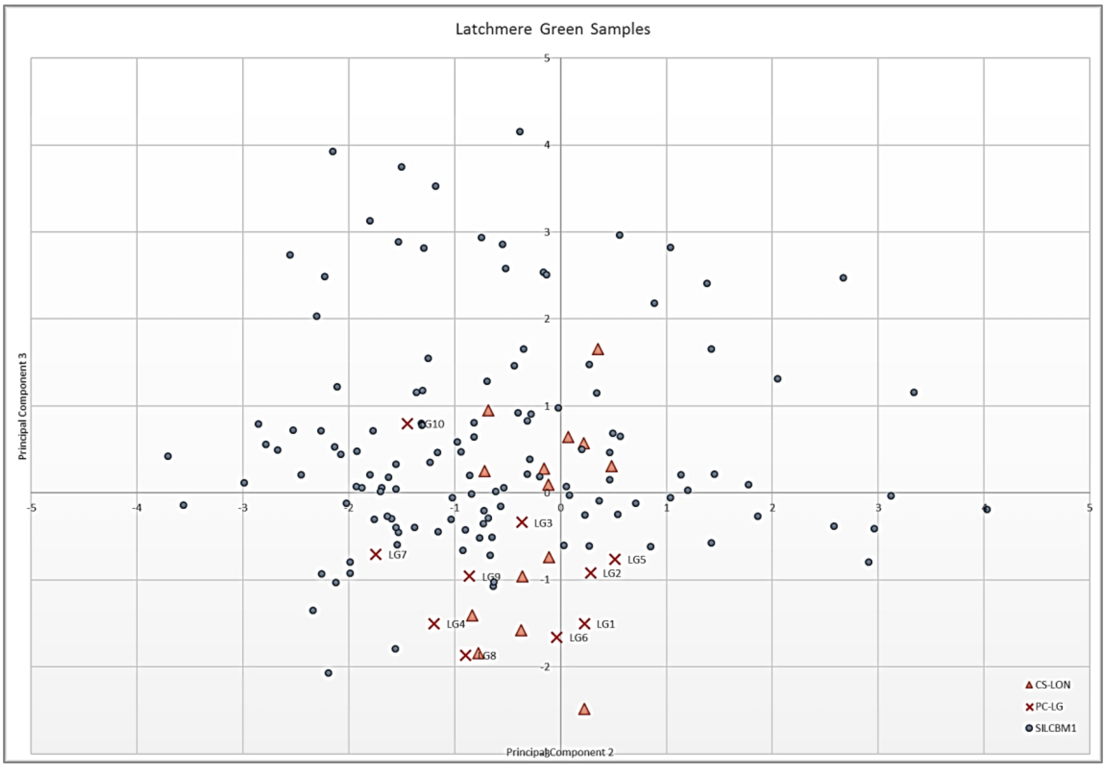


Figure 7.11: *Results of PCA classification of the Latchmere Green,* ***SILCBM1*** *and London Clay Formation clay samples (CS-LON), based on the normalised abundance of 13 elements*

Discussion: The analyses demonstrate the similarities between the material from Latchmere Green and a few groups in the Silchester fabric series. As the *London Clay Formation* dominates the geology around Silchester, it was unsurprising that this comprised the largest proportion of the **SILCBM** fabric series. The Latchmere Green site is situated on the London Clay and the assemblages includes examples matching both **SILCBM1A&B** reflecting the different compositions of *London Clay Formation* on which Latchmere Green is located.

If there is a kiln site in the Latchmere Green area, it is unlikely that there would be a total absence of CBM from other production centres prior to its construction. It is therefore unsurprising to find fabrics from another source within the assemblage. The samples akin to **SILCBM3A** are likely to have been produced using a *Windlesham Formation* source which outcrops in the locality at Little London, where the potential tile kiln site is only 1km in a WSW direction from the settlement at Latchmere Green. The proposed early date of production at Little London would predate the production at Latchmere Green and provide a potential source of material before CBM production was established there. It would be interesting to establish to scale of the use of Little London products at Latchmere Green.

7.4. Little London

Site description: in 1926, it was noted that deep ploughing had brought a large amount of Roman building material to the surface of a field, approximately 3km SSW of the Roman town of Silchester. The presence of highly vitrified examples within this material prompted Lieutenant Colonel Karslake to investigate further. The presence of a large spread of building materials, some 2.5m below the surface, led to the conclusion that this was the site of a Romano-British brick clamp. The material recovered included a fragment of a tile with a complete circular stamp including the title of the emperor Nero (Chapter 2.4). This was seen to evidence tile production in the very early period of the Roman occupation of *Calleva* (Karslake, 1926, p. 75) . The tile kiln is also mentioned in the discussion of the Winchester-to-Silchester Road (Winbolt and Winbolt, 1943, p. 244). Excavations at the site in 2017 revealed two tile kilns and three pottery kilns

Grid reference: SU623598

Kiln structure: Excavations in 2017 revealed a brick-built tile kiln measuring 4.8m by 7.2m (Fulford *et al.*, 2018, p. 3). It comprised of a rectangular firing chamber with stokehole extending to the south-east. Post-excavation analysis of the material recovered during the 2017 excavation is in its early stages.

Figure 7.12*: Main tile kiln at Little London, excavated 2017*

Products: *tegulae*; *imbrices*; Nero-stamped tiles and bricks, as described by Karslake (1926). Field-walked material included relief-patterned box-flue tiles. An example of relief-patterned tile decorated with die 39, a diamond-and-lattice design, is described in the corpus as being recovered from the site during fieldwalking (Betts, Black and Gower, 1994, p. 109). It can no longer be found in the fieldwalking archive (Accession number: 1957.16) at the Hampshire Museum Services stores and is therefore presumed lost. The 2017 excavation confirmed the manufacture of roofing material along with relief-patterned tile, Nero stamped tiles, and some more unusual forms currently awaiting post-excavation analysis. The presence of these specialist products in the assemblage has led to the conclusion that they must be for a regional market rather than just Silchester (Warry, 2012, p. 74)

Dating: The date of the production at the site has been presumed to be mid-to-late 1st century A.D., based on the discovery of the Nero-stamped tile the start of production is assumed to be some point during Nero's reign as Emperor (A.D.54-68). The corpus of products includes relief-patterned tiles, the date range for which has been estimated as A.D.80-A.D.150, however, the association with the Nero stamped tile may require this to be revised. The Nero-stamped tiles provide a *terminus post quem* of production of A.D.54 but there is as yet no evidence as to the duration of the production at the site.

Geology: The field in which the tilery is thought to have been located straddles two separate geological formations. To the north is the *Windlesham Formation,* which is part of the Bracklesham Beds and the south is *London Clay Formation* (Clay, Sand & Silt) (Figure 7.13).

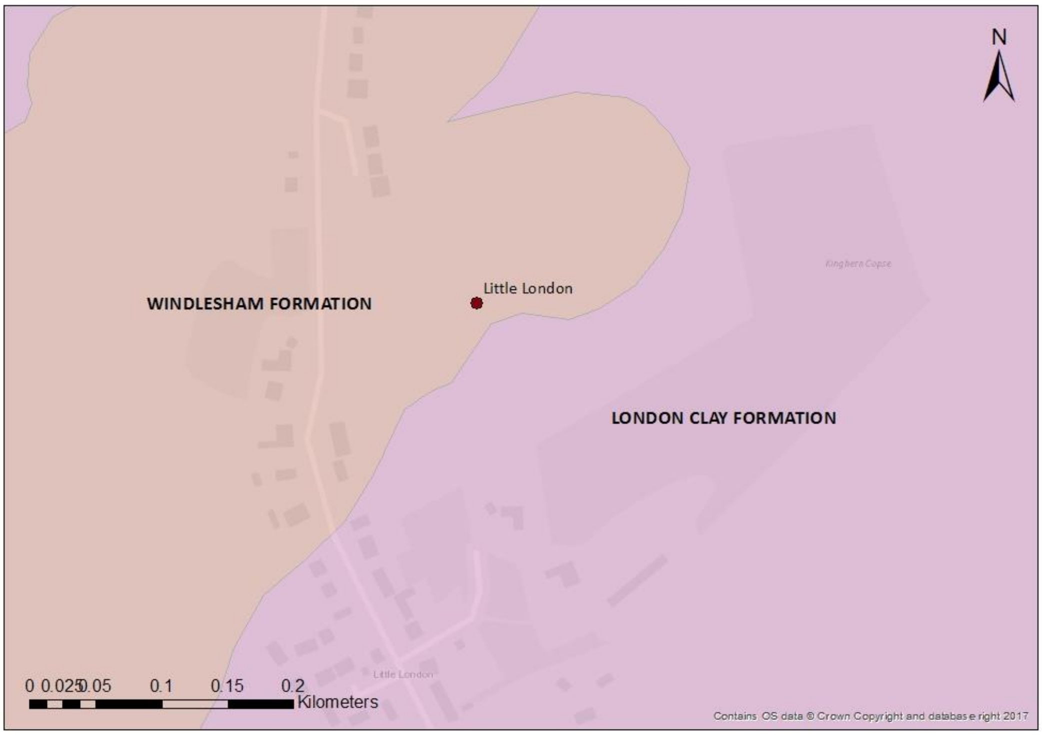


Figure 7.13: *Geological location of the potential production centre at Little London*

Samples: The only artefact identified from the Karslake investigations is the Nero-stamped tile, currently held in the British Museum. This has been analysed using the portable X-ray fluorescence. Macroscopic analysis of the tile confirmed it to be in fabric **SILCBM3A**. Samples of the material collected by Robert Foot during fieldwalking have been used for analysis. As there was brick-making in the area in more recent times, as shown in figure 7.14, the fieldwalking finds have been carefully examined to ensure that only Roman examples have been analysed.

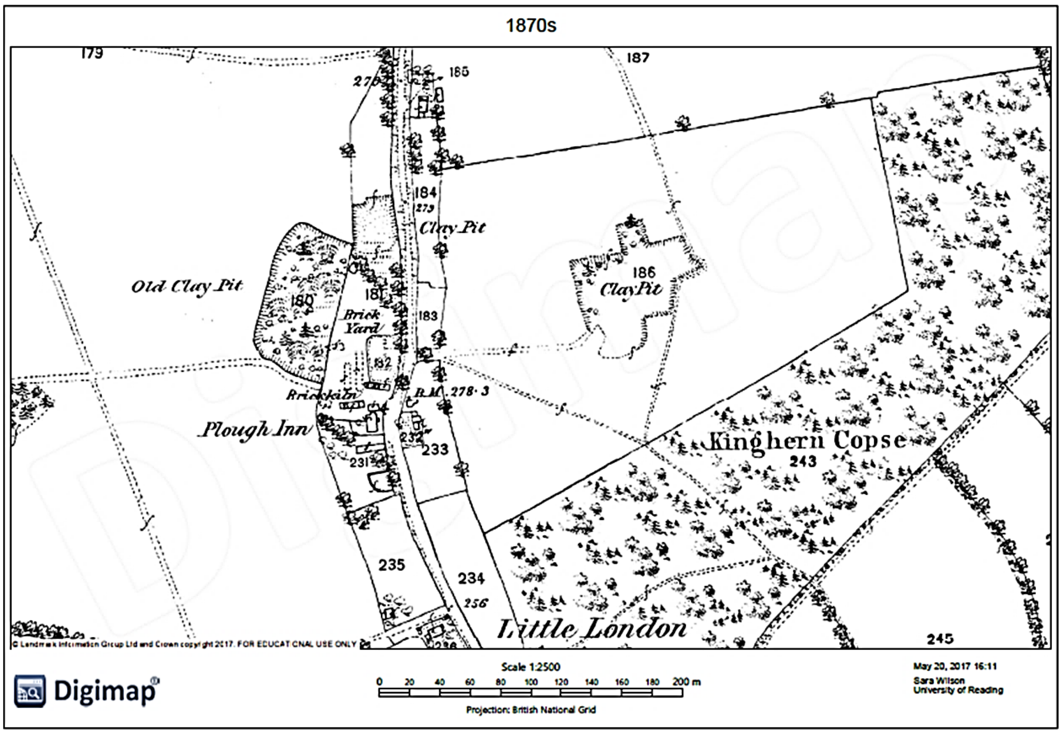
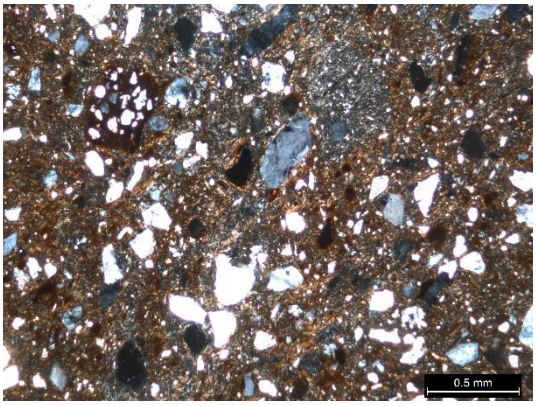
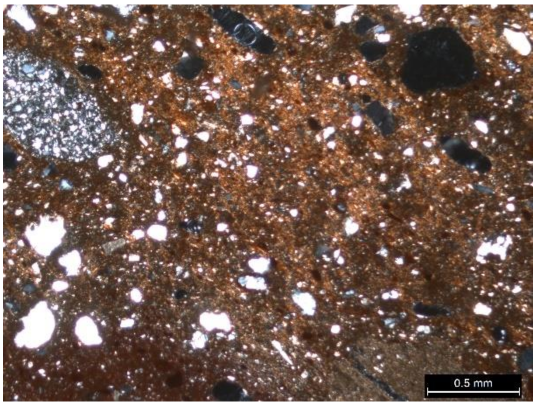
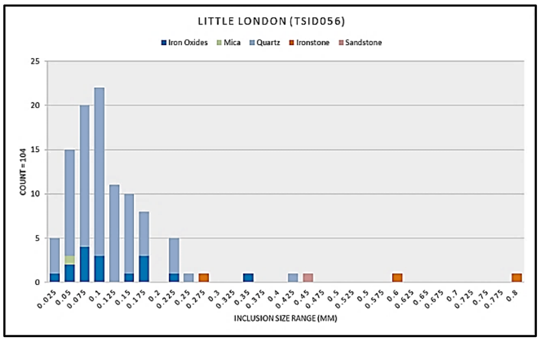


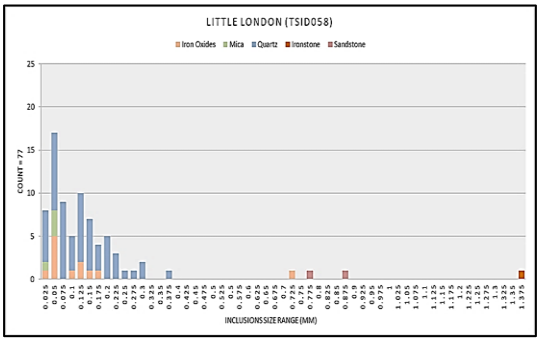
Figure 7.14: 1870s map of the Little London site showing extensive clay pits and brickworks (Digimap: Ancient Roam)

Fabric descriptions: the fabric samples are all heterogenous in hand specimen with evidence of folds within the clay and pale cream clay streaks and pellets visible throughout. The examples are typically oxidised throughout, with occasional iron-oxide grains visible. Surface colours are generally yellowish-brown (10YR 5/4) to pink (7.5YR 7/4). The matrix of the fabric is iron-poor and non-calcareous, very pale brown in both PPL and XP. It exhibits high-speckled optical activity, going in-and-out of extinction in random zones. There is a moderate proportion of quartz present, with sparse iron oxides and rare fragments of iron-stone. Clay pellets are composed of highly optically-active, birefringent clay, exhibiting merging- to- diffuse boundaries and they are equant and distorted in shape. The pellets are very pale brown in colour with neutral optical activity and are typically concordant with the matrix. There is a small proportion of voids, comprising macro-channels and vughs, with preferred alignment and parallel orientation.





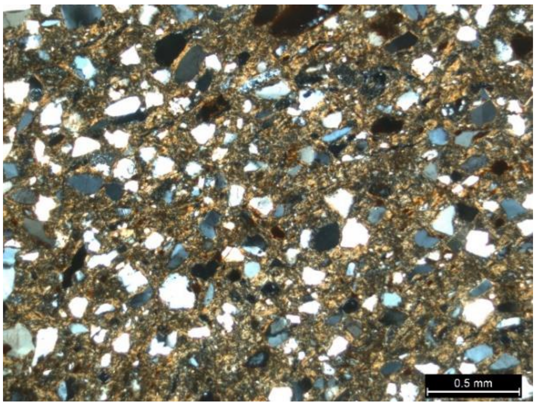




Min = 0.0145mm	Max = 0.7726mm	Mean = 0.11279mm	Mode = 0.0536mm	StdDev = 0.10927mm	Min = 0.0118mm	Max = 1.3684mm	Mean = 0.1463mm	Mode = 0.0623mm	StdDev = 0.2066mm

***Figures 7.14, 7.15, 7.16 & 7.17**: Photomicrographs of Little London fieldwalking samples (TSID056; TSID058) (XP, x40 magnification) along with results of grain-size distribution from textural analysis*

All samples shared compositional similarities with the **SILCBM3** group, which has been identified as originating from a *Windlesham Formation* source. This group includes the fabric of all 12 examples of the Nero-stamped tiles and relief-patterned flue-tiles, dies 39 and 68. When comparing the compositional and textural analysis of the fieldwalking samples with **SILCBM3** (Figures 7.14, 7.15, 7.16 & 7.17), if the larger rock fragments are excluded, then the composition of the inclusions and their sizes are directly comparable. The closest match is the **SILCBM3B** example (TSID288) which exhibits a very similar composition (Figures 7.18 & 7.19).



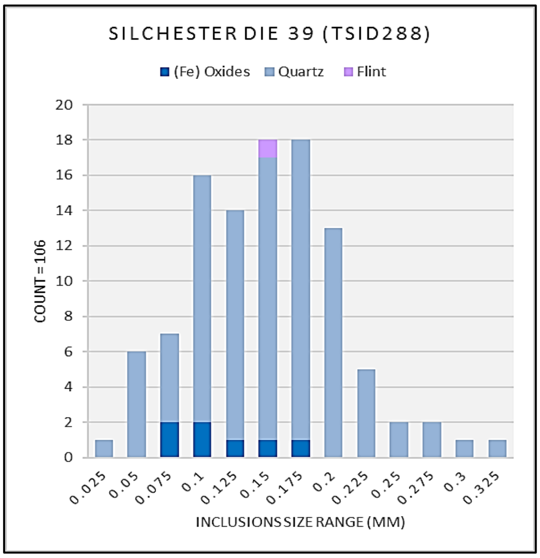


*Figure 7.18: Photomicrograph of **SILCBM3B** fabric (TSID288) (XP, x40 magnification)*

*Figure 7.19: Grain-size distribution of textural data from **SILCBM3B** fabric (TSID288)*

Discussion: These samples have been shown to have strong similarities with both the *Windlesham Formation* clay samples (see section 6.2.4) and the Silchester fabric **SILCBM3** (section 6.3.3) group which includes the Nero-stamped tiles and relief-patterned tiles. This would support the evidence that Little London was the site of an early Romano-British tilery, exploiting the *Bracklesham Formation* to the north, rather than the *London Clay Formation* to the south.

7.5. Scotland Farm, Hampshire

Site Description: deep ploughing at the site in the 1940s revealed an abundance of brick and tile fragments with a noted absence of stone tiles, characteristic of local Roman building traditions. The site was excavated in 1970 for the Farnham Museum Society (Graham, 1971). It is located approximately 14km south-east of Silchester and is around 6km east of the Silchester-to-Chichester Roman road. (Accession number: 1970.464 – Hampshire Cultural Trust).

Grid reference: SU742533

Kiln structure: the kiln was rectangular in shape (2.3 x 5.7m), with an open eastern end and a stokehole approximately half way along the southern wall (Goodburn *et al.*, 1976). The walls were constructed of used tiles and stood, in parts, to a height of 1ft 6in (approximately 45cm) (Figure 7.20). The kiln had been partially demolished after an apparently short period of use. There is no evidence of repairs to the kiln structure, which was dismantled at the end of its life by removing the walls and the filling the central flue with wasters and bonding clay. This dismantling occurred shortly after the final firing as traces of logs were preserved in the ash layer and would suggest that the demand for brick and tile had been met (*ibid.* p.26).

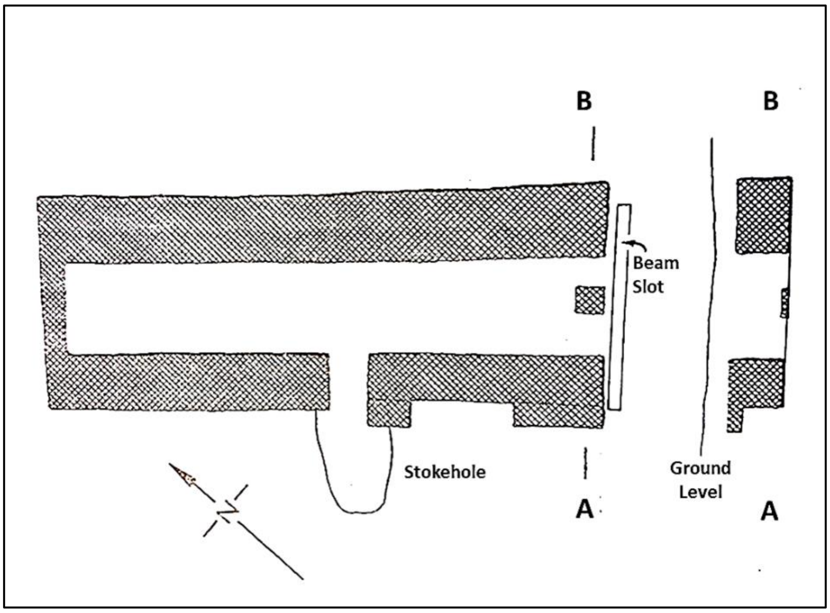


Figure 7.20: *Plan of the kiln structure excavated at Scotland Farm (After McWhirr 1979 Fig.6.12)*

Products: *tegulae* were produced with average dimensions of 37.5cm x 27.5cm (15ins x 11ins), the majority of which had a semi-circular signature (Graham, 1971, p. 29). *Imbrices* were also made, but none with complete dimensions were recovered. *Bessales* would appear to have been the most common product of the kiln.

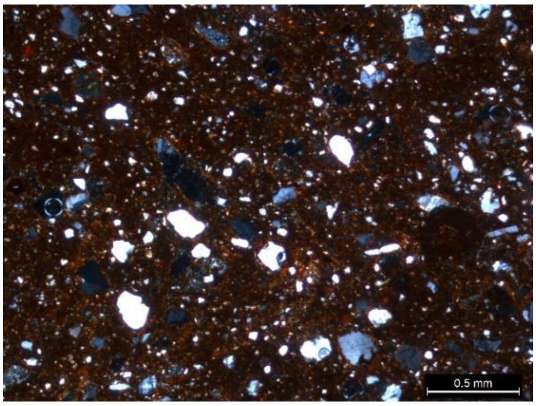
Dating: The sole dateable find came from the rubble infilling of the kiln walls. This was a coin, Constantinian (c.A.D.330-A.D.335). The nearest known Roman building to the kiln is the villa at Lodge Farm, where the occupation has been dated to the 4th Century. It has therefore been hypothesised that the kiln was constructed in order to supply tiles for one of the main phases of construction of the villa (*idem.*).

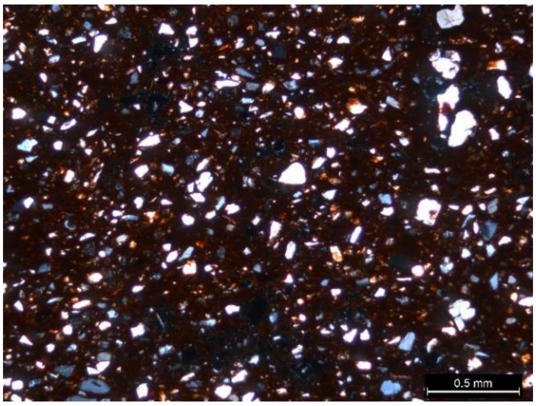
Geology**:** The site is located on the *London Clay Formation (Clay, silt, and sand)*. The kiln was located on the drier valley gravel, rather than the waterlogged *London Clay* nearby, which is within 200 metres of the kiln and likely to have been the source of raw materials for the tile production (*ibid.,* p.26).

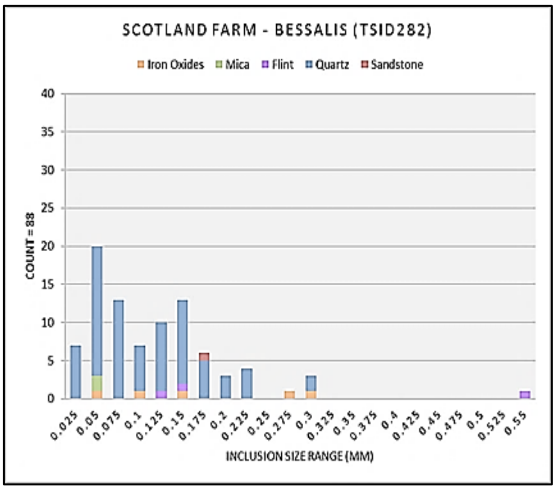
Samples: Only two tiles were retained following the excavation, one fragment of *tegulae* and one complete *bessalis*. Both these have been analysed and sampled for thin section petrography.

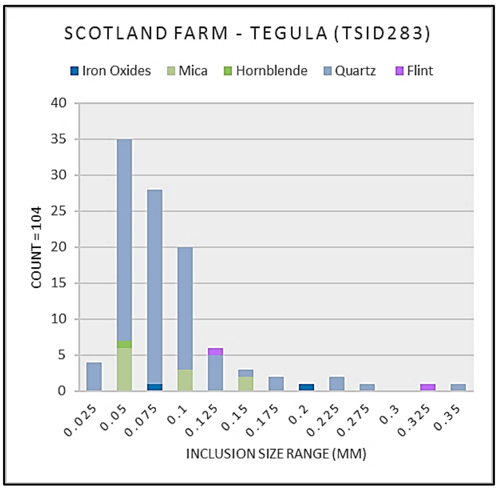
Fabric description: Both fabrics are optically inactive and principally homogeneous. Both have a small proportion of highly birefringent clay pellets, which exhibit neutral optical density, with merging-to-diffuse boundaries and typically discordant with the matrix. The quartz fraction distinguishes the fabrics. The *bessalis* (TSID 282) has equal proportions, approximately 7%, of both silt-sized quartz and medium quartz sand, whilst the *tegula* has common (20%) silt-sized quartz throughout. The other minerals present are iron-oxides, heat-altered glauconite, muscovite mica and fragments of flint. These fabrics are both typical of products made from the *London Clay Formation*.

Figures 7.22 and 7.23, show the weakly bi-modal fabric with small proportions of quartz, up to 3mm, as seen in **SILCBM1A**. Figures 7.23 and 7.24 shows the finer quartz component, the major being <0.125mm as seen in **SILCBM1B**.









Min = 0.0103mm	Max = 0.5496mm	Mean = 0.10499mm	Mode = 0.0396mm	StdDev = 0.08357mm	Min = 0.0065mm	Max = 0.3259mm	Mean = 0.07396mm	Mode = 0.0275mm	SttDev = 0.05455 mm	

Figure 7.21 & 7.22: *Photomicrograph and grain-size distribution of Scotland Farm bessalis (TSID282) (XP, x40 magnification)*

Figure 7.23 & 7.24: *Photomicrograph and grain-size distribution of Scotland Farm tegula (TSID283) (XP, x40 magnification)*

Discussion: the lack of occupation evidence in the environs of the kiln site, along with the restricted range of products is interpreted as evidence that the kiln was intended to supply tiles during a short period of construction in the local area. The 4th century date for production has been linked to local villa sites. It would not be possible to confirm if Scotland Farm products reached Silchester as *London Clay Formation* products are ubiquitous in the area due to the easy access to *London Clay Formation* sources.

7.6. Love Lane, Shaw

Site Description: The site was discovered during a watching brief during construction of a new link road, to the east of Newbury, approximately 17km west-north-west of Silchester. Two circular kilns were excavated along with a large quantity of Roman brickwork which showed evidence of having been subjected to extreme heat (Ford, 1974; Wilson, 1974, p. 457). There was also a large dump of unfired clay found at the site comprising two distinct types of clay from which samples were taken and retained in the archive (Accession number: NEBYM 1988.133 – West Berkshire Heritage).

Grid reference: SU473648

Kiln structure: the two kilns excavated were circular, 1.6m and 1.9m in diameter, see figure 7.25, showing the kilns during excavation. They are described in the archive as pottery kilns built of re-used tile, a third kiln was located but not excavated.

Figure 7.25: *Two pottery/tile kilns at Love Lane, Shaw under excavation. (© West Berkshire Museum Archive).*

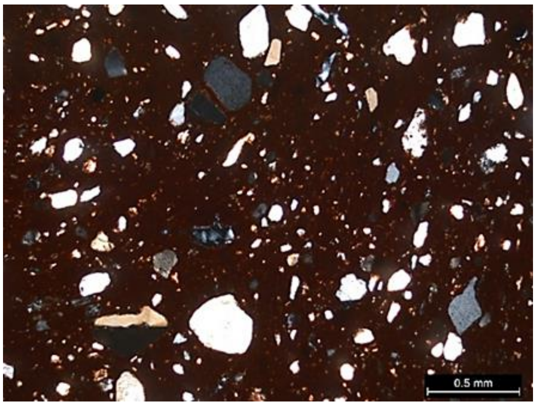
Products: the products of the kiln have been identified as *tegulae* and *imbrices*, along with relief-patterned tiles (die 54) and combed flue-tiles.

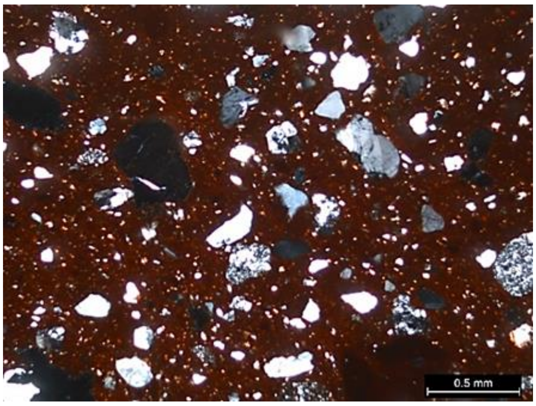
Geological situation: the site is located on the *London Clay Formation (Sand).*

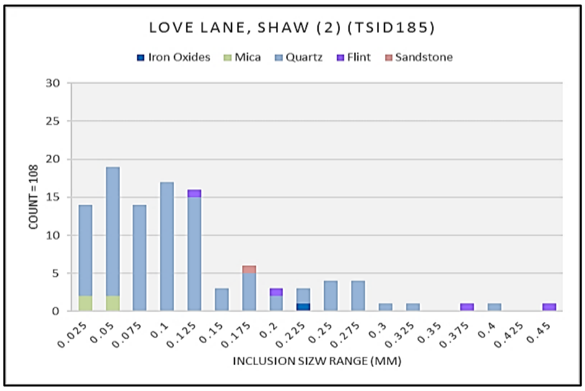
Samples: samples were obtained from the archive held at Newbury museum services. These were selected from examples of relief-patterned tiles, over-fired examples of *tegulae* and *imbrices*, and combed flue-tiles.

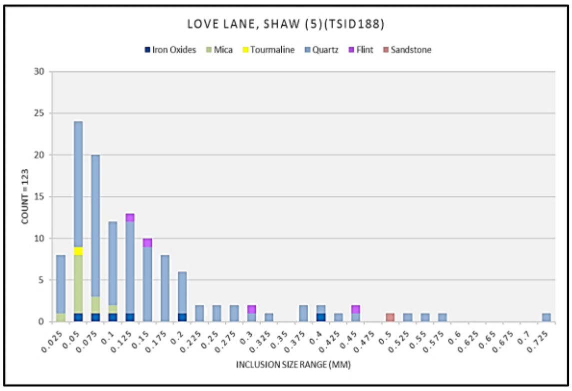
Dating: dating of the kilns is based on the dating of pottery found within the northernmost kiln, this production has been dated to the late-1st to early-2nd century A.D.

7.6.8 Fabric description: the samples can be separated into two distinct fabrics. One, illustrated in figures 7.26, 7.27, 7.28, & 7.29, is an iron-rich, homogeneous, non-calcareous fabric with a high proportion of quartz grains present, both silt-sized and medium-sand quartz grains. The matrix is mid-orange brown in PL and mid-brown-orange in XP. It exhibits weak speckled-optical activity. The inclusions are single-spaced with no preferred orientation and the fabric is weakly bi-modal. In addition to the quartz, rounded grains of non-calcined flint are present along with iron-oxides. There is a small proportion (3%) of voids in the form of macro vesicles with no preferred alignment or orientation.







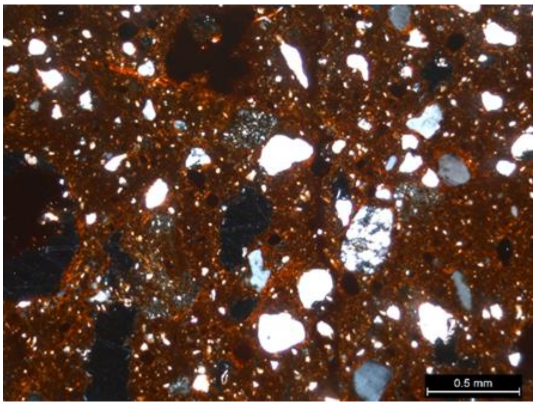


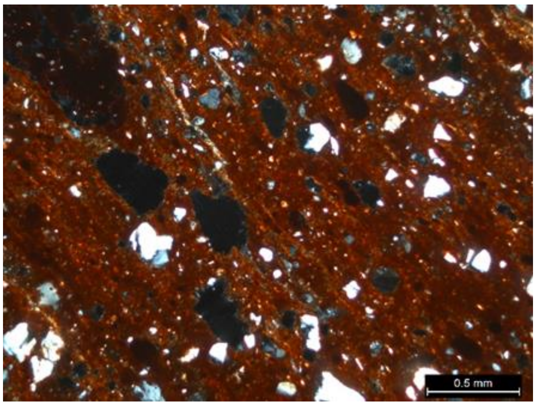
Min = 0.0161mm	Max = 0.4378mm	Mean = 0.10654mm	Mode = 0.0939mm	StdDev = 0.08578mm	Min = 0.0161mm	Max = 0.712mm	Mean = 0.13457mm	Mode = 0.0203mm	Std Dev = 0.13086 mm

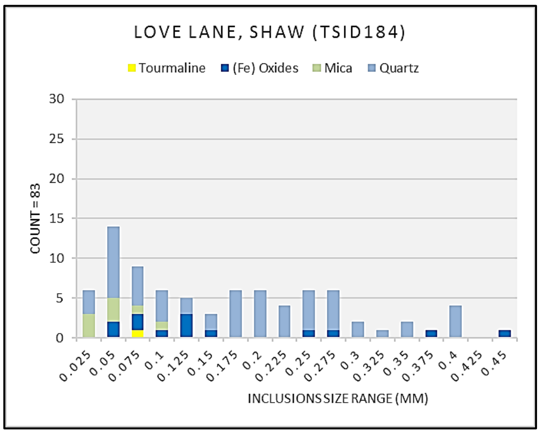
Figures 7.26 & 7.27: *Photomicrograph & grain size distribution of Love Lane sample – combed flue tile (TSID185) (XP, x40 magnification)*

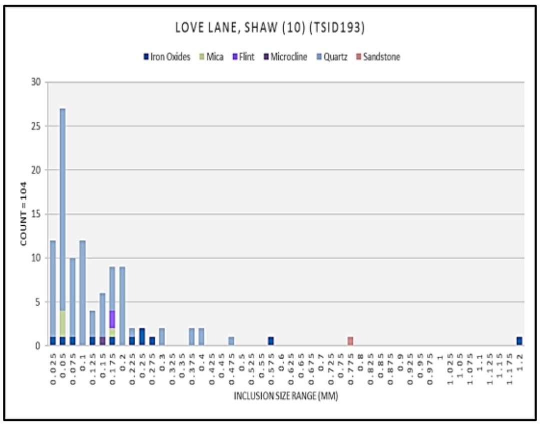
Figures 7.28 & 7.29: *Photomicrograph and grain-size distribution of Love Lane sample – relief-patterned flue-tile die 54 (TSID188) (XP, x40 magnification)*

The other fabric comprises a heterogeneous matrix which is mid-brown in PPL and mid-orange brown in XP, exhibiting moderate-speckled optical activity (Figures: 7.30, 7.31, 7.32, & 7.33). There are quartzose bands visible, cemented by a highly birefringent clay. These quartz grains are larger than the quartz silt present throughout the matrix, and some have become disaggregated through the fabric. There are a few bands of highly birefringent pale clay. Occasional grains of non-calcined flint are also visible. Inclusions are single-double spaced, with weak orientation.









Min=	Max=	Mean=	Mode= n/a	StdDev=	Min=	Max=	Mean=	Mode=	StdDev =
0.0181mm	0.4393mm	0.15635mm		0.11581mm	0.0124mm	1.1933mm	0.12589mm	0.0605mm	0.1610mm

Figure 7.30 & 7.31: *Photomicrograph & grain-size distribution of Love Lane sample – combed flue tile (TSID184) (XP, x40 magnification)*

Figure 7.32 & 7.33*: Photomicrograph & grain-size distribution of Love Lane sample – imbrex (TSID193) (XP, x40 magnification)*

Quartz inclusions dominate all the samples, with occasional larger rock fragments present. The two distinct fabrics have affinities with both clay samples and the Silchester fabric series. The micaceous quartz-rich fabric is likely derived from the *London Clay Formation* and is very similar in composition to the **SILCBM1A** fabric. The second more heterogeneous fabric is like **SILCBM5**, which comprises approximately 4% of the Silchester assemblage. However, geo-chemical results, figure 7.34, show little correlation between **SILCBM1** and **SILCBM5** and the Love Lane samples (PC-SHAW).

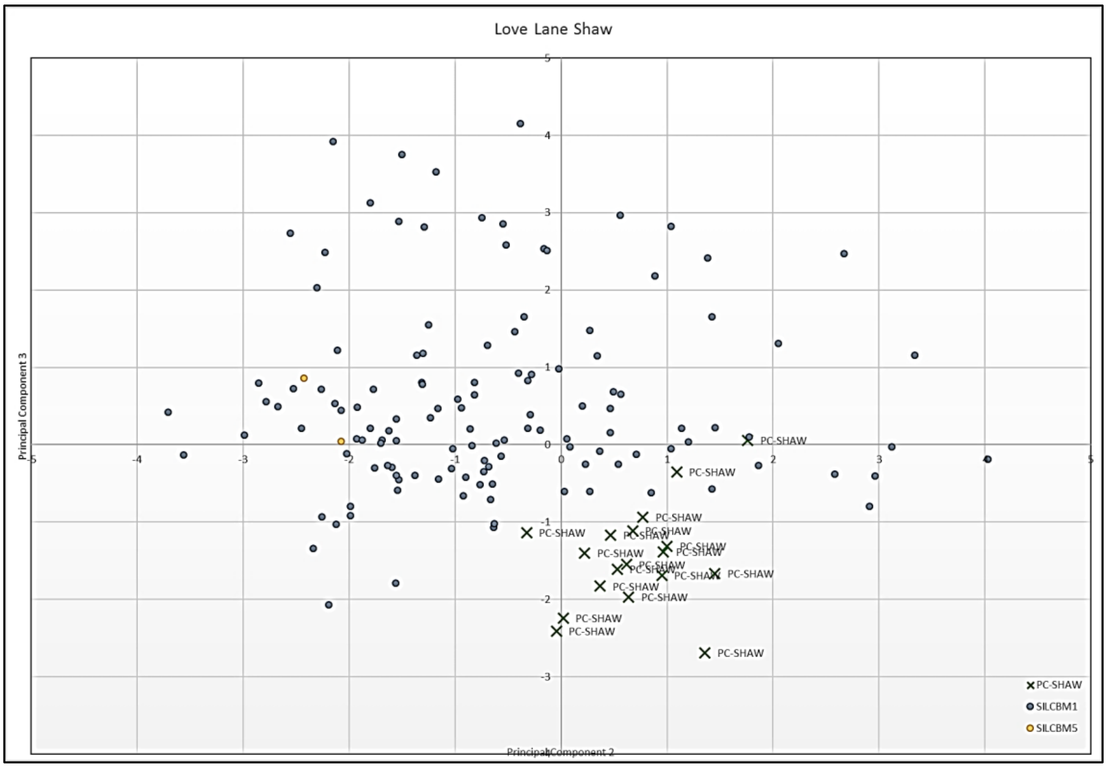


***Figure 7.34**: Results of PCA classification of the Love Lane, Shaw samples and Silchester fabric Series, **SILCBM1** & **SILCBM5** fabrics, based on the normalised abundance of 13 elements;*

Discussion: There must be a note of caution as to whether the assemblage of tile recovered from the site are products of a tilery, or a sample of the construction materials for the 2+ pottery kilns identified. The size and form of the excavated kilns at Love Lane make them more likely to be pottery kilns, rather than for the production of tiles. There are small circular structures which could have taken only an extremely small load of tiles. Though it is likely that given the quantity and variety of CBM in their construction that a tile kiln(s) is/are close by. Whilst, tile kilns often use CBM in their construction, pottery kilns rarely do (M. Fulford, *pers comm.*). Romano-British tile kilns in Britain are typically rectangular or square in shape (McWhirr, 1979c) in Sicily and southern Italy examples of both rectangular/square shape and round/oval shapes have been recorded, see figure 7.35 (Cuomo Di Caprio, 1979).

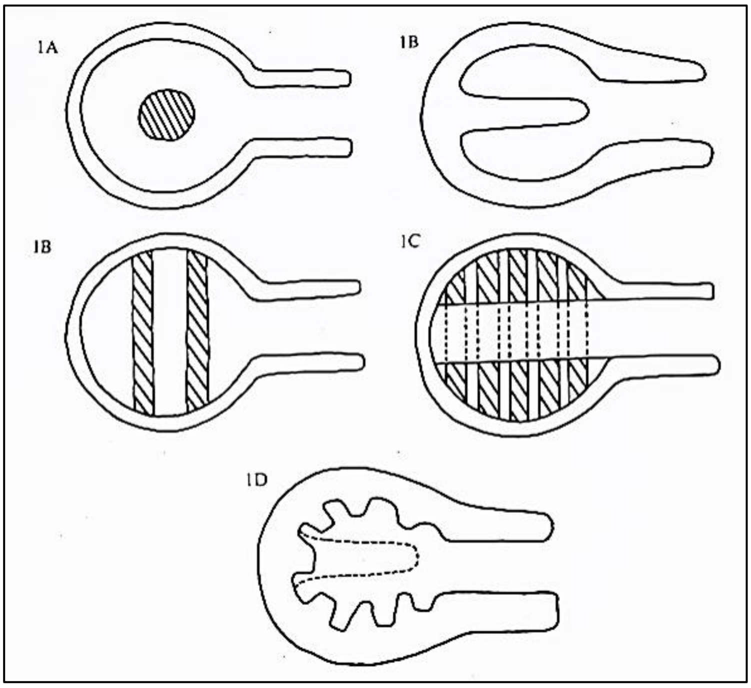


Figure 7.35: *Examples of circular tile kilns* (After Cuomo Di Caprio, 1979 Fig. 5.2)

The assumption of tile production does seem to be based on the presence of tiles that have been subjected to extreme heat. However, as the kilns are described has having been constructed of re-used tile, this tile would then have been subjected to heat during the pottery firings.

7.7. Dockenfield, Hampshire

Site Description: fieldwalking at Dockenfield Farm in 1981 revealed the location of a Romano-British tile kiln. An excavation was undertaken in September 2015 which exposed a tile kiln, the first tile production site recorded in or near the Alice Holt Roman pottery industry (Graham and Graham, 2015). The site is located some 30km to the SSW of Silchester.

Grid reference: SU828404

Kiln structure: the kiln has a square combustion chamber with five, arched, internal cross-walls serviced by a long, tile-built, arched fire-tunnel with a stoke pit at the western end (Figure 7.36); the fire chamber and floor had not survived (Graham and Graham, 2015).

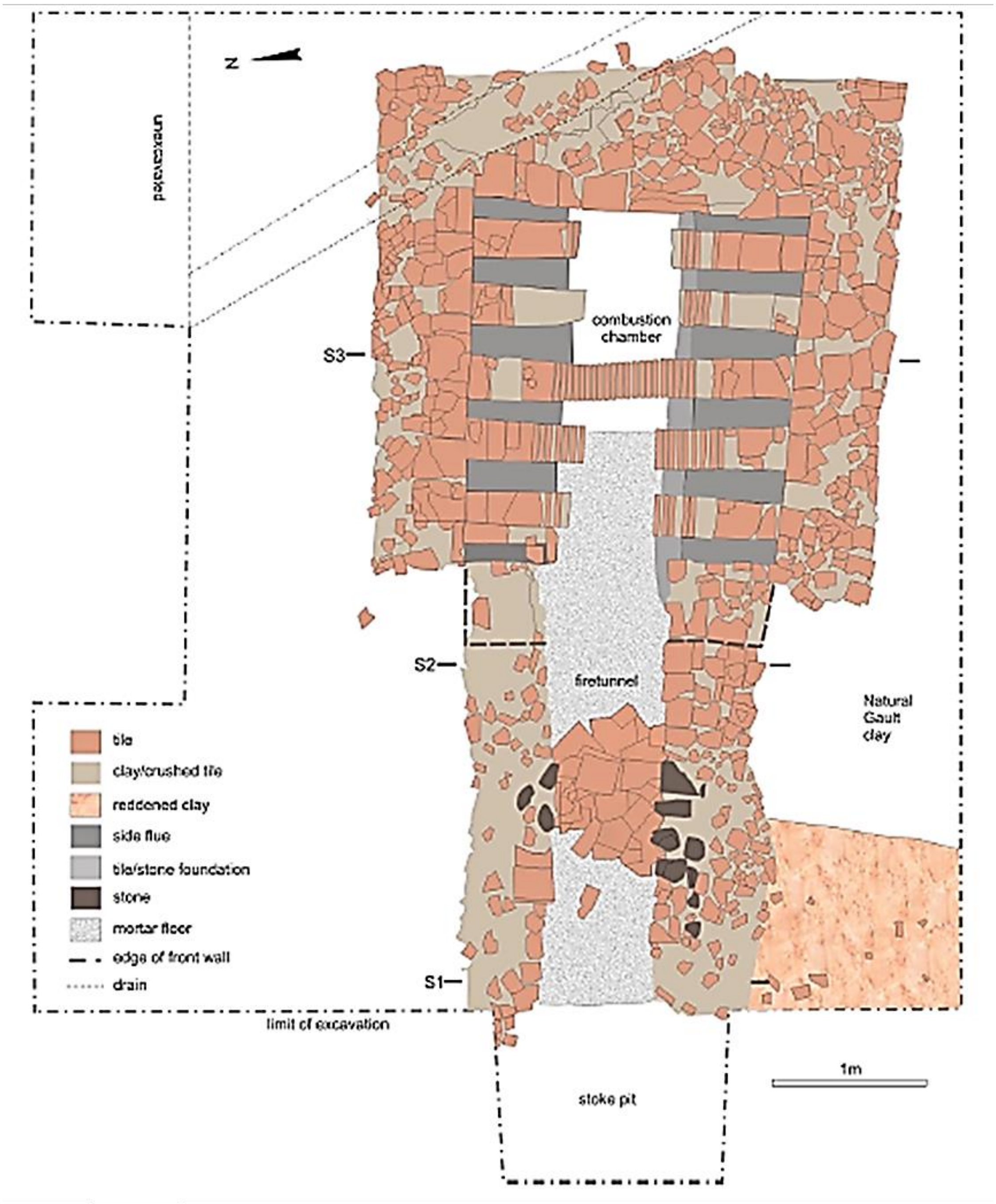


***Figure 7.36**: Post-excavation plan of tile kiln (After Graham & Graham 2015 Fig.3.)*

The structure is comparable in design to other Roman tile kilns excavated in Surrey, for example, Rosehill, Reigate (Jones, 2004) and Ashtead (Bird, 2014), albeit smaller and rather later in date than these examples (Graham and Graham, 2015). The fire tunnel was 2.3m in length and varied in width from 0.77m to 0.58m, the arched tunnel was 0.6m in height and formed of a continuous tile-built arched structure. The combustion chamber measured 2.36m by 2.2m, forming a slightly trapezoidal shape, divided by five arched cross-walls (*ibid*. pp.3–4).

<u>Products:</u> floor tiles, *imbrices* and *tegulae*.

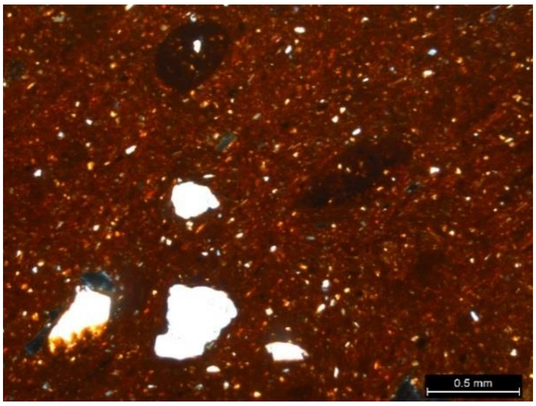
Dating: the kiln has been dated to the late 3rd- early 4th century on basis of the rim of a grey ware beaker recovered from beneath the stone rubble layer in the stokepit of the kiln. This is believed to be from the local Alice Holt industry, (Graham and Graham, 2015).

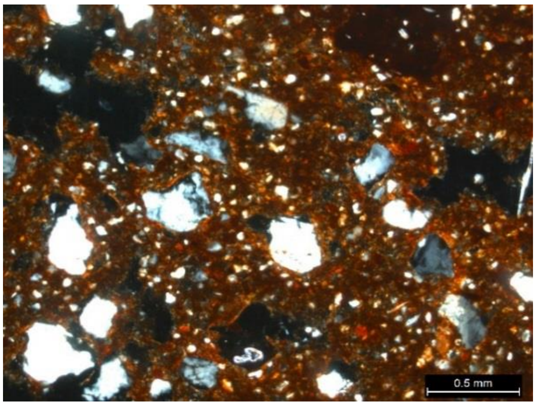
Geology: the site is located on the *Gault Clay Formation*, to the east the clay meets the sands of the *Folkstone Beds* and to the west it ends at the chalk of the *Binsted Ridge.*

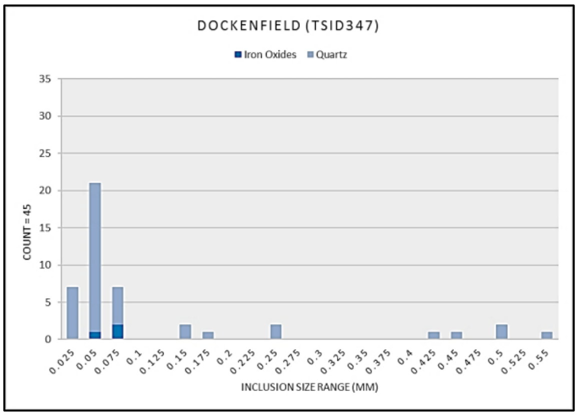
Samples: samples were obtained from the following contexts: 105: kiln waste including *tegulae*; 104: bricks; 201; 203;

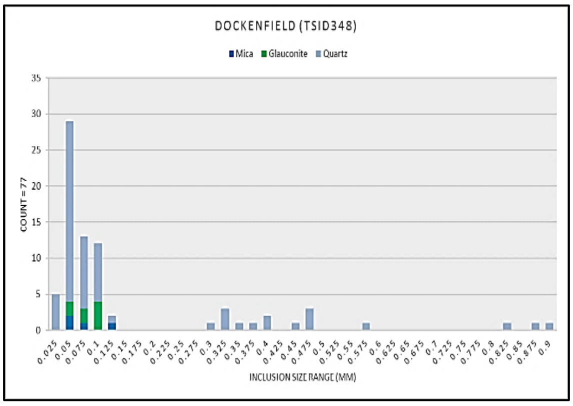
Fabric descriptions: Two fabrics have been identified in the samples from the Dockenfield tilery. One fabric, illustrated in figures 7.37 is weakly bi-modal. This is highlighted in the grain-size distribution, figure 7.38, showing a peak of fine silt quartz and a small proportion of larger quartz grains. The matrix is optically inactive, moderately heterogeneous, and mid-orange colour in both PPL and XP. The small proportion of voids (2%) reflect the low porosity of the fabric, they exhibit no preferred orientation or alignment. The other minerals comprise iron-oxides and biotite mica. There are a small number of clay pellets, which are distorted with diffuse boundaries, they are optically neutral and typically discordant with the matrix. These are of the same colour as the surrounding matrix.

The other fabric, figures 7.39, has a paler matrix, typically mid-yellow brown in PPL and XP. The matrix is micaceous, weakly optically active, and typically oxidised throughout. There are components of both fine quartz silt and medium quartz sand, in much higher proportions than (TSID347) (Figure 7.37). There is a high proportion (10%) of heat-altered glauconite grains, indicating a highly glauconitic clay source. The results of textural analysis, figure 7.40, illustrate the higher proportion of quartz present throughout and the glauconitic nature of the fabric. There are bands/layers of medium quartz sand throughout the matrix. This could be a result of the addition of coarser quartz grains or a remnant of naturally occurring quartzose veins in the source clay. There are pellets of highly birefringent pale yellowish orange clay. These are optically active with diffuse to merging boundaries, rounded equant shape with evidence of distortion demonstrating their plasticity when fired.









Min =	Max =	Mean =	Mode =	StdDev =	Min =	Max =	Mean =	Mode =	StdDev =
0.0162mm	0.5384mm	0.10195mm	n/a	0.14097mm	0.0132mm	0.897mm	0.14337mm	0.0332mm	0.196642mm

Figures 7.37 & 7.38: *Photomicrograph and Grain-size distribution of Dockenfield sample (TSID347) (XP, x40 magnification)*

Figure 7.39 & 7.40: *Photomicrograph and grain-size distribution of Dockenfield sample (TSID348) (XP, x40 magnification)*

Discussion: the kiln was producing a limited range of products, as seen at Scotland Farm (section 7.5), which again would imply a limited market. There are two small Roman farmsteads known in the immediate area, but neither show evidence of having had tiled roofs (Howe, Jackson and Maloney, 2002). It is possible that the market was for the small number of villas in the area, or to supply the Roman towns somewhat farther afield at Chichester, Winchester, and Silchester (located 35km, 36km and 30km distant respectively) with movement facilitated by the Roman road network connections. Sample (TSID347) has definite affinities with the Silchester fabric **SILCBM1A** – having a homogeneous micaceous silty matrix with the addition of medium quartz sand. This again is a product of the abundant *London Clay Formation*.

7.8. Ashtead, Surrey

Site Description: Lowther's 1927 report of investigations at the Roman villa site at Ashtead Common describes the discovery of an area littered with kiln wasters consisting of "fused and over-burned tiles of every description" (p.153). Anomalies near the villa, identified by magnetometer survey, were selected for investigation on the assumption that this was the location of the tile kiln. The kiln was discovered on the edge of a clay pit.

The site is located off a branch road of Stane Street, the London-to-Chichester Roman road, it is approximately 55km east of Silchester.

Grid reference: TQ177602

Kiln structure: the excavated structure consisted of one kiln built on top of a previous kiln structure. The first kiln was built into a large rectangular pit with sloping sides and a deeper trench along the middle for the central flue (Fig. 7.41). The kiln itself was about 3.5m long and 3.25m wide. The whole structure was built of tiles, with eight inclined side-flues. The first structure was eventually replaced with another kiln built on top, at which time the first was truncated to a third of its height and backfilled to allow for a second kiln to constructed on top of it (Bird, 2014).

Figure 7.41*: Ashtead tile kiln under excavation (After Bird 2014, Fig.7)*

Products: *tegulae*; *imbrices*; relief-patterned tiles, dies 1 & 66 are known to have been produced at Ashtead, whilst dies 4, 5, 6 & 14 are used in the adjacent villa and are presumed to be products of the Ashtead kiln, figure 7.42 (Betts, Black and Gower, 1994, p. 16) Box-flue tiles with unusual fish-tail appendages and "lamp-chimneys" were also produced and have been found in the construction of the villa (Lowther, 1934).

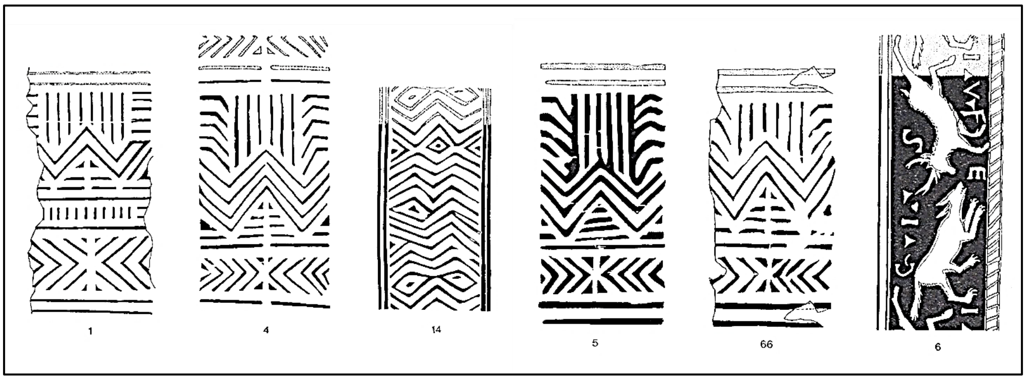


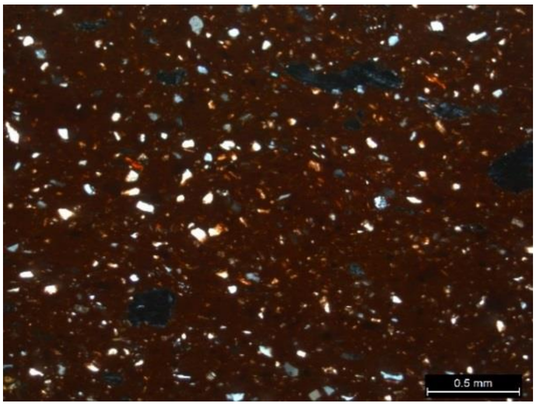
Figure 7.42: examples of the relief-patterned tiles produced at Ashtead, Surrey (After Betts et al. 1994)

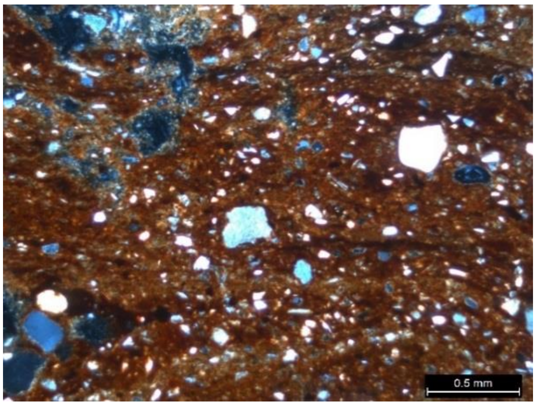
Dating: Both kilns produced almost identical dates following archaeomagnetic analysis, dating the last firing to within the range A.D.205-225 at 95% confidence interval (Noel, 2011). Evidence of repairs to the central flue and the reconstruction of the kiln at the end of the 2nd century, as described above, suggests a prolonged period of use. The clay pit is also noted to cover a considerable area, implying a major industry operating over a prolonged period of time (Bird, 2014).

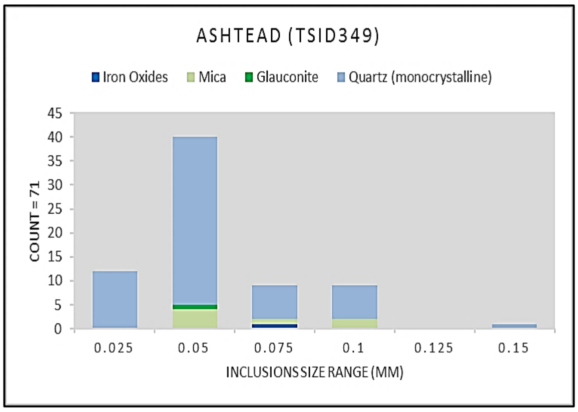
Geology: The site is located on the *London Clay Formation (Clay and Silt).*

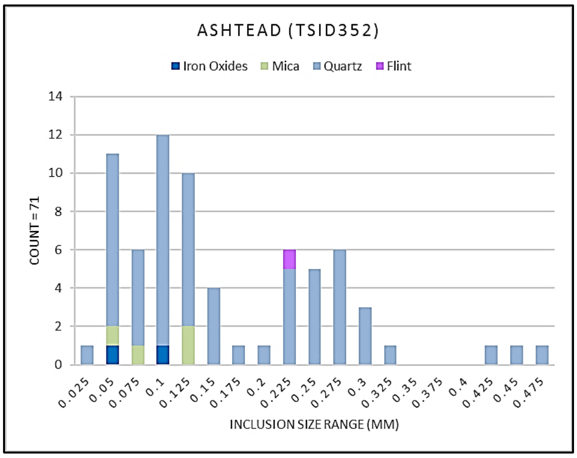
Samples: samples were taken from trench 9 – the kiln trench (ASH4-11), trench 23, kiln related rubbish pit/wasters (ASH14-23); examples of relief-patterned tiles die4 (ASH1-3)

Fabric description: Two fabrics have been identified in the samples from Ashtead. A single example of this iron-rich, non-calcareous, highly micaceous fabric was sampled. The matrix is mid-brown in PPL and mid-reddish brown in XP and optically inactive (Fig. 7.43). The fabric is characterised by a high proportion of quartz silt (20%), along with muscovite mica, heat-altered glauconite and iron-oxides. Inclusions are single-doubled spaced, with weak orientation and no preferred alignment. There are approximately 5% voids, in the form of meso-macro vesicles, with no preferred alignment or orientation. This fabric is comparable with the **SILCBM1B** fabric, of *London Clay Formation* origin, and fine quartz silt throughout. This is reflected in the low maximum and mean values from the textural analysis (Fig. 7.44).









Min = 0.0077mm	Max = 0.1461mm	Mean = 0.04530mm	Mode = 0.0498mm	StdDev = 0.02378mm	Min = 0.0107mm	Max = 0.451mm	Mean = 0.14693mm	Mode = 0.1216mm	StdDev = 0.10265mm

Figures 7.43 & 7.44: *Photomicrograph and grain-size distribution of Ashtead sample (TSID349) (XP, x40 magnification)*

Figures 7.45 & 7.46: *Photomicrograph and grain-size distribution of Ashtead sample (TSID352) (XP, x40 magnification)*

The other fabric, is moderately heterogeneous, mid-orange in both PPL and XP with moderate strial optical activity (Figure 7.45). Inclusions are single-to-double spaced with no preferred orientation. The fabric has been poorly worked with folds visible within the samples. There is around 10% poorly sorted quartz present, along with biotite mica, glauconite, and occasional rock fragments including flit, chert and sandstone. The grain-size distribution (Figure 7.46) clearly illustrates the larger size range of quartz inclusions present. This fabric includes samples from both the kiln trench and the trench which identified a dump of kiln waste material. It compares with the **SILCBM5** fabric, which has not been assigned to a clay source.

Portable XRF results show a very limited overlap between the **SILCBM5** samples and those from Ashtead, however the chimney samples from Silchester both plot into the same quadrant as most of the Ashtead samples (Fig. 7.47). With the location of Ashtead on the *London Clay Formation*, the samples have more in common with those of **SILCBM1** and **SILCBM2** identified to have been made of *London Clay Formation* material.

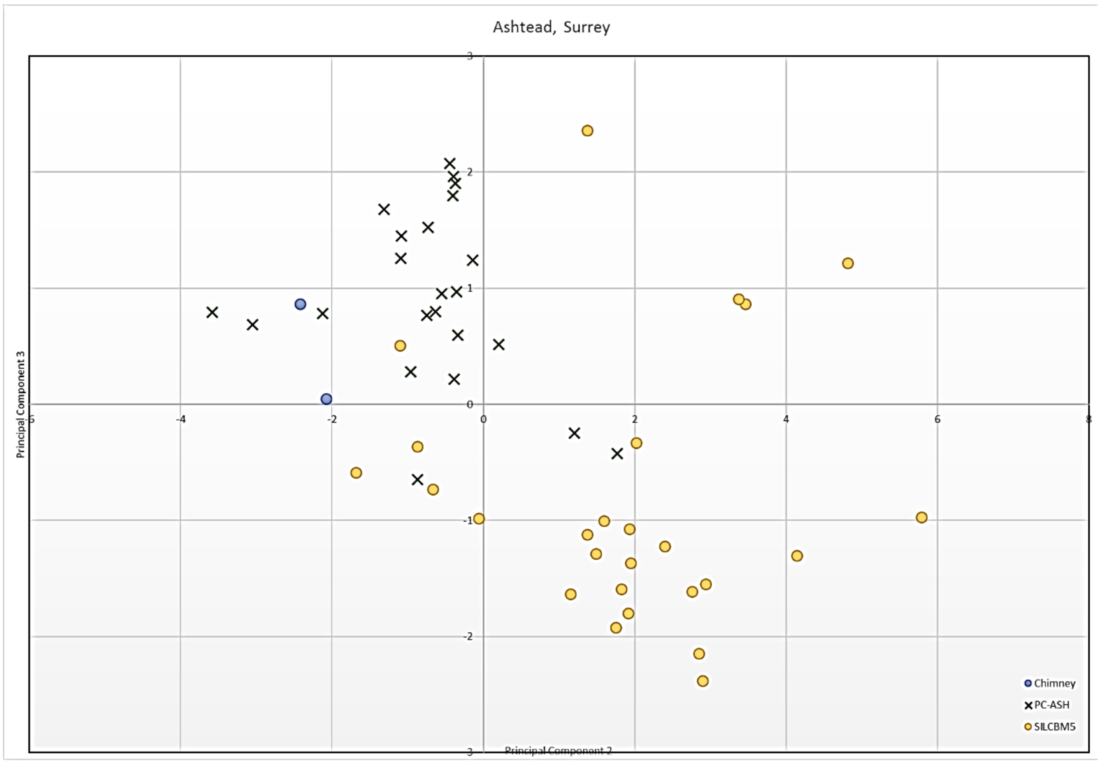
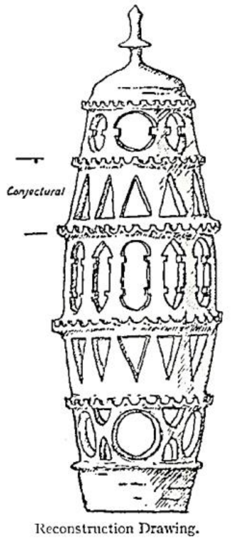


Figure 7.47: *Results of PCA classification of the Ashtead,* ***SILCBM5****, and chimney samples analysed, based on the normalised abundance of 13 elements;*

Discussion: There are clearly two phases of production at Ashtead and it has been suggested that a period of wet weather led to the need to reconstruct the kiln at a slightly higher level than the first. Discussions regarding the tilery at Ashtead suggest that it was originally constructed to produce material for the building of the villa and the bath house, the distribution of relief-patterned *tubuli* demonstrated to have been produced at Ashtead show a concentration in Surrey with the same dies also occurring over very wide areas (Betts, Black and Gower, 1994, p. 29). This has been taken as evidence that this was clearly much more than an estate industry at times, although it likely began as one (Peacock 1982, p.131). The reconstruction of the kiln could be evidence of this shift in production.

As discussed in section 6.3.6, the production of ceramic chimneys would have been a specialist activity, requiring skills beyond those needed for the manufacture of bricks and tiles. The chimney fragments from Silchester have been assigned to **SILCBM5**, which matches the kiln material from Ashtead.



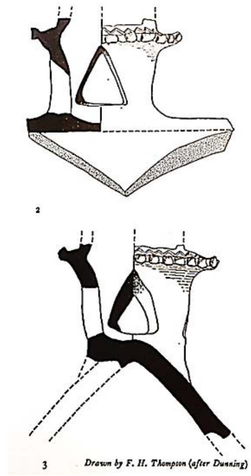


Figure 7.48: *Reconstruction drawing of the chimney from Ashtead (After Lowther 1930 Fig.2.)*

Figure 7.49: *Illustration of chimney from Silchester (After Lowther 1976 Fig4.2/3.)*

The form of the chimney in the Silchester collection has similarities to the Ashtead example (Figure 7.48), particularly the pinched decoration and triangular apertures. Samples of the chimney found in Insula IX are shown in section 6.3.6. Figure 7.49 above shows the chimney from Silchester described by Lowther (Lowther, 1976, p. 39) and takes the form of a chimney which incorporates an *imbrex* for positioning on the roof. They are large, somewhat fragile items. Lowther dismissed the movement of box-flue tiles, particularly those with fish-tail appendages due to their fragility (Lowther, 1948, p. 6). Despite being located approximately 55km east of Silchester, any movement of material would most likely have involved a distance of around 100km. This would involve transporting material into London via Stane Street, then towards Silchester along the River Thames or the road network. It is possible that the material would have been transported directly to Silchester. The villa and kiln at Ashtead is located in close proximity to the Chichester-to-London Roman road, which would have facilitated the transportation of material to London for onwards distribution. However, if the material was to be moved directly to Silchester, this would have required initial transport to the major road, likely to the Silchester-to-London road located approximately 16km north-west of Ashtead. (Fig.7.2). Despite their fragility, Roman pottery is known to have been transported over considerable distances. The similarities in both form and fabric mean it is possible that chimneys were part of Ashtead production repertoire.

7.9. Rosehill, Reigate

Site Description: The kiln is located at Rosehill Way in Reigate and was excavated in 2004.

Grid reference: TQ266506

Kiln structure: the kiln structure is a type III, rectangular, up-draught kiln (Grimes, 1930, p. 59), with upward-sloping flue bottom. The stokehole is square with a 3m fire tunnel and a combustion chamber (4mx 3.5m) comprising of seven cross-walls, diagonal flues and an end wall (Surrey Archaeological Unit 2015). Two piers of Greensand blocks flanked the tunnel entrance and is the earliest known use of Upper Greensand as a building material (Figures 7.50 & 51). Alongside the fire tunnel ran a drain constructed of box-flue tiles, some keyed with combed designs and others with roller-stamped, relief-patterned designs.

Figures 7.50 & 7.51*: Structure of the Rosehill kiln during excavation showing Greensand piers (After Surrey Archaeoogical Unit 2015)*

Products: It is not certain what type of ceramic building materials were being produced, although the backfill debris may be representative. This consisted primarily of *tegulae*, with *lydions* and *imbrices* and very rare examples of combed flue-tiles. A spread of waster material (context 24) was found to the south of the kiln which also consisted of roofing material and floor tiles, but with a larger proportion of flue tiles, some of which were roller-stamped with dies 4 and 5 (Jones, 2004). This spread consisted of lenses of ash and Greensand, supplemented by tile debris, with both over- and under-fired fragments. It is possible that this spread of wasters may have originated from another kiln in the vicinity (Jones, 2004).

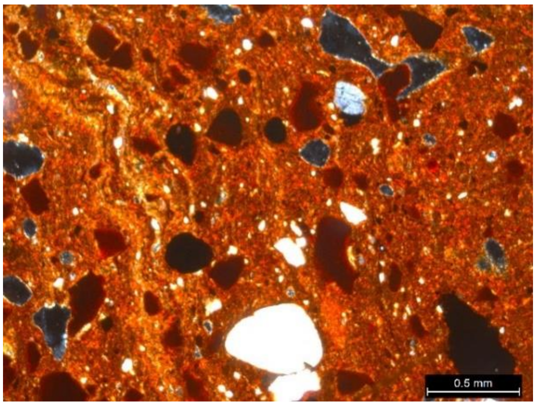
Dating: The basal layers of the stokehole produced sherds of pottery to date the structure to the later 2nd or 3rd century, (Surrey Archaeological Unit 2015). Archaeomagnetic dating of in-situ tiles from the eastern wall of the combustion chamber provided a date of A.D.90-120, which is thought to represent the first phase of usage of the kiln (Jones, 2004). Together, the two strands of evidence suggest a date range for the lifespan of the tilery of cA.D.90 to cA.D.200, indicating a duration of tile production of over 100 years.

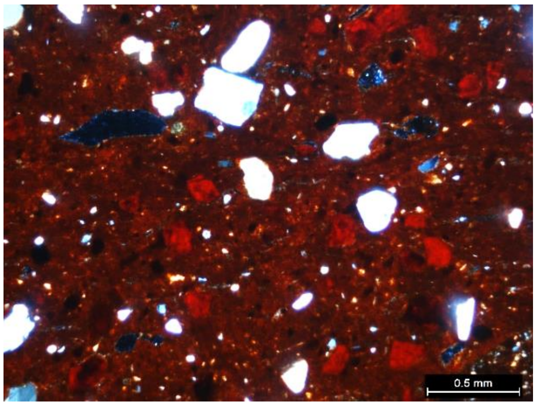
Geology: the site straddles the junction of the *Folkestone Beds* and the *Gault clay*, with sands and sandstones of the former originally lying south of 'Rosehill' garden.

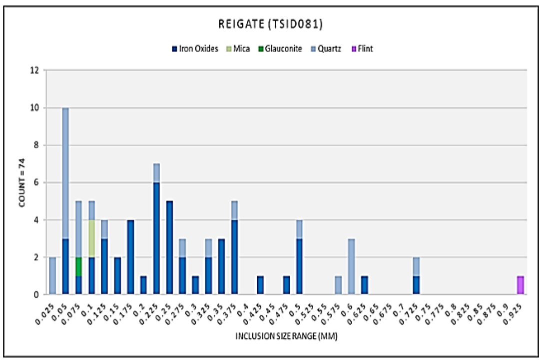
Samples: material was sampled from the waster spread, context 24, including *tegulae*, *imbrices*, and tiles described as 'flat' tiles.

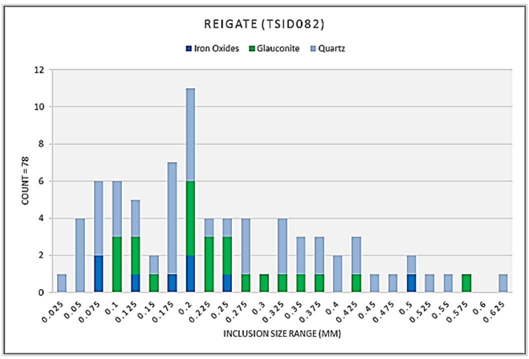
Fabric description: there are brief fabric descriptions included in the site report. All four fabrics are principally iron-rich, with sub-rounded quartz grains and rare sandstone inclusions. The fabrics vary based on the proportion of iron mineral agglomeration present in the material (Jones, 2004). Two of these variations are illustrated in figures 7.52 & 7.54

TSID081 (Fig. 7.52) shows a fabric which is moderately heterogeneous and mid-brownish orange in both PPL and XP. There are pellets and streaks of a highly birefringent pale brown clay, with merging to diffuse boundaries. There is a fine silt quartz component throughout the matrix with additional medium quartz sand. The fabric is iron-rich with a high proportion of iron-oxides throughout. There is a small quantity of voids, in the form of meso-channels, which exhibit no preferred orientation or alignment, there are traces of post-depositional calcite infill to the voids.









Min = 0.0173mm	Max = 0.9221mm	Mean = 0.24855mm	Mode = n/a	StdDev = 0.19876mm	Min = 0.0241mm	Max = 0.6052mm	Mean = 0.22726mm	Mode = 0.1553mm	StdDev: 0.14315mm

Figures 7.52 & 7.53: *Photomicrograph and grain-size distribution of Rosehill, Reigate sample (TSID081) (XP, x40 magnification)*

Figure 7.54 & 7.55: *Photomicrograph and grain-size distribution of Rosehill, Reigate sample (TSID082) (XP, x40 magnification)*

TSID082 (Fig.7.54) is a darker fabric, mid-brownish orange in both PPL and XP. It is a homogeneous fabric, with moderate strial optical activity, going in and out of extinction as a whole. The fabric is bimodal, with weak preferred orientation and open-spaced inclusions. The quartz components again are both fine silt and medium sand but in much higher proportions than TSID081. There is a high proportion of well-rounded, heat-altered, glauconite grains and occasional fragments of non-calcined flint. Streaks and pellets of a glauconitic, birefringent clay are present, with merging to diffuse boundaries. The grain-size distributions demonstrate the differences between the two fabrics in terms of the proportions of quartz, iron-oxides and glauconite (Figs. 7.53& 7.55).

Discussion: The kiln forms part of a complex in the area, including the structure excavated at Doods Farm, Reigate (Surrey County Archaeological Unit 2015), which is thought to have formed part of a wide-scale industry including the tilery at Ashtead. The fabric from the Doods Farm site uses the same raw materials as Rosehill and has been macroscopically and geo-chemically compared with material from London (MOLA fabric 3050). There seems little doubt that material from the complex was used for building projects in the Provincial capital, being part of a far-flung municipal enterprise (Jones, 2004). The MOLA fabric series dates the production of material from Reigate to A.D.140-230, which falls within the estimated production date range for this kiln. There are no fabrics in the Silchester fabric series which compare with the Rosehill fabrics which are highly iron-rich or glauconitic. It therefore seems that this distinctive material was not used at *Calleva*.

7.10. Minety, Wiltshire

Site Description: The site was first noted by A.W.G. Crawford (Crawford, 1921) who noticed a large mound thickly covered with broken fragments of tile. Following a survey of the area a sketch plan was produced by M Stone, which included up to ten kiln structures along with mounds interpreted as tile dumps and hollows as clay pits (Stone, 1983) (Fig. 7.56).

Two kilns were partially excavated by AJ Scammel but this investigation was curtailed following the designation of the site as a scheduled ancient monument (Scammell, no date, p. 3). It is described as a multi-kiln production site, established primarily to supply building materials to the expanding urban centre at Cirencester, around the middle of the 2nd century (Warry, 2017, p. 95). There is also a wide range of pottery types produced at the site, including flagons, mortaria, *ollae* and jugs (Scammell, no date, pp. 16–21). It is not certain whether all the kilns were in use at the site at any one time, or if the number of kilns is evidence of prolonged production over a long period of time.

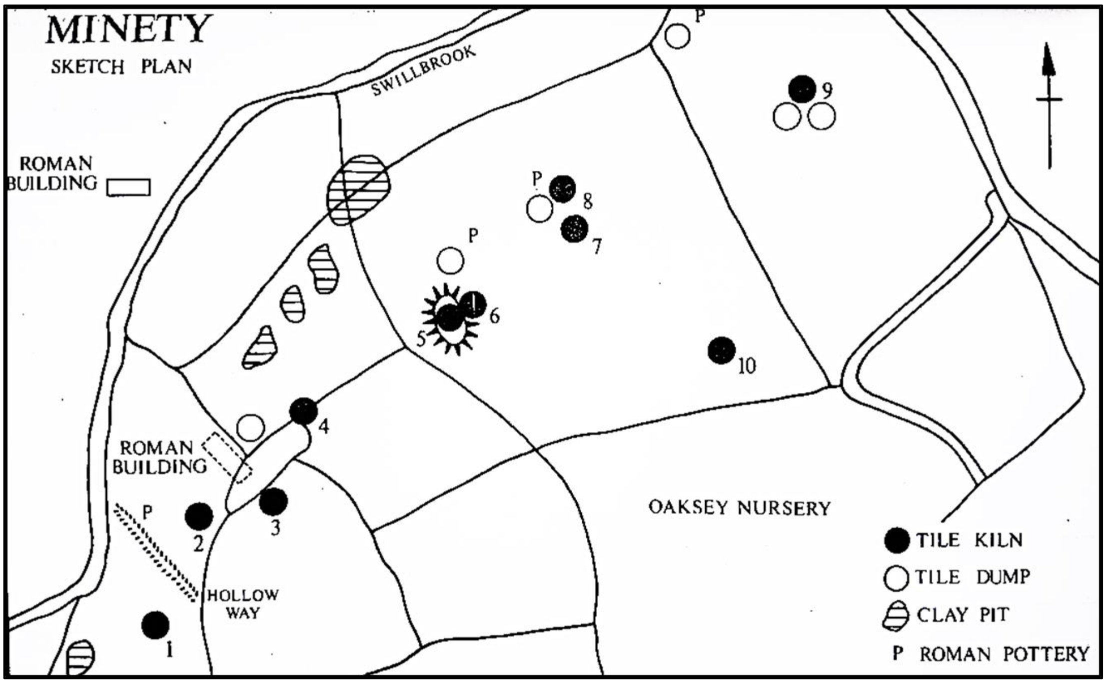


Figure 7.56: *Sketch plan of the large-scale tile production centre at Minety. (After McWhirr 1979 Fig.6.1)*.

Grid reference: ST994921

Kiln structure: Kiln (A) was almost square in shape, 3.4m by 3.3m and constructed of stone, with a tile-built central flue. There is no evidence of burning or traces of ash, leading to the original interpretation of the structure as a fabrication shed. However, it is considered more likely that the structure is that of a tile kiln, which was perhaps never completed (McWhirr, 1979c, p. 182). Kiln (B) was not completely excavated; an outline sketch plan is included in the site report. Despite this, Scammel describes five phases of restructuring of this kiln (Scammell, no date, pp. 6–7). The two kilns excavated were constructed on the same alignment, differing in orientation with kiln (A) having the flue opening to the south-east, whilst kiln (B) opened in a north-westerly direction (*ibid.*, p.10).

Products: *tegulae* and *imbrices* were produced (Scammell, no date, p. 14) along with a wide range of combed products including box-flue tiles, *voussoirs* and flat bricks (McWhirr, 1979c, p. 183) along with relief-patterned tiles (die 556; (Betts, Black and Gower, 1994, p. 28)). There is a wide variety of box-flue tiles keyed with combed designs in the Minety assemblage; 27 different designs were identified, which are illustrated in figure 7.57 The products also included tiles with the stamp TPF, of which 21 different variants are believed to have originated from Minety, with an approximate production-span of *circa* 50 years (Warry, 2017, p. 95).

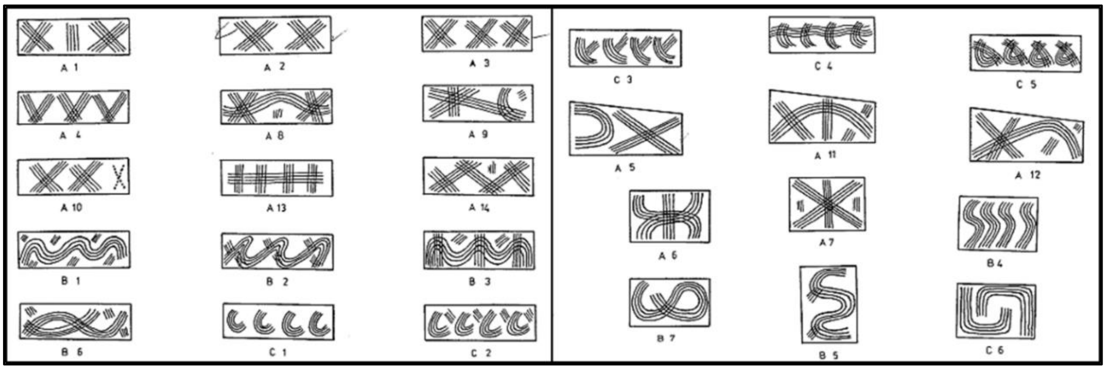


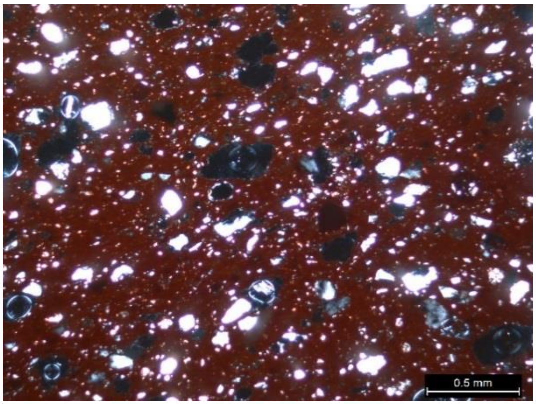
Figure 7.57: *examples of combed flue-tile designs from Minety (After* (Scammell, no date)*Fig. 7.52)*

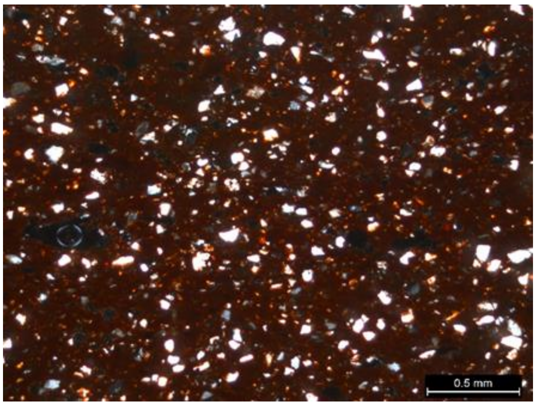
Samples: Material recovered during fieldwalking at the site at Oaksey Park, collected by Michael Stone, was sampled. They include fragments of *tegulae*, *imbrices*, and combed flue-tile, along with a single example of relief-patterned tile (die 56).

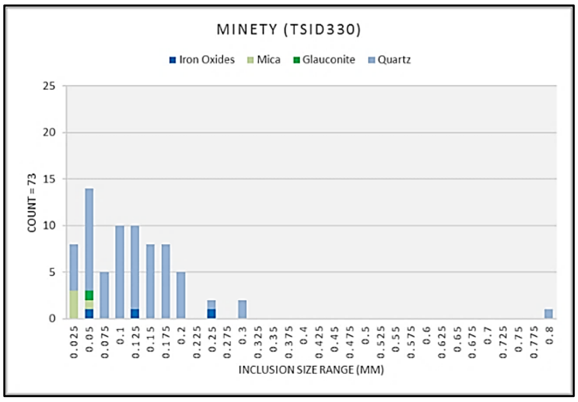
Dating: The kiln site has been dated to the 2nd-to-4th centuries by association with the pottery recovered. A production date range of A.D.65-150 was proposed by Mike Stone, based on the dating of tiles believed to have been produced at Minety and recovered from early contexts at Lower Wanborough roadside settlement (Mepham, 2001, p. 316). TPF-stamped tiles have rarely been found built into structures which themselves have been independently dated. However, most of the TPF-stamped tiles from Hucclecote villa were found in the first-phase building which was demolished *c.*A.D.150 (Warry, 2017).

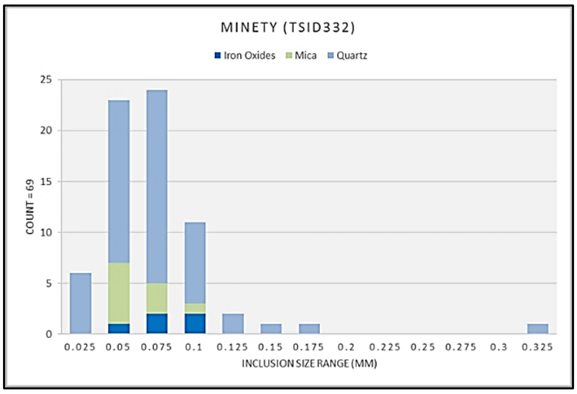
Geology: The site is located on the *Oxford Clay Formation*, with *Upper Lias*, *Lower Lias* and *Kimmeridge Clays* also accessible. The excavation report confirms that both the *Oxford Clay* and *Lias Clay*s were used in the production, often with the addition of temper, including crushed flint (Scammell, no date, p. 4). The *Oxford Clay Formation* has a tradition of being used for brick-making due to its high carbon content that burns off during firing, therefore requiring less energy during the firing process. It is also characterised by a comparatively high moisture content which allows for moulding without the addition of extra water (Sumbler, 1996).

Fabric description: two fabrics have been identified within the material from Minety. One is an iron-rich, non-calcareous fabric. Inclusions are unimodal, double-to-open spaced and with weak preferred orientation. The proportion of quartz silt varies from 10-20%, some examples include a proportion of medium quartz sand (Figures 7.58 & 7.60). Other inclusions comprise muscovite mica, glauconite, plagioclase feldspar and iron-oxides. These fabrics are comparable with the **SILCBM2** fabrics, with the variable quartz proportions. The grain-size distribution shows the different proportions of quartz between these two samples (Figs. 7.56 & 7.61).







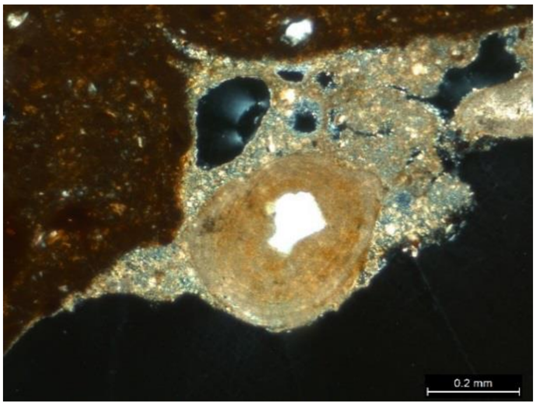


Min = 0.0175mm	Max = 0.7937mm	Mean = 0.1115mm	Mode = 0.02mm	StdDev = 0.10394mm	Min = 0.0117mm	Max = 0.3193 mm	Mean = 0.066197mm	Mode = 0.0537mm	StdDev = 0.04191mm

Figure 7.58 & 7.59: *Photomicrograph and grain-size distribution of Minety fieldwalking sample (TSID330) (XP, x40 magnification)*

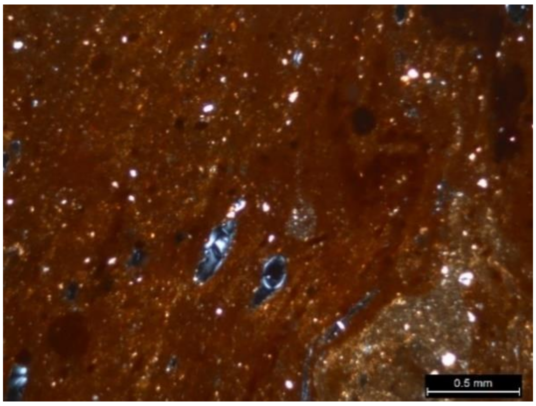
Figure 7.60 & 7.61: *Photomicrograph and grain-size distribution of Minety fieldwalking sample (TSID332) (XP, x40 magnification)*

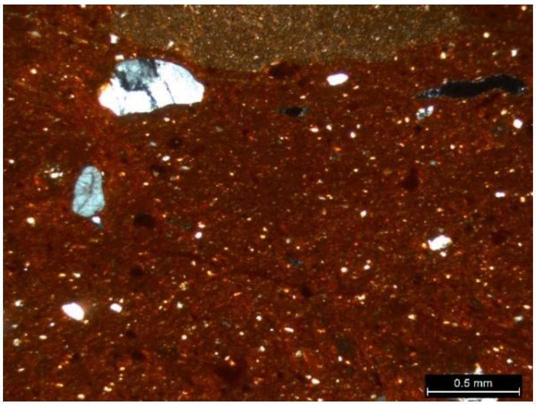
The other fabric is very different in its composition. It is a highly heterogeneous fabric, with pellets and zones of highly birefringent cream coloured clay through. The fabric exhibits moderate speckled optical activity, mid-brown colour in PPL and mid-orange to mid-brown in XP. There is approximately 10% quartz silt present, with a scatter of medium quartz sand grains. There are few other inclusions noted and the matrix is not micaceous. There are approximately 5% voids throughout in the form of micro vesicles, with preferred orientation, parallel alignment, and some post-depositional infill evident. One surface of the sample shows remnants of the mortar used, which is calcareous (Figs. 7.62 & 7.63).

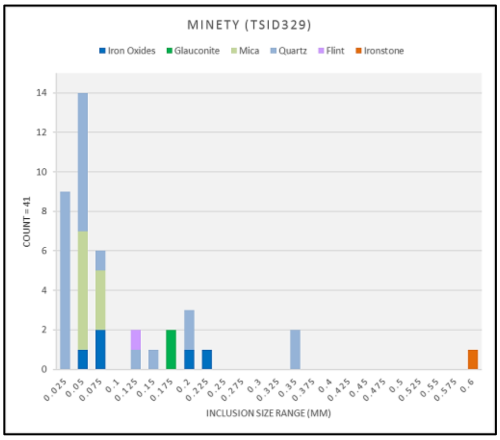


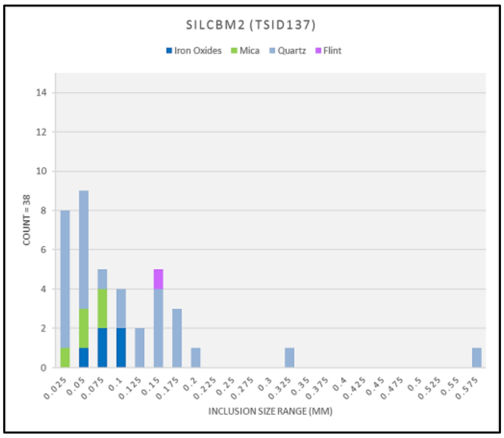
Figures 7.62 & 7.63: Calcareous mortar on Minety sample (TSID329)

The overall composition of the fabric has been compared with **SILCBM2** and both the photomicrographs (Figs. 7.64 & 7.66) and the grain-size distribution plots (Figs. 7.65 & 7.67) show the similarity between the two. These illustrate the similarity between the two fabrics with matching distribution and standard deviations for inclusions sizes of 0.114164mm and 0.109312mm.









Min = 0.0133mm	Max = 0.5829mm	Mean = 0.09002mm	Mode = 0.0357mm	StdDev = 0.114164mm	Min = 0.0115mm	Max = 0.5615mm	Mean = 0.12262mm	Mode = 0.0939mm	StdDev = 0.109312mm

Figures 7.64 & 7.65: Photomicrograph and grain-size distribution of Minety sample (TSID329) (XP, x40 magnification)

*Figures 7.66 & 7.67: Photomicrograph and grain-size distribution of **SILCBM2** sample (TSID187) (XP, x40 magnification)*

The portable X-ray fluorescence results show the variety within the **SILCBM2** examples (Fig.7.68). The heterogeneity of the fabric results in a widespread scatter of points across the plot. Most of the

Minety fabrics cluster in top right-hand quadrant of the plot around a small group of **SILCBM2** samples.

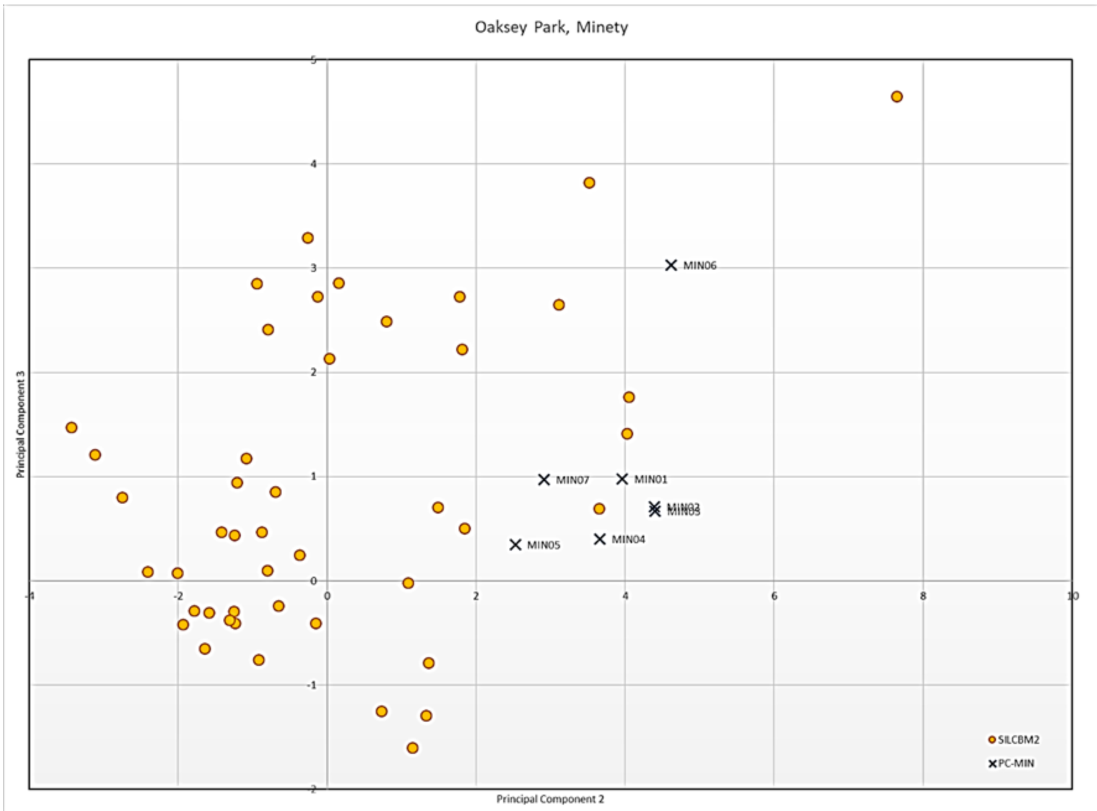


Figure 7.68: *Results of PCA classification of the Minety and* ***SILCBM2*** *samples analysed, based on the normalised abundance of 13 elements;*

<u>Discussion:</u> The site is approximately seven miles south of Cirencester and conveniently located for access to the major Roman roads of Ermine Street and Fosse Way. This led the excavator to assume that the production centre was located to supply major Roman urban centres, though the proximity of raw material resources would be a primary consideration too. It has been suggested that the tilery at Minety acted as a municipal tilery to Cirencester, in the same way that St Oswald's Priory supplied tiles to Gloucester with the distribution of TPF-stamped tiles is tightly focused around Cirencester and the immediate environs. Minety is also known to have produced the LHS-stamped tiles, one of which is held in the Silchester collection at Reading Museum. The distribution of LHS stamped tiles is typically restricted to Minety, Cirencester, and Lower Wanborough (Warry, 2017, p. 95), with "export" dies found at a number of other sites, including the single example in the Silchester archive. As discussed in section 6.3.3, the provenance of this tile had been called into question, but it is now generally accepted to have been found from Silchester. It has been suggested that LHS was a sub-tenant on the site at Minety, who was occasionally allowed to supply Cirencester to meet peaks in demand but had to supplement this with export sales outside the Cirencester hinterland (Warry, 2017). There is no overlap between the material produced at St Oswald's Priory and Minety. Whilst

they were contemporaneous in the dates of their production, their distribution areas are demonstrably mutually exclusive.

In the corpus of material from Silchester **SILCBM2** fabric is represented by a large proportion of combed box-flue tiles, which, as discussed, made up a large proportion of the output from the Minety kiln. Of the 386 items recorded in fabric **SILCBM2** 86 (almost 30%) were combed box-flue tiles. Of the complete examples held in the Reading Museum collection, only four have designs that matches those illustrated in figure 7.52. However, as the combed designs are probably random patterns to provide a key, this does not negate the combed examples in the Silchester assemblage being Minety products. It would therefore appear that Minety products were being transported to the Roman town at Silchester, a straight-line distance of approximately 70km. However, the distance moved is likely to have been greater than this, utilising the Roman road network into Cirencester firstly, then secondly moving south-eastwards to Silchester, a total distance of nearly 90km. The LHS-stamped tile in the Silchester collection has been assigned to fabric **SILCBM2**, along with the DIGNI stamped tile. Fabric **SILCBM2** comprises almost 20% of the retained material in the Silchester archive and has not otherwise been assigned to a clay source from the clay sampling analysis.

7.11. Eccles, Kent

Site Description: the villa site at Eccles was excavated extensively between 1963-1976. In 1966, a site approximately 450m from the villa was investigated and which led to the discovery of a tile kiln (Detsicas, 1967, p. 171), which was severely damaged by a bulldozer before archaeological investigation commenced.

Grid reference: TQ717604

Kiln structure: the kiln was rectangular in plan, externally it measured 8m x 7.5m and internally 5m x 4.75m. The firing tunnel pierced the west wall, and there was also a gap in the east wall which must have been the loading point. The oven consisted of a centrally placed flue traversed by nine cross-walls, and two chambers (Fig. 7.69). The central flue was 4m long and 0.85m wide, whilst the firing flue was 2.5m x 0.75m wide. Four types of tiles were recorded having been used for the construction of the lining, flue sides and the floor of the kiln. All these tiles were buff in colour and included *pilae*, bonding tiles and *bessales* (Detsicas, 1967, p. 173).

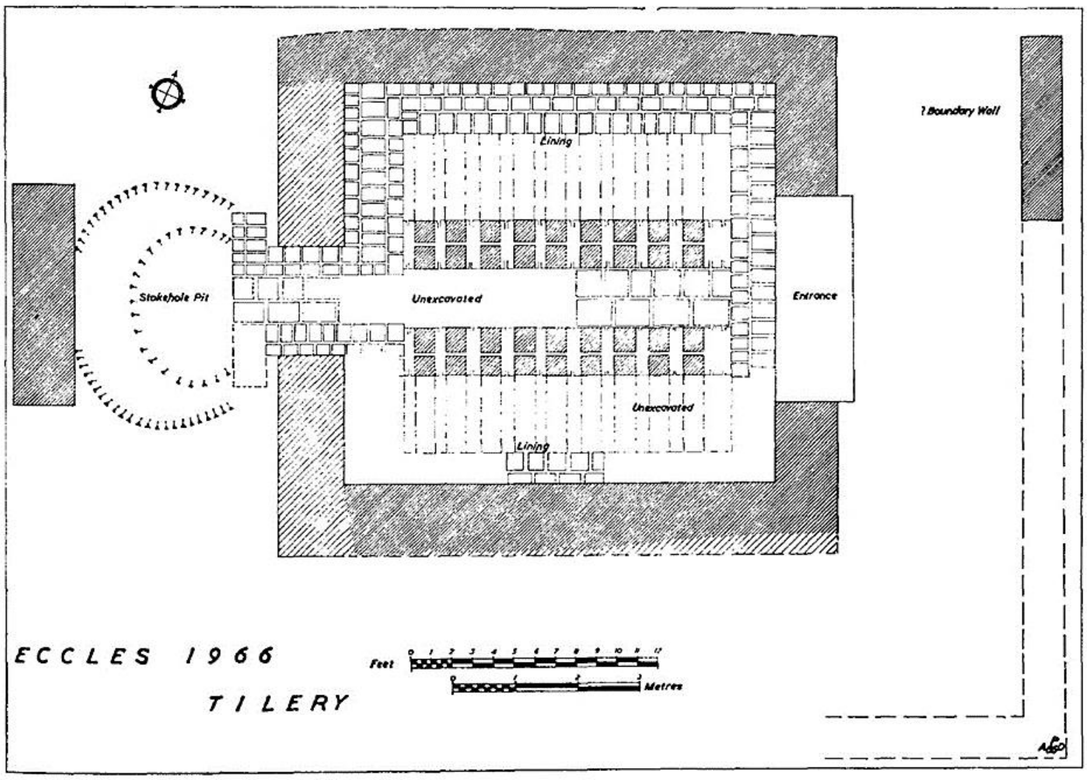


Figure 7.69: *Plan of tile kiln at Eccles (After Detsicas 1967 Plate VI)*

Products: no certain evidence could be rescued to establish the products of the kiln, as distinct from those used in its construction.

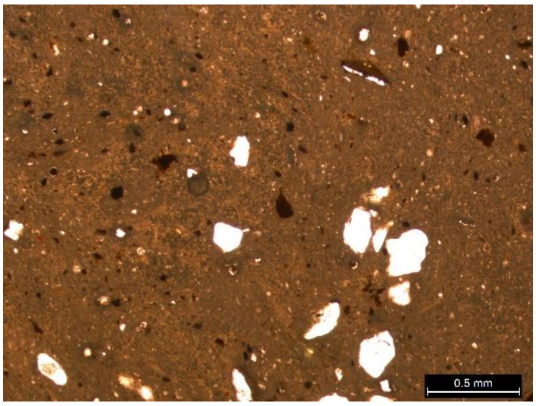
Dating: there is some evidence that the cross-walls may have been rebuilt once however the bulldozer damage precluded this being confirmed (Detsicas, 1967, p. 172). The stratified pottery recovered below the lining of the northern chamber would suggest the date of the construction of the kiln to the late- 2nd century A.D. The pottery recovered from the backfilling of the stokehole and firing tunnel indicates that the tilery had a long period of use and was still in production in the late 3rd century A.D. (*ibid*., p.174).

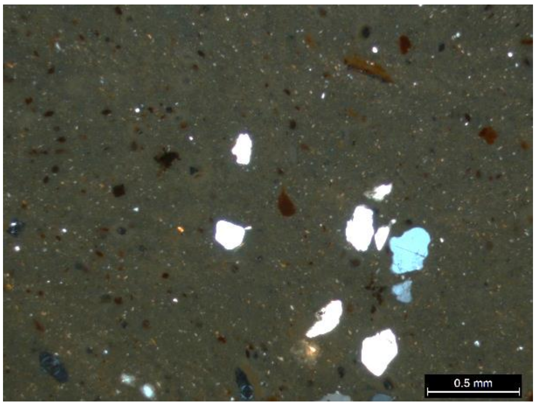
The kiln is associated with the villa complex situated 450m to the north-east, located on the local gault clay. The earliest fragment of tile in a Kent fabric at Colchester occurs in a pre-Boudican context, and thus dates to the period AD43-60/1. This agrees well with the dating evidence from London, where Eccles area tiles, identical in fabric to those found at Colchester, first appear in the period c.AD50-60/1. The tile kiln excavated at Eccles dates to the late 2nd century, however, as McWhirr (1979c, p. 158) has pointed out, other kilns must have existed in the area to provide tiles for the earlier phases of the villa at Eccles, dated cAD55-65, and for the construction of the kiln itself (Betts, 1992).

Geology: The site is located on the gault clay formation with coarse- to fine-grained interbedded sequences. The bulk of the Gault formation is clay, with the upper part consisting of marly clay, paler than that of the lower (Worssam, 1963, p. 58).

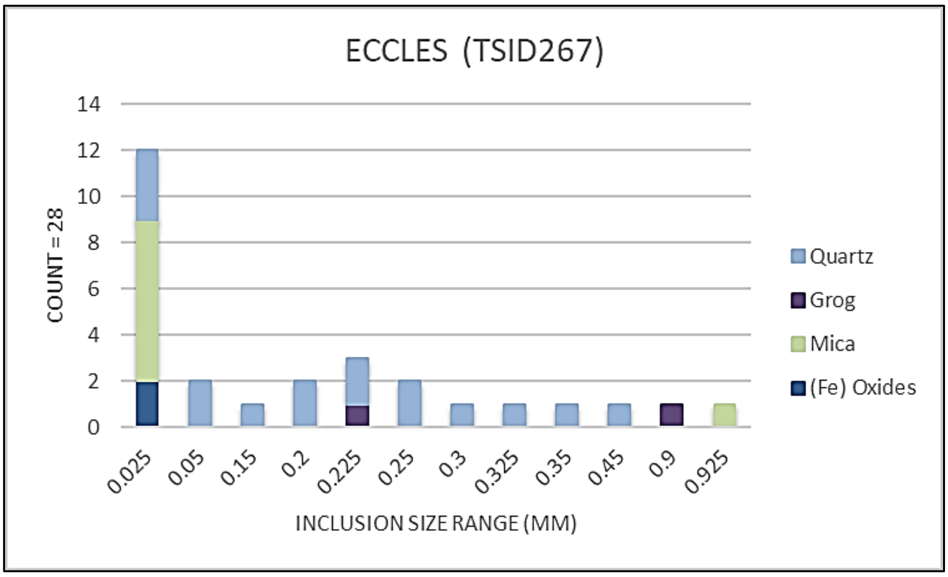
Samples: samples of known Eccles products were obtained via the MOLA archive-(MOLA fabric 2454).

Fabric: This is an iron-poor, non-calcareous, highly homogeneous fabric. It is typically evenly fired throughout, with surface and core colours of pale brown (2.5Y 8/2). In thin section, the fabric is characterised by having very few visible inclusions, with only a small scatter of quartz grains present. The fabric comprises a highly homogeneous micaceous, very fine-grained matrix, very pale brown in PPL and very pale yellow-brown in XP.





Figures 7.70 & 7.71: *Eccles fabric from London (MOLA fabric 2454 (TSID267)) in PPL (left) and XP (right) (x40 magnification)*



Min = 0.011mm	Max = 0.9007mm	Mean = 0.17584mm	Mode = 0.0133mm	StdDev = 0.23216mm

Figure 7.72: *Grain-size distribution of textural data from Eccles fabric sample (TSID267)*

There are very few inclusions in the fabric and these are dominated by fine-grained quartz, with the occasional larger quartz grain present. The fabric is slightly micaceous with rare examples of iron oxides and grog identified. As confirmed in section 6.2.9, the composition of this fabric matches that of **SILCBM8** examples, confirming the movement of material from Eccles, to Silchester.

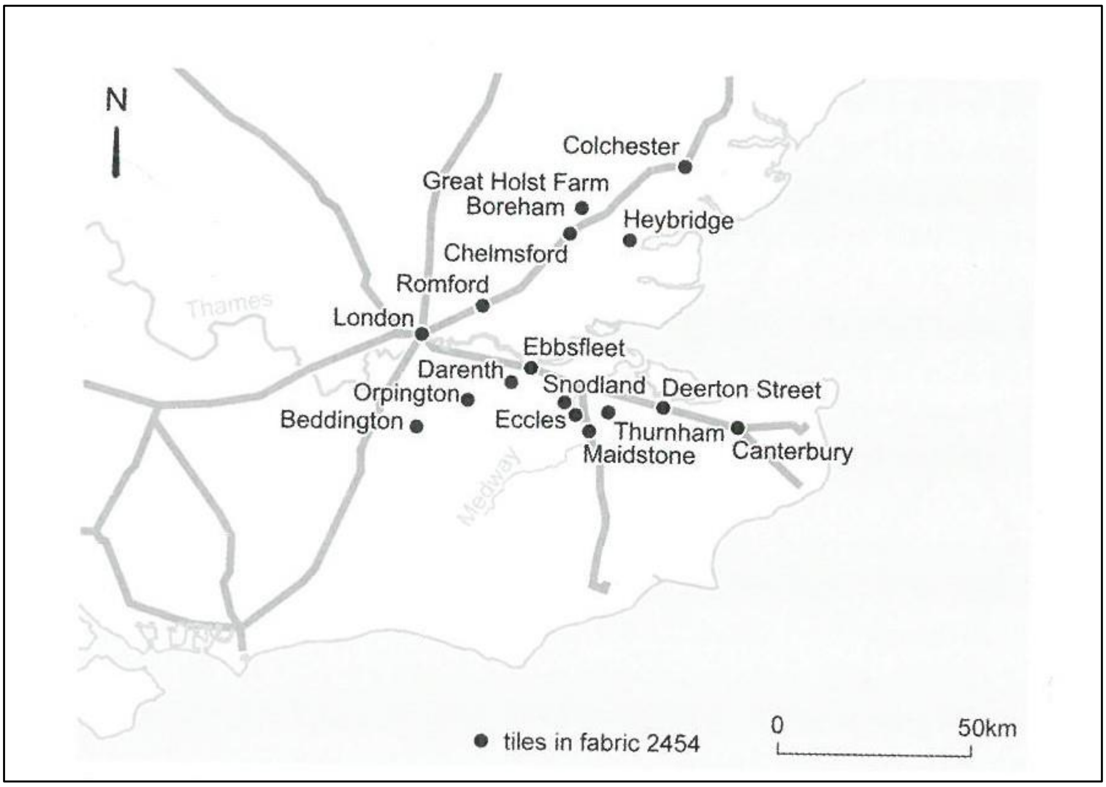


Figure 7.73: Distribution of yellow, cream, white and pink tiles believed to have been made in the Eccles area (After (Betts, 2017 Fig.17.3)

Discussion: The published distribution map of tiles in MOLA fabric 2454 (Fig.7.73), identified as originating from the Eccles kiln, shows the distribution of known examples extends west as far as London and Beddington. The confirmation of Eccles fabric in the Silchester means this distribution can now be extended westward (Figs.7.74 & 7.75). It clearly shows the importance of coastal and river transport for movement of heavy good such as tiles, this could have extended along the Thames from London towards Silchester. The presence of Eccles fabric in the Silchester material is discussed further in Chapter 11.

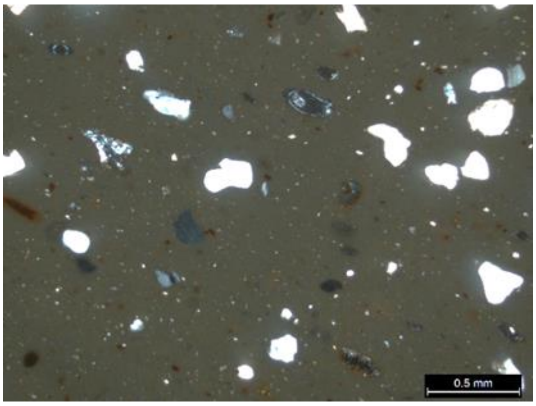


***Figure 7.74**: Eccles fabric (TSID198) XP (x40 magnification)*

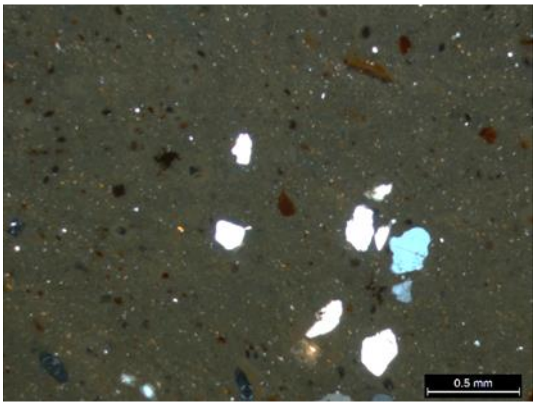


***Figure 7.75:** Eccles fabric from London (MOLA fabric 2454 (TSID267)) XP (x40 magnification)*

7.12 Conclusion – Production centres

The analysis of material from the Silchester fabric series, and production centre outputs has shown some connections between sites. It is apparent that there was local production of building materials within 1-2 kilometres of the town, at Little London (7.4) and Latchmere Green (7.3) accounting respectively for 20.93% (SILCBM3 & SILCBM4) and potentially 49.68% (SILCBM1) respectively. Long distance movement of material (>100 km) has also been suggested with the potential supply of chimneys from the tilery at Ashtead and the potential supply of combed box-flue tiles, amongst other forms from the large-scale production centre at Minety.

All the postulated connections discussed between production centres and the Roman town at Silchester are based on the retained assemblage of CBM from Silchester. It is possible that other fabrics were found in past excavations which have not been retained.

These connections to production centres will be tested in chapter 8 where all the material from Insula IX will be reviewed in term of its stratigraphic contexts and the phasing of the site. All CBM will be reviewed and a chronology of the use of the SILCBM fabrics will be established. This will then be compared with the production dates from the tileries to test the connections.

Chapter 8: Fabrics through Time

8.1 Introduction

It has previously been noted (Chapter 2) that there has been a lack of research into the demand for brick and tile on the part of a large Romano-British town. With its constantly changing architecture and ever-active builders, a large town would have exerted different demands on the brick and tile makers when compared to that of a typical villa, which would demonstrate only periodic changes in design. How did the organisation of the Roman brick and tile industry take account of this fluctuating demand for building materials (Darvill, 1982, p. 47)? How did it supply a range of products in an overall pattern of production and distribution?

Initial, large-scale, building projects, for example public baths, forum-basilica and *mansiones*, and the re-organisation of public and private spaces would create a substantial, albeit short-lived, high-demand for building materials. Once the infrastructure of an urban centre was established, with housing, shops and public spaces, the demand for building materials would diminish, except for the occasional reconfiguration of properties. There would remain a small-scale demand from ongoing repairs to existing structures and new initiatives including the provision of masonry defences. The proximity of suitable building stone would have also influenced the demands on tileries. How did towns source the materials needed and how did production centres cope with the changeable demands on their products?

By analysing the fabrics present across the defined chronological phases, this chapter seeks to investigate whether changes in CBM supplies can be identified at Silchester. This is achieved by sorting all the retained CBM (Chapter 4.1) by period/phases and assessing the proportions of each **SILCBM** fabric in each of these phases. This assumes that the proportions of fabrics in the retained material are representative of the assemblage as a whole. All retained CBM from each phase is reviewed, including deposits from pits, wells, and postholes. Where possible, CBM from structures is discussed in order to establish any changes in supply of these building materials to the Roman town, whilst bearing in mind the possibility of the re-use /re-cycling of building materials throughout the life of the town.

The assemblage from the forum-basilica is described first, followed by a period-by-period evaluation of the CBM retained from in Insula IX. The results are then compared to establish if there are similarities or differences in the contemporaneous supplies of CBM to the private residences of Insula IX and the public building of the forum-basilica.

8.2 Forum-basilica

There were several previous investigations at the site of the forum-basilica, located in Insula IV, prior to Fulford's excavations of the 1980s (Fulford and Timby 2000, pp.5-7). The recent excavations were undertaken to further understand the Late Iron Age occupation of the site and succeeded in locating both late Iron Age and earliest Roman occupation levels beneath the foundations of the basilica (Fulford & Timby 2000, pp.7-8). As discussed in chapter 4.1, approximately 4% of the recorded CBM was retained. The retained material comprised mainly fragments of intrinsic interest and most of the material from pre-conquest levels. The retained material includes a large sample of flat tile that had been marked either deliberately, with batch or maker's marks, or accidently, by animal or human foot imprints (Timby, 2000, p. 116). The chronology of the site is divided into the ten periods, (Table 8.1).

Period	Description
Pre-Roman Occupation	
1	Earliest occupation (c.25-c.15 B.C)
2	Planned layout (c.15 B.C. - c.A.D. 40-50)
3	Claudio-Neronian (c.A.D. 40 - c.A.D.50-60)
Roman *Calleva*	
4	Roman *Calleva*: pre-Flavian courtyard building
5	The Flavian timber basilica
6	The masonry forum-basilica
7	Late Roman occupation of the basilica
Post-Roman activity	
8	Robbing of the basilica
9	The Victorian Excavations
10	Modern plough soil

Table 8.1: *Periods assigned to the chronology of the forum-basilica site*

8.3 Period 1-3 – Pre-Roman occupation

No examples of CBM were retained from Period 1 and 2 contexts.

8.3.1 Period 3 – Claudio-Neronian

A number of rubbish pits dated to Period 3 indicates a greater intensity of occupation associated with an emphasis on boundaries (Fulford and Timby, 2000, p. 14). Period 3 material included a single fragment of Roman **SILCBM** and five examples of **SILOCA** fabrics, pre-Roman building materials described as Belgic bricks, although they are not robust enough to have been weight-bearing and probably formed part of small structures, hearths or ovens (Timby, 2000, p. 120).

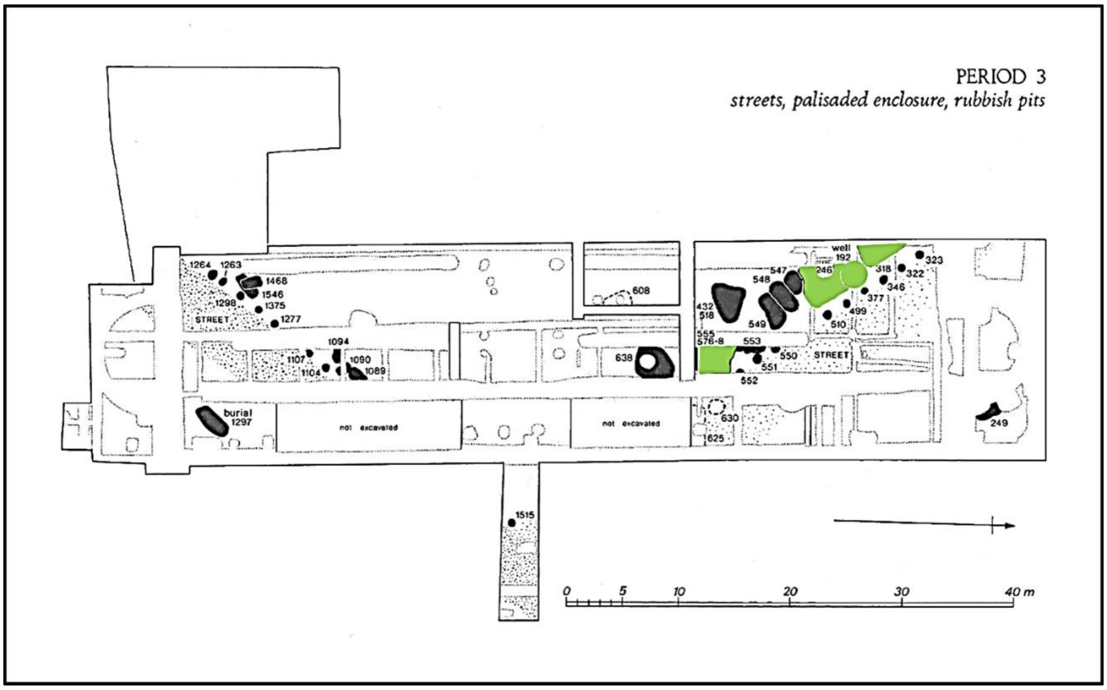


Figure 8.1: *Plan of Period 3 contexts with SILOCA fabrics (after Fulford & Timby 2000, Fig. 7.)*

The contexts from which the pre-Roman building materials were recovered are highlighted on figure 8.1, in the north-west of the excavation area. Contexts (1008) and (549) are pit-fills (**F576** & **F318** respectively) both assigned to phase 3.3. While context (1008) included only a very small fragment of poorly fired Iron Age ceramic, context (549) contained a large assemblage of small fragments of Iron Age building materials (**SILOCA1**). These were from the main fill of the pit, **F318**, which consisted of a charcoal-rich, black soil with small orange and yellow clay lenses. Over 25kg of pottery was also recovered, including sherds of at least 24 samian ware vessels (*ibid*. p.32).

Context (325) representing the upper fill of well **F192** is assigned to phase 3.6**.** A spread of tiles was encountered in the north-west quadrant of the shaft (*ibid*. p.20), associated with a large quantity of pottery (33.99kg) and daub. These included two small fragments of fabric **SILOCA1** – flint-rich fabric tempered with fragments of grog derived from Silchester Ware vessels (Chapter 6.4.1) along with several fragments of mud-brick (**SILOCA2**).

A single small fragment of brick (100g) in a Roman fabric, **SILCBM3A**, was recovered from a period 3 context. It was found in the upper fill (402) of pit **F246/546**. The pit has been dated to the pre-Roman period based on finds recovered from the lower levels. The upper levels, which included context (402), correspond with (324) at the top of well **F192** which has been linked to build-up at the time of the construction of the Period 5 basilica. This fragment of CBM therefore dates to period 5, specifically phase 5.17.

8.4 Periods 4-7 Roman *Calleva*

8.4.1 Period 4 – Roman *Calleva* – pre-Flavian courtyard building

The end of Period 3 and the 'Iron Age' settlement can be placed towards the end of the second-quarter or the very beginning of the third-quarter, of the 1^{st} century A.D. There is evidence to suggest a brief period of abandonment between the end of this settlement and the first demonstrably Roman buildings of Period 4, which may partly account for the radical change in orientation of the Roman town plan. The Period 4 assemblage is the first to be made up entirely of Roman CBM fabrics, albeit with only six retained samples from Period 4 contexts. These are made up of three tiles, and three brick fragments with a total weight of just over 3kg. The features from which CBM was retained are highlighted in figure 8.2.

The earliest Roman structures consist of two ranges of timber buildings, one range (Building 1) is aligned east-west, whilst the second (Building 2) is aligned north-south (*ibid*. p.37). There are no complete examples of brick or tile from period 4 contexts and all retained samples were recovered from slots, postholes, or occupation deposits rather than structural features.

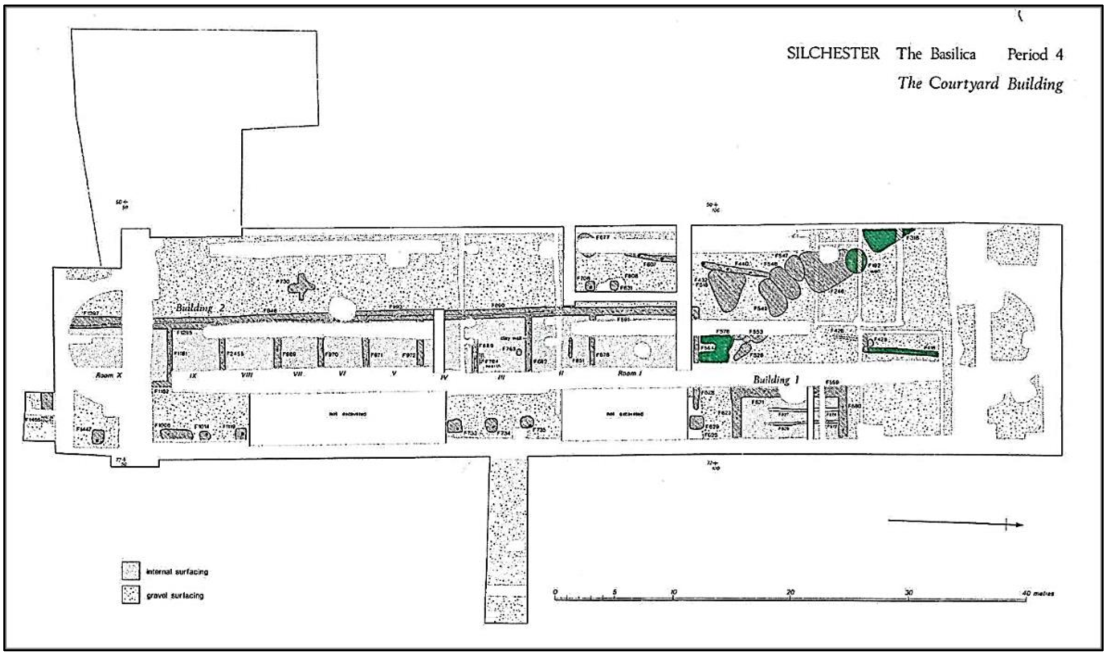


Figure 8.2*: Plan of Period 4 – courtyard building (after Fulford & Timby 2000, Fig. 27.)*

A small fragment of tile in fabric **SILCBM3A** was recovered from context (722) a deposit within **F418,** a slot dated to phase 4.1, which formed part of the structure in area 2 of the excavation (*idem*). A further fragment of tile of fabric **SILCBM3A**, possibly a *tegula* bed, was found in context (832) assigned to phase 4.10 (**F423**), which consisted of a gravel-metalled surface external to the Period 4 buildings (*ibid.,* p.43).

A fragment of brick in fabric **SILCBM1A** was found in layer (958) assigned to Period 4.4 (Building 1: occupation) comprising a compacted yellow clay sealing one of two linear slots interior to Building 1, interpreted as traces of floor joists, **F572/626** (*Ibid.* p.38).

Context (1019), one of several occupation deposits overlying the second clay floor of Building 2, yielded two brick fragments, totalling 1745g in **SILCBM5A**. These deposits, assigned to phase 4.14, were varied in nature and included a variety of finds: brooches, glass vessels, beads, iron objects and a substantial volume of pottery (*ibid.*, pp.41–42).

Figure 8.3: Nero-stamped tile NER […]GR present (RIB.2482.3)

The Period 4 assemblage also includes a small fragment of tile recovered from a Neronian or Flavian context (2460), specifically Period 4.5a. This tile is in fabric **SILCBM3A,** although with a higher than typical proportion of small fragments of flint which are clearly visible on the surface of the tile (Fig. 8.3). This tile bears a partial stamp with the name and designation of the Emperor Nero, **NER […] GR** (Frere and Tomlin, 1993, p. 26 RIB.2482.3; Fulford and Timby, 2000, p. 118 Fig.95.1).

Three **SILCBM** fabrics are represented in the Period 4 assemblage (**SILCBM1, 3 & 5**), none were recovered from primary contexts. Fabrics **SILCBM1** and **SILCBM3** have been identified as potential products of local tileries exploiting the London Clay and Windlesham Formations respectively. **SILCBM5**, however, could not be assigned to a local clay source and is potentially imported from some distance away. The evidence for the import of brick and tile from distant tileries is discussed in Chapter 11.

8.4.2 Period 5 - The Flavian timber basilica.

The Flavian timber basilica was discovered immediately beneath the make-up associated with the later stone basilica. The building is composed of a hall, consisting of a nave flanked by aisles with further rooms at the northern and southern ends of the hall. Its shows a clear relationship with the preceding Period 4 buildings. The floors overlie the earlier surfaces and the eastern aisle trench and wall trenches of the entrance hall and north-south ranges cut the period 4 wall trenches (*ibid*. p.46).

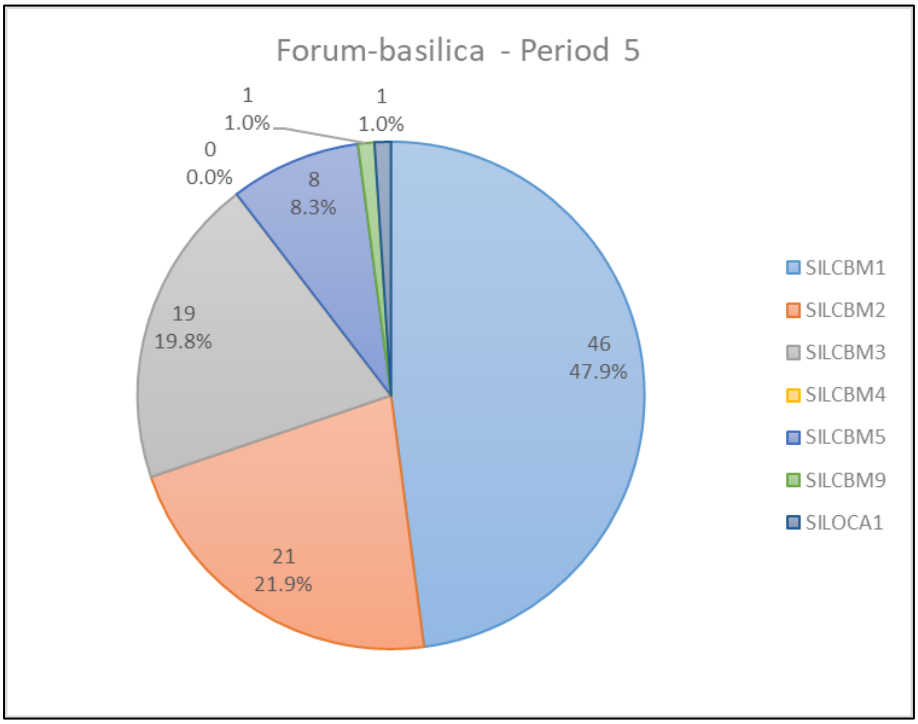


Figure 8.4: *Proportions of Period 5 assemblage by fabric groups (n=96)*

A total of 96 fragments of CBM was retained from Period 5 contexts. The range of fabrics and their proportions are shown in figure 8.4. **SILCBM1** fabrics, produced from clays of a *London Clay Formation* source, account for 47.9% of the Period 5 material. A further 21.9% comprises **SILCBM2**, potentially suppled from the tileworks at Minety, Wiltshire (see Chapter 7.10), whilst 19.8% is in fabric **SILCBM3** originating from a *Windlesham Formation* source, as found at the at Little London (see Chapter 7.4). These three fabrics account for 89.59% of the retained assemblage from Period 5, with the remaining 10.41% (ten fragments) are made up of three different fabrics. This is comparable to the proportions of the entire Silchester CBM assemblage as discussed in chapter 6.5, in which fabric group **SILCBM1** accounted for 49.68%, with **SILCBM2** and **SILCBM3** representing 18.30% and 15.05% respectively, and the three fabrics making up 83.03% of the material.

The eastern construction trench, F401 (702), (738), of the north hall (Phase 5.2) housed a sleeper-beam upon which aisle-posts rested (Fulford and Timby, 2000, p. 50). Several fragments of oven-furniture (**SILOCA1**) were recovered from (702), whilst a brick in fabric **SILCBM2**, with unusual ring-marks to the surface came from (738). The impressions have a diameter of approximately 53mm and could be impressions made by the foot-ring of a small cup (Figure 8.6).

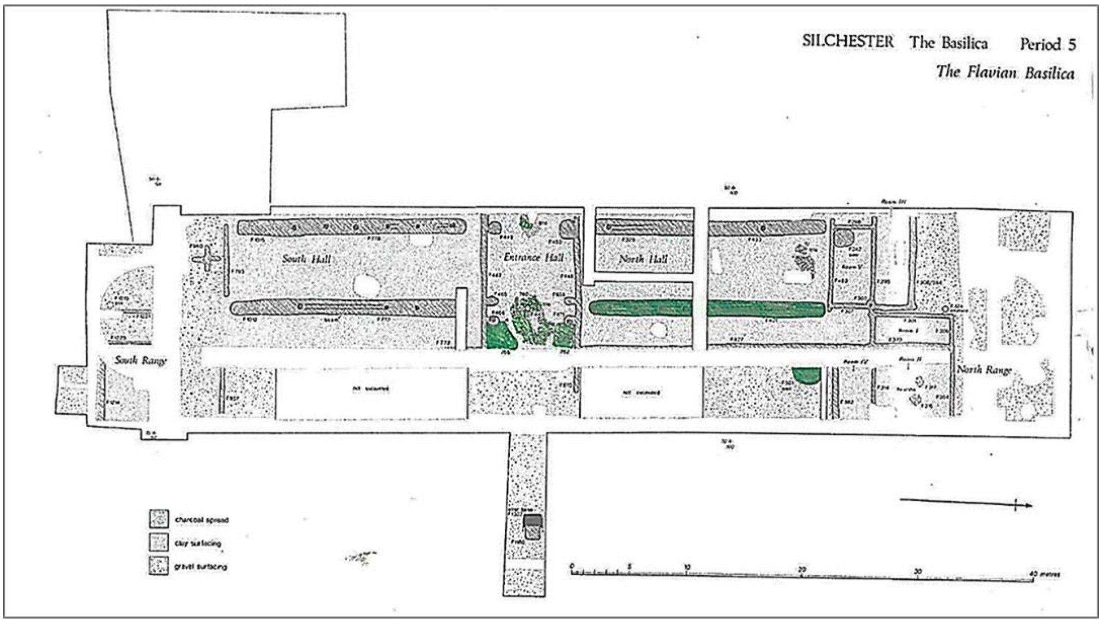


Figure 8.5: Plan of the Period 5: Flavian basilica showing the location of contexts with retained material (after Fulford & Timby 2000, Fig.37.)

Figure 8.6: Brick from context (748) with ring-marks on the surface.

A large proportion of the Period 5 building material was recovered from the entrance hall, Period 5.4 (Fig.8.7). Tile-settings flanked the entrance-way from the forum (762, 765). These consisted of one, or two, courses of un-mortared *lydions* placed either side of the entrance. These bricks showed no signs of wear, but were blackened and covered with charcoal, and have been interpreted as stands for braziers. The floor between these two settings was tiled (760), with these tiles showing considerable evidence of wear (*ibid*. p.51). A further tile setting (814) was recorded in the entrance hall; this comprised a square *c.*90cm laid at a 45-degree angle to the north-south orientation of the basilica. The tiles were also bricks, with a typical thickness of 50mm. A single complete example was retained from these settings along with several bricks where a complete width remained; typically measuring approximately one Roman foot (29.6cm) these bricks would have been either *pedalis* or *lydion*.

From these contexts, a total of 51 pieces of CBM has been retained, consisting of 50 brick fragments and a single fragment of relief-patterned flue-tile. The relief-patterned tile is from the diamond-and-lattice group, die 68, assigned to fabric **SILCBM3A** (see section 9.3.5) and was not in its primary context; there is no recorded hypocaust in the Period 5 basilica.

Figure 8.7: Period 5: The Flavian Basilica – the entrance hall (after Fulford & Timby 2000, Fig.42).

Of the 50 bricks from these phases, 62% (31) are in **SILCBM1;** 24% in **SILCBM2**, 12% in fabric **SILCBM5** and a single example in fabric **SILCBM9**. Seven of these examples, all **SILCBM1** fabrics, include an unusual signature on the surface, which comprises two non-concentric semi-circular swipes (Figures 8.8-9). These signatures are not found on any other bricks in the forum-basilica assemblage. This unusual signature has been interpreted as possibly a letter R (Fulford & Timby 2000, p.118 Fig.94.9) and may represent the signature of a particular brick-maker employed to supply materials for the construction of the early forum-basilica.

Figures 8.8 & 8.9: *examples of unusual signature applied to bricks (760)*

Period 5.24 is represented by well **F501** located in the north-west corner of the forum piazza. This well cuts the foundation trench of the Period 4 east-west building 1 and was filled with rubble partly derived from the demolition of the timber basilica. Of the eight fills identified, the upper six (845, 985, 966-8, and 995) were largely composed of building rubble. Ten items of CBM were retained from contexts (967) and (995). These consist of a single, scored fragment of flue-tile, with lattice design, in fabric **SILCBM3** and nine brick fragments, of which eight were in fabric **SILCBM1** and one in **SILCBM3**. The two lower fills of the well-shaft (1019, 1061) included three CBM fragments, all in fabric **SILCBM3**, two fragments of flue-tile, again one example with lattice-scoring, and a piece of *tegula*. The early Roman date of these two contexts, along with the Nero-stamped tiles and the lattice-scored flue-tile, as discussed in Chapter 9.2, all support a production date in the early Romano-British period for the **SILCBM3** fabric.

Periods 5.7, 5.10, 5.12, and 5.15 are described as floor make-ups and surfaces. The retained assemblage from these consisted of 12 examples in a variety of types comprising brick, tile, *tegulae*, *tegulae mammatae*, all in fragmentary condition with an average weight of less than 300g. The remainder of the retained material from Period 5 comprised CBM recovered from demolition deposits.

Overall the Period 5 CBM assemblage is dominated by bricks, with a large proportion recovered from flooring contexts. A total of 69 examples were recovered, of these 39 (59.5%) were assigned to **SILCBM1** fabrics with 17 (24.6%) examples of **SILCBM2** and 4 (5.8%) of **SILCBM3**. The predominance of **SILCBM1** in the fabric of the bricks from the structure of this early phase suggests that production centres utilising *London Clay Formation* sources were exploited for their building materials for this early phase of the forum-basilica.

8.4.3 Period 6 – Hadrianic-Antonine masonry basilica

The 1980s excavations revealed the entire length of the basilica, measuring some 85 metres. The walls were composed of regular courses of nodular flint in white mortar with gravel aggregate and occasional fragments of tile.

Figure 8.10: *Extent of CBM incorporated into the Period 6 Hadrian-Antonine basilica – north apse (after Fulford & Timby 2000, Fig. 65)*

At the north end, the flint alternated with courses of tile. This is one of the few recorded examples of tile bonding-courses used in wall construction throughout the Roman town (see Fig.4.2). The Victorian plan has been modified with the sequence of construction at either end of the basilica clarified along with confirmation that the basilica was constructed from the outset with a single colonnade (*ibid*. p.59). There are only a few references to CBM in the discussion of Period 6. The floors of the basilica seem to have consisted mainly of uneven spreads of make-up and mortar, possibly as a result of the removal of a timber plank-floor prior to later occupation. Alternatively, the basilica and therefore the floor, was never finished (*ibid*. p.67). Figure 8.10 shows the extent of the CBM uncovered in the north apse.

Only 60 fragments of CBM have been retained from this period (Fig.8.11) and three fabrics again account for almost 90% of the assemblage (**SILCBM1**=66.7%; **SILCBM2**=10%; **SILCBM3** = 10%;). Whilst the total of these three fabrics is consistent with their overall proportion in the collections (Period 6 = 86. 7%; Silchester CBM: 83.03%), the proportions of each fabric are not. This is discussed in more detail in section 8.4.5 below. The average weight per retained fragment in Period 6 is 357g, a reflection of the fragmentary nature of the assemblage.

12

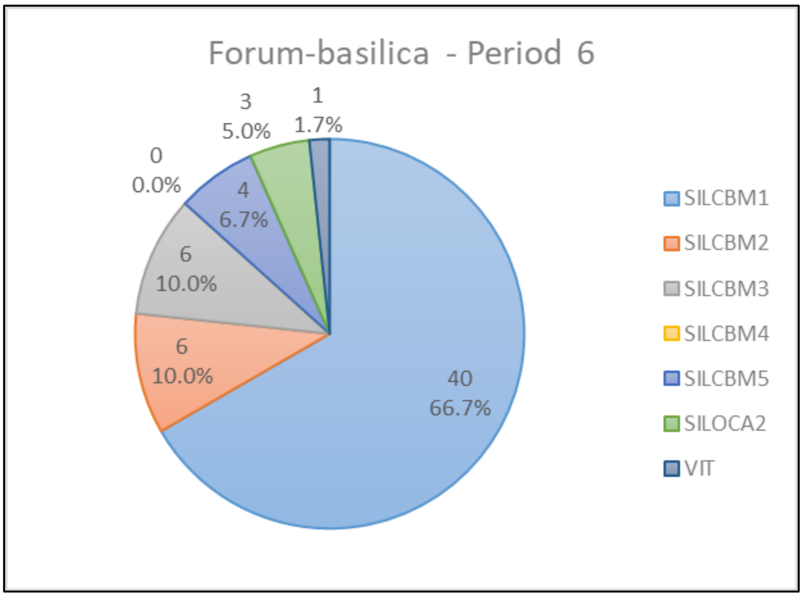


Figure 8.11: *Proportions of Period 6 assemblage by fabric groups (n=60)*

Of the 60 retained fragments, 44 samples can be linked to structural features within Period 6. Period 6.1 represents the initial construction phase of the basilica with an apse at either end, before alterations were made at some point during construction, to block these apses from the main hall. Thirty-four fragments were retained from this phase, comprising seven bricks, two *tegulae*, two tiles (probably *tegulae* beds), three *imbrices* and 20 fragments of flue-tile.

Figure 8.12: Scored flue-tile in ***SILCBM1*** *fabric (492)*

Figure 8.13: Combed flue-tile in ***SILCBM1*** *fabric (492)*

The flue-tiles are of particular interest. All 20 examples of are **SILCBM1** fabrics and comprise 17 thin tiles decorated with a scored lattice design and the other three with a combed with a wavy design (Figures 8.12 and 8.13). As discussed above, (Chapter 2.1), this type of thin, lattice-scored flue-tile is believed to date to the early Romano-British period, the second half of the 1st century AD. All *imbrices*, *tegulae* and tiles were also of **SILCBM1** fabrics whilst the seven bricks were made up of three fabric groups (**SILCBM1** x 2; **SILCBM3** x 2 and **SILCBM5** x 3). A single fragment of CBM was retained from Period 6.7, a base for a statue located within the northern apse. This was a small fragment of lattice-scored flue-tile of **SILCBM1B** fabric.

The final structural elements from which CBM was retained are assigned to Period 6.3 - other structural features. The nine fragments from these contexts are all bricks: **SILCBM3** fabric (2), **SILCBM2** (1), **SILCBM1** fabrics (6). There are no complete examples or dimensions within this assemblage suggesting a re-use of material within these contexts. The similarities in the proportions of fabrics of the bricks between Periods 5 and 6 would reinforce the suggestion of re-use of older building materials.

Period 6.13, the make-up layers for the basilica, contained another example of tile stamped the title of Nero, **[…] CÆA […]** (Frere and Tomlin, 1993, p. 27 RIB.2482.5; Fulford and Timby, 2000, p. 118 Fig.95.3.) (Fig.8.14).

Figure 8.14: *Nero-stamped tile fragment […] CÆ A […] (RIB.2482.5)*

As with Period 5, the CBM retained from Period 6 contexts is dominated by **SILCBM1** fabrics representing two-thirds of the material. The structural features, however, include different proportions of the three principal fabrics, **SILCBM1** = 78.6%, **SILCBM2** = 7.1% and **SILCBM3** = 4.8%, again showing a preference for material from *London Clay Formation* sources and a reduction in the **SILCBM3** material of *Windlesham Formation* origin.

8.4.4 Period 7: Late Roman occupation of the basilica.

The late Roman occupation of the basilica produced several internal features cutting the make-up layers of the basilica floor. Whilst there was little recovered in terms of dating evidence, the fills consistently contained residues from metal-working and these have been distinguished from the others features as 7.6a (Fulford and Timby, 2000, p. 69). Small fragments of CBM were included in these features, along with two large brick fragments that have fused together, weighing almost 2.25kg. The fabric of these bricks is highly vitrified, evidencing their exposure to extreme heat.

Figure 8.15: *Two fused bricks from phase 7.6a (240)*

Approximately 16,000 pieces, 70% by weight, of the tile recorded was derived from Period 7. A total of 179 retained fragments from Period 7 features (figure 8.16) has been assigned to the **SILCBM** fabric series. This assemblage is dominated by **SILCBM1** accounting for 75% of the retained material, which includes the largest volume of roofing material so far encountered in the basilica material. There are 26 examples of *tegulae* made of **SILCBM1**, with a further five *tegulae* in other fabrics (**SILCBM2** x 3, **SILCBM4** x 1, **SILCBM7** x 4). In Period 7 contexts the fabrics **SILCBM1**, **SILCBM2** and **SILCBM3** account for 94% of the retained material (Fig.8.17).

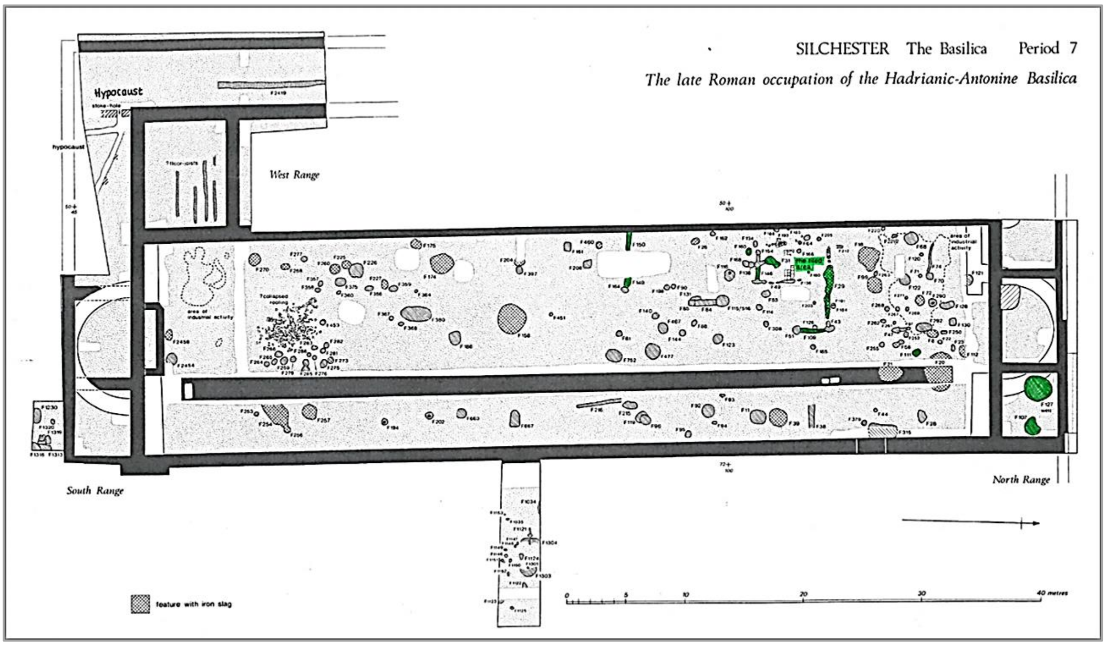


Figure 8.16: *Plan of Period 7 - The Late Roman occupation of the Hadrianic-Antonine basilica (after Fulford & Timby 2000, Fig. 71)*

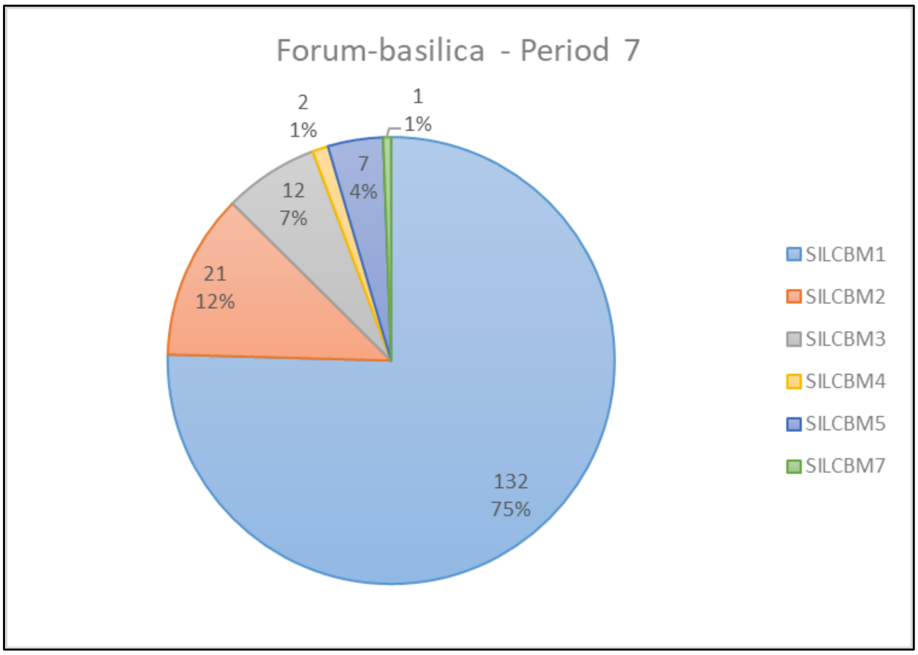


Figure 8.17: *Proportions of Period 7 assemblage by fabric (n=179)*

Of the 179 retained fragments, 111 were recovered from Period 7.6a-c (Other negative features). These contexts contained a fragmentary mix of material including roofing (*imbrices* and *tegulae*), hypocaust material (combed, scored and relief-patterned flue-tiles) and bricks.

Of note in the Period 7 material is the large quantity of relief-patterned tiles. A total of 33 fragments of flue-tile keyed with die 27 (**SILCBM1A**) was recovered from **F111**, a negative feature at the northern end of the basilica, in an area of industrial activity. There is also the large fragment of relief-patterned tile (Wilson, 2017) in **SILCBM1** fabric (Figure 9.2), this joins a smaller fragment recovered from the plough soil (Period 10: section 8.5.3). There was no hypocaust reported in this area, although the remains of a hypocaust system **F2447** was recorded in the southern ambulatory, constructed of broken tile (Fulford and Timby, 2000, p. 75).

A single well belonging to this period, F127 (phase 7.5), produced ten fragments of CBM, including another example of a Nero-stamped tile. This piece was recovered from the upper fill (254) and is larger than the two other fragments, the stamp shows **NER […]R** (Frere & Tomlin 1993, p.27 RIB.2482.4. Fulford & Timby 2000, p.118 fig.95.2) (Fig.8.18).

Figure 8.18: *Nero-stamped tile fragment NER […] R present (RIB.2482.4)*

Well F127 also contained roofing material, flue-tile, bricks, and tiles, which, except for a single brick fragment and two tile fragments, was all **SILCBM1**. The well contained a considerable volume of pottery, dating to the 3rd century (Fulford and Timby, 2000, p. 71).

A tiled area (Period 7.3) was located in the northern half of the main hall, was bounded by **F149/150** and **F109**. The features forming part of this structure had fills free of iron-slag and the area generally appears to have been partitioned from the rest of the basilica (*ibid*. p.75). The CBM retained from this area is made up of four **SILCBM** fabrics, 23 examples of **SILCBM1**, along with two fragments of **SILCBM5** and a single example each of **SILCBM2** and **SILCBM3**.

The Period 7 material is a mostly fragmentary assemblage, dominated by **SILCBM1** fabrics. Building materials have been re-used, with the contexts from which material has been retained concentrated in the north of the basilica.

8.4.5 Roman occupation overview

To ascertain any changes over time in the use of CBM fabrics the proportions of each from the three Periods, 5, 6, and 7, are compared (Figure 8.19). The proportion of both **SILCBM2** and **SILCBM3** decreases by more than 50% over the three periods, whilst the proportion of **SILCBM1** increases from less than 50% of the total to over 75%.

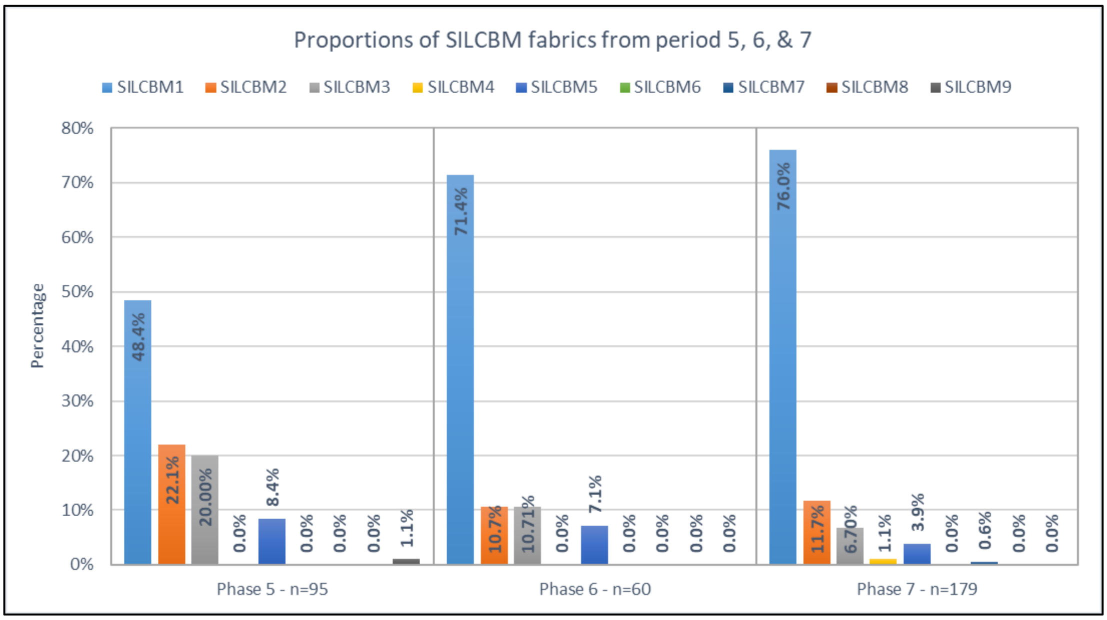


Figure 8.19: *Proportions of fabric by Period (5, 6, & 7)*

8.5 Periods 8-10 – Post-Roman activity

8.5.1 Period 8 – Robbing of the basilica

This period has been assigned to the robbing of the basilica and is divided into two phases. Period 8.1 includes robber trenches evidencing the removal of the walls down to the contemporary floor level and the robbing of some to the top of the rubble foundations (*ibid*. p.78). These differential approaches suggest two stages of robbing. Period 8.2 consists of a series of plough ruts which have scored the surface of the of the forum (*idem.*) Only two fragments of CBM were retained from Period 8; one small fragment of *tegula* (100g) in fabric **SILCBM2** and a large brick (1910g) in fabric **SILCBM5A**. Both were recovered from a robber trench context (069).

8.5.2 Period 9 – The Victorian excavations

This period is allocated to features that can be assigned to the Victorian investigations of the forum-basilica, in particular the excavations undertaken by Revd. J. G. Joyce (1881) and Fox & Hope (1893), which cut through the make-up and earliest occupation below the latest floor surface (Fulford and Timby, 2000, p. 80). A total of 54 CBM fragments was retained from these features and the proportions of each fabric are shown in figure 8.20. In this period the proportions of each fabric in the assemblage reflect those of the assemblage as whole.

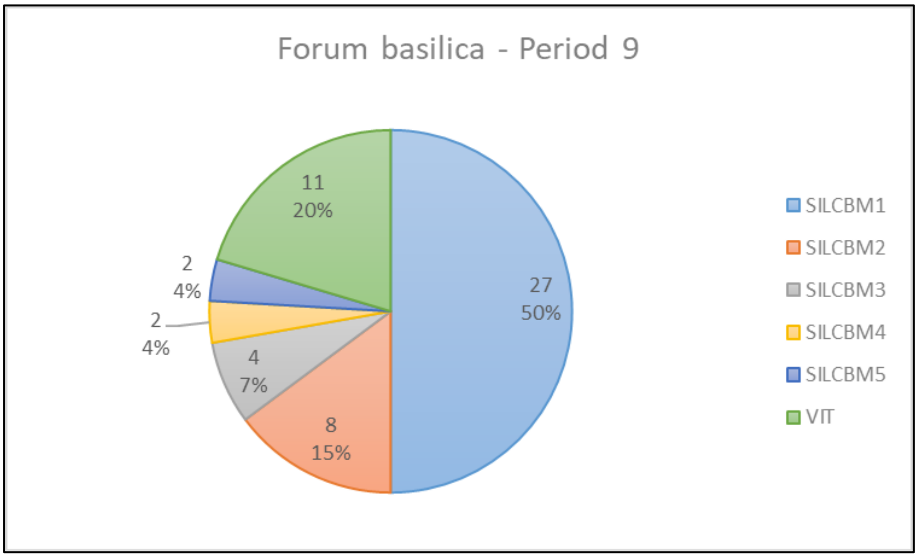


***Figure 8.20**: Proportions of Period 9 CBM by fabric (n=54)*

8.5.3 Period 10 – Modern plough soil

A single fragment of CBM was retained from the plough soil and is described above (Period 7: 8.4.4).

8.6 Insula IX

Between 1997 and 2014 a large-scale excavation investigated in detail the structural and stratigraphic development of a large area of insula IX, located at the intersection of the main north-south and east-west streets of the town, through all phases of occupation from the Iron Age to the end of the Roman period. In contrast to the forum-basilica excavation, Insula IX contained no public buildings (Fulford and Clarke, 2011, p. xix). The chronology of this area of the Roman town has been divided into a number of periods (table 8.2).

Period	Description
Pre-Roman Occupation	
0	Iron Age occupation (c.20 B.C. - A.D. 44)
Roman *Calleva*	
1	Conquest & Client Kingdom (A.D. 44 – c.AD 80)
2	Early Roman I (c. A.D. 80 – 125/150)
3	Early Roman II (c. A.D. 125/150 – 200)
4	Later Roman I (c. A.D. 200 – 250/300)
5	Later Roman II (c. A.D. 250/300 – 450/500)

Table 8.2: *Table of periods assigned to the chronology of the Insula IX excavations*

Periods 3 and 4 are described in detail in Fulford and Clarke (2011) while Period 5 is published in Fulford *et al*. (2006). While publication of the Iron Age Period 0 is in press (Fulford *et al*. 2018), that of Periods 1 and 2 is ongoing.

8.6 Period 0 – Pre-Roman occupation

A single fragment of CBM was retained from a well whose primary fills have been assigned to Period 0. Context (10439) is a fill of well [10421]. The CBM recovered was a small fragment of tile, <50g in weight, in fabric **SILCBM3.** The context contained a range of finds including and Iron Age coin mould fragment (SF5668) along with over 5kg of Silchester Ware and 1kg of pre-Roman pottery. Context (10439) was a substantial fill, deposited evenly across the well and is interpreted as a dump of domestic waste and thought to represent a prolonged period of backfilling which continued into the post-conquest period (Period 1) and should probably be considered to be intrusive and as such forms part of the Period 1 assemblage.

8.7 Roman *Calleva*

8.7.1 Period 1 - Conquest & Client Kingdom (A.D. 44 – c.AD 80)

A total of 105 items of CBM were retained from Period 1 contexts (Fig. 8.21). The Period 1 assemblage is dominated by **SILCBM3** (35.2%) with relatively equal proportions of fabrics **SILCBM1**, **SILCBM2**, and **SILCBM5** (17.1%, 13.3%, and 16.2% respectively). These four fabrics accounting for a total of 81.8% of the building materials retained (Fig.8.22). The remaining 18.2% is made up of a further four fabrics (**SILCBM4**:9.5%; **SILCBM6**:1%; **SILCBM7**: 3.8%; Vitrified: 3.8%).

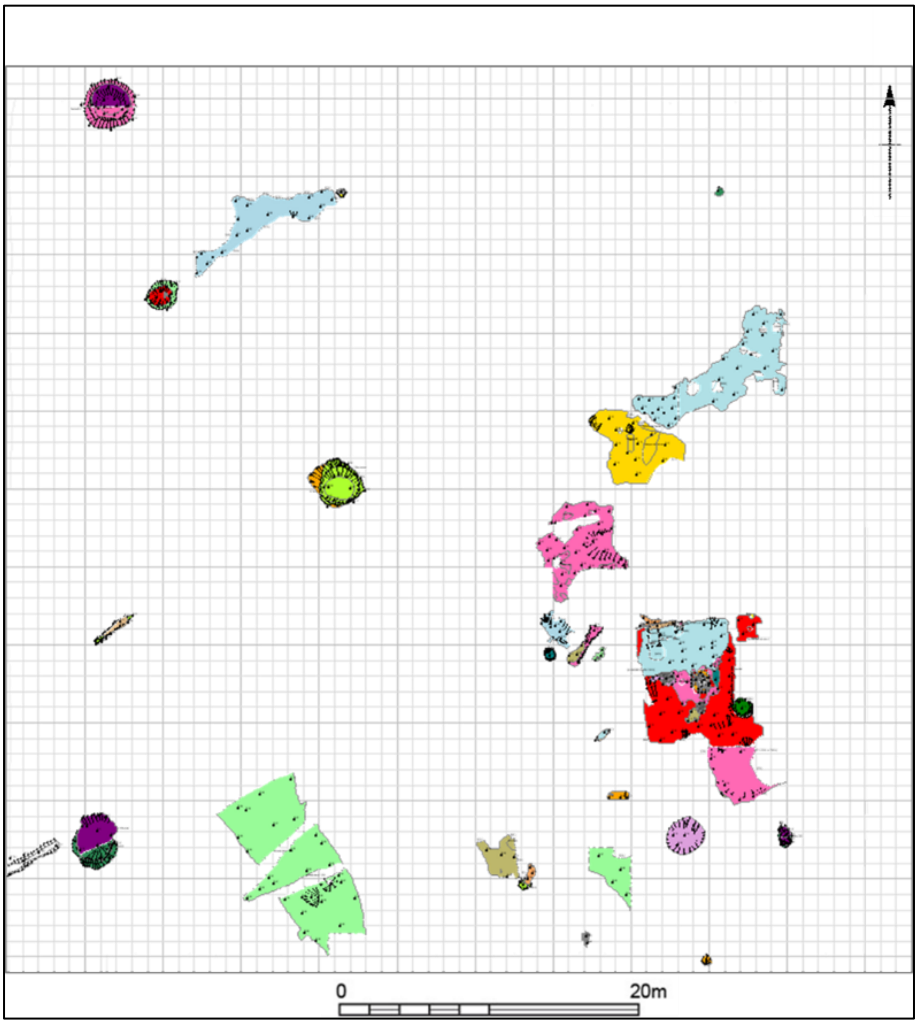


Figure 8.21: *Plan of Period 1 contexts from which CBM was retained*

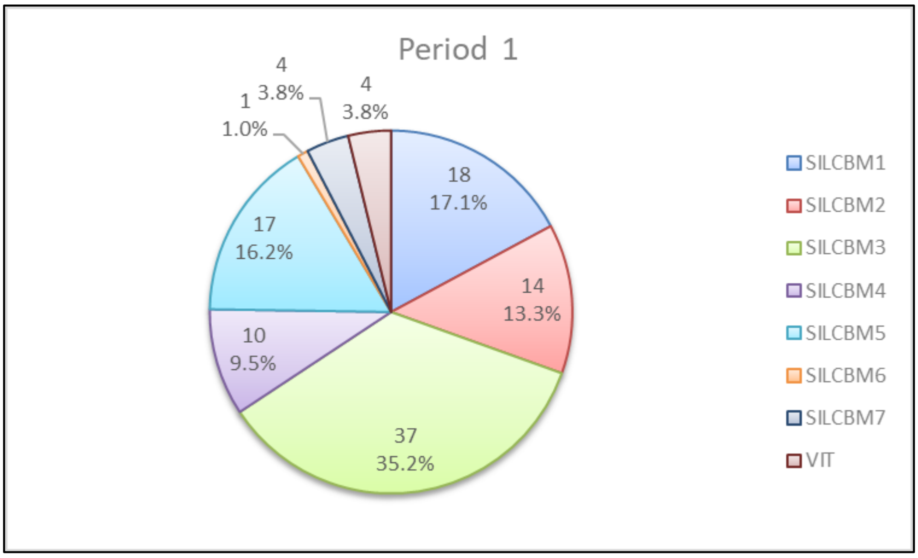


Figure 8.22: *Proportions of* ***SILCBM*** *fabrics represented in Period 1 contexts (n=105)*

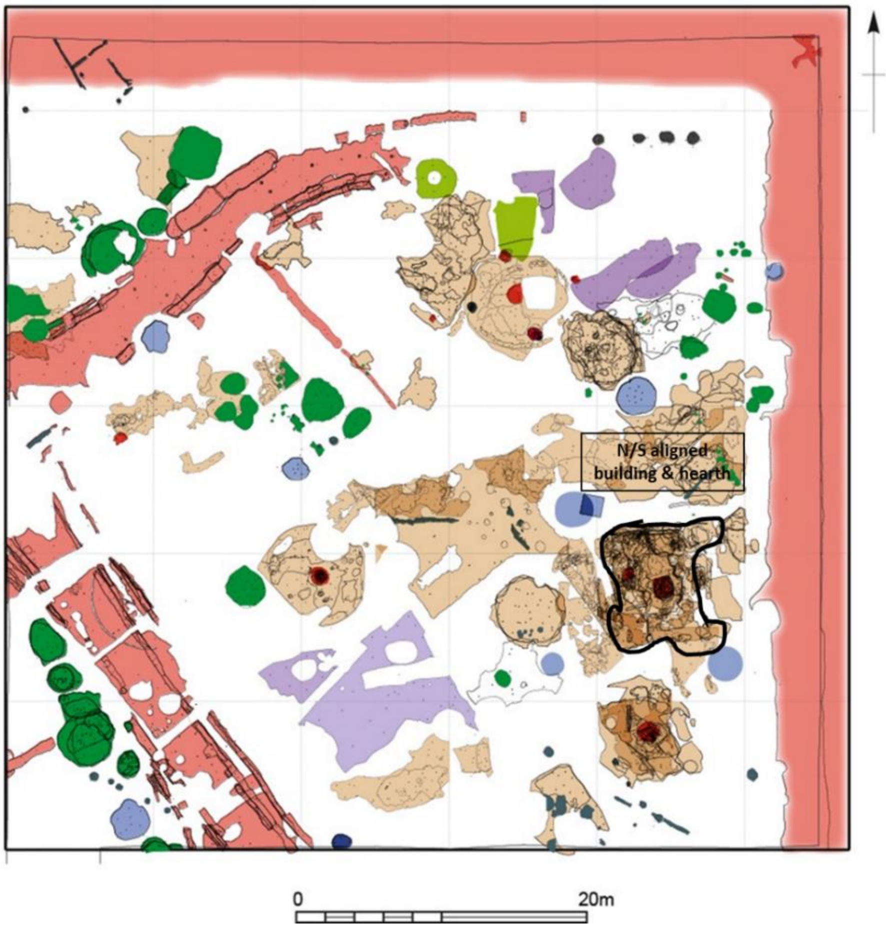


Figure 8.23: *Plan of period 1 features with north-south aligned building and integral hearth highlighted*

A prominent structure of Period 1 is the north-south aligned building located to the south-east corner of the trench (Figure 8.23). The proportions of **SILCBM** fabrics represented in this building (contexts 12204, 12384, 12395, 14800, 14807, 14857, 14991, 15024, 15889, 15958) and its associated hearth (11496, 11524, 11539, 11546, 12231, 12296) are shown in Figures 8.24 and 8.25. In both these **SILCBM3** dominates, representing 47% and 43% of the assemblages, with broadly similar proportions of all other **SILCBM** fabrics present. These two structures account for two-thirds of the total retained CBM assemblage from Period 1.

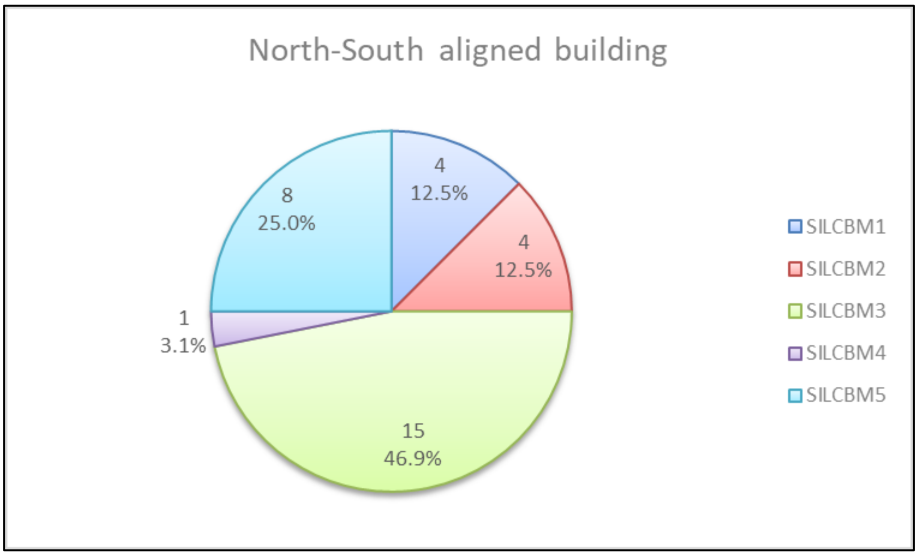


Figure 8.24: *Proportions of fabrics represented in the North-South aligned building (n=35)*

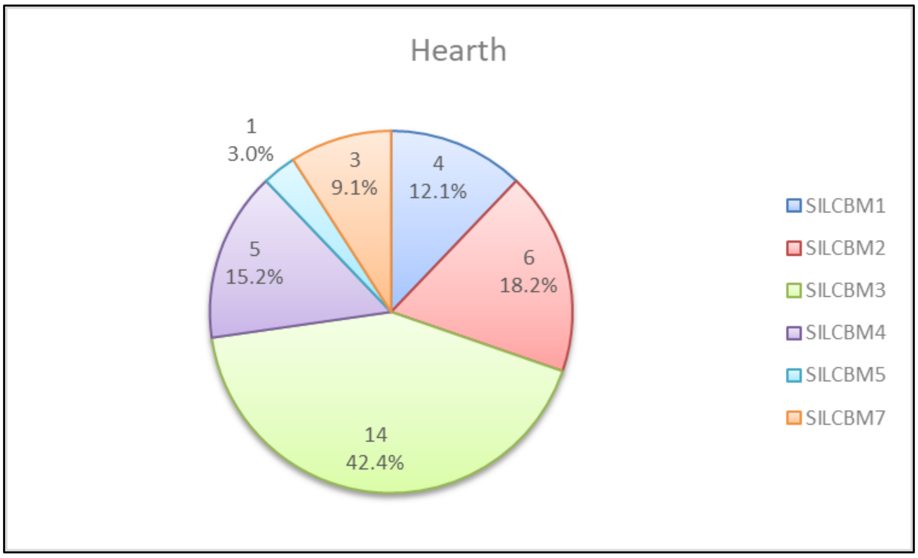


Figure 8.25: *Proportions of fabrics represented in the hearth associated with the North-South aligned building (n=34)*

In contrast, the assemblages from negative features dated to Period 1 are different in terms of the composition of fabrics. Figures 8.26 shows the location of the three Period 1 wells from which CBM was retained. The proportions of fabrics present in the fills of wells ([5100] – (8059), [8328] – (8452) & [8580] – (9592)) assigned to Period 1 are shown in figure 8.27. This shows a higher proportion of **SILCBM1** fabric (38%) than is seen in the north-south building.

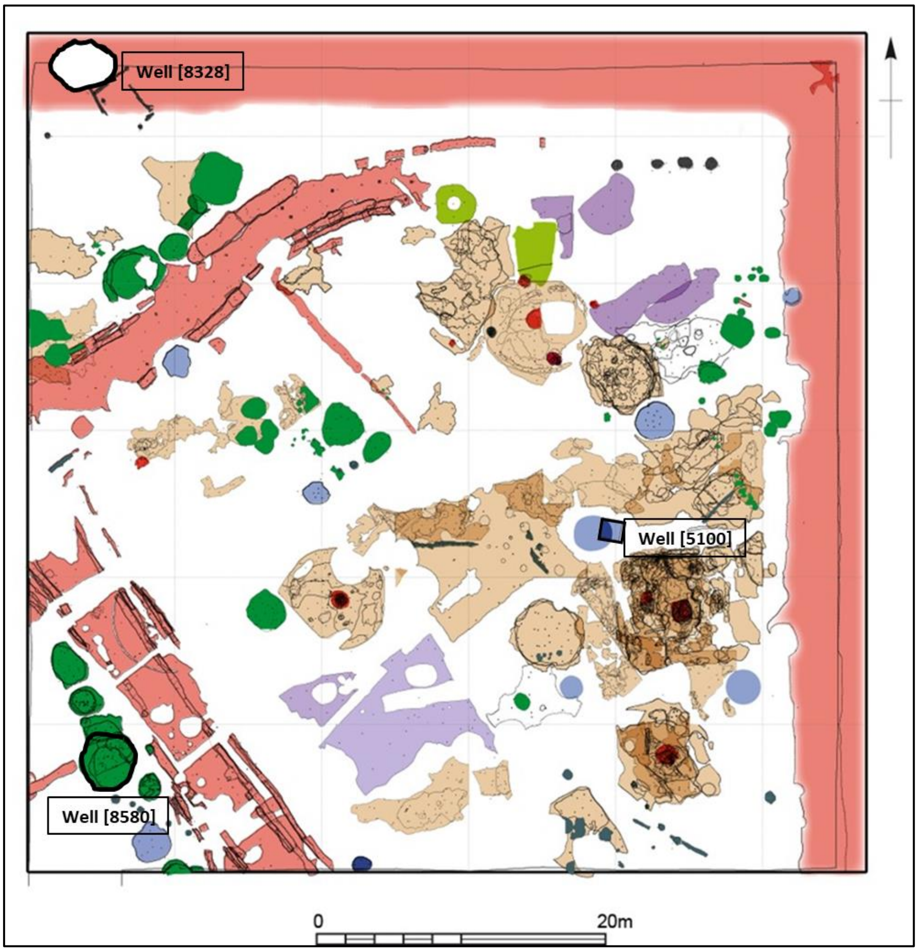


Figure 8.26: Plan of Period 1 features with wells [5100], [8328], & [8580] highlighted

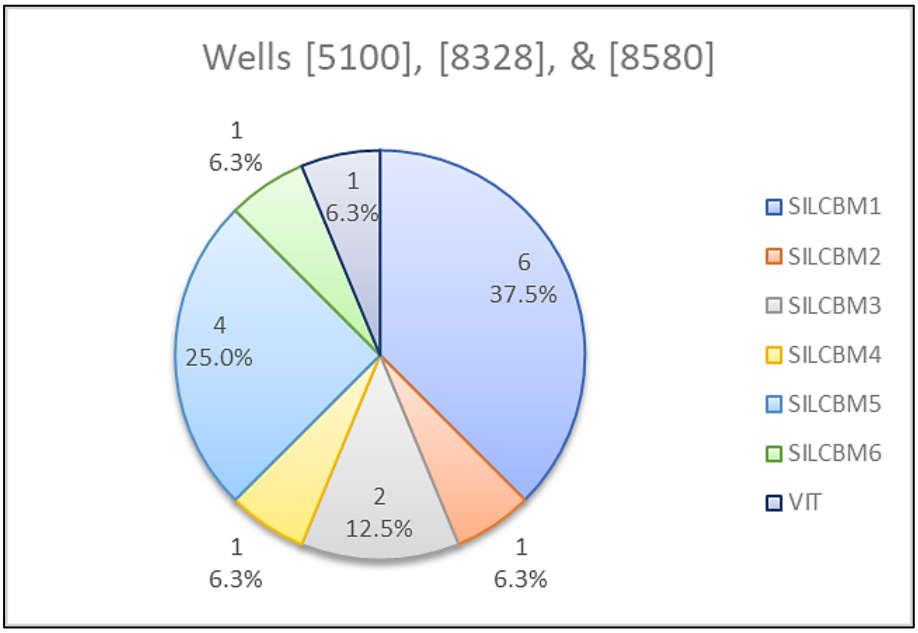


Figure 8.27: Composition of well fills assigned to Period 1

8.7.2 Period 2 - Early Roman I (c.A.D. 80 – 125/150)

The excavation of Period 2 features highlighted a major hiatus in the settlement in Insula IX in the third-quarter of the 1st century AD, with evidence of burning across a large portion of the trench along with the disuse of the Iron Age lanes and the imposition of the Roman street grid. Within the excavation area there was no evidence for the re-building of structures existing before the fire or for the continued use of pits and wells (Fulford and Clarke, 2009; Fulford, Clarke and Taylor, 2010).

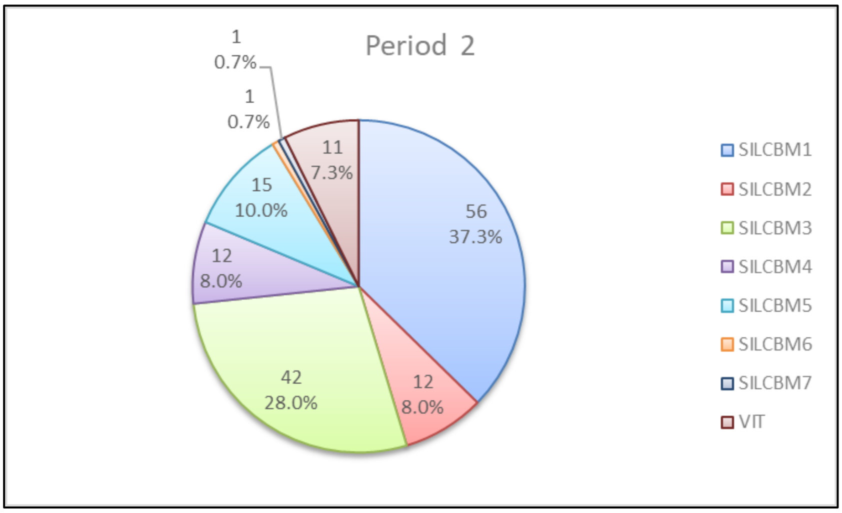


Figure 8.28: *Proportions of* ***SILCBM*** *fabrics represented in Period 2 contexts (n=150)*

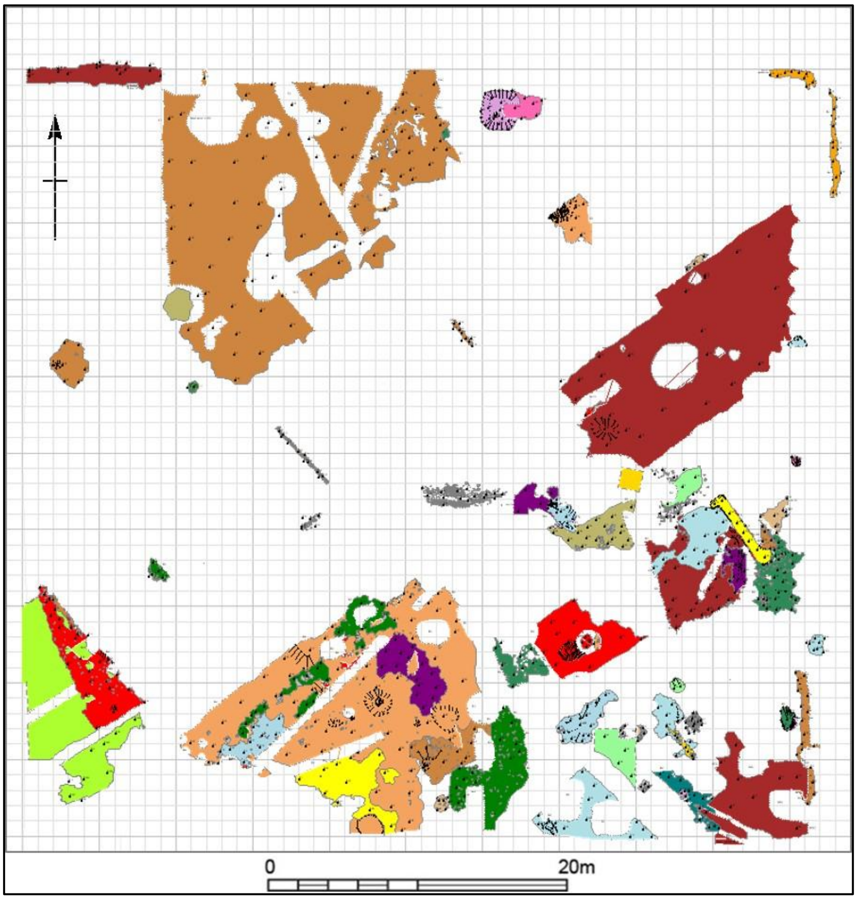


Figure 8.29: *Period 2 features with retained CBM*

A total of 150 items of CBM was retained from Period 2 contexts (Fig.8.29). In contrast to Period 1 this assemblage is dominated by **SILCBM1** (37%), with **SILCBM3** representing 28% of the retained material. The remainder of the assemblage is made up of relatively equal proportions of fabrics **SILCBM2**, **SILCBM4**, and **SILCBM5** (8%, 8%, and 10% respectively), Figure 8.29 shows the Period 2 contexts from which CBM was retained.

Early Roman timber buildings 1, 2 & 3 (ERTB1, ERTB2 & ERTB3)

All buildings assigned to Period 2 favour a north-east to south-west alignment. The proximity of **ERTB1, ERTB2**, & **ERTB3** to one another suggests that they are connected and belong to the same property (Fig.8.30).

Figure 8.30 *Period 2 timber buildings*

Very little CBM was retained from the contexts associated with these three buildings, with a total of five fragments recorded. Besides a single piece of combed flue-tile in fabric **SILCBM1** from **ERTB2**, the remaining four examples were all recovered from **ERTB1**. A fragment of *Opus Spicatum* brick, fabric **SILCBM4**, with one surface worn smooth through use, and two fragments of *imbrex* are recorded, one of fabric **SILCBM1** and the other highly fired/vitrified. There was also a small fragment of chimney in fabric **SILCBM5**, which shows wheel-throwing marks on the interior and finger-pinched decoration to the exterior. This is of the same form as the ventilator/finial fragments reported by Timby (2011).

Early Roman Timber Building 5 (ERTB5)

ERTB5 is a square/rectilinear structure with a central hearth exhibiting several phases of occupation (Banerjea, 2001, p. 105). The composition of the CBM retained from this structure is illustrated in figure 8.31. Of the assemblage of 33 fragments, 24 are from context (12397) a sequence of hearth structures located to the centre of the building (Fig.8.32), the latest phase of which was formed of complete or near-complete tiles. These show a greater proportion of **SILCBM1** (62.50%:48.48%) and less **SILCBM3** (8.33% compared to 18.18%) when set against the structure as a whole.

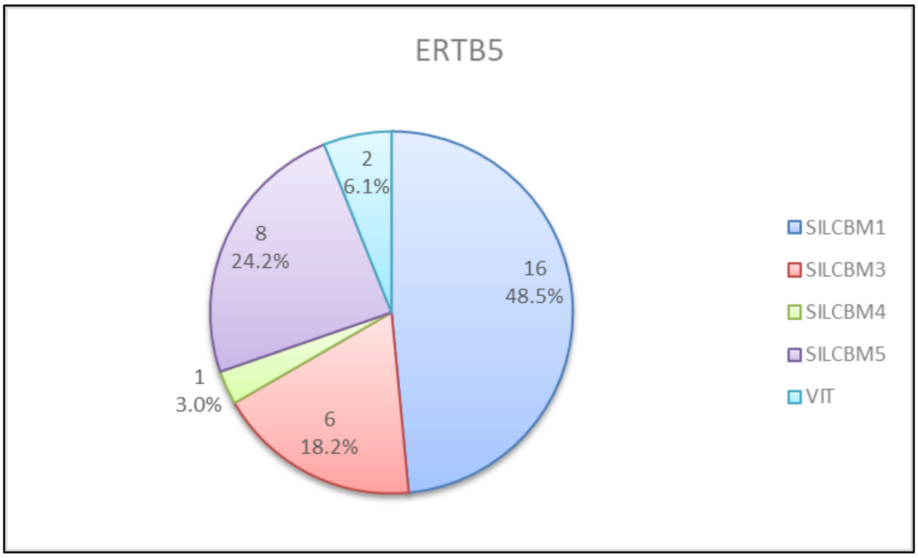


Figure 8.31: Composition of fabrics from ERTB5 contexts (n=33)

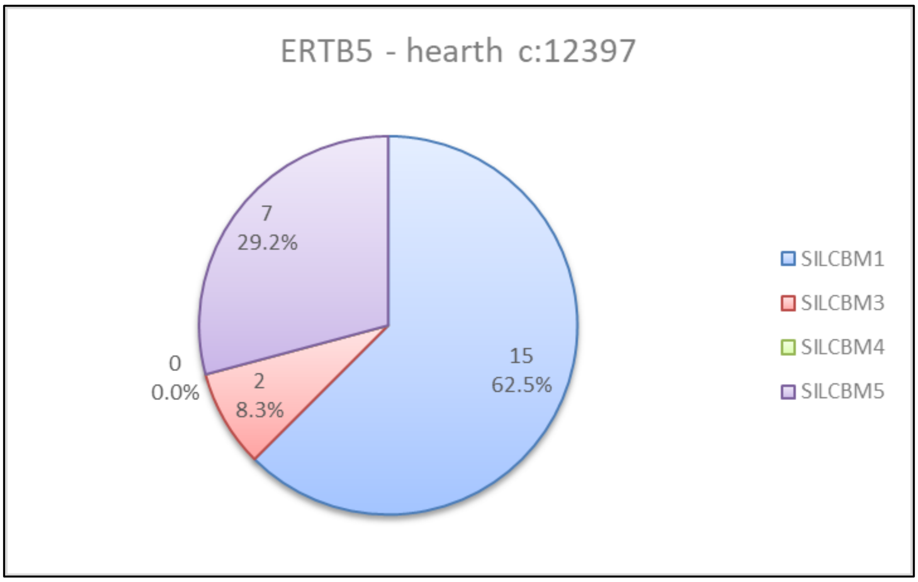


Figure 8.32: Composition of fabrics from ERTB5 – hearth c:12397 (n=24)

Early Roman Timber Building 6 (ERTB6)

ERTB6, a timber-framed building with substantial clay footings, extended beyond the extent of the excavation area (Fulford and Clarke, 2009). Attached to the north-east corner was a substantial furnace (C:5154), constructed from multiple courses of brick and tile (Banerjea, 2001, p. 107). Following the demolition of the furnace, **ERTB5** was constructed next to **ERTB6**. **ERTB5** is therefore contemporary with in the later phase of **ERTB6**. The proportions of **SILCBM** fabrics retained from ERTB6 are illustrated in figure 8.33.

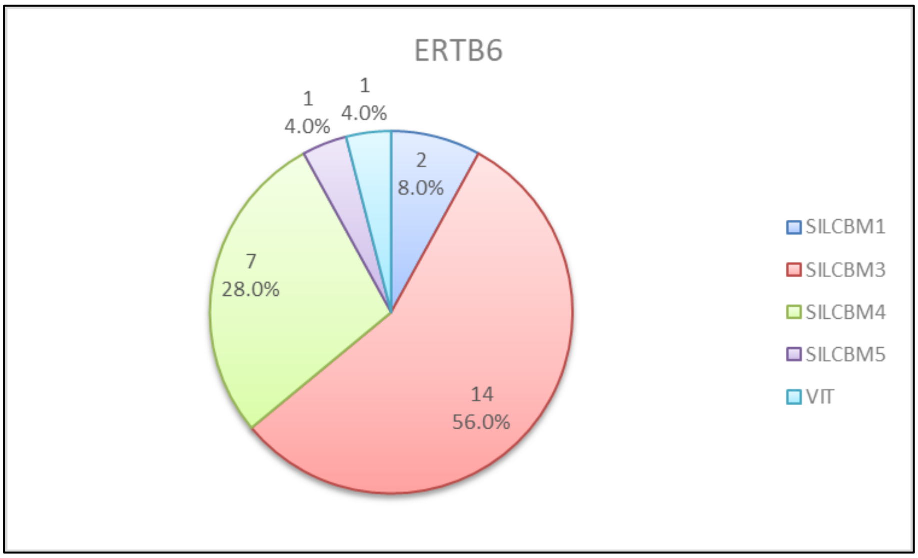


***Figure 8.33**: Composition of fabrics from ERTB6 (n=25)*

Of this assemblage of 25 fragments, 19 are from context (5154), the furnace located to the north-east of the building. These comprise 12 examples of **SILCBM3** and seven examples of **SILCBM4**. As discussed in Chapter 6.3.5, **SILCBM4** could be a variant of **SILCBM3**, which would mean this furnace was constructed of a single fabric group. It was extant to a height of 0.5 metres above the firing-platform (Fig.8.34) and was probably originally roofed over to create an almost closed structure (Fulford and Clarke, 2009).

***Figure 8.34**: image of hearth 5154*

Early Roman Timber Building (ERTB7)

ERTB7 is a relatively well-preserved, rectangular, timber-framed building consisting of a single room with a central tiled hearth, flanked on two sides by a corridor (Fulford and Clarke, 2009). A total of seven CBM fragments was retained from this structure. Of these, five were in **SILCBM1** fabrics, including two large brick fragments (1040g, 960g) recovered from the hearth structure (C:4525). The other two pieces were small fragments of unidentified building material in, respectively, fabrics **SILCBM3** and **SILCBM4**.

Early Roman Timber Building (ERTB8)

ERTB8 lay immediately adjacent to the north-east of **ERTB7** and also evidenced several phases of occupation and alterations, with at least four hearth areas identified (5125, 5745, 5690/8102, and 8154) (Banerjea, 2001, p. 108). Hearth (5690) was located centrally in the building, whilst (5125 & 5745) were located to the south-west corner. The south-east facing corridor contained hearth (8154) which slumps into an earlier well.

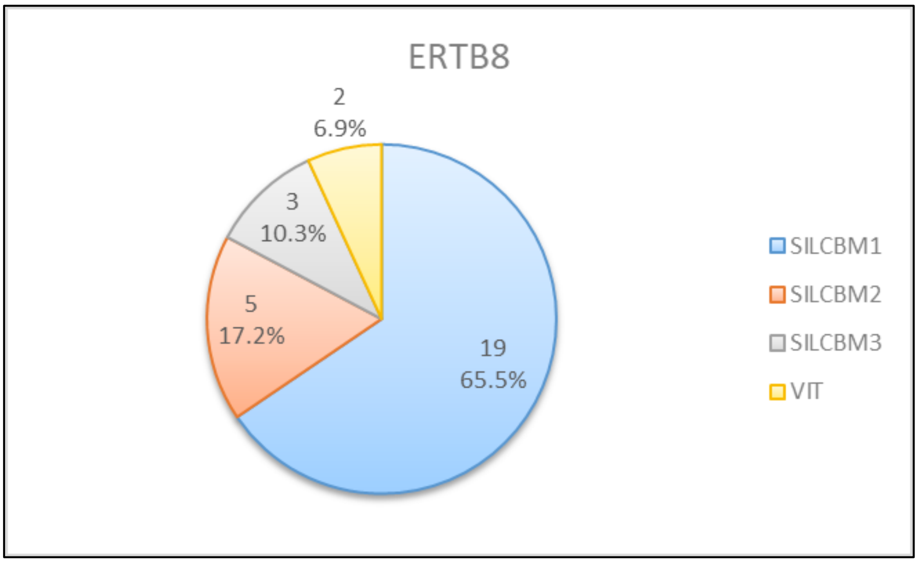


Figure 8.35: Composition of fabrics from ERTB8 (n=29)

A total of 29 fragments of CBM was retained from contexts belonging to **ERTB8**, weighing a total of kg (figure 8.35). Of these 19 are fabric **SILCBM1**, which includes 13 fragments of brick recovered from the hearth structure (C:(8154)). Of the remainder, five are **SILCBM2** and 3 are **SILCBM3**, with two fragments being highly vitrified.

ERTB 5, ERTB6, & ERTB8

To compare the incidence of **SILCBM** fabrics across buildings, the results from **ERTB5**, **ERTB6** and **ERTB8** have been plotted (Fig.8.37). **ERTB5** and **ERTB8** show a similar composition of fabrics, with **SILCBM1** dominating the retained assemblages. However, **ERTB6** has only two examples of this fabric, with 60% of the material in fabric **SILCBM3**. While the small volumes of material from these buildings could be disproportionately affecting the ratios, it is possible that there was a change in the sources of building material, as we know the construction of **ERTB6** preceded **ERTB5**.

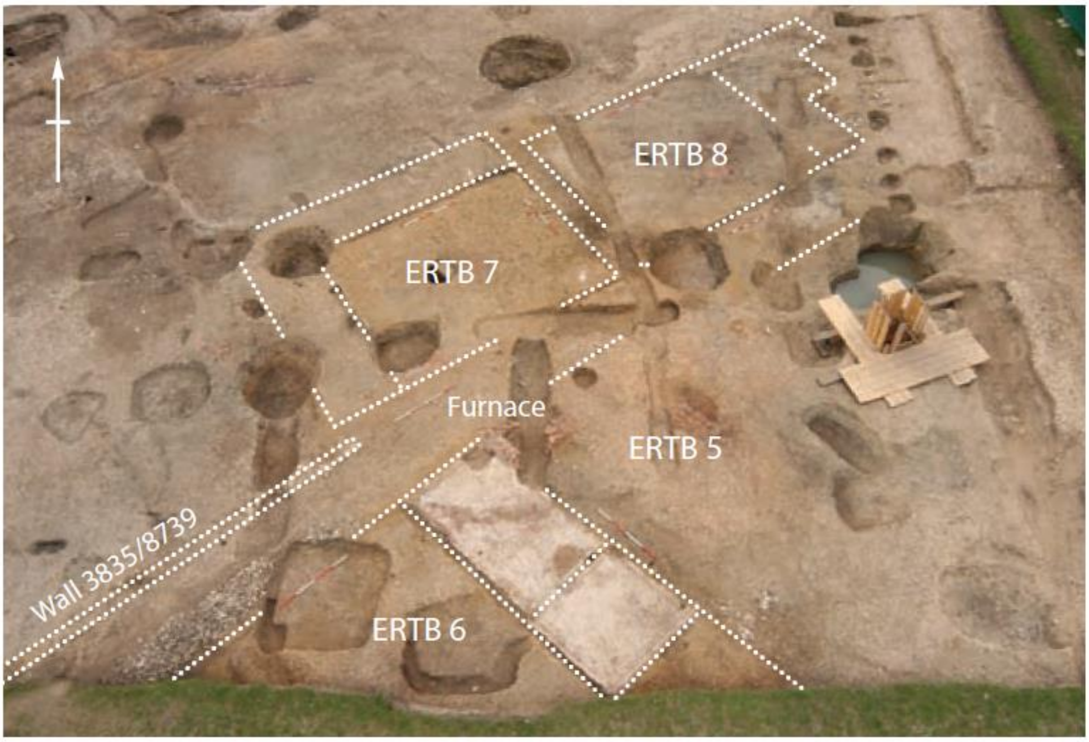
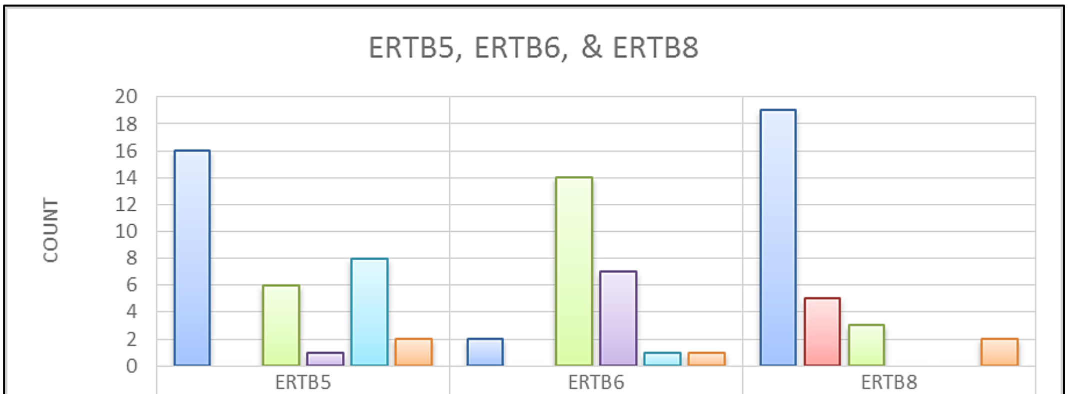


Figure 8.36: ERTB5, 6, 7, & 8 under excavation



	ERTB5	ERTB6	ERTB8
SILCBM1	16	2	19
SILCBM2	0	0	5
SILCBM3	6	14	3
SILCBM4	1	7	0
SILCBM5	8	1	0
VIT	2	1	2

SILCBM1 SILCBM2 SILCBM3 SILCBM4 SILCBM5 VIT

*Figure 8.37: Comparison of **SILCBM** fabrics across ERTB5, ERTB6, & ERTB8*

Overall, the Period 2 materials highlight a shift towards the use of CBM from tile production centres exploiting raw materials from *London Clay Formation* sources, rather than from the *Windlesham Formation*.

8.7.3 Period 3 - Early Roman II (c.A.D. 125/150 – 200)

The start of this period coincides with the construction of the forum-basilica in masonry, at a time when the town was without defences (Fulford and Timby, 2000, pp. 58–68). By the end of the 2nd century, however, the city had been provided with earthwork defences which were eventually replaced in masonry by the late 3rd century (Fulford, 1984). This period sees the appearance of masonry-founded buildings rather than structures built exclusively of timber as in Period 2 (Fulford and Clarke 2011). Masonry Buildings 1 (**MB1**) and 2 (**MB2**), along with Mid-Roman Timber Building 1 (**MRTB1**) replaced the two earlier timber buildings **ERTB2** & **ERTB3** on a north-east/south-west alignment. Initially **ERTB1** continued in use into Period 3 before being replaced by **MRTB1** (Fig.8.38).

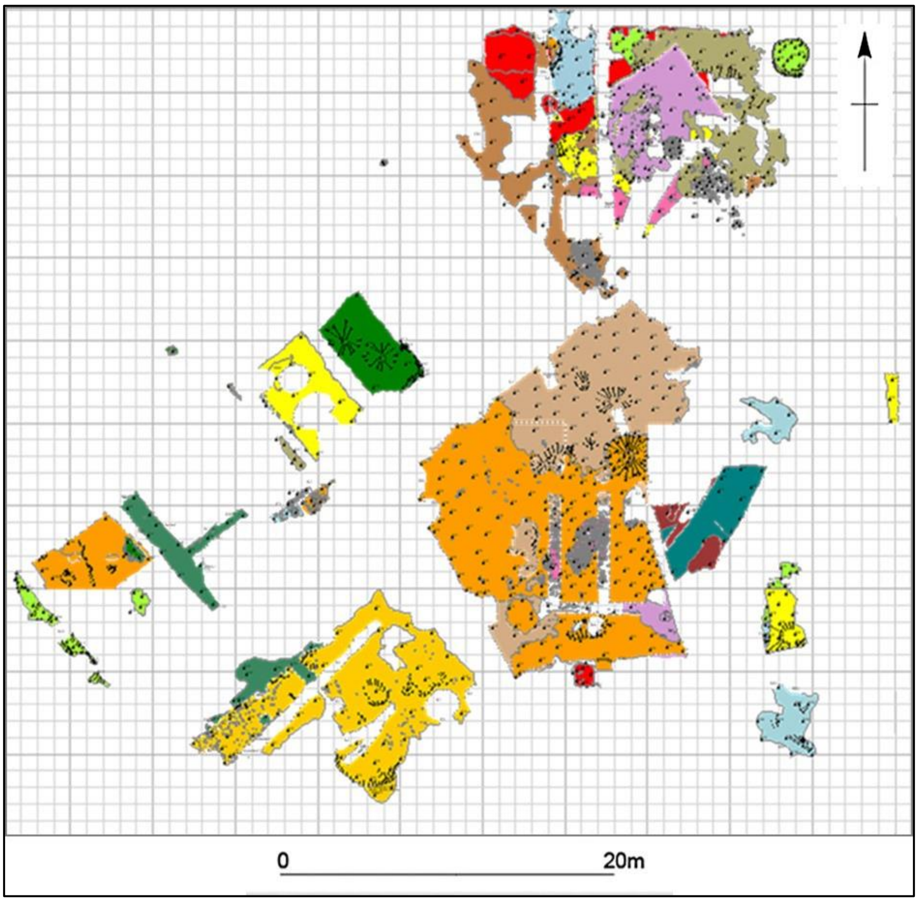


Figure 8.38: Plan of Period 3 contexts from which CBM was retained

A total of 125 items of CBM was retained from Period 3 contexts and their proportions are shown in figure 8.39. The dominance of **SILCBM1**, witnessed in Period 2, continues with this fabric accounting for over half (56.80%) of the retained material. The proportion of **SILCBM3** has now reduced to 6.40%.

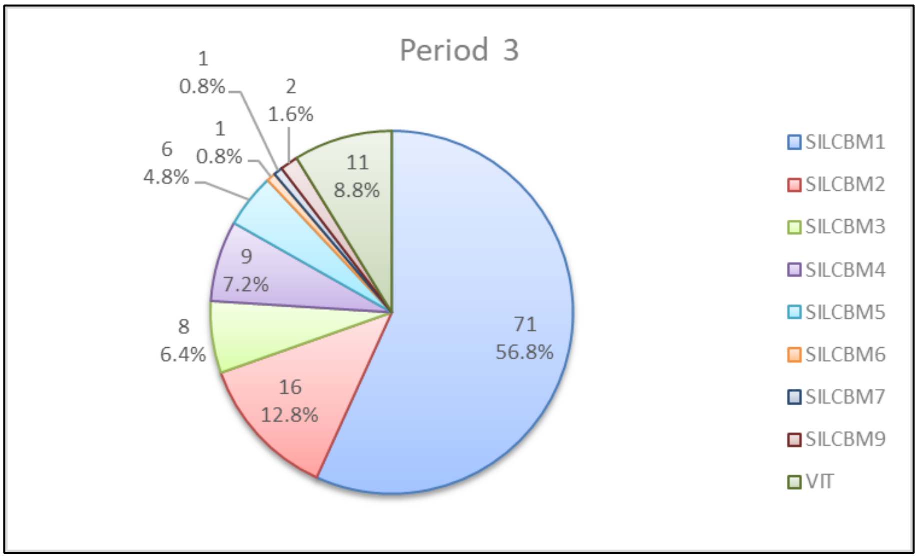


Figure 8.39: *Proportions of **SILCBM** fabrics represented in Period 3 contexts (n=125)*

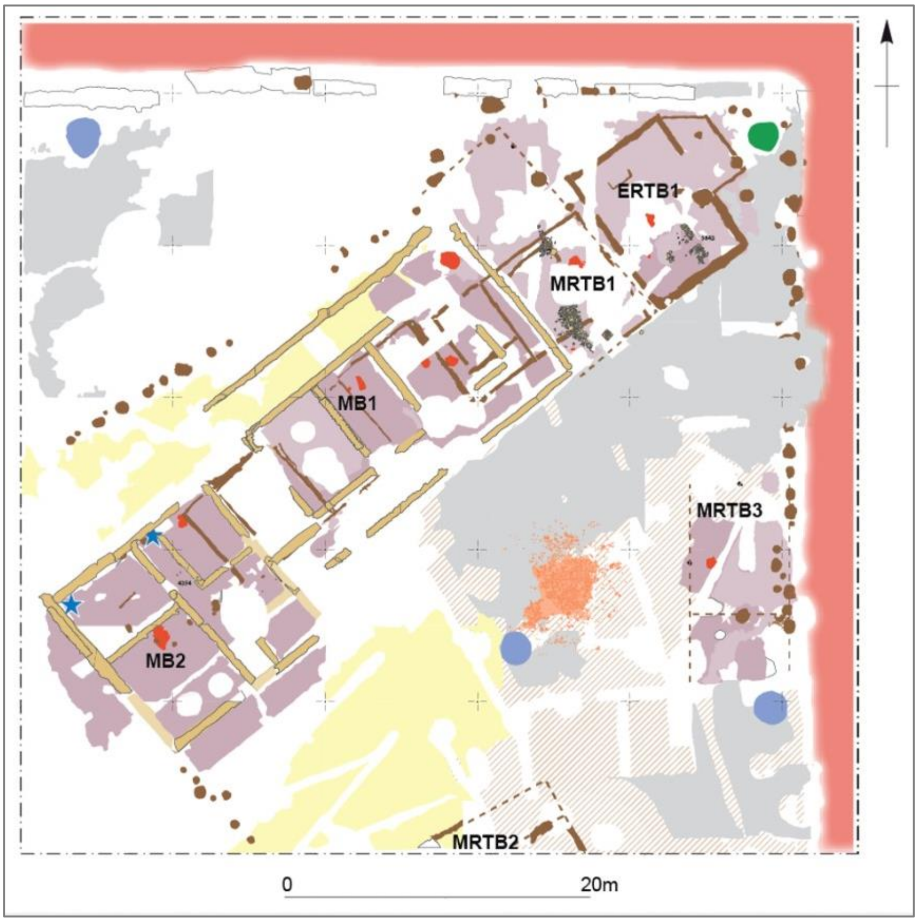


Figure 8.40: *Plan of period 3 features*

Fulford & Clarke (2011, pp. 11–35) describe the Period 3 properties, their development, associations, and related features (Fig.8.40). To the south-east there is evidence for occupation along the north-south street, and spreading westwards across the excavated area, associated with a possible, but not certain, built structure, **MRTB3** (Fulford and Clarke, 2011, p. 12). A second possible timber building **MRTB2** extended south beyond the limits of the excavation trench (Fulford and Clarke, 2011, p. 13).

Masonry Buildings 1 (MB1 – Object: 50018) & 2 (MB2 – Object:50019)

MB1 overlay the principal town-house building **ERTB2** of period 2 and has also been interpreted as a town-house. It was immediately adjacent to **MRTB1** to the north-east and no more than 4.0m distant from **MB2** to the south-west. It was of a row-type plan comprising three rooms and surrounded by a corridor on at least three sides. No CBM was recorded as having been used in its construction, although traces of tessellated floor were recorded. Room 1 measured 7.0m by 7.0m but was divided by later intrusion. Two areas of burnt clay, (**3203**; **2192**) are both interpreted as small hearths, along with a third feature (**3222**), from which no CBM was retained, filled with ash and fragments of burnt ceramic tile and also interpreted as the remains of a hearth (Fulford and Clarke, 2011, p. 15). The central room, Room 2, measured 7.0 by 4.0m, whilst the third room, Room 3, measured 7.0 by 5.0m and was floored with nodular flint pressed into gravel and yellow clay (Fulford and Clarke, 2011, p. 16). At the southern end of the corridor, and appearing to block it, was a linear spread (**3693**) of ceramic tile on clay, again no CBM was retained from this context. It may have supported a wall, but its function is otherwise unclear.

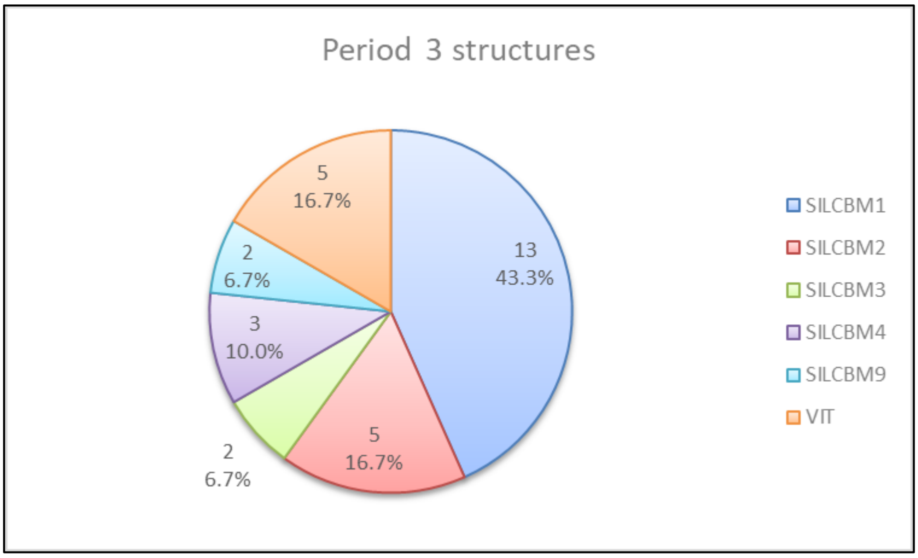


Figure 8.41: *Proportions of CBM fabrics retained from Period 3 structures (MB1, MB2, MRTB1, & MRTB3) (n=30)*

Located some 4.0m to the south-west of the surviving end wall of **MB1**, **MB2** was square in plan and comprising four rooms with linking cross-corridor and possible entrance-hall space. It was constructed on the same north-west/south-west alignment (Fulford and Clarke, 2011, p. 19). The building seems to have been intended for residential occupation, while the foundations are more modest than those of MB1, they were nevertheless capable of supporting an upper storey. The relationship of these two masonry buildings is discussed in the *Silchester: City in Transition* (Fulford and Clarke, 2011, pp. 21–22).

The CBM assemblage from Period 3 structures (Fig. 8.41) is representative of the overall proportions of Period 3 material, albeit with slightly less **SILCBM1** and more **SILCBM2**.

Negative features

There are several pits and a well, from which CBM was retained. Feature [4835] was a sub-rectangular pit adjacent to **ERTB1**, whilst context [5039] was circular in plan, with upper fills containing building material and a slump of decayed wall-plaster (Fulford and Clarke, 2011, p. 28). The CBM retained from these negative features is dominated by **SILCBM1** (73%), with no examples of fabrics **SILCBM2** or **SILCBM3** (Fig.8.42).

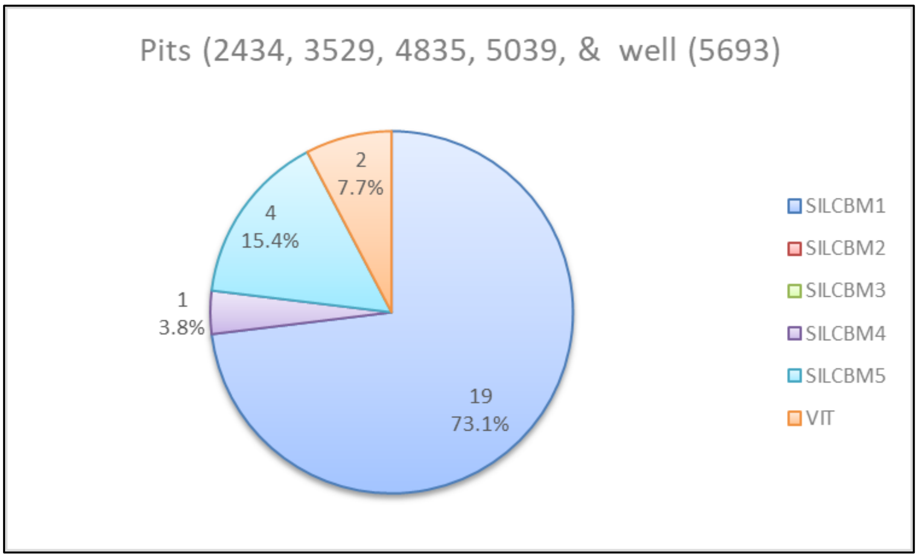


Figure 8.42: *Proportions of CBM fabrics retained from Period 3 negative features (n=26)*

CBM Dump

Following the demolition of the Period 2 buildings in the south-east of the excavation trench, the area was covered with gravel spreads and a very large dump of ceramic building material, mainly comprised of *imbrices* and *tegulae* (4265/4528), thought to have derived from the demolition of Period 2 buildings (Fulford and Clarke, 2011, p. 32; Warry, 2011, p. 225). Whilst, the fabric composition of these dump contexts (Fig.8.43) does not correspond with that of the Period 2 assemblage, none of the Period 2 material was recovered from primary contexts.

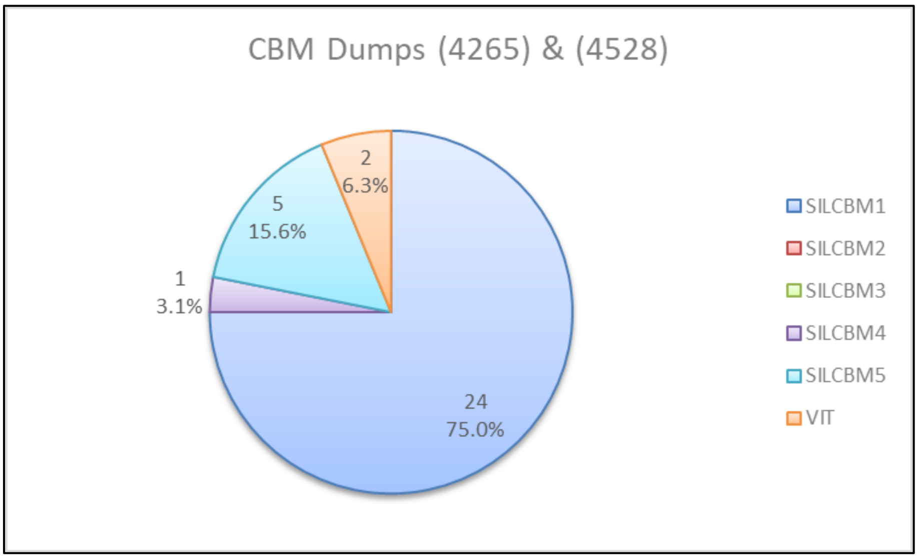


Figure 8.43: *Proportions of CBM fabrics retained form Period 3 CBM dumps (n=32)*

Overall, the CBM assemblage retained from Period 3 demonstrates a further increasing proportion of materials from a *London Clay formation* source (**SILCBM1**) and shows a marked decrease in the proportion of **SILCBM3**, from 28% in Period 2 to 6.4% in Period 3.

8.7.4 Period 4 - Later Roman I (c. A.D. 200 – 250/300)

Period 4 sees the demolition of two town-houses, **MB1** and **MB2**, which are replaced by the construction of Masonry Building 3 (**MB3**), continuing to favour a north-east/south-west alignment of previous buildings. (Fig8.44).

There is no evidence to suggest the continuation in use of the Period 3 buildings (**MRTB1** and **MRTB2**) in the north-east corner of the Insula, whilst **MRTB2** and **MRTB3** were demolished and replaced with two, equally insubstantial, new timber buildings, **MRTB4** and **MRTB5**, both of which were constructed on the line of the north-south street. Two successive wells, ([5735] & [1750]) were sunk to the north of the southern building, **MRTB4**, and a further four pits ([2434], [2601], [3406], & [3102] were dug to its west (Fulford and Clarke, 2011, p. 35) (Fig.8.45). The proportions of retained CBM from Period 4 compares well with those from Period 3 (Fig. 8.46).

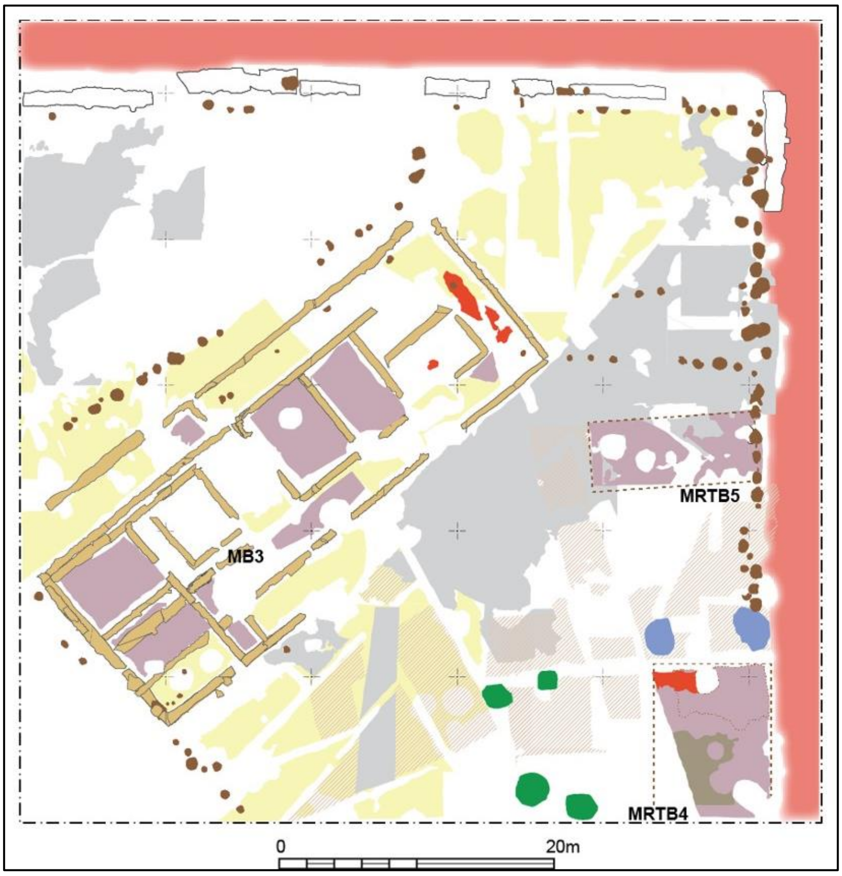


Figure 8.44: *Plan of Period 4 features*

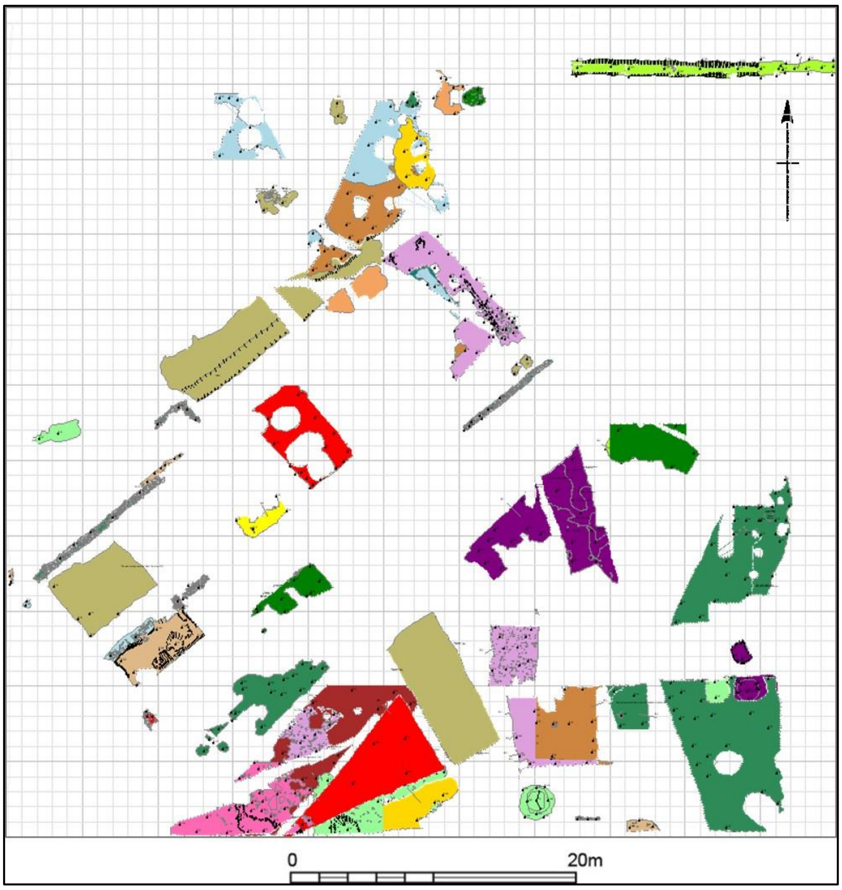


Figure 8.45: *Period 4 contexts from which CBM was retained*

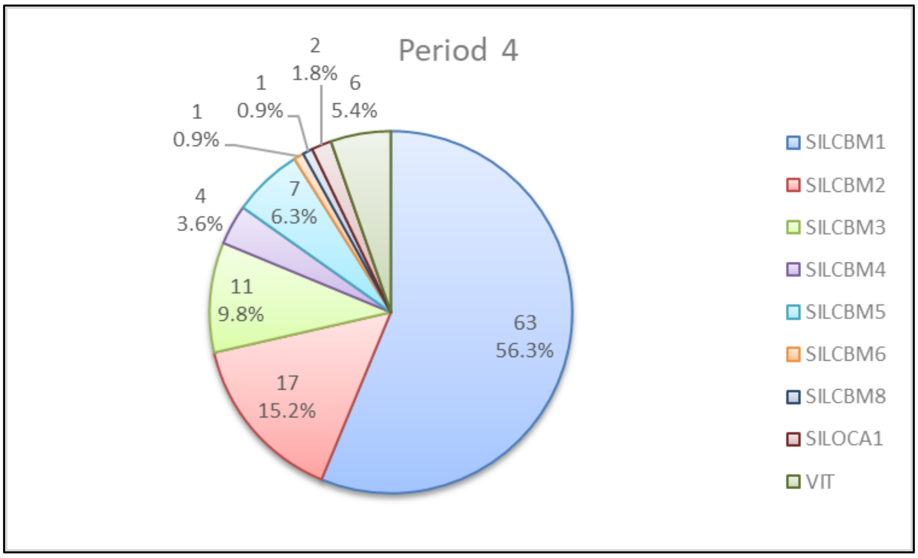


Figure 8.46: *Proportions of* ***SILCBM*** *fabrics represented in Period 4 contexts (n=112)*

Masonry Building 3 (MB3 – Object: 50046)

The construction of this large house represented an extension south-westward of the footprint of **MB1**. The new walls were constructed of flint, with a further parallel wall extending the line of the internal wall of **MB1**, which re-used tile, as well as flint in its foundations (Fulford and Clarke, 2011, p. 35). This house was one of the larger buildings in *Calleva* and was therefore presumably of considerable status. While the date of construction is blurred as it involved the cutting into floor make-ups associated with Period 3, the date of abandonment and demolition is clearer. The foundations of the house are cut by a number of pits, the earliest of which have contents dateable to around the second half of the 3rd century (Fulford, Clarke and Eckhardt, 2006, p. 14). The assemblage from this building is again dominated by **SILCBM1** (Fig. 8.47).

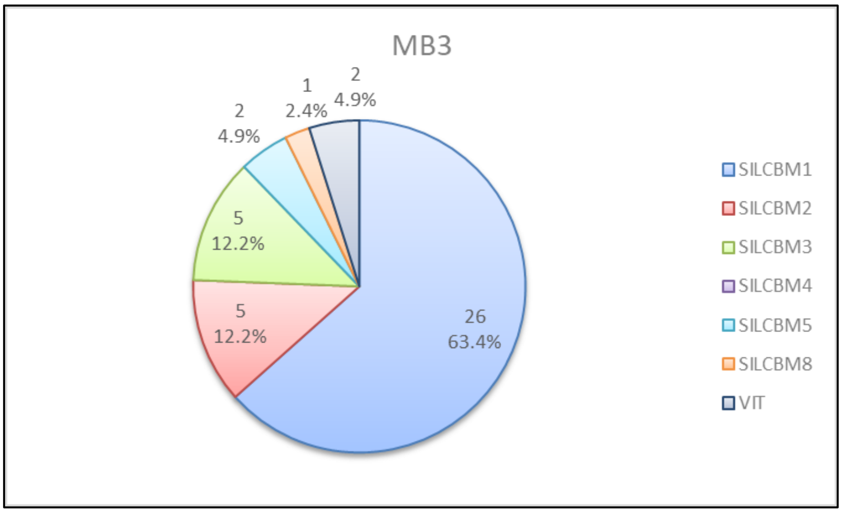


Figure 8.47: *Proportions of* ***SILCBM*** *fabrics retained from MB3*

Mid Roman Timber Building 4 (MRTB4)

This building is one of two new timber buildings dated to period 4. The CBM assemblage in terms of fabric composition shows a lower proportion of **SILCBM1** than seen in the overall period 3 contexts, with a higher proportion of **SILCBM2**, otherwise, the proportions of the remaining fabrics are typical of Period 4 levels (Fig. 8.48).

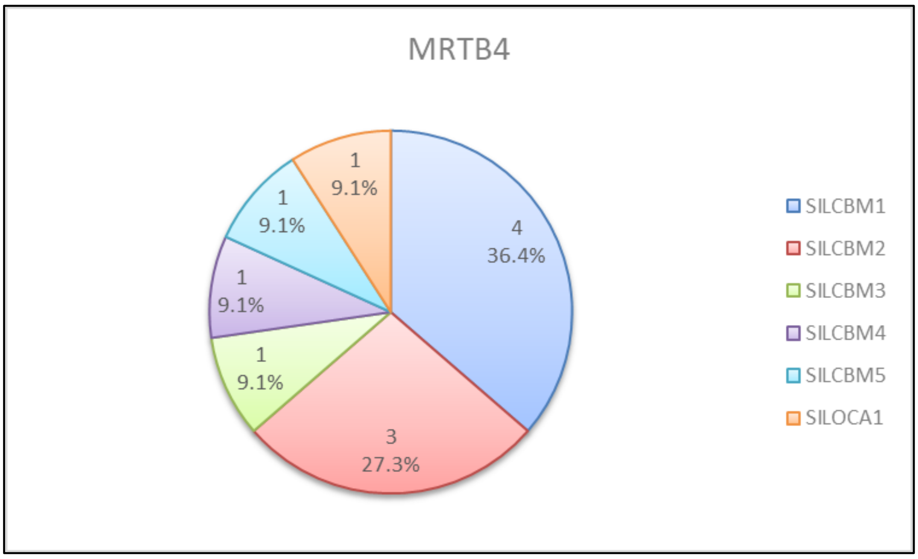


Figure 8.48: *Proportions of **SILCBM** fabrics retained from MRTB4*

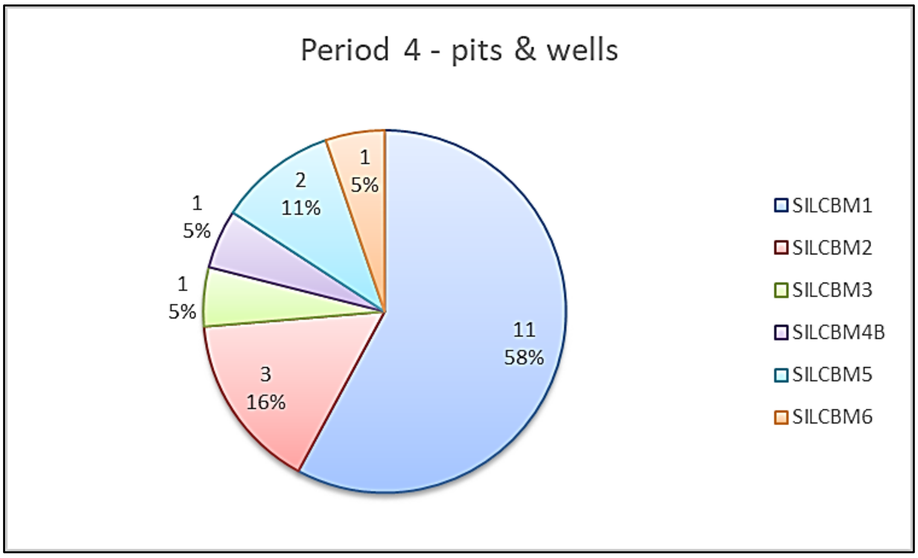


Figure 8.49: *Proportions of **SILCBM** fabrics from Period 4 pits and wells*

Pits and wells

There are six substantial cut features associated with the Period 4 occupation. All are in relatively close proximity to each other in the south-east corner of the excavation trench. Two (**1750** and **5735**) certainly served as wells; and two might have had this function (**3102**, **3406**); while the remaining two were almost certainly dug as cess- or rubbish-pits from the outset. The proportions of CBM fabrics represented in these negative features are comparable to those recorded overall for Periods 3 and 4 (Fig.8.49).

8.7.5 Period 5 - Later Roman II (c. A.D. 250/300 – 450/500)

By the end of Period 4, **MB3** had been completely demolished and new properties were constructed on a new orientation, the same as that of the street grid, which itself was aligned with the cardinal points (Fulford and Clarke, 2011, p. 3) (Fig. 8.50 & 8.51). The CBM retained from this phase again shows similarity with the proportions of fabrics from Periods 3 and 4, but with an increase in the proportion of **SILCBM2** to 21.70% of the retained material (Fig.8.52).

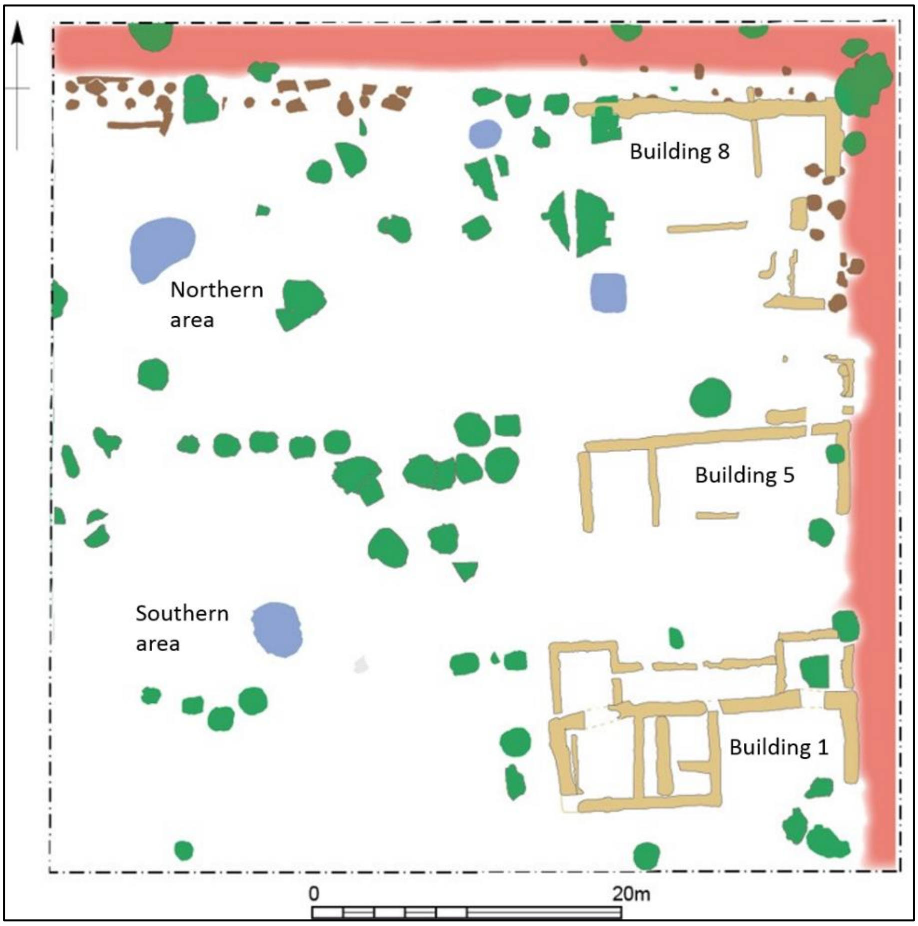


Figure 8.50: *Outline plan of Late Roman II features*

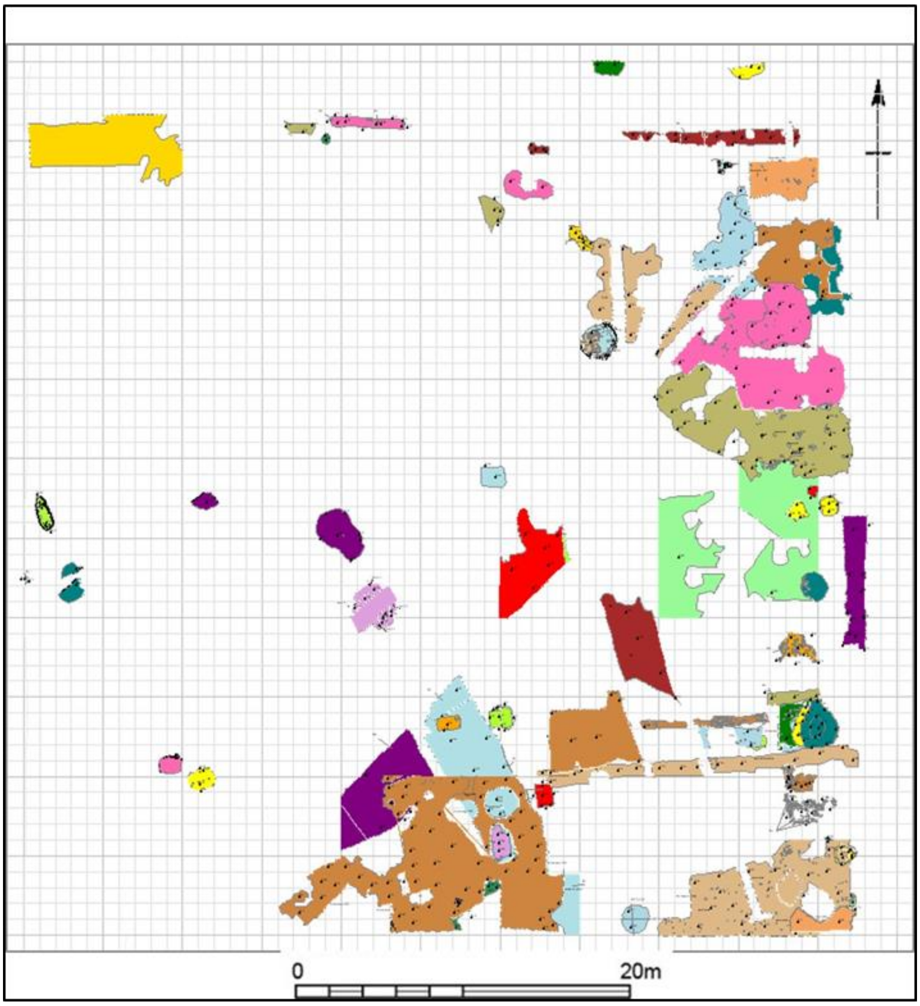


Figure 8.51: Plan of Period 5- Late Roman II features from which CBM was retained

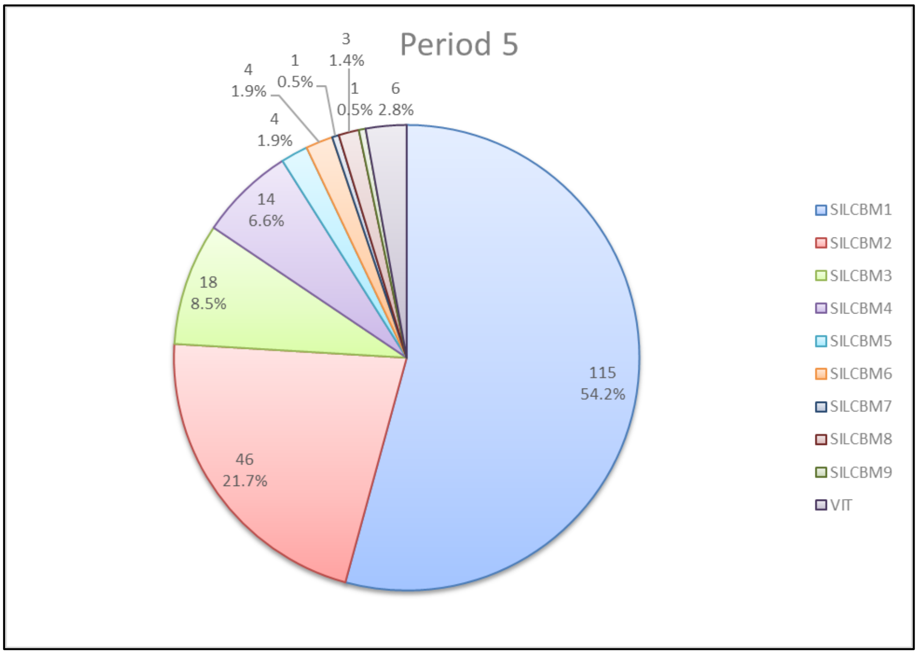


*Figure 8.52: Proportions of **SILCBM** fabrics represented in Period 5 contexts*

The complex stratigraphy of this period has enabled a detailed chronology of the developments in this area of the town to be described (Fulford, Clarke and Eckhardt, 2006, pp. 16–78). However, the selective retention of CBM from these contexts negates the division of material between the periods. The material is therefore considered in terms of that recovered from structures, Buildings 1, 5, 7, and 8, and the large number of negative features, primarily pits, found across the excavation area.

Late Roman II buildings

Four buildings were constructed in this period, all with their frontages aligned to the north-south street. Evidence shows Buildings 1 and 5 to be contemporary. It is possible that they included shared space in the form of access, or were part of the same property (Fulford, Clarke and Eckhardt, 2006, p. 30). **SILCBM1** fabric makes up 50% of the CBM retained from the structures. These assemblages also reflect the increase in the presence of **SILCBM2**, at 23.91% (Fig.8.53).

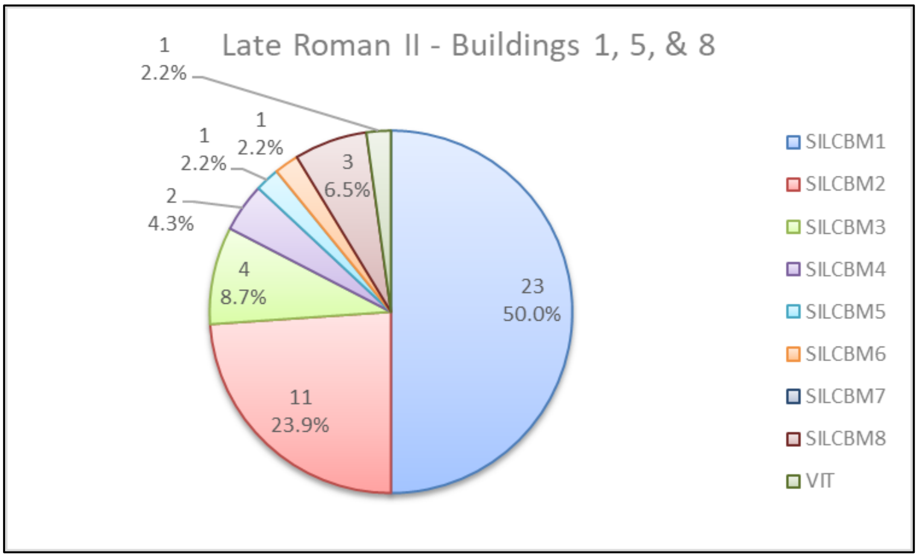


Figure 8.53: *Proportions of **SILCBM** fabrics represented in Period 5 buildings*

Pits

The material retained from the Late Roman pits is representative of the overall assemblage from this phase of the Roman town, with a predominance of **SILCBM1** material (Fig.8.54). Overall, the CBM assemblage retained from the Late Roman II phases continues the dominance of **SILCBM1**, but with an increase in the **SILCBM2**, possibly supplied from the tilery at Minety, Wiltshire (Chapter 7.10).

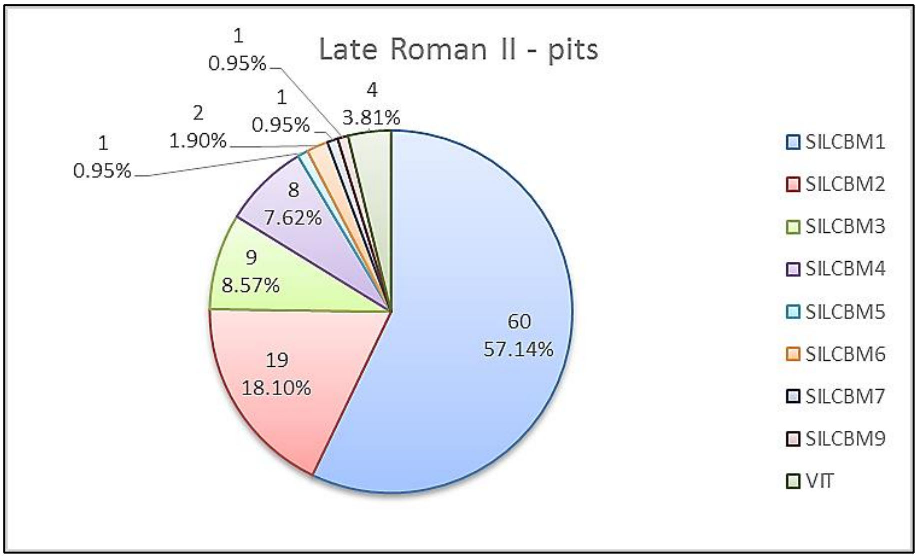


*Figure 8.54: Proportions of **SILCBM** fabrics represented in Period 5 pits*

8.8 Other dating evidence

As already discussed, a chronology of tegulae lower cutaways forms was devised by Warry (Chapter 2.6; Warry, 2006). There are 78 lower cutaway forms identified in the Silchester material. Of these, 76 are on **SILCBM1** *tegulae* and the other two on **SILCBM3** material (Fig.8.55). The fabric analysis of the Silchester material that Warry considered alongside the cutaway forms distinguished one major early fabric, used with cutaway groups A & B and some C, and two major later fabrics used with groups C & D. All evidently derived from the local London clay (Warry, 2012, p. 69). This study has shown the variability within *London Clay Formation* deposits and the methods employed mean it is not possible to distinguish products from different outcrops of the same formation. The lack of secure dating contexts for most of this material also negates the validation of the cutaway dating. The **SILCBM1** fabric is used throughout the life of the town, **SILCBM3** is found in FBIX-2, and has a terminus post quem of A.D.54 based on the production of the Nero-stamped tiles at the Little London tilery. Both cutaways on the **SILCBM3** *tegulae* are Warry type C5 (Warry, 2006, p. 137) which were assigned a date range for manufacture of AD160-260.

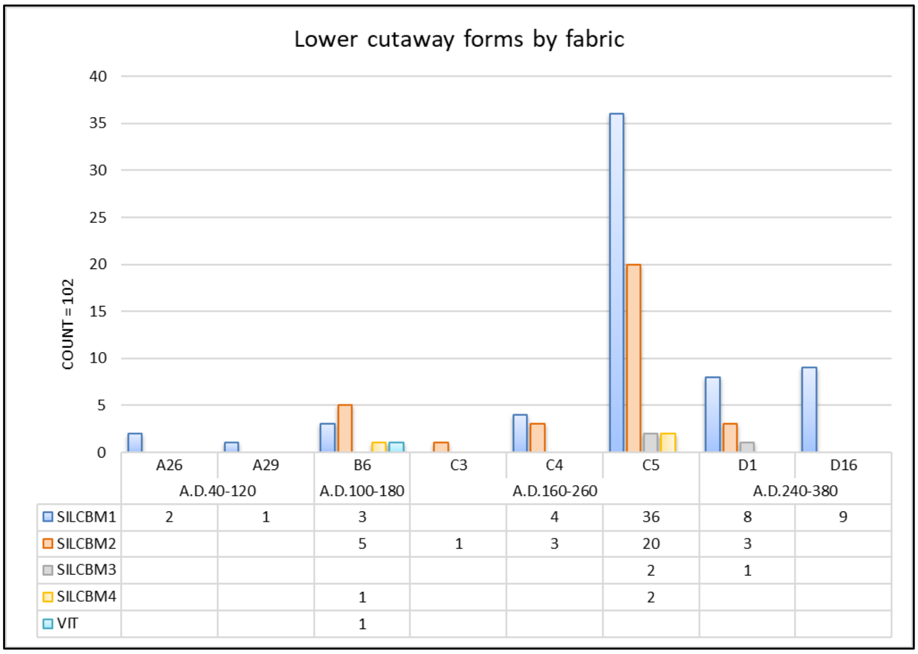


***Figure 8.55**: forum-basilica lower cutaway forms by fabric*

8.9 Public and Private building materials

The final analysis of the chronology of fabrics compares the changes in **SILCBM** fabrics used in both the private residential area of Insula IX and the public spaces of the forum-basilica complex. Table 8.3 shows the concordance of the different periods from the two areas, which can be grouped into five periods, labelled FBIX1 – FBIX5.

FBIX Period	Forum-Basilica Period (s)	Insula IX Period(s)
FBIX-1	1. Earliest occupation 25-15B.C. & 2. Planned layout 15 B.C. to A.D. 40-50	Period 0 – pre-Roman
FBIX-2	3. Claudio-Neronian A.D. 40-50/60 & 4. Roman - Pre-Flavian courtyard building	Period 1 – Early Roman I
FBIX-3	5. The Flavian timber building	Period 2 – Early Roman II
FBIX-4	6. The Masonry forum-basilica	Period 3&4 – Later Roman I
FBIX-5	7. Late Roman occupation	Period 5 – Later Roman II

***Table 8.3:** Concordance of forum-basilica and Insula IX chronologies*

The proportions of the **SILCBM** fabrics from each of the FBIX phases are compared in figure 8.56. This shows a preference for **SILCBM3** in FBIX-2. **SILCBM1** is found in relatively equal proportions at both sites in FBIX2, whilst **SILCBM5** has a higher representation in the forum basilica compared with Insula IX. From phase FBIX-3 onwards the proportions of **SILCBM** fabrics from the two areas are broadly comparable and show that the same production centres, or at least, the same raw material sources were being exploited.

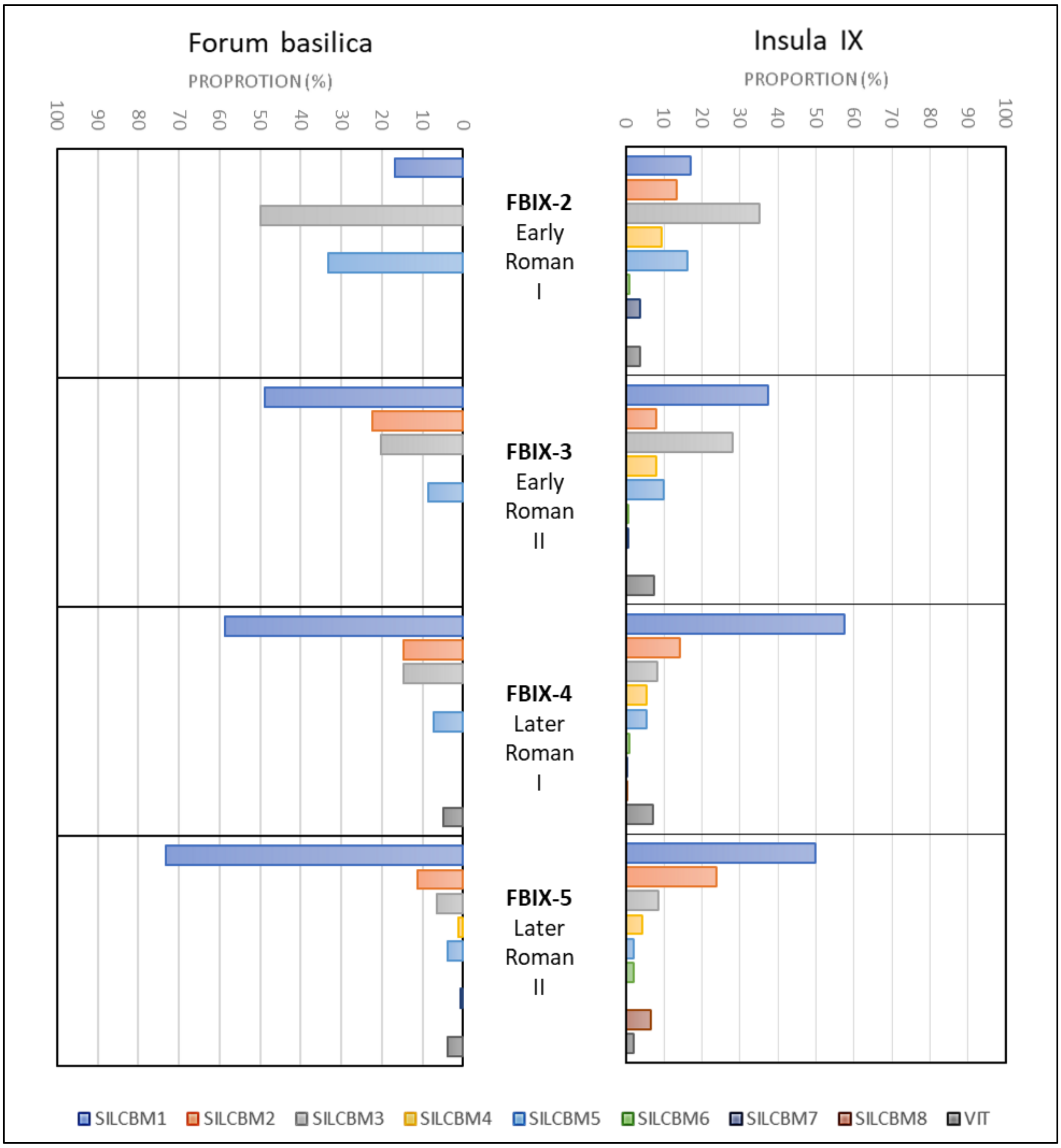


Figure 8.56: Chronology of fabrics at the forum-basilica and Insula IX

It is clear that from FBIX-2 there is evidence for the recycling and re-use of material from within and without the areas and it is unlikely that any of the CBM was recovered from primary contexts as material was not recorded as having been removed from structures. It should also be considered that FBIX5, post A.D. 300, sees the transition to the use of stone roofing tiles in preference to ceramic products.

It is estimated that 11 *tegulae* and 11 *imbrices* are required to roof 1m^2 of floor space (Warry, 2012, p. 57). Based on the assumption that the average *tegulae* weighs 7.5kg and the average *imbrex* weighs 3.125kg (based on the weight of a *tegulae* being 2.4 times that of an *imbrex* (Brodribb, 1987, p. 11), the roofing material required for 1m^2 coverage would have a total weight of 116.875kg. By calculating the total weight of roofing material required to cover two Insula IX, Period 2 buildings, it can be estimated what proportion of the total roofing material remained within the structure and related features. ERTB1 and ERTB5 shall be considered as these structures were not replaced and their footprint was not reoccupied in later periods. Firstly, ERTB1 has a floor area of 9mx11m = 99m^2, therefore, the total roofing material required for this building would be 11,570.625kg. However, the total recorded roofing material, including both retained and discarded material, from all ERTB1 associated contexts was 111.22kg, which represents only 0.96% of the required material. Secondly, ERTB5, with a floor area of 6mx10m = 60m^2, would have required 7012.50kg of roofing tiles. The roofing material recovered from ERTB5 associated contexts had a total weight of 61.405kg, equating to 0.9% of the required material. It must be considered that some of the material recorded as tile, and therefore not included in the roofing total, could be from *tegulae*. This assumes that the recovered roofing material in fact originated from the roofs of these structures. There were no recorded demolition horizons, and indeed, these buildings could have been roofed with thatch or wooden shingles. This is, however, a useful demonstration of how small the quantity of recovered CBM is in relation to how it may have been used.

The fabric chronology shows a trend away from the use of **SILCBM3/4**, with its proportion of assemblages reducing gradually from FBIX2 onwards. The tilery at Little London, which included the production of relief-patterned tiles and Nero-stamped tiles has a *terminus post quem* of A.D.54. The end of the production there has not yet been ascertained from the post-excavation work underway (chapter 7.4), however, the comparison of the fabrics against the chronology of the site would suggest an end date of production before A.D.125. The use of **SILCBM5**, which has been suggested to have been produced at Ashtead in Surrey, also decreases after its use in FBIX-2. The final firing date of the kiln at Ashtead was given as A.D. 205-225. The production of relief-patterned tiles at Ashtead would also give a start date of the production there in the second half of the 1st century A.D. Therefore, assuming that Ashtead is the production centre from which **SILCBM5** originated, the material was being transported to Silchester in the early years of its production, a time when the material has generally been assumed to be intended for the construction of the villa on the site. Coincident with this the proportion of **SILCBM2** increased through the chronology of Insula IX whilst in the forum basilica material **SILCBM2** was not present until FBIX-3, after which the proportion decreased. There is an increasing dependency on **SILCBM1** fabrics throughout the chronology of the forum basilica, whilst there is a slight reduction in the proportion of **SILCBM1** in the FBIX5 phase of Insula IX.

The chronology of the Silchester fabrics are discussed in more detail in Chapter 11, along with a comparison of the changing CBM supplies to Roman London over the same periods. The following chapter (Relief-patterned flue-tiles) considers one distinctive form of CBM found in the Silchester CBM collections and uses fabrics analyses to discuss the nature of the production and distribution systems identified in its manufacture.

9. Relief-patterned flue-tiles

9.1 Introduction

The focus of this chapter will be one particular form of ceramic building materials, relief-patterned flue-tiles. The chapter begins with a background to relief-patterned tiles including a review of previous studies of the material and ideas about the organisation of production and distribution networks.

Each of the examples from Silchester are then considered in turn, along with all other known examples of the same relief-patterned dies (Appendix 6 – Relief-patterned tile site information). Each die group is mapped to show its distribution. The samples are analysed using portable x-ray fluorescence and thin section petrography, where permissible, to establish any similarities in fabrics between the samples from different sites. These are then reviewed to establish potential production centres and determine trade distributions.

9.2 Background and previous work

The distinctive decoration on relief-patterned tiles generally ensures their retention and therefore provides a geographically widespread corpus of material for study. The history of the research of this material is summarised by Betts *et al.*(1994). A.W.G. Lowther is the prominent name in the literature on the subject. He first published his findings after recording tiles bearing relief-patterned designs during his excavations at Ashtead Common. He divided the designs into nine preliminary die-groups, described their decorative schemes, listed the sites at which each had been found, and proposed a date for each of the groups (Lowther, 1948, pp. 7–10).

Relief-patterned tiles differ from others in that instead of the surface having been combed or scored to provide a key, the surface has been covered with an impressed design applied using a roller. The patterns vary from relatively simple, geometric diamond-and-lattice designs to complex motifs and often elaborate decorative schemes. Whilst relief-pattern keying is primarily found on box-flue tiles, a number of different types have been identified as being keyed in this way, these include *voussoir*, *parietalis,* and flat wall-tile (Betts, Black and Gower, 1994, pp. 8–12). Once the requisite roller-die had been made, no greater effort would be involved than necessary to comb the surfaces and the resultant product could readily be identified as the work of an individual craftsman or workshop, which, it was thought, would facilitate payment according to output (Lowther, 1948, p. 6).

Early examples of relief-patterned dies display diamond-and-lattice and plain chevron designs (Black, 1996, p. 64) and there seems little doubt that the practice of keying ceramic tiles with a roller-stamp derived from the earlier practice of using similar types of rollers to key the daub walls of clay-and-timber buildings, though tile rollers are smaller and more intricate than those used for keying daub

(Russell, 1990, p. 111). Black, however, argues that the introduction of the simple chevron or lattice designs was a development, in the late 1st century, from the incised cross-hatching on box-flue tiles employed in the construction of the Neronian proto-palace at Fishbourne (1985, pp. 354–8).

Lowther (1948, p. 6) describes the idea that the more elaborate designs would have been left exposed rather than concealed under layers of plaster as fanciful, as, at the time of his study, all examples were found with mortar still adhering. He also argues that despite some designs being made to be viewed horizontally, for example die 6 (dog-and-stag design), this is not the position which it normally occupied when in use (*idem.*). Nevertheless, there are known examples of box-flue tiles laid horizontally (Betts, Black and Gower, 1994, p. 10), for example at Silchester the hypocaust in room 8 of the baths in *Insula* VIII is described as having a series of horizontal flues composed of box-flue tiles (Hilton Price, 1887, p. 278). However, this arrangement would still not have necessarily resulted in the design being on display. Additionally, as the tiles only butted end to end, the vents would still allow fumes and smoke to enter the living room were they not plastered over (Russell, 1990, p. 105).

The potential of these tiles as a tool for dating was recognised by Lowther, especially where pottery or coins were not present or poorly represented in significant stratified contexts (Lowther, 1948). He proposed an overall production date range of c.A.D.80-150 as the period in which most of the examples were in use, without attempting to assign more specific date ranges to particular dies (Betts, Black and Gower, 1994, p. 5). The lack of a proper chronology for what must be the work of at least two generations of artisans prevents us tracing the origins, development and decline of this branch of the industry. The basic forms of brick and tile underwent little change over four centuries, yet this manufacturing technique appears in the Flavian period and only lasts for only around 70 years (Johnston and Williams, 1979, p. 383). After c.A.D.150 box-flue tiles remained the same standard shape but the use of rollers came to an end and a range of combed keying and scoring is all that is found subsequently (Black, 1996, p. 70). The cessation of relief-patterned keying may be linked to the completion of work on public building contracts and a consequent decline in the demand for box-flues (*ibid.*, p.60). In London, this coincides with apparent changes in the distribution and supply of ceramic tile with increasing evidence for the re-use of tile from the demolition of existing buildings (Betts, Black and Gower, 1994, p. 51). Re-use of tiles in the construction of buildings of later date renders the final date of their production somewhat obscure, but there is no evidence of their use later than (or as late as) c.AD200 (Lowther, 1948, p. 10).

The practice of roller-stamping tiles is rare on the continent with a small number of examples known from sites in Germania Superior and two sites in Germania Inferior, but there are no examples known from elsewhere (Betts, Black and Gower, 1994, p. 5). As in Britain the practice is seen to be a development where the roller-keying of daub walls is transferred to keying ceramic tiles. The examples from Germany are all on flat tiles (Baatz, 1988) and the designs would be assigned to Lowther's Diamond-and-Lattice group. The dating evidence indicates that the production of relief-patterned tiles in this area occurred in the second half of the 2nd century, and is therefore towards the end of the suggested production date range in Britain (Betts, Black and Gower, 1994, p. 46).

The distribution of tiles with matching dies lends itself to the study of the production, distribution, and marketing of roller-stamped tiles (Lowther, 1948). The plotting of roller-stamp distributions serves to illustrate the area within which a producer operated (McWhirr and Viner, 1978, p. 369) assuming the movement of the tiler and not just the roller-die. One point noted by Lowther was that flue tiles were made in a range of fabrics with evidence of the same dies used on different fabrics and other dies in a single fabric only. He therefore proposed two potential modes of production. Relief-patterned tiles were either made at one centre and distributed to sites at which they were used, or, alternatively, the tile-makers travelled between brickworks (Lowther, 1948, p. 6). Lowther favoured the idea of an itinerant tiler as he considered the movement of complete tiles to be unlikely, partly based on the usual premise of CBM being a high-bulk, low-value commodity, and partly also on the consideration of the relative fragility of the finished product (Middleton, 1997, p. 162). The idea of an itinerant tile producer is dismissed by Rodwell, who concluded that the manufacture of box-flue tiles was not a specialist activity and the evidence for the movement of the tiler was unconvincing (1978, p. 24). However, there is evidence to support the movement of tilers/rollers. For example, in the case of die 13, a diamond-and-lattice type, the roller-die split at some point during its working life and both split and un-split examples have been found at Vine Street, Leicester, whilst further examples of the split version occur at Colchester and St Albans. This is seen as evidence of the movement of the tiler after supplying tiles to Leicester (Mills, 2013b, p. 461). However, this interpretation is based solely on the mapping of the split and un-split roller designs and there is no mention of fabric analysis to confirm if it is in fact the movement of the tiles or the tiler.

As the manufacture of relief-patterned tiles appears to be confined to civilian sites, the craftsmen were probably paid according to their output and would have wanted to make their products easily identifiable (Lowther, 1948, p. 10) and by doing so ensure correct reimbursement was received (Brodribb, 1987, p. 110). Die 31 reinforces the argument that some decorative schemes were personal to the tile maker as it includes the name CABRIBANUS (Johnston and Williams, 1979, p. 376). The motifs may also have acted as advertisements of the craftsman's work to generate orders for future business. This evidence makes it hard to avoid the conclusion that some of these stamps were used by itinerant tile makers, skilled specialists producing flue-tiles using local tileries alongside other tile makers, and thus needing to differentiate their products, like potters sharing the same kiln (Peacock, 1982, p. 122), but this is clearly not the only organisational system in place.

It has been suggested that roller-dies with similar designs were supplied to different tile-makers, at random, by a small group of craftsmen or a single die-maker. The avoidance of exact repetition implies that the patterns were significant for the identification of products, perhaps by a small number of builders' merchants (Black, 1996, p. 69). Rodwell also suggests that each of Lowther's (1948) die-groups represents a successive or contemporary series of related patterns as a trademark of a firm of contractors (1978, p. 23). Citing examples of relief-patterned tiles found at the early Roman villas of Essex, Rodwell further suggests that the villas where these tiles were found had public or official connections and were not the home of native farmers. He references supporting evidence that none of these villas have been found to be directly associated with native Romanised patera-and-ewer type burials (*ibid*. p.26).

Much of the information regarding the production and marketing is derived from the geographical distribution of relief-patterned tile groups (Betts, Black and Gower, 1994, p. 5). Four main production areas in south-east England have been suggested: London, Ashtead, Angmering and Verulamium, from each of which tiles were distributed (Johnston and Williams, 1979). The latter also acknowledge the evidence of peripatetic tile-makers moving between production centres (*ibid*., p384-5.). Drury (1988, p. 83) also supports the idea of a concentration of the production of relief-patterned tiles in a small number of areas. The association of relief-patterned tiles with the tilery at Little London, which also manufactured the Nero-stamped tiles (Chapter 7.4) had led to the suggestion that the production of these relief-patterned tiles was potentially an imperial monopoly (Warry, 2012, p. 74); however, the tilery at Little London is the only Romano-British tile production centre to have a known imperial connection.

The association of the same die at several sites makes it possible to define groups of dies that were possibly used by tile-makers working together. At a few locations a number of different dies have been found together, for example, at Lower Wanborough, Wiltshire, suggesting either the movement of tile makers in groups working together or at least supplying their products consistently to the same builders' merchants (Betts, Black and Gower, 1994, p. 5). Alternatively, this could represent the co-ordination of delivery of product from several dispersed production centres (Warry, 2012, p. 52) or builders' merchants (Betts, Black and Gower, 1994, p. 5), who would have been involved in the marketing of the material and would have probably maintained stocks of tiles from more than one kiln site (Middleton, Cowell and Black, 1992, p. 17).

Evidence from London also provides further insight into the production and distribution of relief-pattern tiles. Whilst it is evident that the majority of London's brick and tile demands were being met by tileries situated close to the city (Betts, 1987), there is also evidence for the importation of box-flue tiles into London from further afield during the later-1st and early-2nd centuries. It was during this period that many of London's public buildings, such as the forum-basilica, were constructed, and this suggests that additional supplies were needed from further afield to supplement local production (Betts, Black and Gower, 1994, p. 52). *Londinium*, in its role as the provincial capital, would have been the location where contracts for major public buildings were arranged and it was no doubt in London, or on its outskirts that the builders' merchants had their yards (Black, 1996, p. 69).

Some work on fabric analysis has enabled the mapping of movements of tile-makers showing the tile industry was clearly much more complex than Lowther and others have suggested. Betts *et al.* (1994, pp. 33–34) proposed a number of co-eval systems for the production of relief-patterned tiles: local production for use in the immediate area of the kiln sites; itinerant production with a tile-maker moving between production centres; and perhaps central production for distribution to different building projects. It is a combination of geographic distribution, typological and fabric analyses that is needed to give a fuller picture of the production and movement of these distinctive tile groups.

9.3 Silchester relief-patterned dies

There are four dies in the 1994 corpus that are recorded as being found at Silchester, these are dies 3, 27, 38 and 39. A further three dies have been identified following the re-examination of the entire CBM corpus from Silchester for this study. Examples of die 68 and 104 are found at Silchester along with one further relief-patterned tile not included in the corpus but recently published (Wilson, 2017) (Figs.9.1 & 9.2).

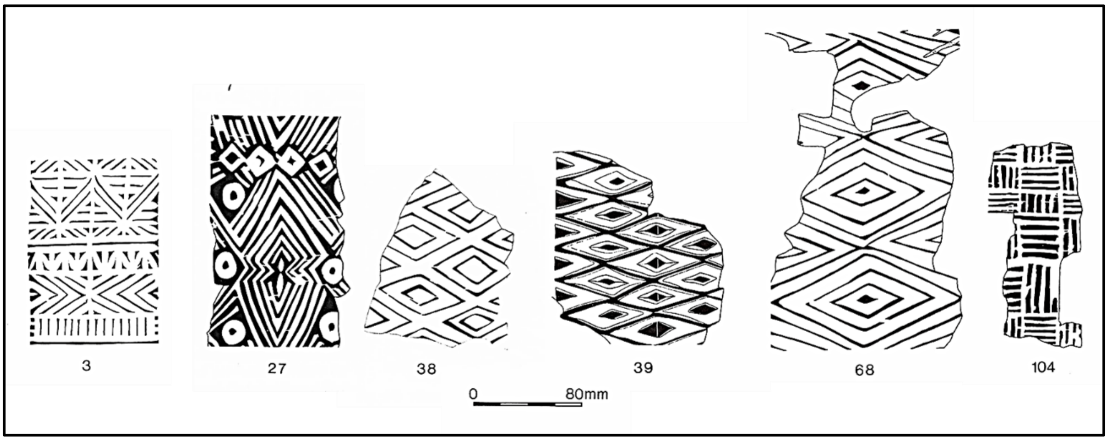


Figure 9.1: *Six relief-pattered die at Silchester, as illustrated in the 1994 corpus (After Betts et al. 1994 Figs. 27a,b,c, d, e, & f)*

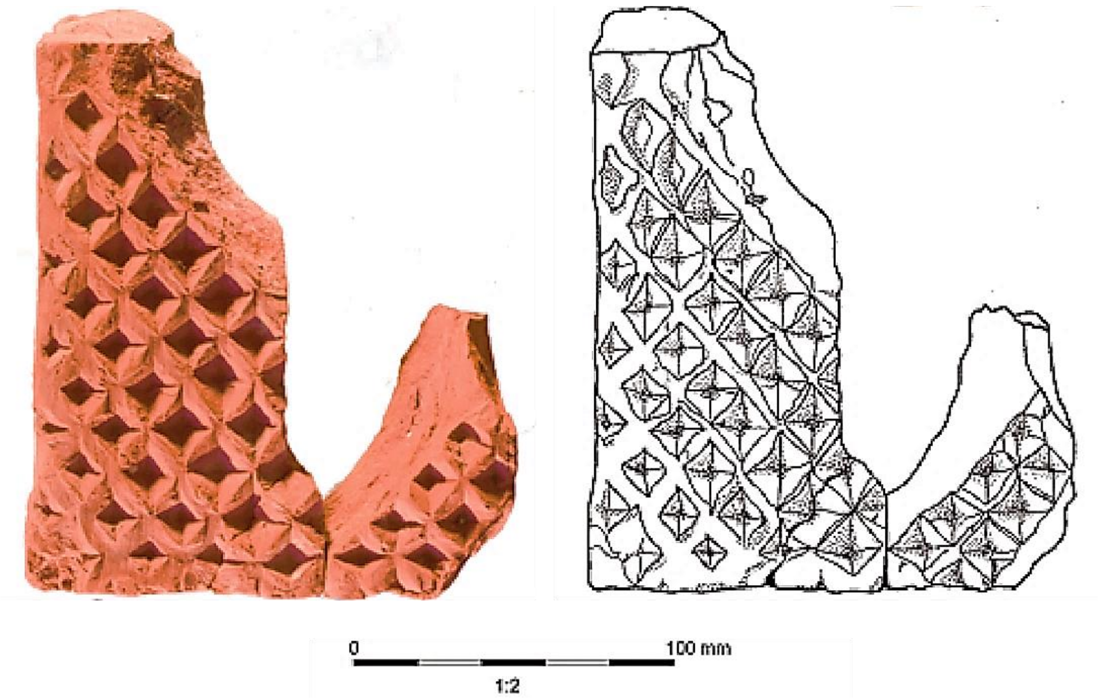


Figure 9.2: new relief-patterned design from the forum-basilica archive (After Wilson 2017 Fig.14.)

It was noted in the report of ceramic building material from Silchester Insula IX, periods 3-4 (*c.* AD150-300) that there were surprisingly few examples of relief-patterned tiles found in the Silchester assemblage considering the extent of the excavations of the *civitas* capital (Warry, 2011, pp. 227–228). At the time only four dies were known to have been recovered from the Roman town. This can now be revised to seven, making the total more consistent with that from other large Roman towns, e.g. Chelmsford (8) and Cirencester (6).

9.3.1 Die 3

Die 3 is a part of Lowther's W-chevron group (Lowther, 1948, p. 7). One example is recorded from Silchester, along with another from the roadside settlement at Lower Wanborough and at least 23 examples from London (Fig. 9.3, Table 9.1).

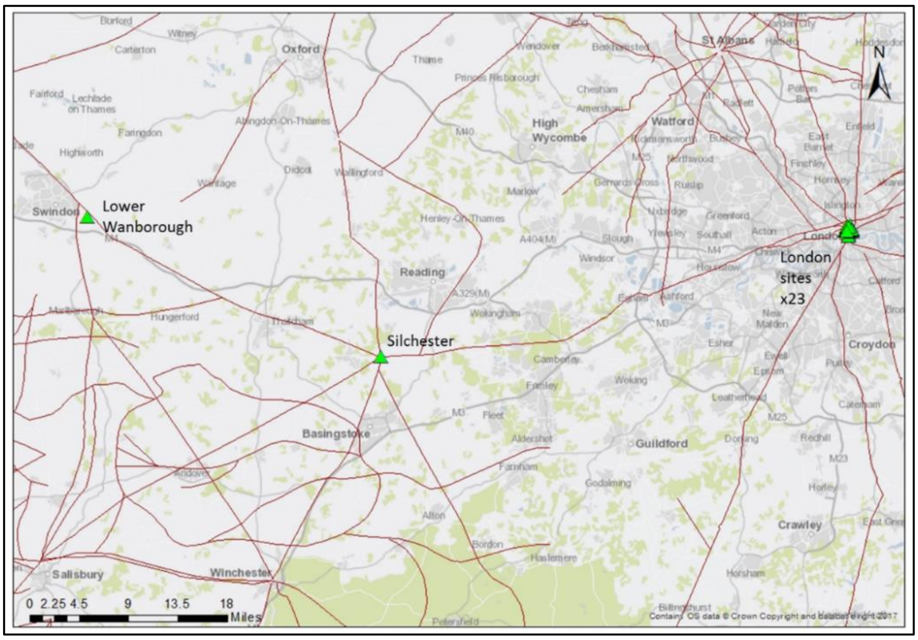


Figure 9.3: Distribution of relief-patterned tiles – die 3

1	152 Upper Thames Street	13	St Albans House
2	10 Milk Street	14	Billingsgate Bathhouse
3	Pudding Lane	15	62 Cornhill
4	Peter's Hill	16	Dowgate Hill House
5	Winchester Palace	17	Aldermanbury
6	Culverts Buildings	18	DLR Shaft/Lothbury
7	Rangoon Street	19	Thames Exchange Buildings
8	Laurence Pountney	20	27-30 Lime Street
9	Watling Court	21	1-7 Whittington Avenue
10	1-6 Milk Street	22	Guildhall Art Gallery
11	Guildhall House	23	68 Upper Thames Street
12	Finsbury Circus		

Table 9.1: Relief-patterned tile (die 3) from sites in London

Silchester - The Silchester example was found during the 1889 excavations (Figure 9.4). It was found in the pillared hypocaust **11** of house **2** in Insula **I**. It is described as a tile with reeded ornamentation and was thought to have formed part of the wall decoration of one of the Winter rooms (Fox and

Hope, 1890, p. 739). The corpus records the example as being lost, formerly of Reading Museum (Betts, Black and Gower, 1994, p. 66), and it cannot be located in the Silchester Collection at Reading Museum.

Figure 9.4: *Relief-patterned flue-tile – die 3 – from excavations at Insula I (After Fox & Hope 1890 Fig.4.)*

Lower Wanborough - The Lower Wanborough example is first noted as having no published reference (Betts, Black and Gower, 1994, p. 67), but it has since been published in the report of the excavations and recorded as unstratified (Mepham, 2001, p. 313). This example could not be traced in the archive and has thus been recorded as lost.

London - The London examples are from many sites within the city, table 9.1, but all are of the same fabric, MOLA 3006 (I. Betts, *pers. comm*.). The MOLA fabric 3006 is a typically red, orange, or brown fabric with varying proportions of quartz sand and iron oxides. This fabric has been linked to the kiln site at Park Street, Hertfordshire, on Watling Street between London and Verulamium, although there are no records of relief-patterned tiles having been found there.

9.3.2 Die 27

Die 27 is one of the more elaborate relief-patterned designs and is the most common relief-patterned design in the Silchester archive. Of all the dies found at Silchester it has the most widespread distribution with examples found at Lincoln, Dover, Colchester, and London (Fig.9.5, table 9.2).

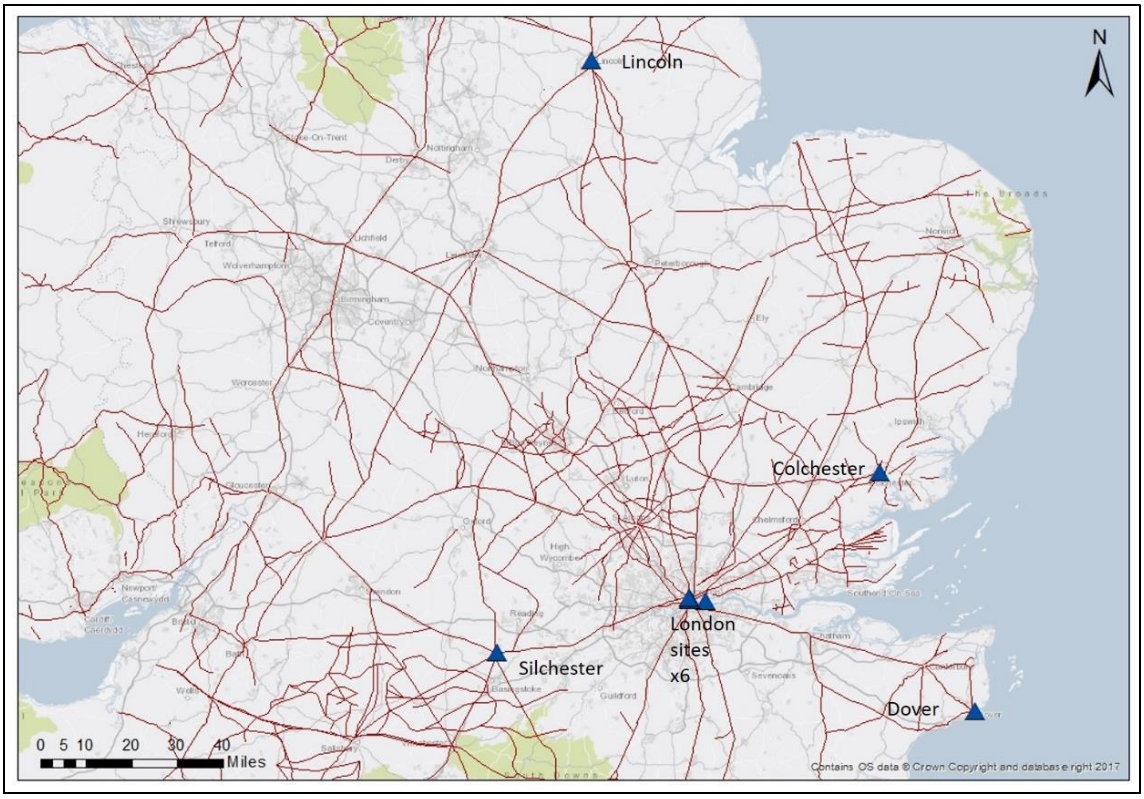


Figure 9.5: Distribution of examples of relief-patterned tiles (die 27)

No.	Site name	Site type	Single example	Notes	Reference(s)/Site Codes
1	Silchester, Hampshire	Civitas capital	N	Described in section 9.3.2	(Warry 2011, p.226)
2	Dover, Kent	Port	Y	The tile was found to be on display in the Church-of-St-Mary-In-Castro, within the walls of Dover castle. The tile is under the ownership of the church. There is no record of the provenance.	(Lowther 1948, p.14)
3	Beaver House, London	Provincial capital	Y	Found in a post-Roman context.	No published reference (MOLA SLO82)
4	Post Office, London	Provincial capital	Y	Found in a late 2nd century or later pit (Perring *et al.* 1991, 26). Found with die 35 (example 5)	No published reference (MOLA GPO75)
5	Billingsgate Market, London	Provincial capital	Y	The specimen was retrieved by C.St.J.Breen from spoil from the site dumped at Dartford Heath, Purfleet, and Chequers Lane, Dagenham	No published reference
6	Watling Court, London	Provincial capital	Y	Found from a post-Roman context	No published reference
7	Colchester, Essex	Colonia	Y	From the Gilberd School site. The specimen came from context A89, a post-medieval foundation.	(Crummy 1992, p.262)
8	Dominant House, London	Provincial capital	N	These examples form part of the archive from the excavation of the bath complex at Huggin Hill.	No published reference (MOLA DMT88)
9	Lincoln, Lincolnshire	Colonia	Y	From an early 12th century dump layer from Flaxengate; described in the site archive as a late Saxon pit.	(Steane et al. 2016) F74 AVV
10	St Bartholomew's hospital, London	Provincial capital	N		No published reference (MOLA SBQ14)

Table 9.2: *Die 27 site information*

Silchester - The excavations at Insula IX recovered a total of five fragments of flue tile keyed with die 27. Three fragments of box-flue tile were recovered from context (2420) dated to period 4, c.AD200-c.AD250/300 (Warry, 2011, p. 226) with a further two fragments were recovered from (1504), the last layer of Victorian backfill of well [1503].

The forum-basilica ceramic building material report notes an absence of relief-patterned tiles in the assemblage (Timby, 2000, p. 119). However, a re-assessment of the archive for this project has recorded a total of approximately 40 fragments of die 27 relief-patterned flue-tile from the forum-basilica CBM assemblage. Thirty fragments were found in a late Roman pit (Phase 7.6), along with numerous fragments from a phase 9 context, assigned to the trenches of the Victorian excavations of the site. A further two small pieces were recovered from a late Roman footing (Phase 7.3).

Two fragments of flue-tile keyed with die 27 are held in the Silchester archive at the Reading museum. These are not described in the Antiquarian excavation reports and therefore cannot be attributed to any particular building or phase. The fragmentary nature of the material from Silchester would account for no more than three or four complete, relief-patterned, box-flue tiles.

Lincoln –The example of die 27 from Lincoln was recovered from a 12th century dump (Betts, Black and Gower, 1994, p. 99) during the excavations at Flaxengate. The earliest Roman occupation at the Flaxengate site has been dated to the late 2nd to early-mid 3rd century, with buildings of timber and wattle-and-daub construction (Steane *et al.*, 2016, p. 48), the relief-patterned tile presumably deriving from another area of the city. A stone-built structure on the site, with an apse and tessellated floors has been dated to the 3rd century and is believed to have been a private residence. There were no traces of a hypocaust associated with this structure but the volume of undecorated box-flue tiles recovered from the area suggests an earlier building in the vicinity which included a hypocaust (Steane *et al.*, 2016, pp. 49–50). The public baths at Lincoln were located c.100m south-west of the site (Stocker (ed.) 2003, p.90).

London – as table 9.2 shows there are several examples from sites in London. Samples for analysis were obtained from the Dominant House (DMT88- Huggin Hill baths) excavations. This site has not been published therefore it is unknown if any of the tiles were found in primary contexts. These have been assigned to MOLA fabrics 2452 and 2459A. Both these fabrics are part of the MOLA fabric group 2815. This is the same group that includes MOLA fabric 3006 (section 9.3.1). The tiles in the MOLA 2815 fabric group are thought to have made in London or at tileries situated in the Greater London area particularly along Watling Street between London and St Albans. The differences in fabrics almost certainly reflect natural variation in the clays around London and do not necessarily represent different production sources (I. Betts, *pers*. *comm*.). This large number of examples across London suggests local production.

Colchester – A single example was recovered from a post-medieval foundation context at the Gilberd School site (A) (Black, 1992, p. 262). The tile is heavily abraded and whilst still having traces of mortar adhering to the keyed surface (Fig.9.6).

***Figure 9.6**: Example of die 27 from the Gilberd School site, Colchester (GBS84 (A89))*

Dover – The example from Dover is unprovenanced. It is currently on display in the church of St-Mary-In-Castro, at Dover Castle. The church is located adjacent to the Roman pharos and has a large quantity of re-used Roman tile visible in its construction (Fig.9.7).

***Figure 9.7:** Church of St-Mary-In-Castro, Dover, adjacent to the Roman pharos; internal features of re-used Roman brick and tile.*

Fabric analysis

In hand-specimen, all the examples have an iron-rich, non-calcareous, oxidised, homogeneous matrix with little evidence of clay pellets, except for the sample from Dover, which has more fine-grained, birefringent clay pellets visible. The example from Lincoln is observed to be highly micaceous with fragments of iron oxides and non-calcined flint, with a coarser quartz component when compared to the other samples. The Silchester examples all have a much finer quartz silt constituent, along with rare examples of flint fragments. The example from Lincoln is the thickest, measuring 23mm, whilst the Silchester examples are typically 18-19mm. The flue-tile from Dover is thinner measuring 14mm. The MOLA examples are consistently homogeneous and their macroscopic fabrics are similar to both the Colchester and Dover examples. There was no evidence of the gypsum precipitation to the inner surfaces as seen on the Silchester examples, Chapter 6.3.1. All samples of the die 27 tiles were analysed using the portable XRF. The PCA plot of the results are shown in figure 9.8.

The three examples from London cluster in the upper left quadrant of the plot along with the Colchester example. The Silchester examples are spread mainly in the lower left-hand quadrant whilst the Lincoln and Dover examples are both separate on the right-hand side of the plot.

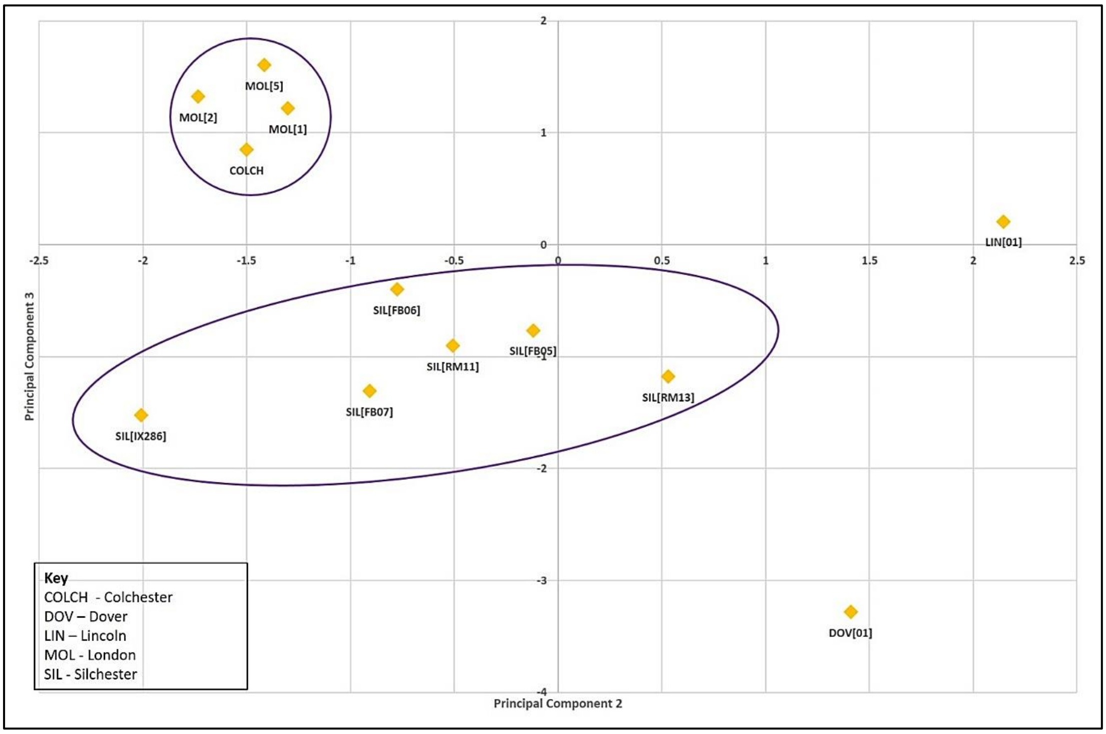
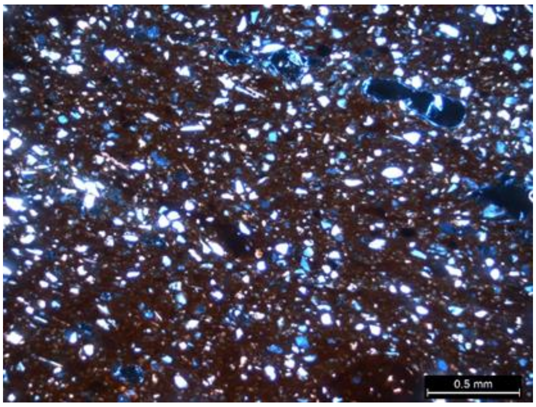


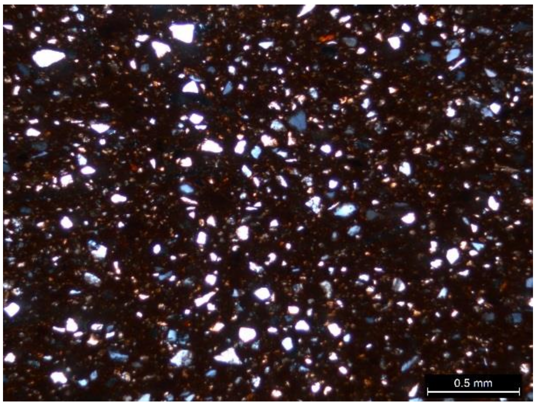
Figure 9.8: Results of PCA classification of the die 27 examples, based on the normalised abundance of 13 elements.

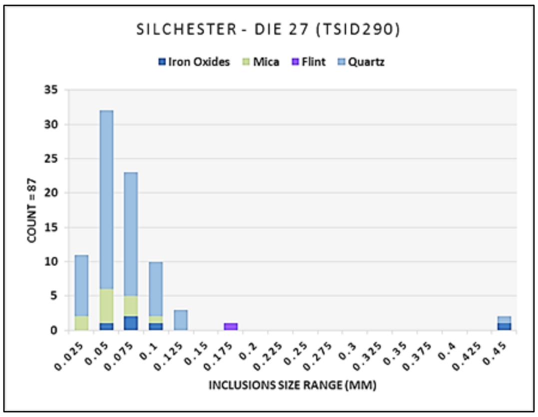
Compositional and textural analysis

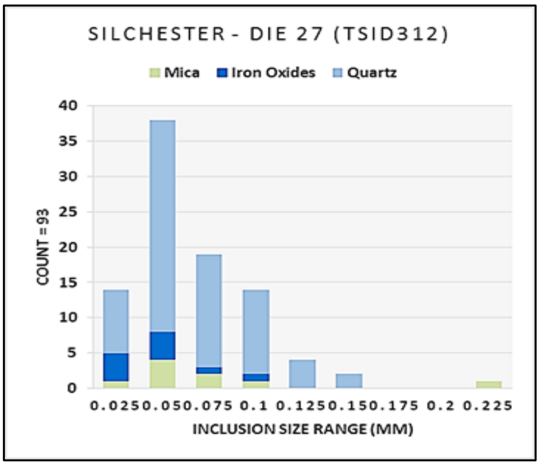
Compositionally, the fabrics can be divided into three categories. Those with fine quartz silt throughout, which comprise the Silchester examples (TSID290; TSID312), are assigned to Silchester fabric **SILCBM1B,** as is the single example from Dover (TSID325).

The second group comprises those with a weakly bi-modal fabric consisting of a fine silt quartz and larger medium quartz-sand, including the London (TSID293; TSID294; TSID297) and Colchester (TSID295) examples, akin to **SILCBM1A**.









Min =	Max =	Mean =	Mode =	Std Dev =	Min =	Max =	Mean =	Mode =	Std Dev =
0.012mm	0.4404mm	0.06306mm	0.0224mm	0.06435mm	0.0124mm	0.2046mm	0.05318mm	0.0305mm	0.03212mm

Figure 9.9 & 9.10: *Grain-size distribution and photomicrograph of die 27 example from Silchester (TSID290) (XP, x40 magnification)*

Figure 9.11 & 9.12*: Grain-size distribution and photomicrograph of die 27 example from Silchester (TSID312) (XP, x40 magnification)*

The Lincoln sample (TSID324) stands alone with a very small percentage of inclusions throughout the matrix. However, as stated above, these differences do not necessarily indicate three different production centres. It is entirely possible that the London, Colchester, Dover and Silchester examples are all the products of a single production centre with natural variations within raw material sources being reflected in mineralogical and compositional differences between the samples.

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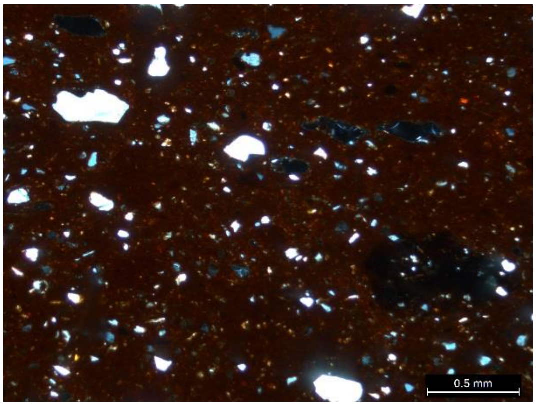
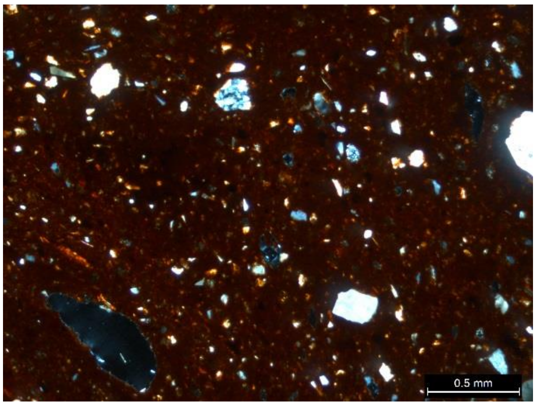
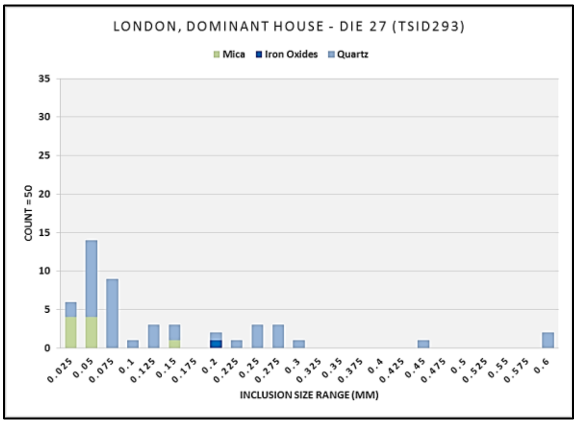
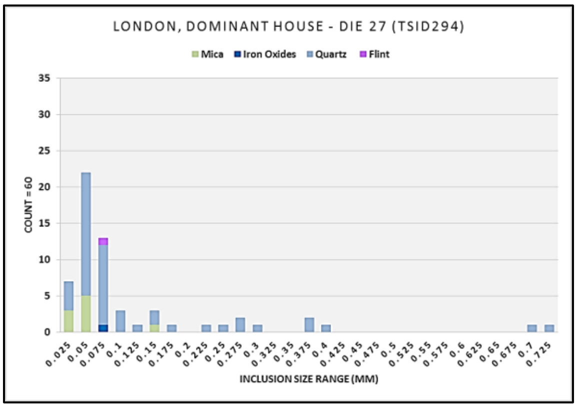








Min =	Max =	Mean =	Mode =	Std Dev =	Min =	Max =	Mean =	Mode =	Std Dev =
0.0192mm	0.5834mm	0.12475mm	0.5834mm	0.13323mm	0.0196mm	0.7037mm	0.10882mm	n/a	0.14513mm

Figure 9.13 & 9.14: *Grain-size distribution and photomicrograph of die 27 example from London (TSID293) (XP, x40 magnification)*

Figure 9.15 & 9.16*: Grain-size distribution and photomicrograph of die 27 example from London (TSID294) (XP, x40 magnification)*

All the examples of die 27 therefore correspond with material from *London Clay Formation* sources, albeit of slightly differing compositions. They have been shown to include a wide variation in the proportions and sizes of their quartz fraction, along with other compositional variations. The larger proportion of clay pellets in the Dover samples is probably a remnant of this raw material not having been homogenised into the clay matrix. Whilst the mineralogical composition of the Lincoln sample corresponds with all the other samples, it is the proportions that make this example distinctive, and could account for the separation of the sample in the plot of portable XRF results.

Potential Production Centres

Based on the assumption that the die 27 tiles were manufactured using raw materials from the *London Clay Formation*, the pXRF results have been compared with those from sampled production centres located on the *London Clay Formation*. These are Ashtead, Latchmere Green, and Love Lane, Shaw.

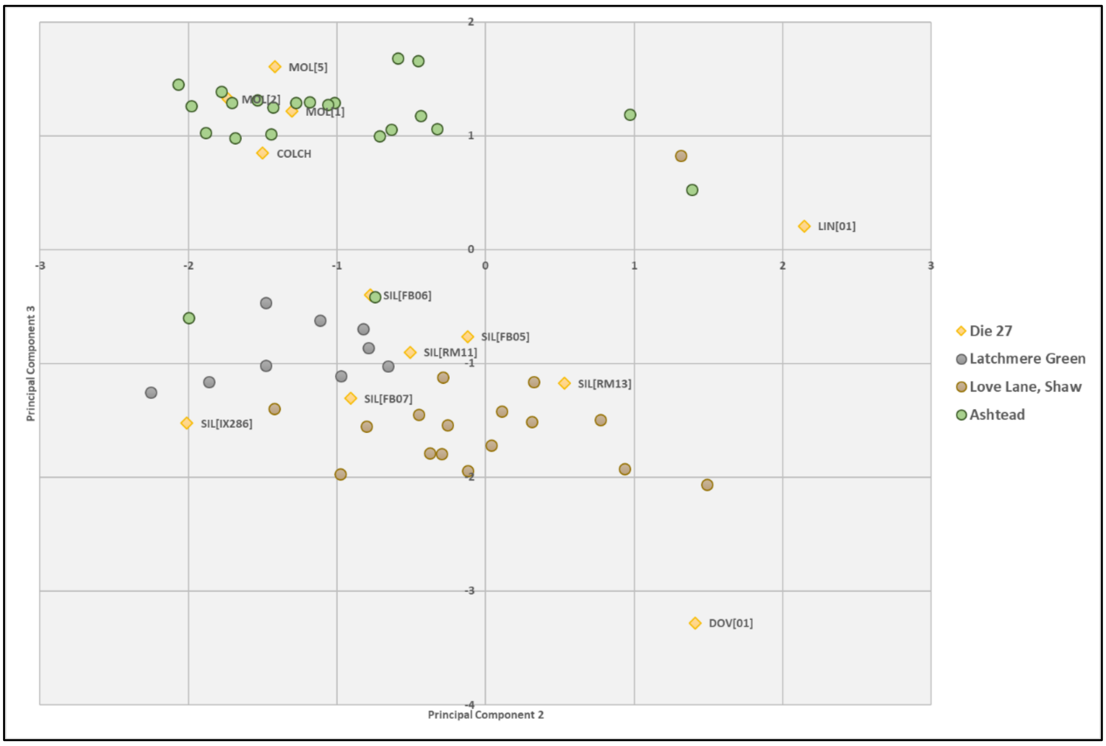


Figure 9.17: *Results of PCA classification of the die 27 examples and production centre samples, based on the normalised abundance of 13 elements.*

The plot (Fig.9.17) shows that the London and Colchester examples correlate with the samples from Ashtead, as does one sample from Silchester. The remainder of the Silchester examples lie between the samples from Love Lane, Shaw, and Latchmere Green.

Relief-patterned tile, die 54, have been found at Love Lane, but there was no certain evidence of their production at the site and the kilns were potentially used to produce pottery, rather than tile (section 7.6). Tile production at Latchmere Green is based on an abundance of over- and under-fired building material, but there were no relief-patterned tiles in this assemblage. The pXRF results confirm that die 27 originated from a *London Clay Formation* source. The London die 27 examples have traditionally been associated with production centres to the north, on the Roman road to Verulamium, however, it is entirely possible that they were produced at the tilery at Ashtead. Relief-patterned tiles were known to have been produced there, and whilst no examples of die 27 have yet been found at the Ashtead villa, they could have been produced solely for export to building projects elsewhere. As discussed in chapter 7, there is potential evidence for the transportation of building materials from the tilery at Ashtead to Silchester, including chimneys or roof-finials. It is therefore possible that relief-patterned flue tiles were also produced for building projects elsewhere. But, to sound a note of caution, there are also many other production centres based on *London Clay Formation* sources that have not been sampled for this study.

9.3.3 Die 38

Die 38 is part of the diamond-and-lattice group. There is a small number of examples, with a relatively widespread distribution (Figure 9.18) from Alchester, Oxfordshire to the west and Canterbury, Kent to the south-east.

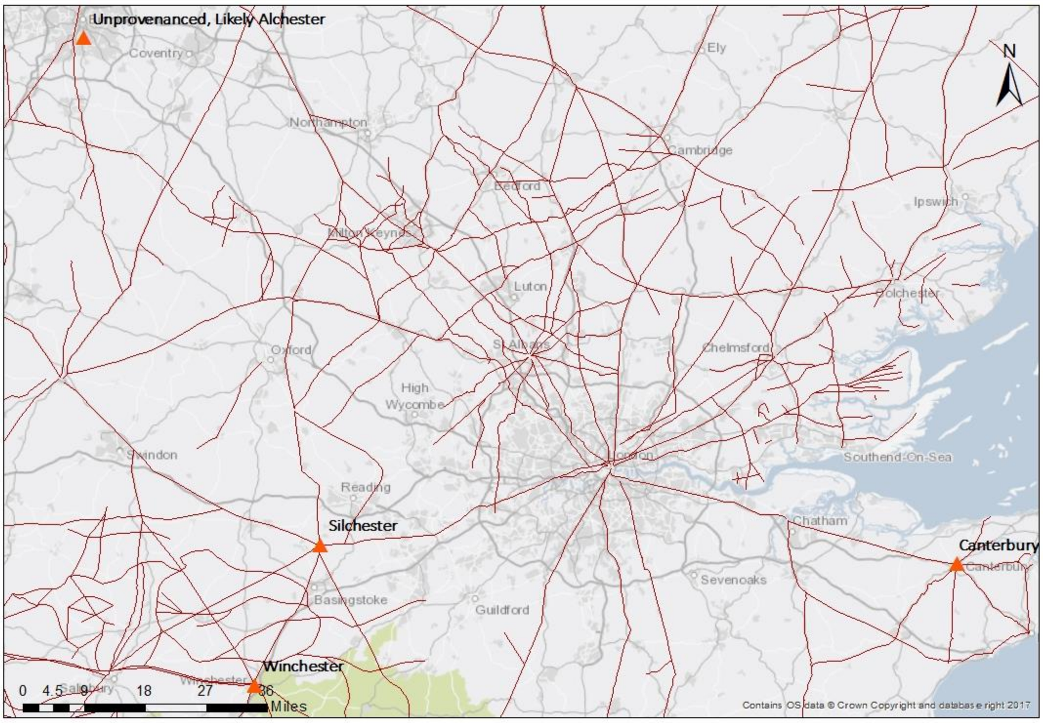


Figure 9.18: *Distribution of relief-patterned tiles keyed with die 38.*

Figure 9.19: *Examples of relief-patterned tile from Silchester – die 38. British Museum – Lowther collection (1973.0403.308)*

Silchester - there are six examples of die 38 in the Reading Museum collection. These were examined in hand specimen and were identified to be fabric **SILCBM2** (Section: 6.3.3). One example is labelled as "*Calleva* Ins XXXIII Baths Dec 1975". A single example is held in the British Museum, as part of the Lowther collection. This is recorded as being from Silchester and was also in fabric **SILCBM2** (Figure: 9.19)

Winchester - A single example is recorded from Winchester, this was found in demolition debris, dated AD270-400, during trial excavations at the Pilgrim School site (Betts, Black and Gower, 1994, p. 109). This example could not be located at Winchester Museum services and has been recorded as lost.

Canterbury - A single specimen was recorded from Canterbury, excavated during investigations at Stour Street, site B in 1986 (*idem.)*. This tile could not be located in the archive and has been recorded as lost.

Ashmolean Collection - The only other example of die 38 is held in the collection at the Ashmolean Museum. It is a single tile donated to the museum by a resident of Oxford. The tile is recorded as being from Alchester. A label on the reverse of the tile reads "Roman Brick Tile from Aichester" (Figure: 9.20). The first two letters are certainly open to interpretation, but it has generally been accepted to refer to the Roman settlement at Alchester, Oxfordshire. The keyed surface of the tile also shows evidence of repeated runs of the roller over the surface, which are mis-aligned.

Figure 9.20: *Keyed surface of die 38 example from the Ashmolean Museum collection with detail of label on reverse of tile (Accession number:1967.709)*

Fabric analysis

All the Silchester examples were assigned to the **SILCBM2** fabric group. The fabric of the sample from Alchester has similarities to **SILCBM2**, though it differs in that it contains little or no mica in the matrix, no flint fragments, and large ironstone fragments. Thin section analysis was not permissible on the Silchester samples from the Reading Museum or British Museum collections and therefore only portable XRF analysis has been carried out. Figure 9.21 shows the results of the seven Silchester examples along with the example from Alchester.

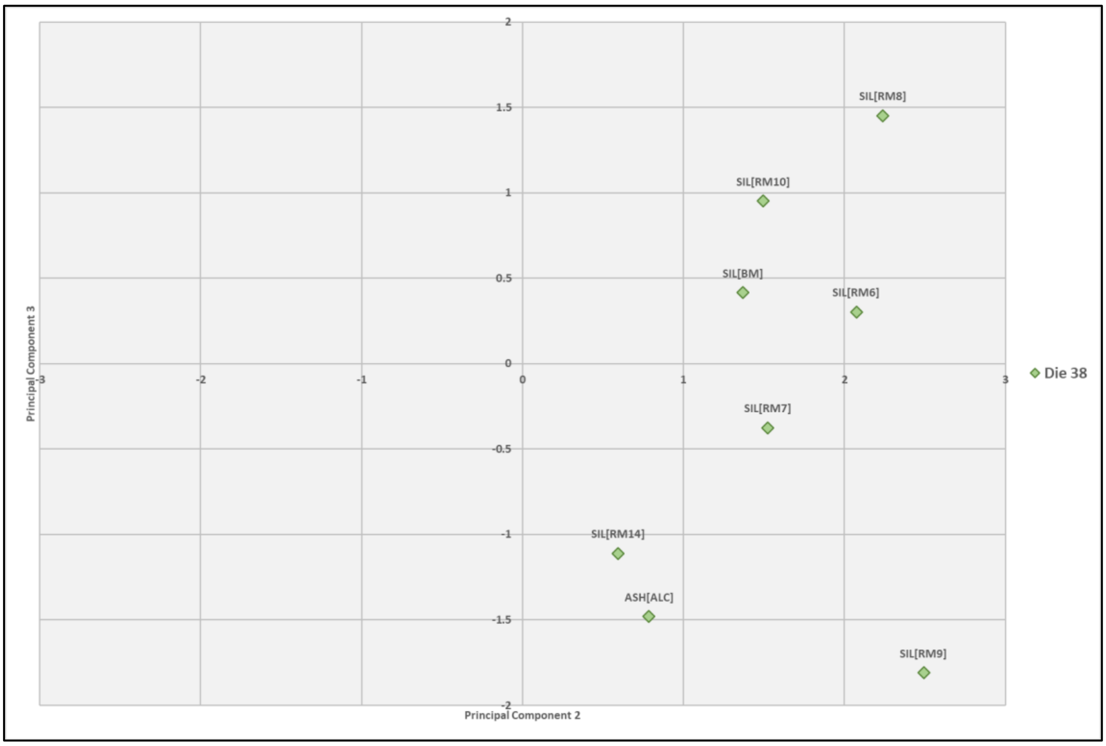


Figure 9.21: *Results of PCA classification of the die 38 examples, based on the normalised abundance of 13 elements.*

All samples plot on the right-hand side of the chart, reflecting similarities in geo-chemical composition between the samples.

Potential production centres

When considering potential production centres for the die 38 examples, the pXRF results have been compared with those from the production centre at Minety. As discussed in section 7.10, there are similarities between some of the samples from the Minety tilery and **SILCBM2**. The plot below, figure 9.22, includes all the samples from the Minety fieldwalking along with the **SILCBM2** samples. This shows a correlation between the three groups and would support the possibility of Minety supplying relief-patterned tiles, as well as occasional stamped tile, to Silchester.

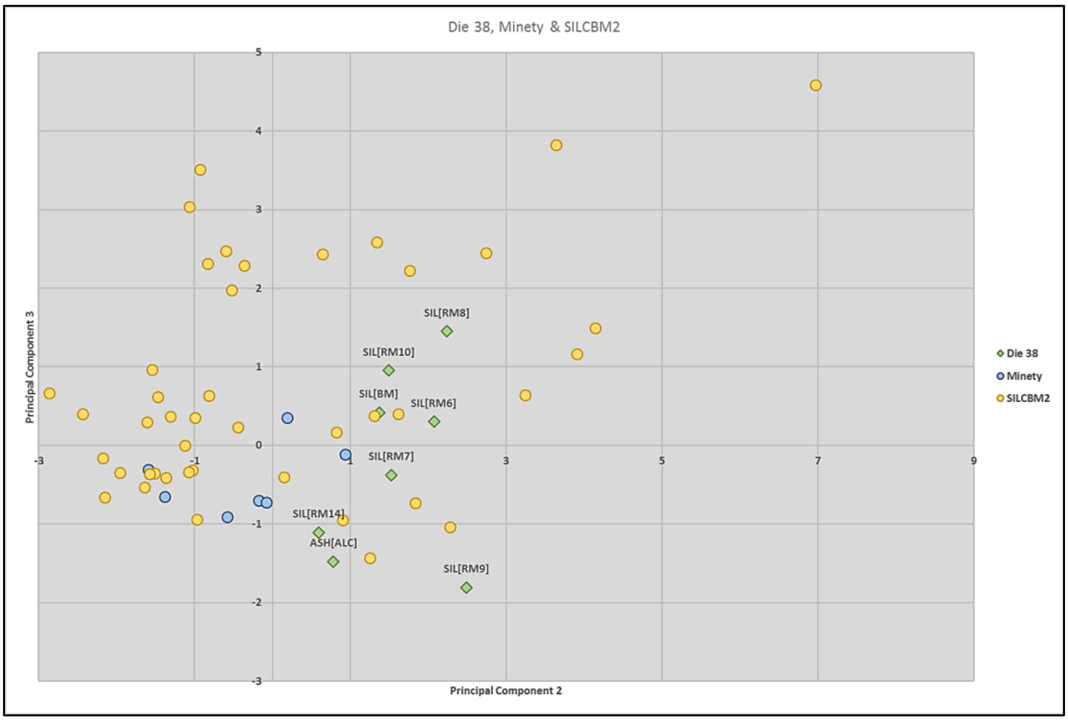


***Figure 9.22** Results of PCA classification of the die 38 examples, Minety & **SILCBM2** samples, based on the normalised abundance of 13 elements.*

The **SILCBM2** samples are compared with one of the Minety fabrics (TSID329) in section 7.10. Die 56 is the only relief-patterned die to have been identified as far as a product of the Minety tilery. It is compositionally a match for the **SILCBM2** samples, and geo-chemically comparable with all the die 38 samples, therefore, again supporting the hypothesis that Minety products were transported to Silchester.

9.3.4 Die 39

Die 39 is also an example of Lowther's diamond-and-lattice group, with smaller design elements (Fig. 9.23).

Figure 9.23: *Example of die 39. (Insula IX - A.2002.15 (3468))*

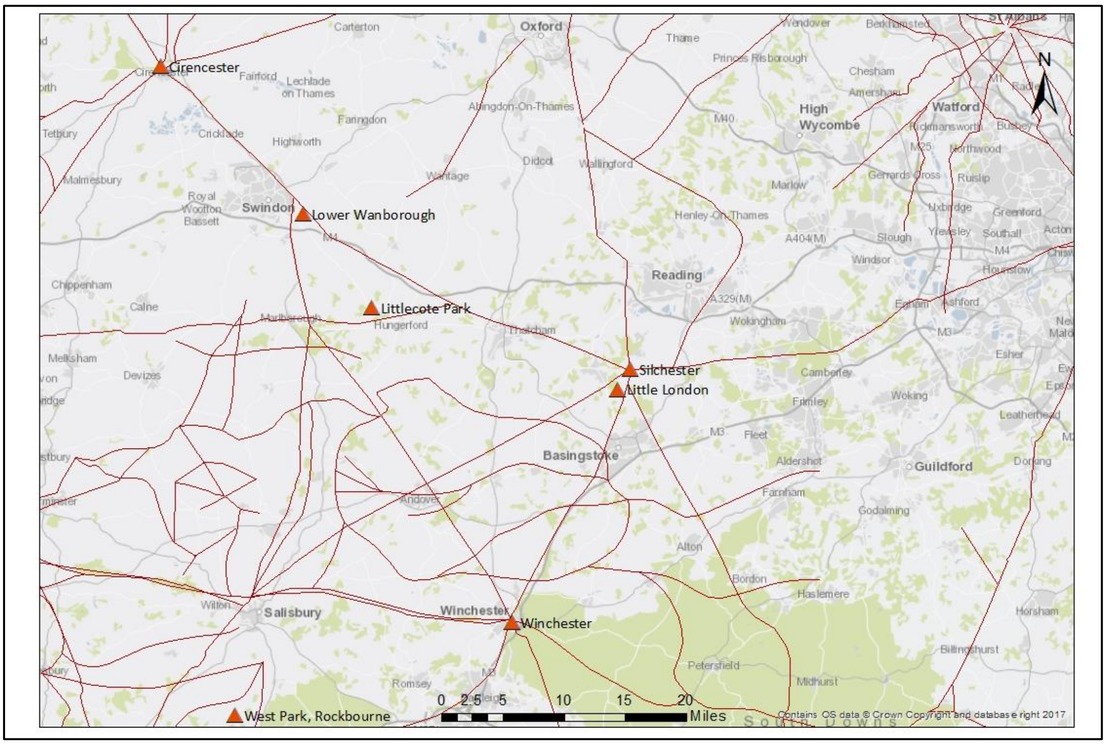


Figure: 9.24 *Distribution map of examples of tiles keyed with die 39.*

The distribution of these design is shown in figure 9.24. The examples are found to the south-west and north-west of Silchester and Little London.

Silchester – there are nine examples of tiles keyed with die 39 in the Silchester archive, of which four are held in the Reading Museum collection. One example recovered by Cotton during her 1938 excavations at the town is labelled as "SC 38.103.1938 EARLY OCC" (RM12). Another example in the Reading Museum archive is thicker than the typical flue-tile at 30mm, where usual examples are less than 20mm. It is probably an example of a *parietalis* as there is a notch visible on one of the edges for the insertion of a cramp to fix the tile to the wall.

Four examples have been recovered from the Insula IX excavations, whilst there are no examples from the forum-basilica archive. At Insula IX, three examples were from period 4 or later contexts (IX783 – context 1775; IX1075 – context 3833; IX1076 – context 2420) and are described in the ceramic building material report for the mid-Roman occupation (Warry, 2011, pp. 226–228 Fig.14.3). The final example was recovered from an unstratified context, it is a *parietalis*, with evidence of two circular cut-outs to the edges and a small portion of relief-patterned design visible (Fig.9.25).

Figure 9.25: *Relief-patterned parietalis from Insula IX (IX54 – A.2012.12 (14501))*

<u>Cirencester –</u> The corpus reports no published reference for these tiles, described as recovered from post-Roman contexts. One specimen from the Abbey Walls site was 28mm thick and was probably from a flat tile or brick (CIR02). There were two examples of die 39 in the archive along with a sample of *parietalis*. The latter has no visible, relief-patterned keying, but is similar in fabric and form to the Silchester example above, figure 9.33, and was therefore included in the sampling.

<u>Littlecote Park</u> – The villa at Littlecote Park was first discovered in 1730 and re-excavated between 1978 and 1991. The first interim report mentions a fairly large number of roller-stamped box-flue tile fragments recovered during the 1978 excavation season (Walters and Phillips, 1979, p. 7) and two examples of die 39 were found in the archive.

Little London – An over-fired example of die 39 is ascribed to the site and referenced as being held at Basingstoke Museum (OC767) (Greenaway, 1981, p. 291). This archive has since been transferred to Hampshire Museum Services where, unfortunately, the relief-patterned example is no loger part of the collection and is now recorded as lost. The find is understood to be the results of a fieldwalking exercise.

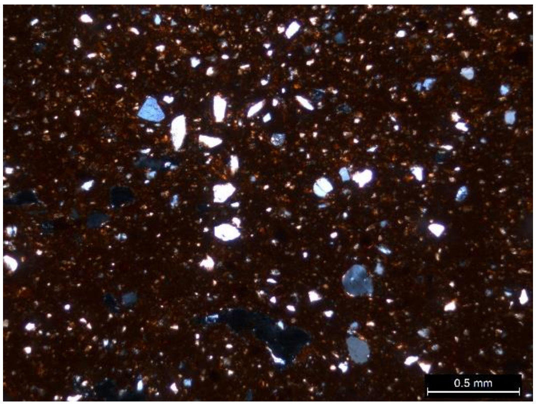
Lower Wanborough - One specimen from a context provisionally dated *c*. AD150 (WAN1859) is incorrectly identified as an example of die 22 in the published volume (Mepham, 2001, p. 313 Fig.109.8). There is also another very small fragment in the assemblage (Context: (WAN67A IX (1))

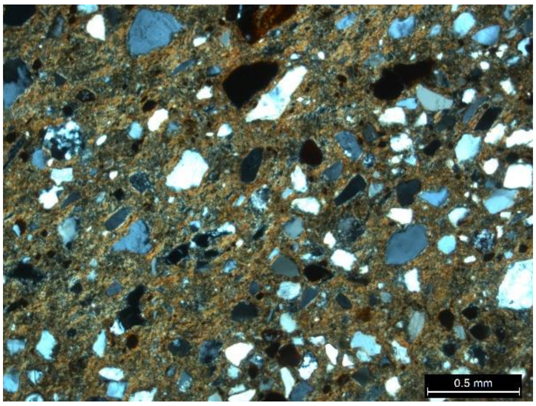
Rockbourne – The specimens from Rockbourne were associated with an early bath-house the plunge-bath of which was incorporated into the south-west wall of building 49 (RCHM, 1983, p. 132). A single example was found in the archive marked with the word ***well.***

Winchester – Four specimens of tile keyed with die 39 were recovered during the 1988 Brooks excavation in the city. These had been formed into tesserae and were incorporated into a mosaic pavement of late Roman date, AD 240-400 (Betts, Black and Gower, 1994, p. 109). I was unable to locate this fragment of mosaic floor in the Winchester archive and has been recorded as lost. The fabric of these samples has been described as resembling the fabric of the Little London example, however, it was also noted that the clay deposits at Little London are closely matched elsewhere in the Hampshire Basin (Foot, no date).

Fabric analysis

In hand specimen, the tiles can be sorted into two distinct fabric groups, table 9.3, both of which correspond with fabrics from the Silchester fabric series, **SILCBM2** (section 6.3.3) and **SILCBM3B** (section 6.3.4) The samples in thin section show a clear difference in the composition of the two fabrics (Figs.9.26 & 9.27). These differences are reflected in the plot of the portable XRF results (Fig. 9.28).





Figures 9.26 & 9.27: *Examples of die 39 in* ***SILCBM2*** *(CIR02) and* ***SILCBM3*** *(WAN19) (x40 magnification, XP)*

SILCBM2 Examples	SILCBM3B examples
Silchester – IX17	Silchester – RM01, RM05, RM12
Cirencester – CIR02, CIR11	Cirencester – *parietalis* CIR07
Lower Wanborough – WAN9	Lower Wanborough – WAN19
Rockbourne	Littlecote Villa – LCV02, LV03

Table 9.3: *Breakdown of die 39 examples by fabric groups*

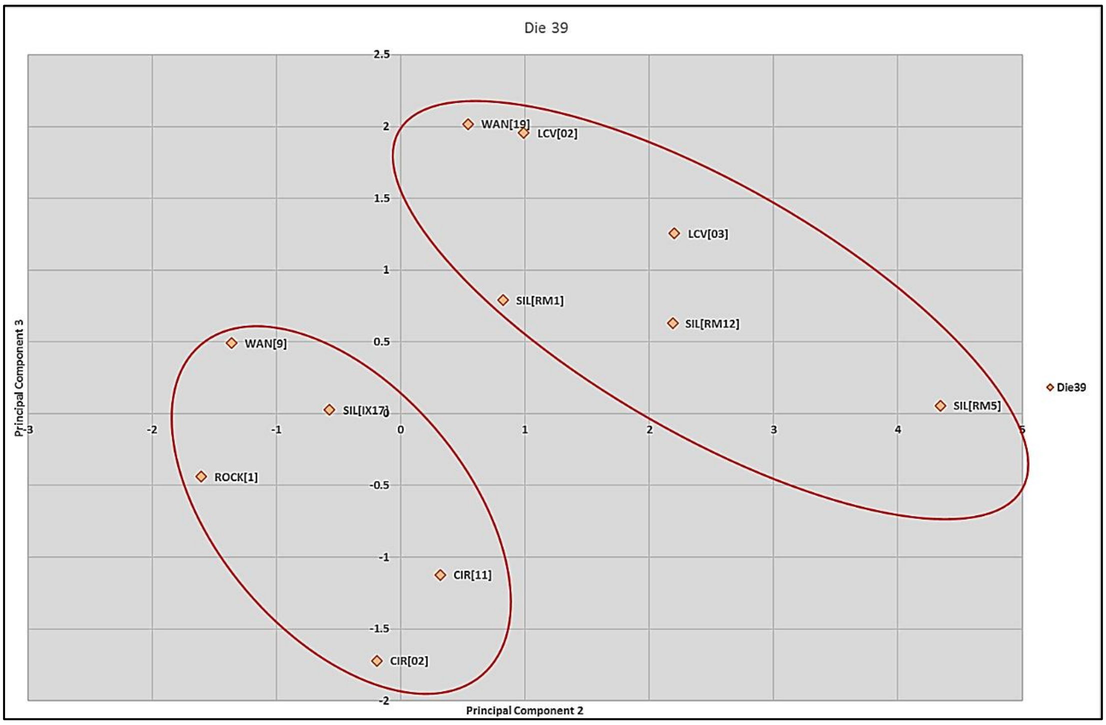


Figure 9.28: *Results of PCA classification of the die 38 examples based on the normalised abundance of 13 elements.*

The second plot (Fig.9.29) includes the material from the production centre at Minety and Little London. As discussed in chapter 7, Minety has been proposed as a potential source for the **SILCBM2** fabric, and Little London the probable source for the **SILCBM3** fabrics. The two groups of die 39 samples align with the two groups of material from the production centres. This would suggest that the tiler, or at least the roller-die, was moving between production centres. The map below (Fig.9.30), has the die 39 samples highlighted by fabric to illustrate the distribution range of the examples from each production centre.

The distribution would suggest that the die 39 flue-tiles produced at Little London were distributed to Silchester, Winchester and Rockbourne to the south-west. The potential products of the Minety production centre are distributed to the north to Cirencester and south-east to Lower Wanborough and Silchester.

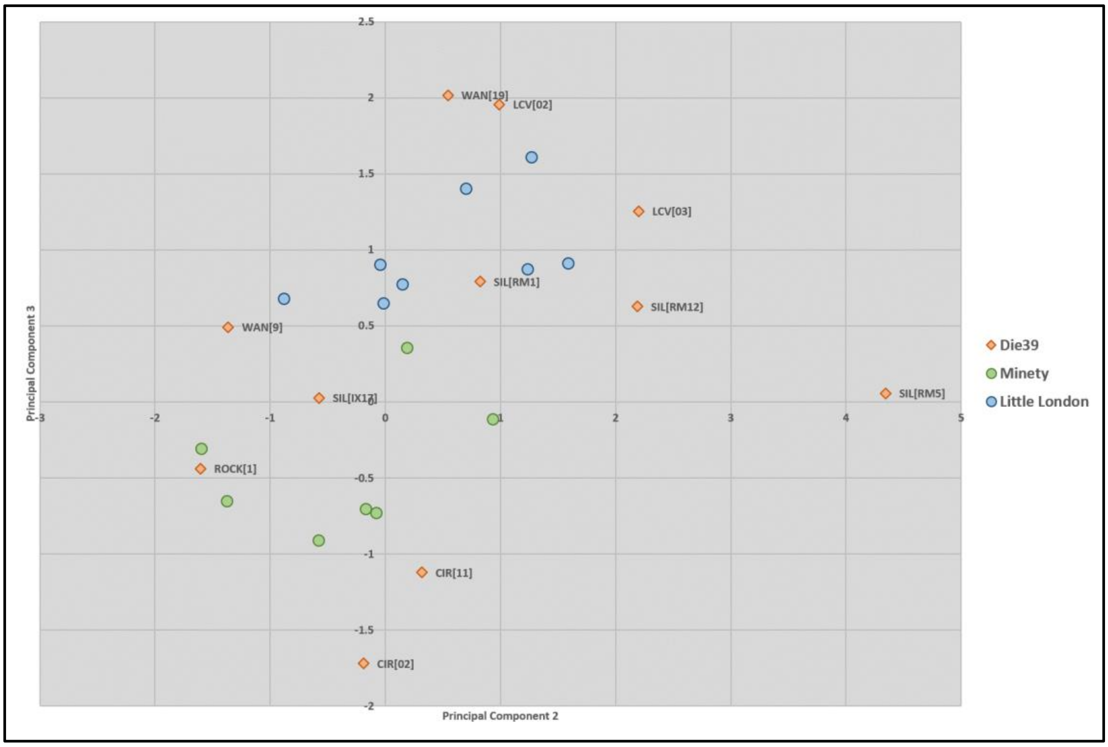


Figure 9.29: Results of PCA classification of the die 39 examples, Minety & Little London samples, based on the normalised abundance of 13 elements.

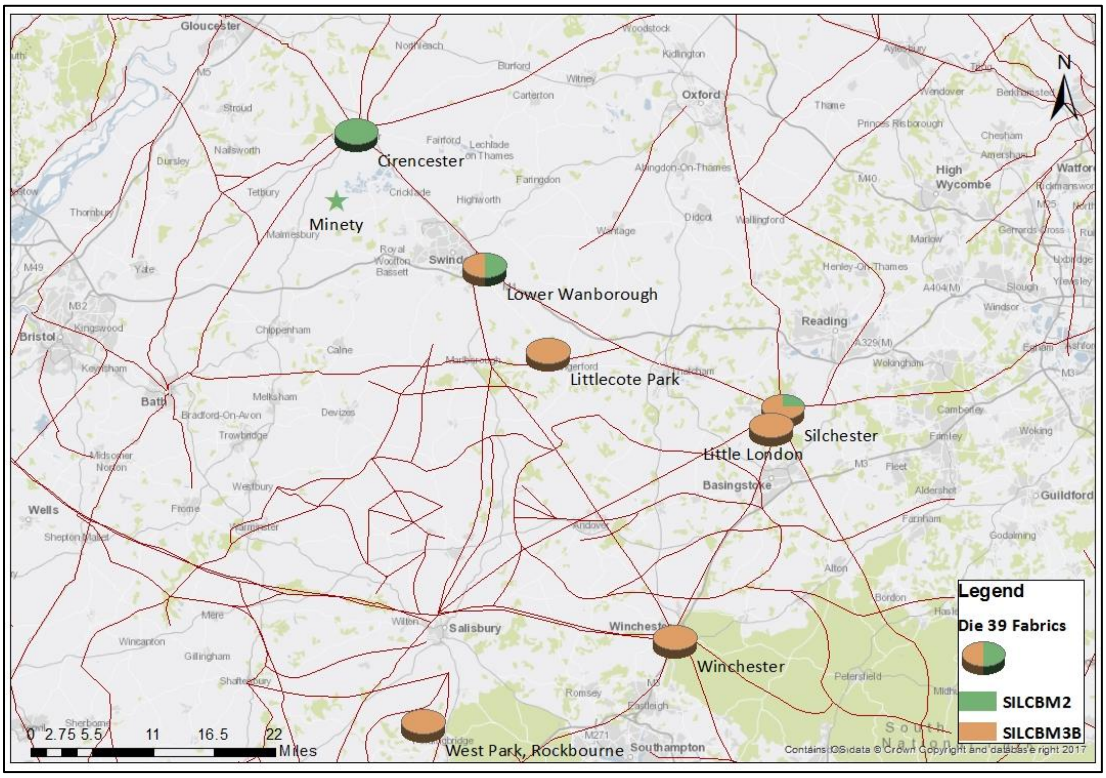


Figure 9.30: Distribution of die 39 illustrating fabric proportions

9.3.5 Die 68

Die 68 is another example of the diamond-and-lattice design groups with a larger design element than the die 38 and 39 examples. These types are found at four of the sites where die 39 is also found. They demonstrate an approximate linear distribution from Silchester, north-west to Cirencester (Fig.9.31).

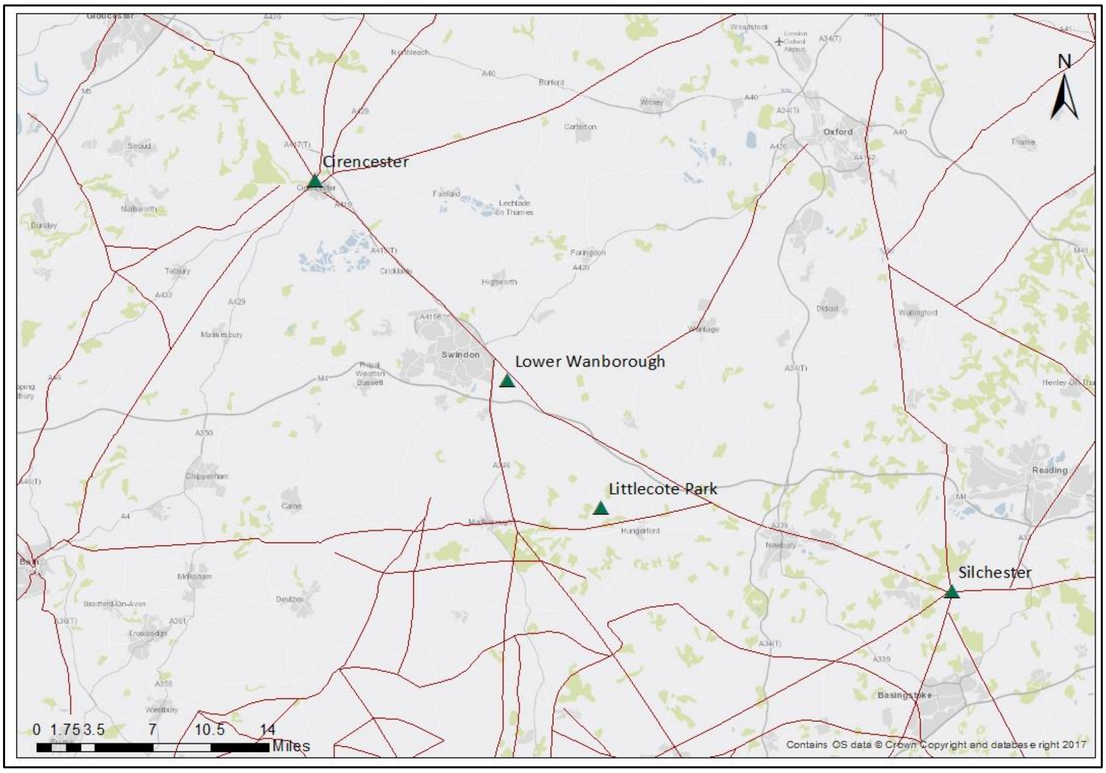


Figure 9.31: *Distribution of relief-patterned tiles keyed with die 68*

Silchester – The two examples of die 68 were recovered during the forum-basilica excavations. They were recovered from contexts (029), dated to phase 6.13, the make-ups for the masonry forum-basilica *c*. AD150-300 (Fulford and Timby, 2000, p. 68) and context (809) dated to phase 5.20, a tile setting in the entrance passageway of the Flavian timber basilica dating from *c*. AD 85 (*ibid*. p.45).

Cirencester – The example in the corpus is recorded as being from an unknown site within the city (Betts, Black and Gower, 1994, p. 126). Further samples were obtained from the archive of the 1964-1966 investigations at Cirencester Abbey and the Saxon church (Wacher, 1965; Brown and McWhirr, 1966, 1967) and six examples of die 68 were found.

Littlecote Park - There is no published reference to provide contexts for the relief-patterned tiles recovered from the villa excavations, though the first interim report refers to a large number of roller-stamped box-flue tile fragments recovered during the 1978 excavation season (Walters and Phillips, 1979, p. 7). The site produced more than one example of die 68.

Lower Wanborough - One specimen of die 68 from context (WAN1766) is incorrectly identified as an example of die 13 in the site publication (Mepham, 2001, p. 313 Fig.109.8). Another very small fragment was also identified in the assemblage (Context: (WAN67A IX (1)).

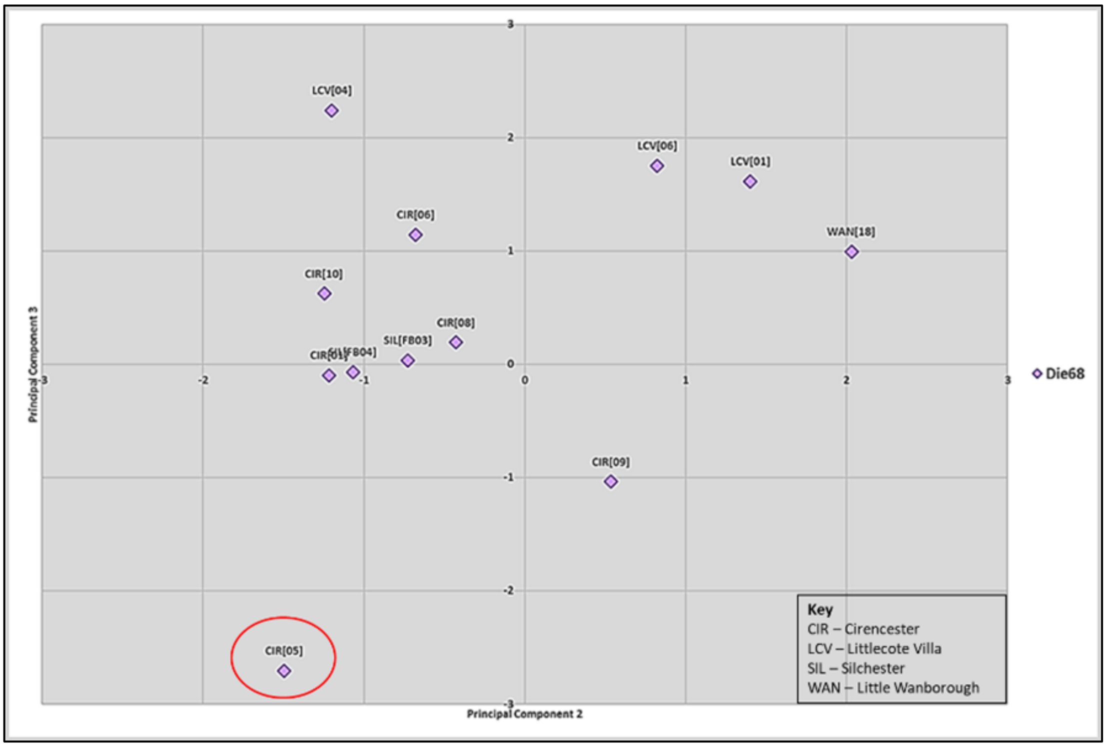


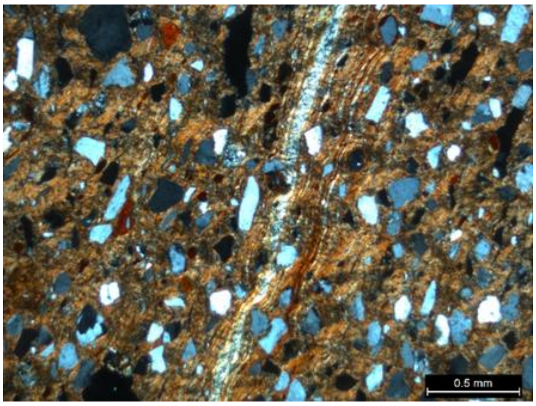
Figure 9.32: *Results of PCA classification of the die 68 examples based on the normalised abundance of 13 elements.*

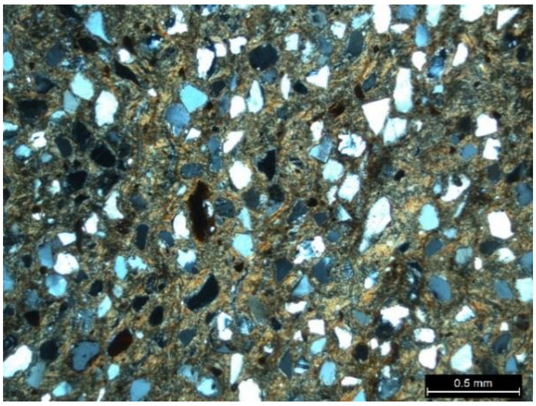
Fabric analysis

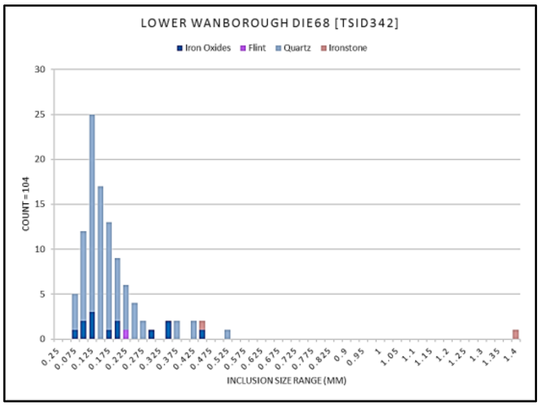
Both the examples from the Silchester forum-basilica have been assigned to the SILCBM3A, deriving from a *Windlesham Formation* source. In hand specimen, all the samples, except for one example from Cirencester (CIR05-TSID275), are of the same composition as the SILCBM3 fabric series.

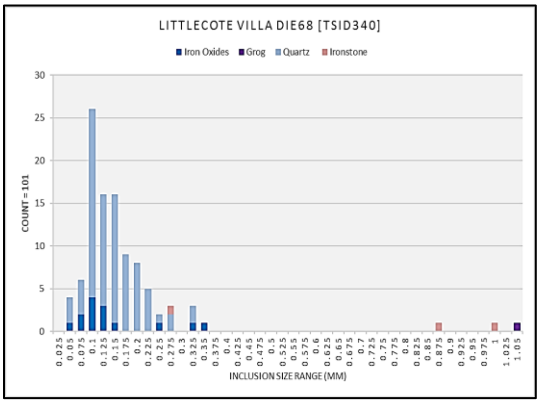
They are heterogeneous with varying proportions of quartz, iron oxides, and clay pellets. Example CIR05 is a homogeneous, iron-rich fabric with a high proportion of fine quartz-silt throughout the matrix with a scatter of larger quartz sand.

The geo-chemical results from the analysis of the die 68 sample (Fig. 9.32), most samples form a group in the top left-hand quadrant of the plot, with a few samples to the top right-hand quadrant. The CIR05 sample from Cirencester plots separately to the bottom-left.





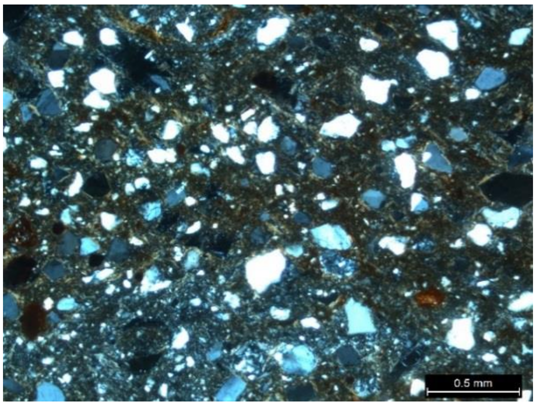


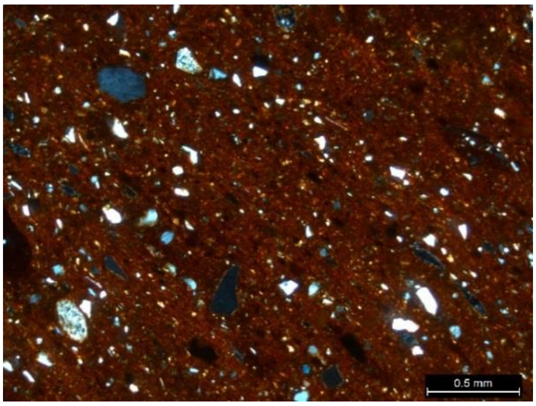


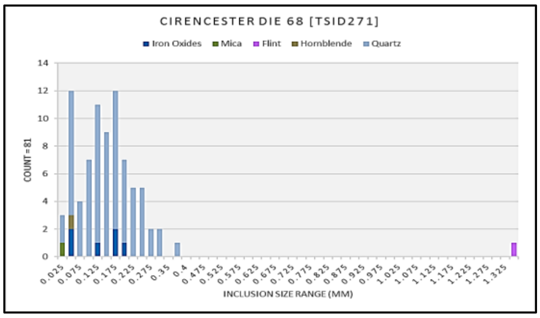
Min = 0.0509mm	Max = 1.3906mm	Mean = 0.176658mm	Mode = 0.1065mm	Std Dev = 0.149076mm	Min = 0.0454mm	Max = 1.0297mm	Mean = 0.160744mm	Mode = n/a	Std Dev = 0.153952mm

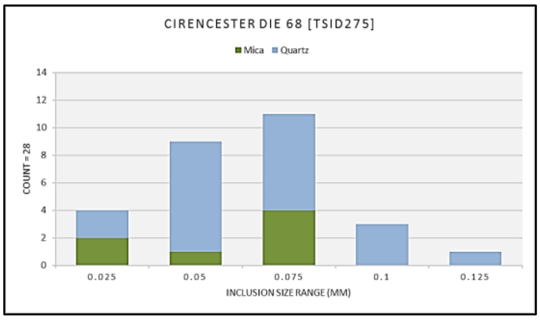
Figure 9.33 & 9.34: *Grain-size distribution and photomicrograph of die 68 example from Lower Wanborough (TSID342) (XP, x40 magnification)*

Figure 9.35 & 9.36: *Grain-size distribution and photomicrograph of die 68 example from Littlecote Villa (TSID340) (XP, x40 magnification)*









Min = 0.018mm	Max = 1.3379mm	Mean -= 0.150054mm	Mode = 0.1208mm	Std Dev = 0.152191mm	Min = 0.0198mm	Max = 0.1148mm	Mean = 0.052557mm	Mode = 0.0762mm	Std Dev = 0.023029mm

Figure 9.37 & 9.38: *Grain-size distribution and photomicrograph of die 68 example from Cirencester (TSID271) (XP, x40 magnification)*

Figure 9.39 & 9.40: *Grain-size distribution and photomicrograph of die 68 example from Cirencester (TSID275) (XP, x40 magnification)*

The similarities between the samples can be seen in the photomicrographs and grain-size distribution. Most of the examples are similar in composition to **SILCBM3A** and the pXRF results have been plotted against the samples from Little London, identified as the source of **SILCBM3**. Most of the samples overlap on the plot, (Fig.9.41) confirming a similarity in geo-chemical composition. This would suggest that the majority of die 68 samples were made from a *Windlesham Formation* source. One Cirencester sample (CIR05 - TSID275) stands out in terms of the lack of inclusions and iron-rich homogeneous matrix and is an outlier on the pXRF results plot. This Cirencester example (CIR05) is clearly from a different raw material source. There are compositional similarities between this sample and TSID329-CIR05 and samples from Love Lane. Relief-patterned tiles were included in the assemblage from Minety. As discussed previously, Minety supplied brick and tile to the *civitas* capital at Cirencester (Warry, 2017, p. 77). Love Lane, die 56, and this is included in the pXRF analysis. Figure 9.47 shows the results of this analysis plotted alongside the die 68 samples. The results of the analysis of the Love Lane samples plot in the bottom half of the chart and this could may indicate that they are from a common source. However, there is some doubt as to the production of tile and brick at Love Lane (Chapter 7.6).

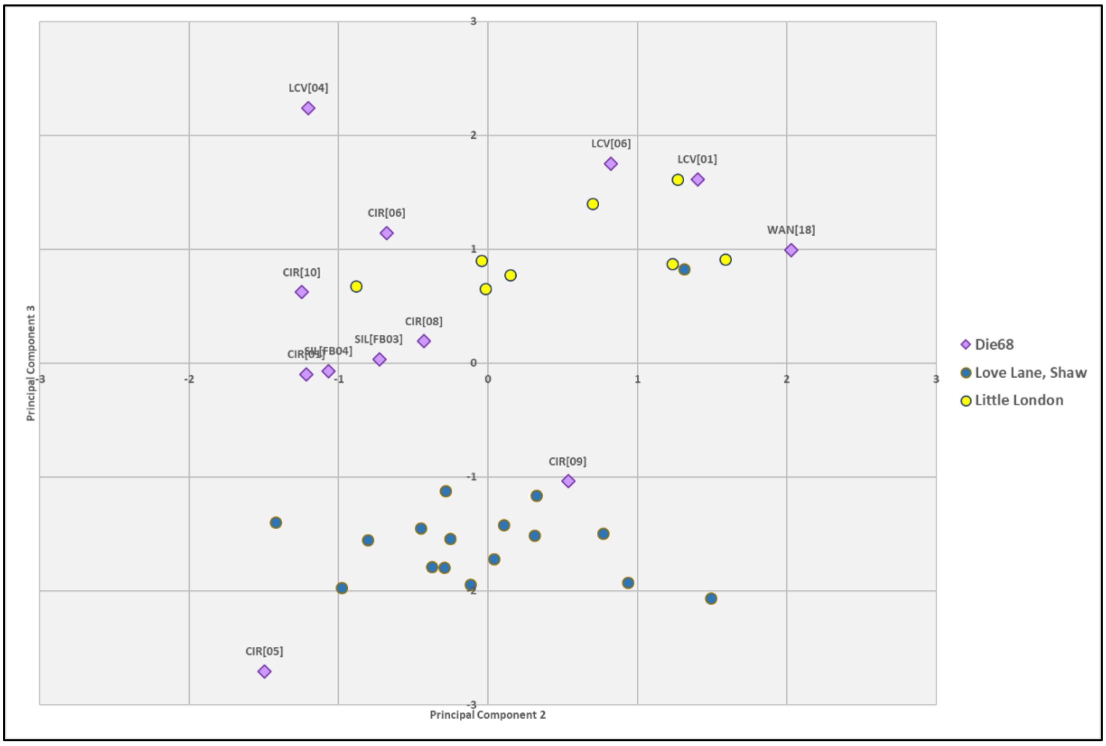


Figure 9.41: Results of PCA classification of the die 68 and Little London examples based on the normalised abundance of 13 elements.

9.3.6 Die 104

The examples of die 104 are part of the billet-design group. There are only two sites recorded as having samples of die 104 in the corpus, St Albans and Staines, (Fig. 9.42) (Betts, Black and Gower, 1994, p. 144).

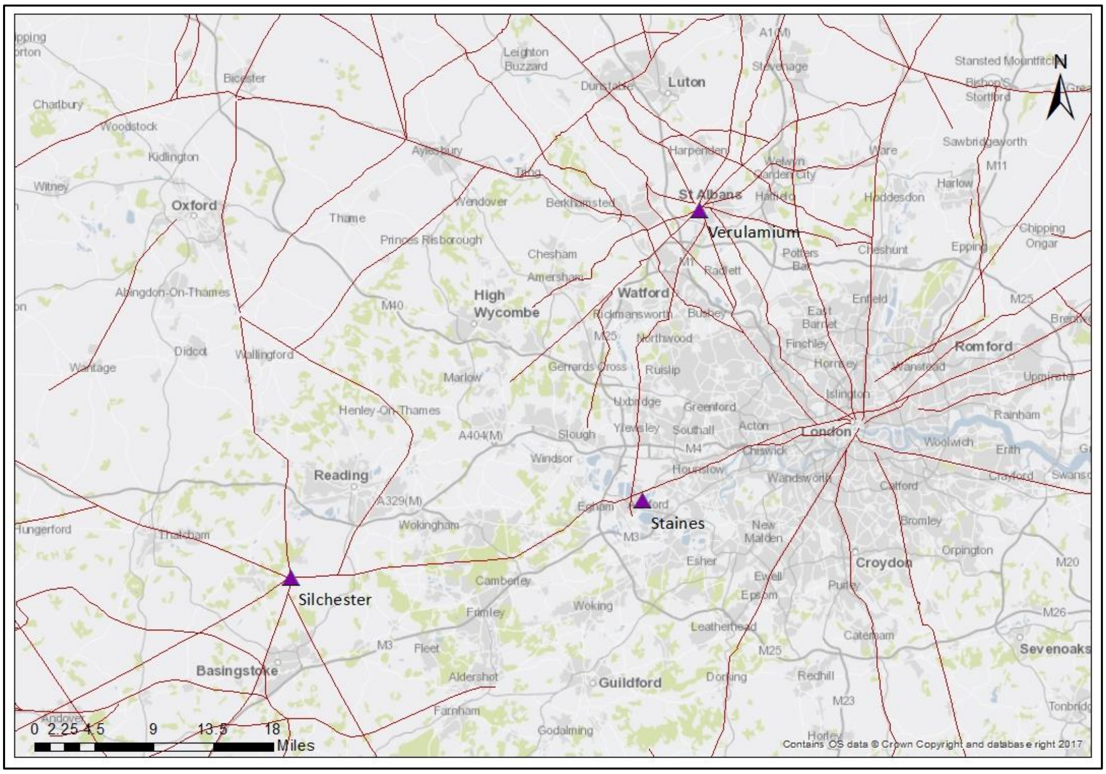


Figure 9.42*: Distribution of examples of die 104.*

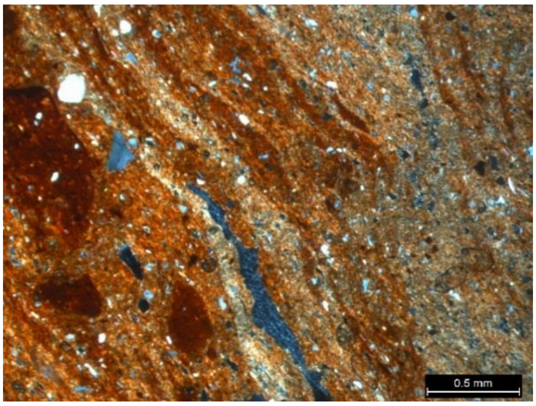
Silchester – A single example of die 104 was found in the Reading Museum archive (1995.85. B33). The item is labelled **June 1964 Richmond**. This is understood to be a reference to the excavation of the church at Silchester by Sir Ian Richmond in 1961 (Frere, 1976). There is no mention of any relief-patterned tiles in the published report.

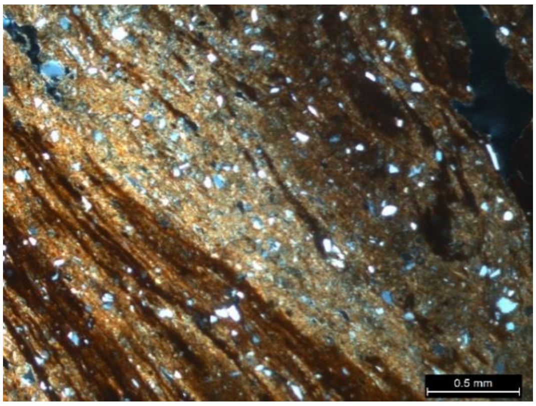
St Albans – The die 104 relief-patterned tiles from St Albans are identified as die 25 in the *Verulamium Excavations* Volume III (Frere, 1984). One example was unstratified in Insula **XXVIII** - VER58 G (1) (VER2) with another from Insula **XXII**, and a third from Insula **XIV** (VER1), from a robber trench of building XXII (Wilson, 1984).

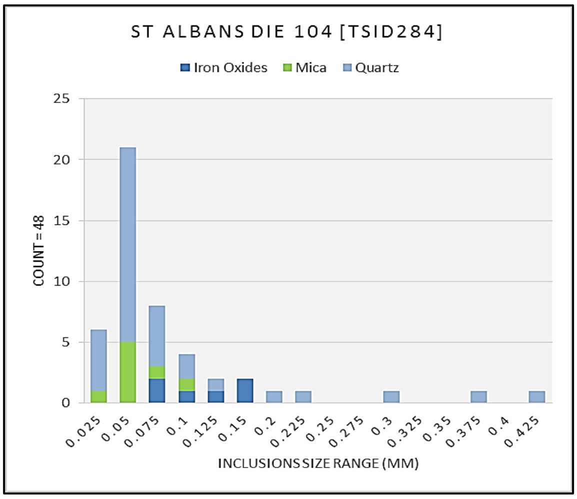
Staines - The examples of die 104 from Staines are recorded in the corpus as having no published reference. Six fragments were obtained from various contexts during the excavations at the Johnson & Clark site (Jones, 2010, p. 280). Another example was recovered from the excavations at the Emsleigh Centre (Gower, 2010). The similarity in designs between die 104 and dies 25 and 105 is noted. Whilst die 25 has a predominantly West Country distribution with find-spots in Somerset, Cirencester, Minety, Oxfordshire, and Lower Wanborough, die 105 is restricted to St Albans, from where examples of die 104 have also been recorded (see above).

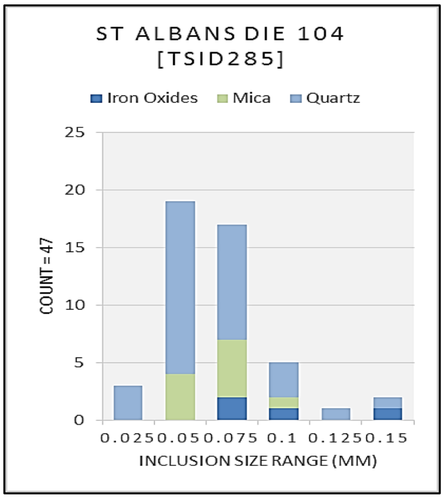
Fabric analysis

The Silchester examples was assigned to the **SILCBM2** fabric group. This is a moderately heterogeneous fabric with distinctive cream clay pellets and streaks. The two samples from Verulamium are visibly heterogeneous in hand specimen, whilst exhibiting the same range of inclusions as the Silchester sample. Both have low values for the standard deviation reflecting the narrow range of size of the inclusions, with both examples having mean inclusion size range values of <0.1mm.





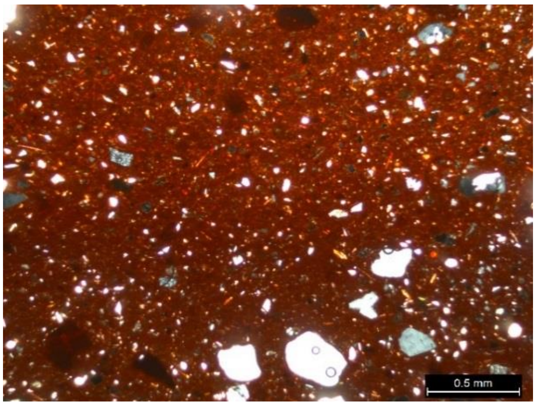


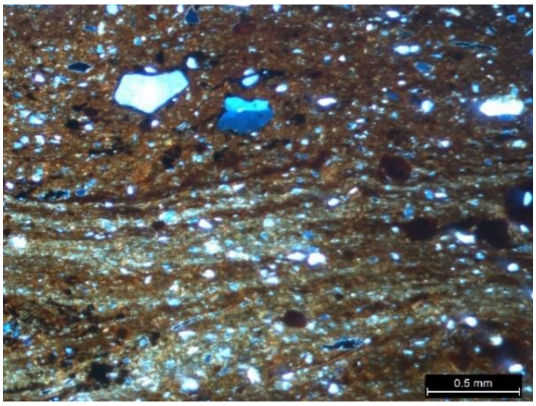


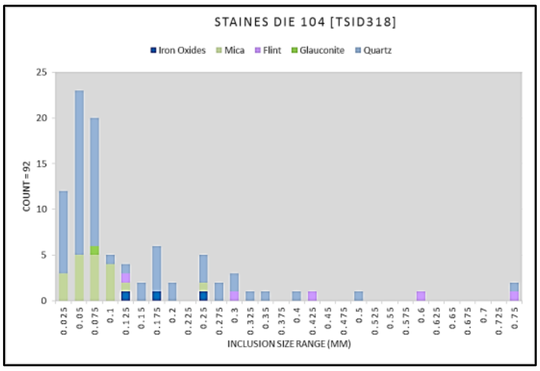
Min = 0.0146mm	Max = 0.4151mm	Mean = 0.076575mm	Mode = 0.0146mm	Std Dev = 0.083279mm	Min = 0.0169mm	Max = 0.1358mm	Mean = 0.05543mm	Mode = n/a	Std Dev = 0.025052mm

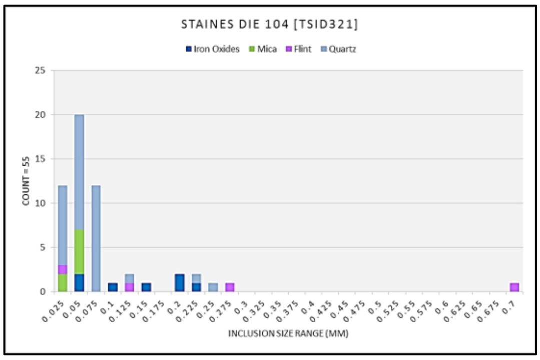
Figure 9.43 & 9.44: *Grain-size distribution and photomicrograph of die 104 example from Verulamium (TSID284) (XP, x40 magnification)*

Figure 9.45 & 9.46: *Grain-size distribution and photomicrograph of die 104 example from Verulamium (TSID285) (XP, x40 magnification)*









Min = 0.0086mm	Max = 0.7435mm	Mean = 0.121108	Mode – 0.0109mm	Std Dev = 0.145961mm	Min = 0.0127mm	Max = 0.6772mm	Mean = 0.0734127mm	Mode = n/a	Std Dev = 0.1029362mm

Figure 9.47 &9.48: *Grain-size distribution and photomicrograph of die 104 example from Staines (TSID318) (XP, x40 magnification)*

Figure 9.49 &9.50: *Grain-size distribution and photomicrograph of die 104 example from Staines (TSID321) (XP, x40 magnification)*

There is variety within the hand-specimens from Staines (Figs. 9.45 - 9.48). Samples STA01/03/04/05 (TSID317/319/320/321) are heterogeneous fabrics with highly birefringent clay streaks and pellets visible throughout, STA02 and STA06 (TSID318/322) are homogenous, iron-rich fabrics with fine quartz-silt throughout and a scatter of larger quartz-sand, akin to SILCBM1A.

The pXRF results show the geo-chemical similarities between the majority of samples (Fig. 9.51), whilst confirming that STA02 & STA06 are compositionally different.

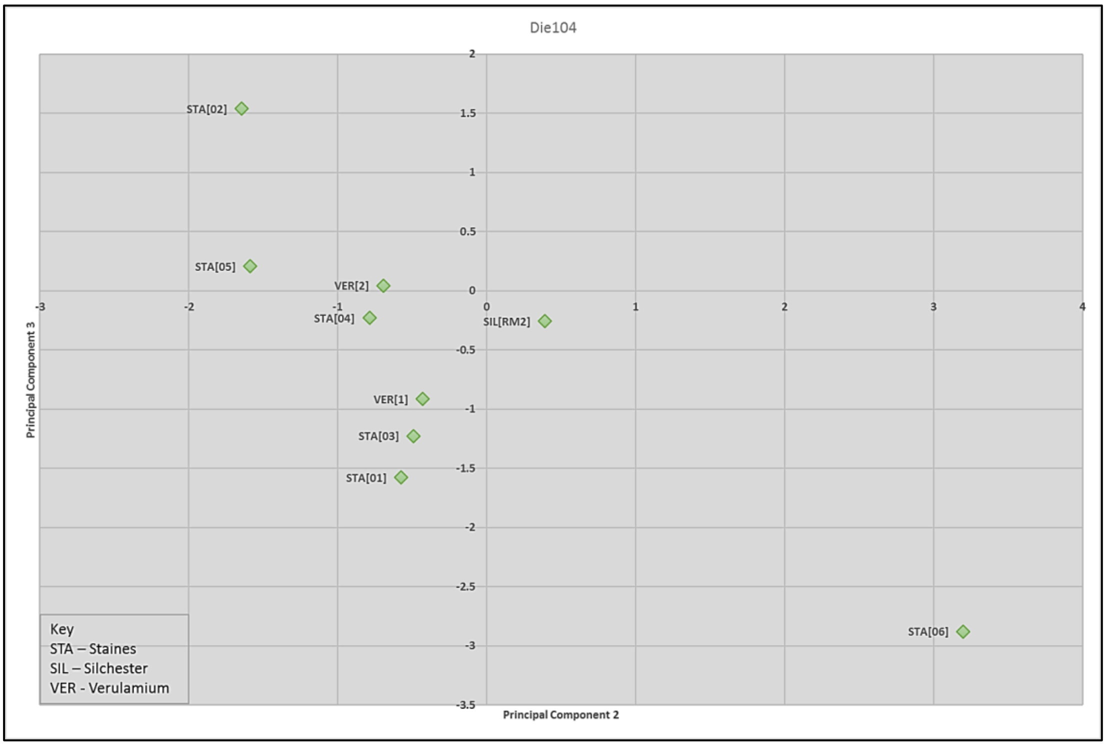


Figure 9.51: *Results of PCA classification of the die 104 examples based on the normalised abundance of 13 elements.*

Potential production centres

The report from the Elmsleigh Centre in Staines, referenced above, discusses the fabric of the samples of die 104 recovered from the site. It is described as a fine matrix with clay swirls, with quartz, mica, iron oxides, and occasional flint (Gower, 2010). Preliminary examination was said to conclude that the fabric was not a match for Minety products, and this was said to explain the limited distribution of die 104 when compared to die 25. However, there is clearly a correlation in terms of composition between the die 104 samples and the samples from Minety. If the tiles were not the production of the tileworks at Minety, there were probably made of the same raw material sources, *Oxford Clay Formation,* and *Lias Clay*, as used in the production at Minety.

The other die 104 samples from Staines are probably the product of a tilery using a *London Clay Formation* source. As discussed previously, there are several tileries situated along the Roman road from London to St Albans and these would have utilised *London Clay Formation* sources, but there is as yet no evidence of relief-patterned tile production at any of these sites. As discussed in section 9.3.2, there is potential evidence for the movement of relief-patterned tiles keyed with die 27 from the tilery at Ashtead which is known to have produced relief-patterned tiles and is also located on the *London Clay Formation*.

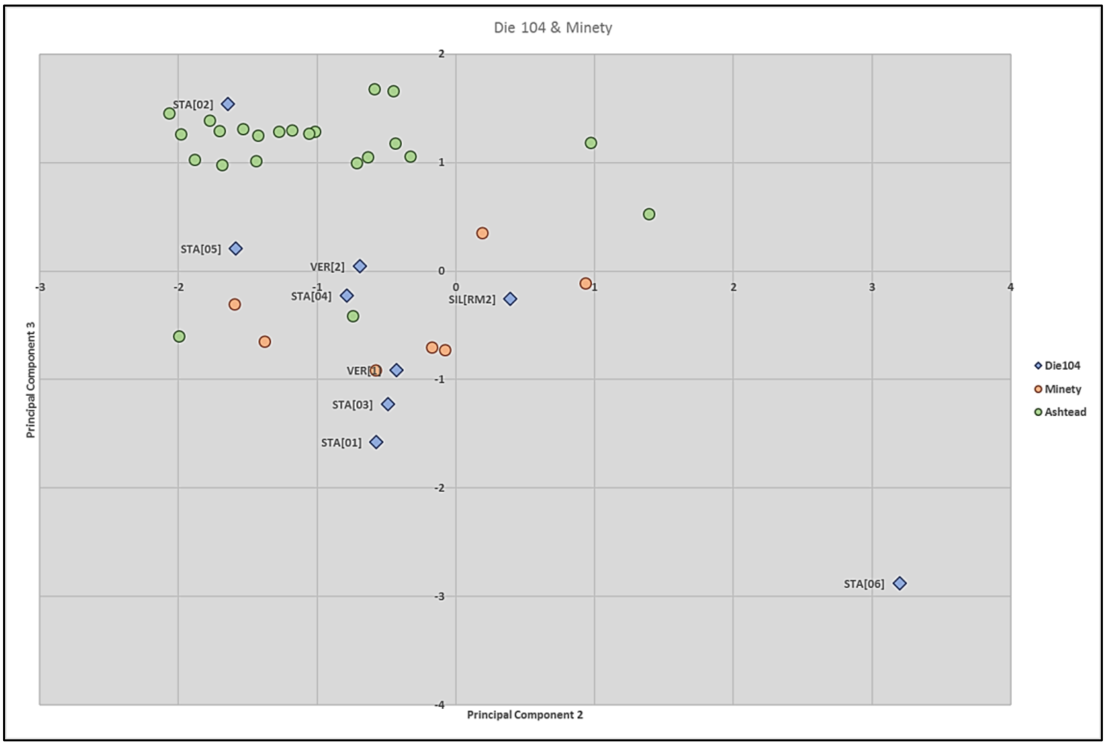


Figure 9.52*: Results of PCA classification of the die 104 examples, with Minety samples based on the normalised abundance of 13 elements.*

The **SILCBM2** fabric group, discussed in section 7.10, has been linked to the production centre at Minety, Wiltshire. The pXRF results from Minety are plotted against the die 104 examples and the **SILCBM2** samples (Fig 9.52), the plot also includes the pXRF results from the Ashtead samples. This would appear to confirm a *London Clay Formation* source for the STA02 sample. Whilst no examples of die 104 have yet been found at Ashtead, as previously discussed, they could have been produced solely for export, once the production at the tilery expanded beyond meeting the local need for constructing the villa at the site.

9.4 Conclusions – Relief-patterned tiles

Of the relief-patterned dies studied in this chapter die 38 would appear to be the only type originating from a single production centre, in this case from a *Windlesham Formation* source and so, probably, from the tilery at Little London. Whilst the die 27 examples show geo-chemical differences between the fabrics, they are all probably from *London Clay Formation* sources, which have been shown to exhibit compositional differences between outcrops. There is the possibility that the examples from London and Colchester were produced at Ashtead, whilst the Lincoln and Dover examples were produced from more local *London Clay Formation* sources, implying the movement of the tiler or roller-die between production centres.

Dies 39 and 68 have samples matching both a *Windlesham Formation* source as found at Little London and **SILCBM2**, which has been linked to the Minety tileworks, implying the movement of the tiler, or roller-die, between the two production centres. Their distributions could be the result of the intervention of builder's merchants, sourcing tiles from several production centres to meet contracts for large scale building projects (see Chapter 11 for further discussion).

Of all the examples of the six dies reviewed in this chapter, only one was found in-situ, an example of die 3 found during the DLR Shaft/Lothbury excavation in London. The tile was found in-situ in the west wall of a masonry building in the first phase of the building believed to be of post-Hadrianic date (Betts, Black and Gower, 1994, p. 68). A post-Hadrianic date would be at the very end of the proposed date range of production for these products. The majority of the other examples were either unstratified or recovered from secondary or post-Roman contexts. The sites from where relief-patterned tiles have been recovered varies considerably. They include public buildings including the bath complexes at Silchester and Huggin Hill (Betts, Black and Gower, 1994, p. 35) along with the Silchester forum-basilica (Timby, 2000) and the governors palace, London (Marsden, 1976, p. 94 Fig. 42 No. 289 & 96). Examples have been found within *colonia* at Colchester (Black, 1992, pp. 262–3) and Lincoln (Steane *et al.*, 2016, pp. 11–62), villa complexes at Rockbourne (Betts, Black and Gower, 1994, p. 109) and Lower Wanborough rural settlement (Mepham, 2001). Whilst the examples from Dover has no direct provenance it is assumed to have originated from a Roman military site.

The following chapter reviews the footprints found on the surface of bricks and tile, the footprints are identified, where possible, and considered alongside the fabric of the material. The results are analysed in terms of the environment and infrastructure surrounding the tileworks.

Chapter 10: Footprint evidence

10.1 Introduction

Animal, bird, and human footprints are often found on tile, the impressions having been made whilst the tiles were laid out to dry before firing. Animal footprints provide evidence of the composition of animal communities (Bar-Oz and Tepper, 2010), the nature of the infrastructure, and activities surrounding the tilery. Assuming the brick maker disposed of those tiles that were no longer suitable for use (Cram and Fulford, 1979, p. 202), an assemblage of foot-impressed tiles from a tilery excavation would be more representative of the number of tiles which carried impressions than those recovered from building excavations. The only record of footprints from production sites are those described in the excavation reports, but there is typically no reference to the proportion of material they represent. Retention policies adopted on site favour complete or exceptional examples, resulting in examples bearing footprints being proportionally overrepresented in retained collections.

It is traditionally assumed that tile making in Britain was restricted to the summer months, to facilitate the laying out of tiles to dry during the least inclement weather. Indeed, Boon's study of all tiles marked with dates before firing argued for a seasonal activity which would call for other occupations such as farming to support the tile makers (Boon, 1974, p. 279;365). The practice of more recent traditional industries in north-west Europe also suggests that brick-making was a summer occupation. This however relates only to the forming and firing of the tiles, the other related activities of clay preparation, weathering, and timber felling for fuel would be autumn and winter tasks. Cram (2000a, p. 123) puts forward the idea that an absence of wild animals prints would suggests that fencing or hedging was used to prevent access. However, if a fence was sufficient to prevent wild animal access it would also have been sufficient to restrict access of the domesticated livestock too. Tile-makers may be engaged in farming activities for some of their remaining time (Soffe, Nicholls and Moore, 1989, p. 83) showing the tile industry as complementary to agriculture and stock rearing. Domesticated livestock prints would not be expected where tile-making was a full-time year-round occupation, leaving no opportunity for farming or stock-keeping (Cram & Fulford 1979, p.201), thus leading to the picture of the tile industry as a semi-specialised or craft industry.

In this chapter the footprints found on the bricks and tiles in the Silchester collections including the material from Insula IX **(IX)**, the forum-basilica **(FB)**, and the Reading Museum **(RM)** collection are analysed. First, the assemblages of ungulate, other mammals, and bird footprints are summarised. Second, these are described in conjunction with the **SILCBM** fabric series. There then follows a discussion of the environments surrounding the tileries and the activities taking place alongside brick and tile production.

10.2 Footprint assemblage

A total of 394 footprints have been identified on the bricks and tiles in the collections from the forum-basilica, Reading museum and Insula IX. It is not possible to ascertain the proportions of the total material used that was impressed in such a way. The report into the brick and tile from the forum-basilica records a total of 23,620 items of brick and tile. From these a total of 87 footprints have been recorded, representing a proportion of 0.37% but it should also be borne in mind that the recovered assemblage is itself a fraction of the whole.

The prints have been divided into three categories: a) those made by ungulates, animals with hoofs, cloven or otherwise, including domesticated species such as cattle, pigs, and sheep/goats; b) other mammals which includes cats and dogs, wild animals and human and c) impressions made by birds, including domestic and wild bird species. Whilst there are some references to animal skeletal assemblages from the Roman period, this has been used sparingly as the footprints are not representations of the consumption of animals by the Romano-British population but is rather a reflection of the animals living near the tileworks.

10.2.1 Ungulate prints

Ungulate footprints have been identified on a total of 82 bricks and tiles. Of these, 24 are incomplete prints with indeterminate morphology where it has not been possible for the species to be identified: 14 in fabric **SILCBM1**, with three examples in **SILCBM2**, four examples in **SILCBM3**, and two vitrified examples. The remaining 58 examples comprise deer, cattle, sheep, pig and a single horse hoof print (Fig.10.1).

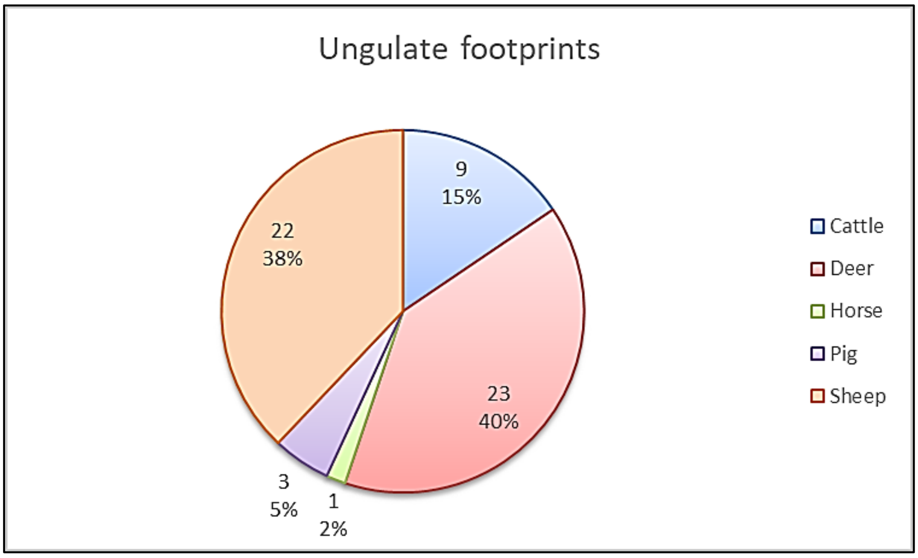


Figure 10.1: *Proportions of identified ungulate footprints (n=58)*

10.2.2 Mammal prints

There are 282 bricks and tiles which include mammal footprints, of which 113 are partial pawprints with insufficient characteristics to make a positive identification and so have been categorised as unidentified. These unidentified footprints are made up of 75 examples on **SILCBM1**, 16 examples in **SILCBM2**, seven examples in **SILCBM3**, six examples each in **SILCBM5** and vitrified bricks, along with a single partial print on bricks of **SILCBM4**, **SILCBM6** and **SILCBM9**. Seven species are represented in the remaining 165 mammal footprints (Fig.10.2).

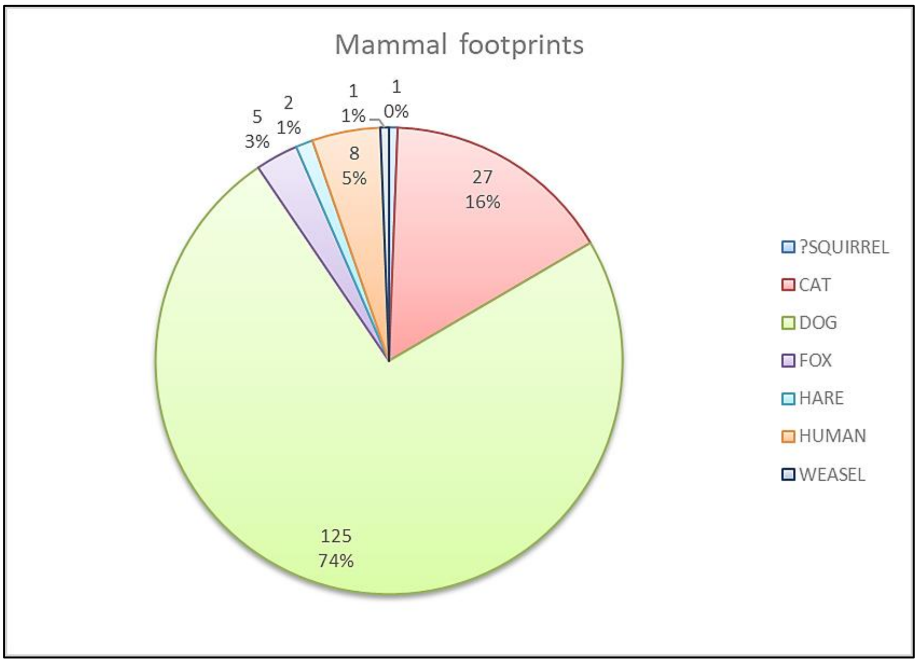


Figure 10.2: *Proportions of identified mammal footprints (n=169)*

10.2.3 Bird prints

A total of 30 impressions of bird feet have been identified in the Silchester assemblage, of which 12 are incomplete prints with indeterminate morphology: six on **SILCBM1** tiles, along with five examples in **SILCBM2** and a single specimen in **SILCBM3**. The remaining 19 examples consist of eight footprints identified as chicken, with the other 11 prints made by wild bird species.

10.3 Footprints by fabric type

This section discusses the range of prints found on each of the major **SILCBM** fabrics. Most of the footprints are found on fabrics **SILCBM1-4**, with six unidentified paw prints on **SILCBM5** tiles, two paw prints on **SILCBM6** bricks (one dog and one unidentified) and a single unidentified paw print on **SILCBM9** tile.

10.3.1 **SILCBM1**

There is a total of 244 prints on **SILCBM1** bricks and tiles and of these 94 partial prints have been classed as unidentified (74 mammals, 13 ungulates, and seven birds). Figure 10.3 illustrates the numbers of identified prints and their proportions within the bird, ungulate and mammal categories.

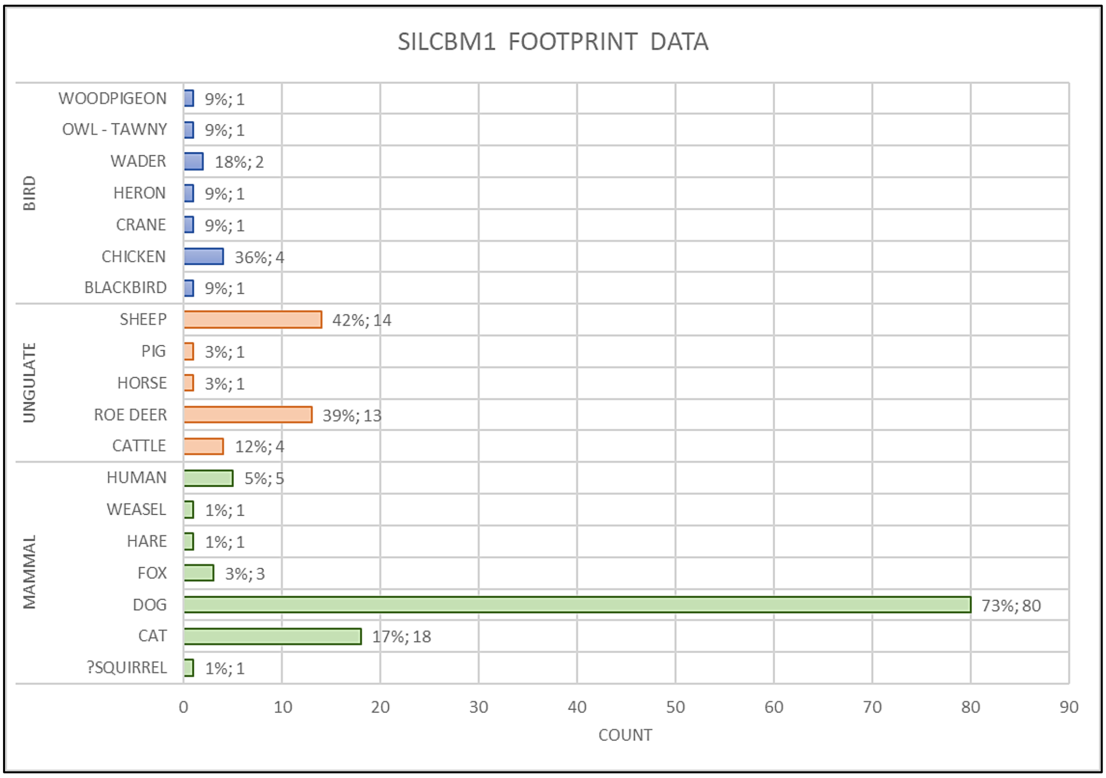


Figure 10.3: *Count and proportions of species on* ***SILCBM1*** *material (n=152)*

Ungulates

Impressions from the hooves of sheep/goat account for 14 of the 33 identified ungulate impressions. Experimental work by Cram (2000a, p. 123) showed that it is not possible to distinguish those prints made by a sheep from those of a goat. The track of a domestic sheep bears similarities to that of a roe deer but has more rounded tips to the hoofs (Fig.10.4). The hoof prints are typically asymmetrical, and the size, dependent on the age and breed, is usually about 50-60mm long and 40-50mm wide (Bang and Dahlstrom, 1974, p. 73). Using the method described by Barr & Bell (2017) (Chapter 3.1.1) three examples have been identified as having been made by new-born (<1month old) lambs and five by a sheep aged between three-and-five months old, indicating that these tiles were laid out to dry during the lambing season, in the spring months of March and April, into the summer months. Another five hoofprints have been estimated to have been made by sheep aged between 10-and-14 months. The largest hoofprint would have been made by a fully grown adult specimen, estimated to be aged 50+ months. The sheep footprints evidence the proximity of pasture to the tileworks. Sheep mortality rates estimated from urban skeletal deposits typically include animals of a wide range of ages, with some apparently bred for slaughter and others retained for wool and milk supplies before consumption (Grant 2004, p.377). Most urban assemblages have produced substantial percentages of mandibles evidencing sheep slaughter between 18 and 36 months old, indicating a focus on meat production. Where older populations are evidenced, this is a sign of wool production. Material from a small number of sites has included a higher percentage of bones of young lambs, including the assemblage from the forum-basilica at Silchester (Grant 2000).

Figure 10.4: *Sheep/goat print on brick (IX413: A.2004.30 (5654))*

Figure 10.5: *Roe deer print on brick (IX123 – A.2010.48 (11042))*

There are four cattle-hoof impressions on SILCBM1 samples, which are rounded prints, often broad in relation to their length. Three of these were made by new-born cattle, less than one-month-old and the other by a cow aged approximately 2 months old. Beef production was of paramount importance in animal husbandry practices in Roman Britain. There is little doubt that beef was by far the most common meat consumed throughout the province, even allowing for biases against sheep and pig in the faunal assemblages (Maltby 2017, p.190). Typical urban Roman cattle remains show animals were slaughtered between four and eight years of age and therefore old enough to have produce young and be used as dairy herds (Maltby, 2016, p. 793). The skeletal remains from Insula IX at Silchester include few examples of very young cattle with only two specimens from animals below three months of age, evidencing their removal of young from their mothers to reduce the competition for milk (Ingrem, 2011, p. 265). The majority of cattle were slaughtered in their third year, a prime age for beef production, or as adults, suggesting that secondary products were also important (*ibid*, p.264). Fully grown cattle would have been preferred for slaughter for their larger meat yield and bigger hides for tanning. The assemblage from the forum-basilica contained a large proportion of calf bones, indicating the consumption of veal (Grant, 2000); veal may have been considered a luxury food and can be seen as a by-product of the dairy industry (Maltby, 2017, p. 194). The absence of hoofprints made by older cattle would not negate their presence near the tileworks. For there to be young cattle there must be older individuals and it is likely that any brick or tile trampled by fully grown adult cattle would be destroyed and not make it to the kiln for firing.

Figure10.6: Pig hoofprint on tile showing dew claws (**IX296** – A.2005.27 (5809)).

There is a single pig footprint (Fig.10.6) present. The morphology of the footprint of a domestic pig is the same as that of a wild boar, though the dew claws on a wild boar nearly always leave a clear impression (Bang and Dahlstrom, 1974). The impression measures 12mm long and 18mm broad and despite the dew claws being clearly visible, the impression was made on a very wet tile which does not necessarily indicate that is was made by a wild boar. The small size of the print shows it was made by a young, probably neonate animal.

There is a single example of a horse hoof print on a **SILCBM1** brick held in the Reading Museum collection (Fig. 10.7). Despite the print being incomplete, the presence of a frog (the deep indent to the rear of the print) confirms that a horse made it. The print measures at least 84mm broad and shows that the horse was not shod. Since the wild horse, Tarpan, was no longer present in the fauna of the Romano-British period (Yalden, 1999, p. 98), the print must have been made by a domestic animal. Horses were not primarily exploited for their meat, and in urban centres their value lay in their use

***Figure 10.7**: Horse hoof-print (RM82: 1995.98.32) © Reading Museum*

as working animals (Allen *et al.*, 2017, p. 131).

Along with donkeys and mules, horses would have been used as beasts of burden to pull carts; they were not used as plough animals until the medieval period (Maltby, 2017, p. 201).

There are 13 examples of roe deer footprints characterised by small size tracks, typically 45mm long and 30mm wide, and, when walking, the hind-foot registers in the fore-hoof track (Bang and Dahlstrom, 1974, p. 69). In the SILCBM1 examples, eight measure less than 33mm in length and are indicative of young deer. The birth of roe deer kids peaks from May to mid-June (Hewison and Staines, 2008, p. 608) thus indicating tiles laid out to dry in the summer. There are three larger prints up to 45mm representing adult roe deer. Roe deer are found in a variety of habitats with open mixed coniferous and deciduous woodland, where sufficient cover is provided (Hewison and Staines, 2008, p. 606) but can also use agricultural fields in these areas too. It is therefore not surprising to find a mix of Roe deer alongside sheep and cattle.

Mammals

A total of 106 paw prints recorded on this fabric group have been assigned to species, including 80 dog paw prints. Of these 65 have complete breadth measurements, the range of sizes represented is plotted in figure 10.8. The size of prints across all fabrics in the Silchester material ranges from 24mm to 78mm, with just over three-quarters (n=49) of these measuring between 36-55mm broad. In the Roman period, the size of dogs becomes more variable than in the preceding periods, with shoulder heights ranging from 23-72cm compared to heights of 29-58cm in the Iron Age (Yalden, 1999, p. 99). The larger examples are within the size range of wolf footprints, which can be up to 100mm broad for the fore-foot and 70mm for the hind-foot (Bang and Dahlstrom, 1974, p. 56). The range of sizes may represent different ages of dog or reflect the variety of dog breeds present.

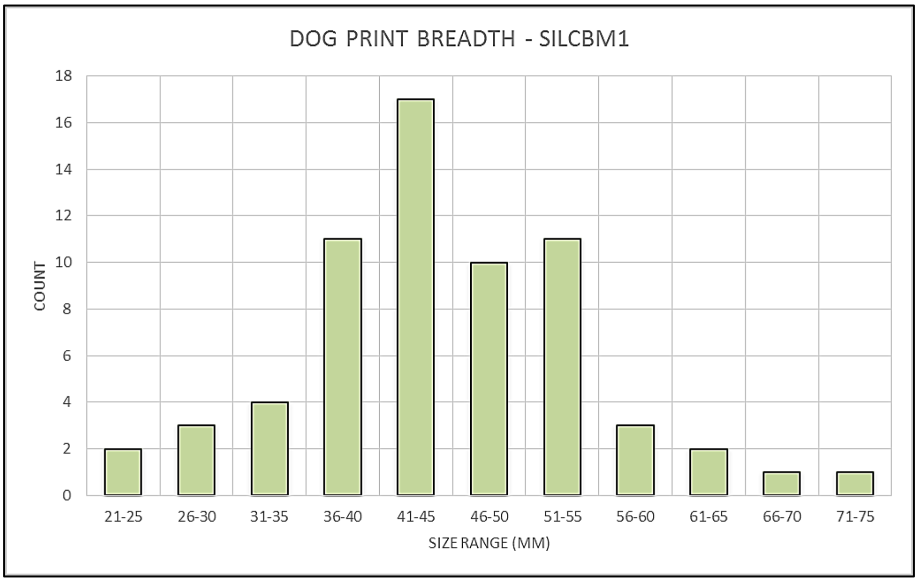


Figure 10.8: *Range of dog paw print breadth measurements*

There are 18 cat prints found on **SILCBM1** material (Fig.10.9). Cat footprints are distinguished from those made by dogs by their overall size and the lack of claw impressions, as, unlike dogs, cats can retract their claws. Cats have five toes on the fore-foot and four toes on the hind-foot with the inner toe of the fore-foot positioned so high as to leave no track (Bang & Dahlstrom 1974, p.42). The overall pad is almost circular in shape with the toes pads well-defined and separated from the three-lobed intermediate pad. A medium-sized cat would leave a paw print about 30-35mm long and 30mm wide (*ibid*., p.43). Fifteen of the cat prints on **SILCBM1** material have complete breadth measurements, which range from 21-40mm, with 10 of the prints measuring 30mm wide or less. Identifying domestic cats can be somewhat uncertain from the archaeological record (O'Connor, 1992, p. 112) not least because of the difficulties in distinguishing their bones from those of the wild cat *Felis silverstris*. Some of the tracks of cats are large enough to have been made by wild cats whose prints are typically 40mm long and 35mm broad. It is traditionally believed that the Romans introduced the domestic cat to Britain.

Cat remains have been recovered from several Roman sites, for example, there is a possible instance of one from the late Iron Age site at Gussage-All-Saints in Dorset (Davis, 2000, p. 182), dated to 250B.C. (Engels, 2001, p. 107). There are depictions of cats in Roman art but with nowhere near the frequency of where dogs are represented (Toynbee, 1973, p. 87), suggesting they were less widespread as a domestic pet.

Figure 10.9: *Cat pawprints on a brick (IX680 - A.2000.20 (2383))*

Overall domestic cats seem to have been valued as pest control, as part of Roman public health policies to control the population of rats and mice thus controlling the spread of disease (Engels, 2001, p. 108) Romans associated the cat with *Libertas*, the Goddess of Liberty, who was often depicted with a cat at her feet. Cats were also considered to be lucky and the inclusion of cat emblems on military regalia have been interpreted as apotropaic devices (*ibid*., p.107).

Fox paw-prints share many morphological characteristics with those made by dogs. However, the toe pads of the fox are typically smaller and spaced further apart (Fig.10.10). While, the two front toe pads of the fox are further forward, creating a larger space between these and the intermediate pad, the claw marks created by a fox are slimmer and more pointed. Three SILCBM1 paw prints have been identified as having been made by a fox (Fig. 10.11). They are all very similar in size, ranging from 30-34mm in breadth and 39-42mm in length. Foxes are highly adaptable, requiring no specific habitat.

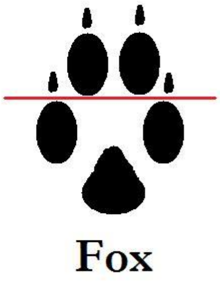


Figure 10.10: *Morphological differences between dog and fox prints (After* (Bang and Dahlstrom, 1974)

*Figure 10.11: An example of fox paw print (IX1245 - Insula IX unstratified). Fabric: **SILCBM1***

There is a single footprint in the **SILCBM1** assemblage (Fig. 10.12) which could have been made by either a rabbit or hare. Rabbit and hare prints share a similar morphology, having five toes on each fore-foot whilst the hind-foot has only four toes. All toes have straight, narrow claws which form marks usually inside the outer border of the track. The prints are asymmetrical, unlike most of the other paw prints in the assemblage. While, the print of the fore-foot of the hare, when impressed on earth, is typically 50mm in length and 30mm broad, that of a rabbit print is 40mm in length and 25mm in breadth (Bang and Dahlstrom, 1974).

***Figure 10.12**: Left fore-foot print of young brown hare or rabbit (A.1998.12 (1500)) – IX888.*

This example, IX888, shows two, overlapping, fore-foot prints. They are small paw prints and incomplete in length. Rabbits were previously believed to have been introduced to Britain by the Normans (Yalden, 1999, p. 158), however, there is evidence of Romano-British rabbits with skeletal remains found at Lynford, Norfolk associated with pottery of late Iron Age or early Roman date and further remains found at Beddingham Roman villa, East Sussex (Pitts, 2006).

As the breadth of this print is two-thirds the width of a small matchbox, it is likely to have been made by a rabbit (Bang and Dahlstrom, 1974, p. 36) or could have been a young wild brown hare, *Lepus europaeus*. Brown hare are most common in arable areas where cereal growing predominates, preferring cultivated areas, leverets are typically born between April and October, with litters sizes of 1-4 young (Harris and Yalden, 2008, p. 214).

There is a possible squirrel footprint on a small fragment of tile showing impressions of very small toe pads to the surface (Fig.10.13). The print is distorted, and it is not possible identify specific structures of the paw. It has previously been recorded as a squirrel print but cannot be confirmed for certain.

Figure 10.13: *Possible red squirrel footprint (A.2008.31 (7757))*

If it is a squirrel footprint, it would have been made by a Red squirrel, *Sciurus vulgaris,* as the now ubiquitous grey squirrel was not introduced until the 19th century (Yalden, 1999, p. 184). The Red squirrel is typically found in broadleaved woods, or small woods or copses which provide food and cover from predation (Gurnell and Hare, 2008, p. 61). Their habitat use varies with the time of the year in relation to food availability.

There is a more defined small footprint which has been identified as a weasel print. It has five toes with claws and intermediate pad clearly visible (Fig. 10.14). The print measures only 14mm in breadth and 13mm in length, with impressions of both the fore- and hind-foot. The morphology of the weasel print is like that of a stoat, albeit smaller in size.

Figure 10.14*: Weasel footprint – (A.2004.30 (5724))*

Weasels, *Mustela nivalis*, occupy a wide range of habitats, strongly associated with hedgerows, rarely venturing into open environments (McDonald and King, 2008, p. 470). Weasels are recorded as being used by Romans as pest control where poultry are kept as an alternative to farm cats because they are less likely to kill the birds (*Columella*, De Re *Rustica*, VIII. 13-14).

Five of the eight unshod human footprints in the collection are on bricks and tiles in fabric **SILCBM1** and include three toddler footprints and two partial adult footprints. One is a faint impression which includes the heel and ball of the foot. The total length of the impression is only 102mm which would indicate it was made by a child, three-to-four years old. The foot is shown to have a high instep and appears to have been shod in a leather shoe (Cram, 2000a, p. 125 Fig.96). Alongside this child footprint is that of an adult wearing a hobnail sandal or boot. There is a small footprint found on a brick in the Reading Museum display, which is also that of a toddler, and likely to be the one recovered during the excavations of the West Gate (Fox, 1892, p. 265). A further example of a child's footprint, approximately 2-3 years of age, was found on a brick recovered from Insula IX. The print is of the right foot, it is incomplete with only impressions of the five toes and ball of the foot (Fig. 10.15). Another partial human footprint consisting of the impressions of the big toe and two adjoining toes of a right foot belongs to an adult. Finally, there is a heel impression on a brick in the Reading Museum archive. The presence of unshod feet around a tilery is unsurprising since clay was prepared by puddling with bare feet before being placed in moulds (Soffe, Nicholls and Moore, 1989, p. 83). The presence of imprints of children's feet has been cited as evidence of the employment of children for parts of the tile-making process (*idem.*).

Figure 10.15: *Impression of a toddler footprint on a tegula A.2003.35 (3679) –* ***IX471***

There are 29 examples of imprints made by the sole of hobnail boots in the SILCBM1 group. It is considered that the design of Roman footwear reflected the status of the wearer. The inclusion of hobnails or studs to the sole of the shoe was not restricted to serving military footwear. An example of a shoe furnished with a full set of iron studs from Vindolanda, is that from a child probably aged approximately 10 months, and thus unable to walk, , is considered to possibly be the show of the child of a prefect (van Driel-Murray, 1993, p. 45). The stud pattern shown on the impression of reflects a utilitarian purpose, large studs covering much of the sole, and is a basic pattern found widely in the western provinces. Often, basic utilitarian shoes have fewer studs with larger heads presumably to spare the expense of iron (Greene, 2014, p. 33).

Birds

Eleven bird prints on the **SILCBM1** group have been identified to species comprising four chicken impressions (Fig. 10.16) and eight prints made by wild bird species. Chicken was the only type of poultry commonly exploited in Roman Britain. Their bones occur more frequently on urban and military sites than on rural sites (Maltby, 1997). Chickens would have served as both a luxury food item and as an animal that fulfilled other roles in ritual and sport. Chickens first appear in the archaeological record in Britain in the early Iron Age, with examples from Houghton Down, Hampshire, where skeletons of a rooster and a hen were part of a 'special deposit' dated to c.A.D.470-360 (Hamilton, 2000, p. 139) and Blackhorse Road, Hertfordshire (Legge, Williams and Williams, 1989), though it was not until the Late Iron Age that domestic populations were established (Poole, 2010, p. 158). Poultry keeping is unlikely to have been a sole component of an agricultural practice, they are probably subsidiary to larger domestic herds, for example, cattle or sheep.

Figure 10.16: *Chicken footprint (FB73 – 80/30 (374)) –* ***SILCBM1***

*Figure 10.17: Footprint of a woodpigeon (**FB116** – 80/30 (333))*

There is also one example of a woodpigeon footprint (Fig. 10.17). The woodpigeon breeds in a variety of woodland and farmland with trees. In winter it can feed on open ground but farmland is preferred (Hume, 2014, p. 218). This is a partial impression, made on almost dry clay. It is a small print, with first toe measuring 21mm, third toe with length of 70mm and an angle of 65° between the second and fourth toes. An angle less than 90° is indicative of a perching bird.

There is a single example of a footprint of a blackbird, which are typically found in woodland with rotting leaf litter on the ground (*ibid.* p.339). There are four examples of footprints of birds which favour water/wetland environments and are identified by an angle between the second and fourth toes greater than 120^{o}. One print has been identified as that from a crane; the angle of 120° between the second and third toes, indicative of a wading bird. The overall print is small, with the third toe measuring only 76mm, indicating is was made by a young bird. Crane colts generally hatch from May to July (*ibid.* p.138). Two further prints have been identified as belonging to the group of birds known as waders, *Calidris sp.,* which includes Oystercatchers, Avocets, and Sandpipers (Hume, 2014, p. 141). The prints are incomplete and cannot be identified to species, though one impression, made on very wet clay, shows evidence of webbing.

Figure 10.18: Heron footprint (RM94: 1995.98.69). © Reading Museum

An example of a heron print, with an angle of 110° between the second and fourth toes, has also been identified (Fig. 10.18). Grey heron frequent both freshwater and saltwater habitats (Hume, 2014, p. 97) and are found all year round in Britain. The presence of birds, such as the crane, in the Romano-British record indicates that worthwhile areas of unimproved wetland remained (Porter 1981).

A single footprint has been identified as that made by an owl (Fig. 10.19). The print is asymmetrical with zygodactyl toes, where only two toes are pointing forwards. The claw and toe impressions are deeper than the central pad, the phalangeal pads, tubercules and claws are prominent (K. Barr, *pers comm.*). The footprint is larger than expected for a tawny owl and may have been made by a Ural owl. The presence of owl in the Romano-British zooarchaeological record, who thrive on traditionally tilled, agricultural land with woodland edges in lowland areas, has been seen as evidence of an untidiness to the Romano-British farm retaining substantial patches of woodland (Parker 1988, p.218).

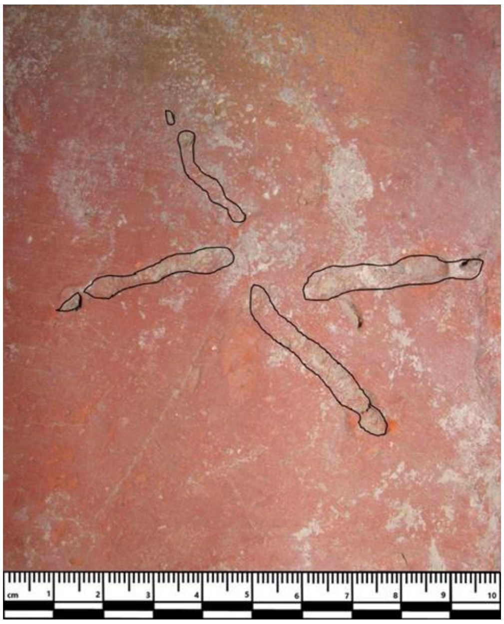


Figure 10.19: *Owl footprint (FB306 – 80/30 (762-765/806)*

Summary of prints on SILCBM1

The numbers of identified mammal, ungulate and bird prints, both wild and domestic, on SILCBM1 bricks and tiles are illustrated in figure 10.20. Domestic mammals, cats, and dogs dominate the footprint assemblage, with a small number of wild mammal species leaving their impressions on the tiles. The footprints of ungulates are fairly evenly split between domestic and wild species. The domestic ungulates include a large proportion of footprints made by neonates. This could be seen as a focus on dairy produce rather than meat production. The bird impressions are mainly of wild species, most of whom are found in wooded areas. The proximity of woodland to a tilery is not unexpected as a large supply of wood would be needed to provide fuel for the kiln firings. The presence of wader prints, including crane and heron, indicates the proximity of freshwater sources to the tileworks.

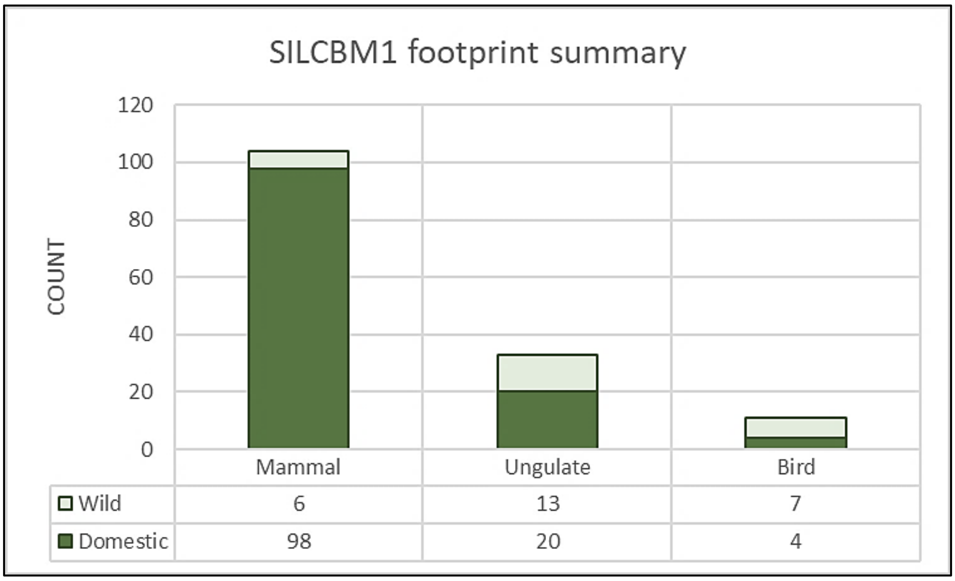


Figure 10.20: *Numbers of wild and domestic footprints identified on* ***SILCBM1*** *bricks and tiles (n=149)*

10.3.2 SILCBM2

There is a total of 59 footprints on **SILCBM2** bricks and tiles, of which 24 partial prints have been classed as unidentified (16 mammals, three ungulates and five birds). All the bird footprints on were partial prints, comprising of single toes and therefore could not be assigned to a species. Figure 10.21 illustrates the numbers of identified prints and their proportions within the ungulate and mammal categories.

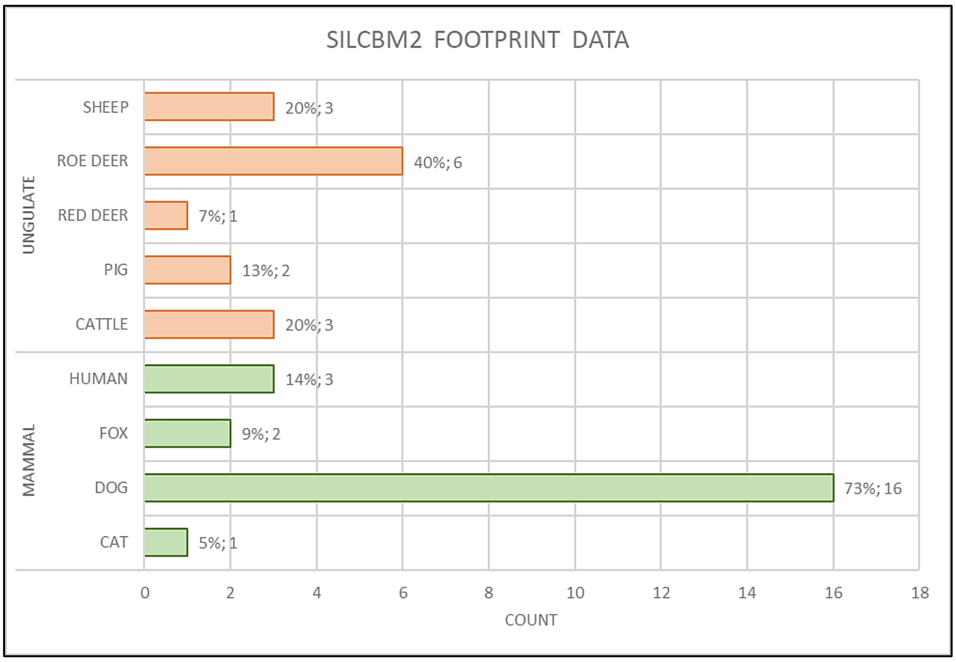


Figure 10.21: *Count and proportions of ungulate and mammal footprints on* ***SILCBM2*** *material (n=37)*

Ungulates

Figure 10.22: *Example of cattle print (IX974: A.1997.25 [1046])*

The **SILCBM2** assemblage includes three examples of cattle hoof-prints (Fig. 10.22). The ages of the animals have been estimated to be four months (Fig.10.22), eight-to nine-months and 14 months of age.

There are three examples of sheep/goat footprints found on two samples in the **SILCBM2** assemblage. The measurements of one example of a sheep hoofprint show the animal to be aged approximately 26 months. The other, in the Reading Museum collection (**RM428** - 1998.98. B1), includes prints of two individuals, aged 17 months, and 48 months. There are also two pig hoof prints represented. One example is small, measuring 33mm in breadth and 31mm in length (**RM430**) whilst the other is much larger, 67mm in breadth and 64mm in length (**IX829**).

The **SILCBM2** material includes a single footprint made by a Red deer (Fig. 10.23) and six examples of Roe deer. Red deer prints exhibit a broad track, with the outer edges of the hooves curving symmetrically towards the tip (Bang and Dahlstrom, 1974, p. 66). The footprint measures at least 51mm long and 41mm broad, indicative of a young animal or a female, being smaller than would be expected for a fully grown Red deer stag (K. Barr. *pers.comm.)*, which typically measures 80-90mm in length and 60-70mm in breadth. Red deer are indigenous to Britain and are typically found in wooded environments and on farmland fringes, actively selecting broadleaved woodland and area with cover over upland heath and conifer forest (Staines, Langbein and Burkitt, 2008, p. 579). Red deer hinds usually calve between mid-May and late-July. Three of the Roe deer prints were made by young animals, all measuring less than 30mm long, and with one example (Fig.10.24) impressed on very wet clay leaving a clear impression of the dew clays to the rear of the print. The other three examples are larger prints, up to 46mm long. One exhibits overlapping prints of the fore and hind hooves, and the splay of the toes indicating the animal was moving quickly (K.Barr. *pers.comm.*).

***Figure 10.23**: Hoof print of Red deer (RM91 – 1995.98.66 © Reading Museum*

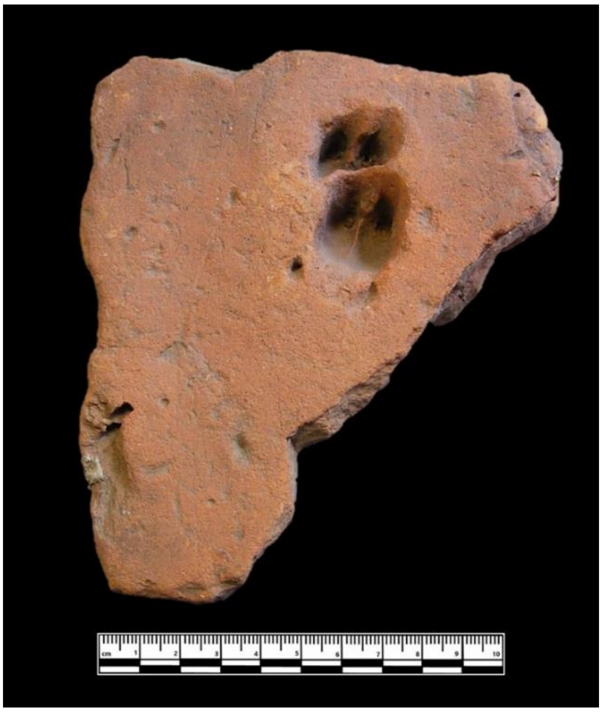


***Figure 10.24**: Hoof print of Roe deer with dew claws visible (IX1080 – A.2005.27 (5700))*

Mammals

There is a total of 16 dog paw-prints of which 15 have complete breath measurements, illustrated in figure 10.25. This again shows a wide range of paw-print sizes with examples of small breeds or young animals, less than 30mm wide and a single example of a large paw-print, measuring 78mm in breadth. The single cat pawprint on a SILCBM2 brick is very small, measuring only 24mm in breadth, suggesting the print was made by a kitten. It occurs on the same brick as a dog pawprint measuring 30mm in breadth.

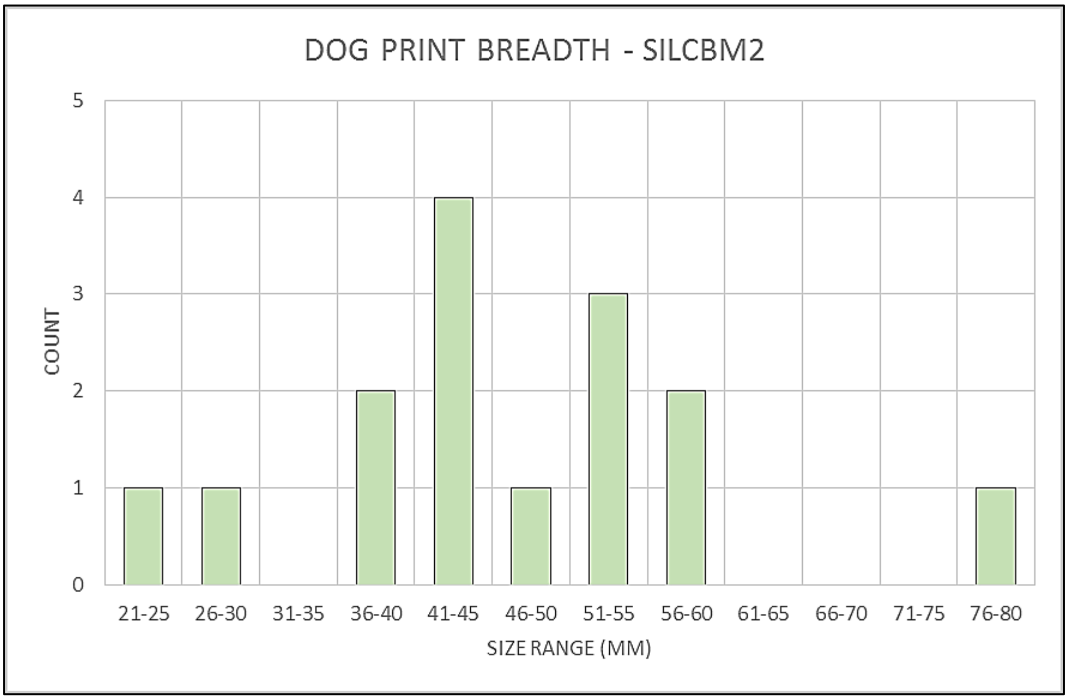


Figure 10.25: *Dog pawprint breadth measurements –* ***SILCBM2*** *(n=15)*

Two fox pawprints have been identified in this group both with the gap between the toes and the intermediate pad differentiating them from dog paw prints (Fig.10.26).

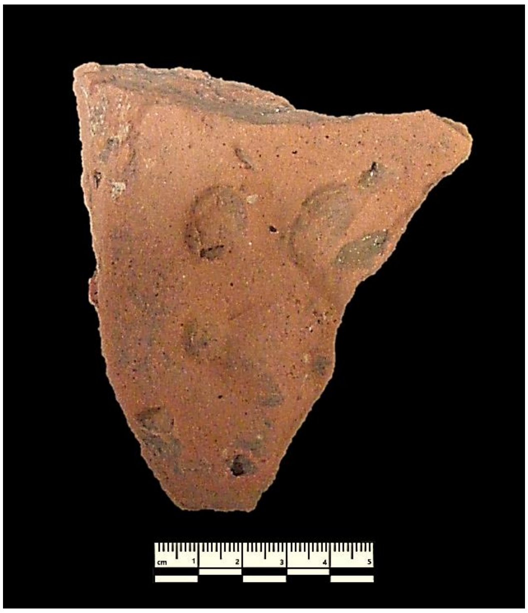


Figure 10.26: *Fox paw print – (Insula IX unstratified – IX1253).*

The human impressions include three unshod footprints of which two are partial prints where one shows the imprint of a big toe and the other part of the ball of the foot; in both cases made by right foot. The other example is a complete footprint identified as female which was recovered from the antiquarian excavations (Reading Museum). Finally, there is a single example of hobnail impressions from a sandal in this group.

Summary of prints on **SILCBM2**

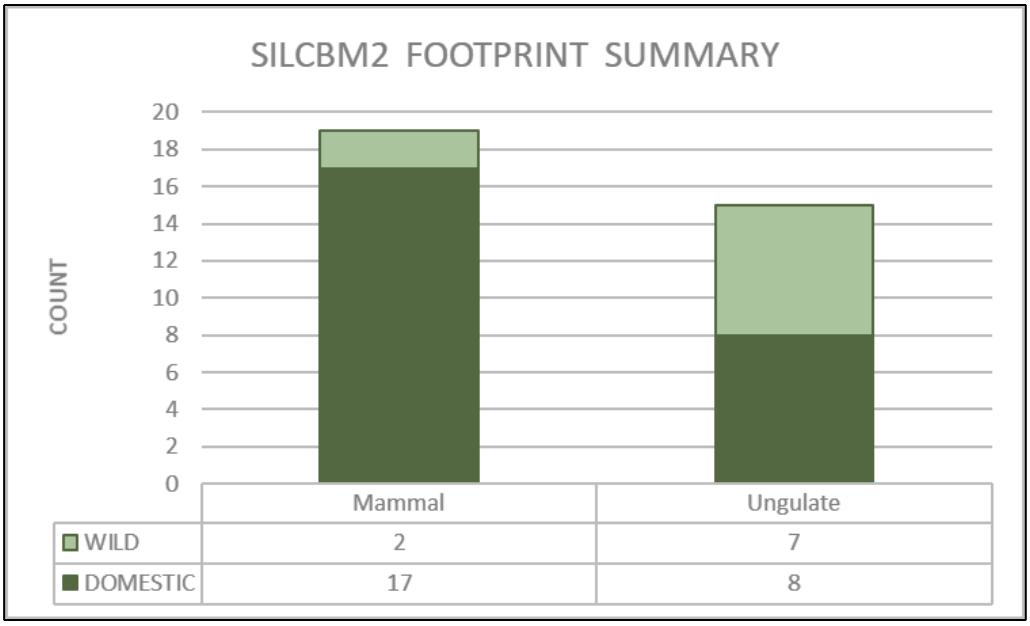


Figure 10.27: *Numbers of wild and domestic footprints identified on **SILCBM2** bricks and tiles (n=34)*

The number of identified mammal and ungulate prints, both wild and domestic, on **SILCBM2** bricks and tiles is illustrated in figure 10.27. The mammal prints are dominated by domestic species, whilst the ungulates' footprints are evenly split between domestic and wild species. There are fewer new-born animals represented in the domesticated ungulate footprints, indicating an older population. The wild ungulate prints are mainly made by roe deer and as discussed earlier, the presence of prints made by very young animals indicates the tiles were laid out to dry in the summer. Roe deer favour wooded habitats, again indicating the proximity of woodland to the tilery. The production centre at Minety has been suggested as a potential source for the **SILCBM2** building materials (Chapter: 7.10) The excavation report for the Minety kiln site makes only brief reference to footprints noted on the tiles. It describes one human heel impression along with a large and small dog, a sheep, and a mouse (Scammell, no date, p. 12).

10.3.3 **SILCBM3**

There is a total of 38 prints on **SILCBM3** bricks and tiles, of which 12 partial prints have been classed as unidentified (seven mammals, four ungulates and one bird). Figure 10.28 illustrates the numbers of identified prints and their proportions within the birds, ungulate and mammal categories.

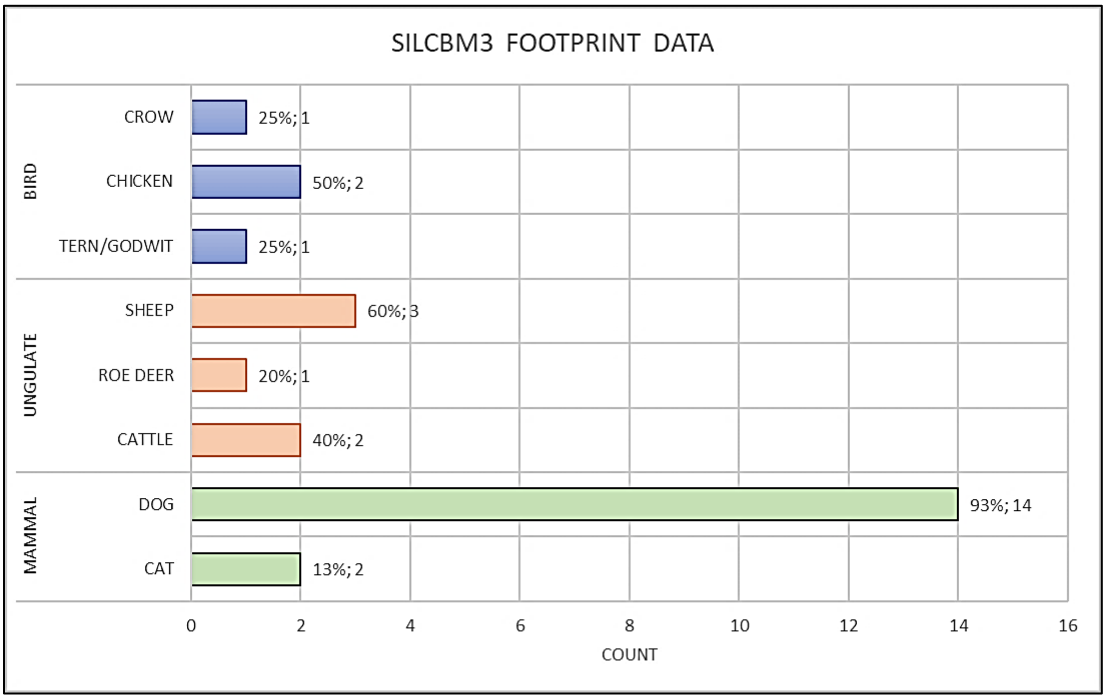


Figure 10.28: *Count and proportions of ungulate and mammal footprints on* ***SILCBM2*** *material (n=26)*

Ungulates

The measurements of the sheep hoof-prints also indicate that these were made by young animals, there are two examples of new-born animals and the other sheep aged approximately three-to-four months.

All the sheep hoofprints are found on the same brick in the Reading Museum collection (RM53: 1995.98.94, Fig. 10.29). This brick includes at least 29 hoofprint impressions, made by at least three animals, moving in different directions.

Figure 10.29: *Multiple sheep hoofprints on brick (RM53: 1995.98.94) © Reading Museum*

Both examples of cattle hoofprints were made by new-born animals, measuring less than 50mm in length. One of the prints is found on a brick alongside a pair of dog pawprints, probably the fore and hind print of the same animal. There is also a single example of a roe deer hoof-print which was made by a young animal.

Mammals

There are two examples of impressions made by the sole of a hobnail boot and of the sixteen pawprints identified, 14 were made by dogs and two by cats. Both cat prints are very small in size, measuring only 31mm and 32mm in breadth, and were probably made by kittens. The breadth of 13 of the dog prints was measured and the size ranges are illustrated in figure 10.30. There is a wide range of sizes present, ranging from 28mm to 64mm.

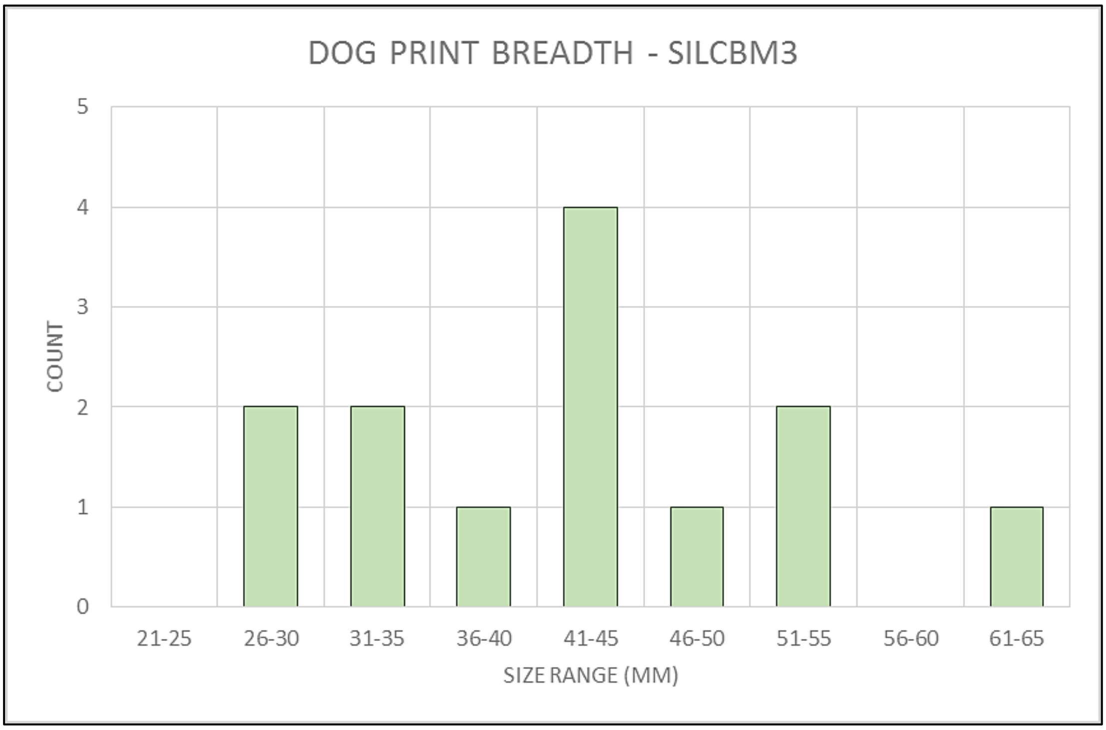
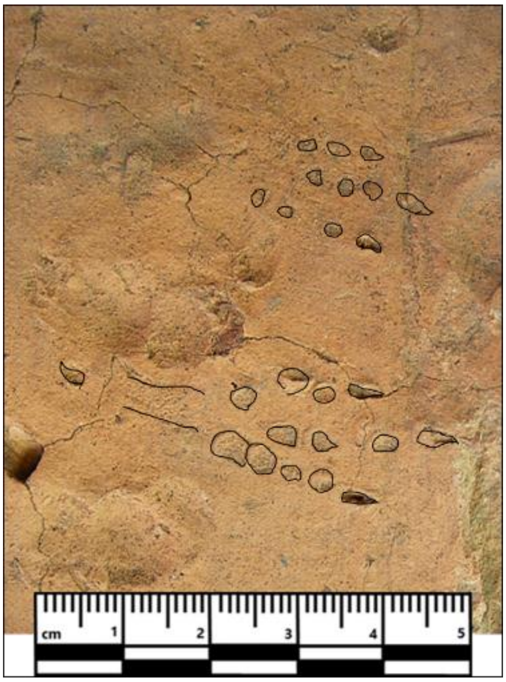


Figure 10.30: *Dog pawprint breadth measurements – **SILCBM3** (n=14)*

<u>Birds</u>

Only four bird prints have been identified; two chicken footprints, both of a similar size, with the third toe measurements of 41mm and 43mm respectively and two wild species.



One of these is a crow footprint (Fig.10.31), which is morphologically very similar to that of the raven, differing only in size (see **SILCBM4** below). The crow footprint measures <50mm in total length and has an angle of only 37° degrees between the second and fourth toes.

Figure10.31: *Crow footprints (IX472: A.2002.15 [3663])*

The Society of Antiquaries report of the investigations at Insula III & IV comment that the most common birds' bones, after those of domestic fowl, have been identified as those of raven, *corvus*. They report that the raven is now believed to be quite extinct in the neighbourhood of Silchester, and the numerous bones amongst the Roman remains would almost point to their having formerly lived there in a semi-domestic state (Fox, 1892, p. 288).

The final bird print is small, measuring only 27mm in length and 34mm in breadth. It shows evidence of mesial concave webbing, with the first toe is absent and toes two and four divergent. There is insufficient detail for a definitive identification, but it was made by a small webbed bird, possibly a Tern (K.Barr, *pers.comm.*). Terns are long distance migrants, those species that frequent the UK are typically found from April to October. Terns breed along coasts with shingle beaches and rocky islands, on rivers and reservoirs, feeding on fish along rivers and over freshwater (Hume, 2014, p. 182)

Figure 10.32: *Possible Tern footprint (IX402: A.2004.30 (5629))*

Summary of prints on **SILCBM3**

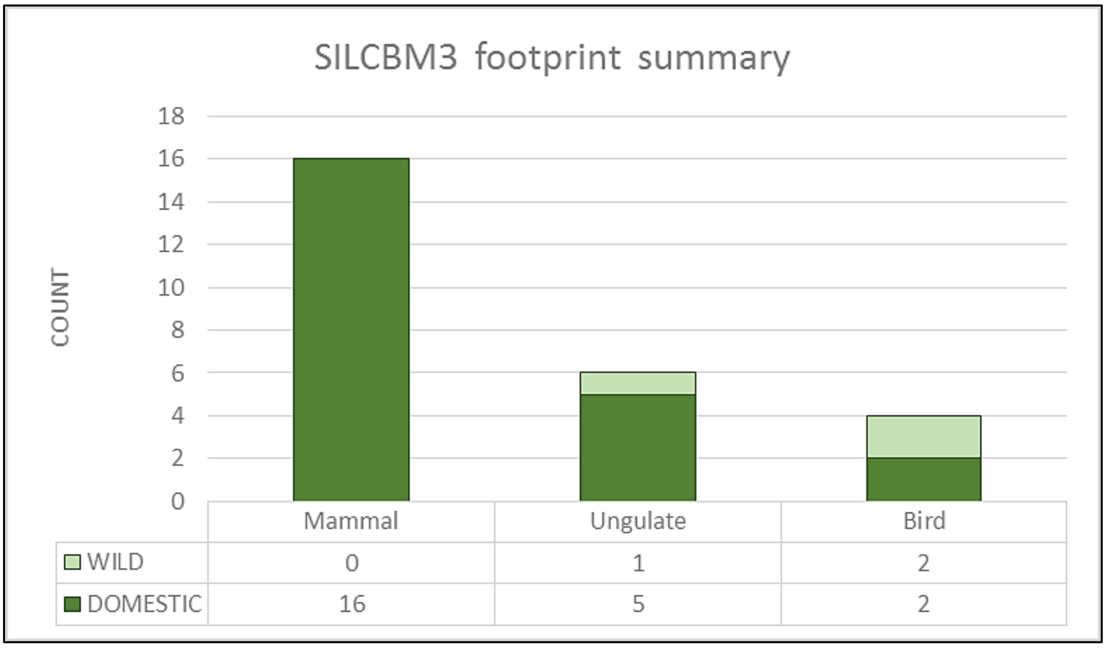


Figure 10.33: *Number of wild and domestic footprints identified on **SILCBM3** bricks and tiles (n=26)*

The mammal prints found on the **SILCBM3** material are all the domestic breeds of cat and dog. Domestic animals also dominate the ungulate prints, with only a single wild roe deer-print identified. The young ages of both the sheep and cattle indicate the proximity of pasture and agricultural activity, including milk production. Dairy production was widespread throughout the Classical period, milk was used to produce cheese which was widely used and of considerable economic importance. Sheep's and goat's milk were much more economically significant that cow's milk, sheep were breed for their wool and their milk (Harden, 2013, p. 146). There is an equal proportion of wild and domestic birds, albeit with only four birds identified in total. The Tern footprint again shows that the tiles were dried in the summer when the Tern was present in the UK.

10.3.4 SILCBM4

There is a much smaller number of prints in this group with only 12 are recorded and of these a single partial pawprint has been classified as unidentified. Figure 10.34 Illustrates the numbers of identified prints and their proportions within the birds, ungulate and mammal categories.

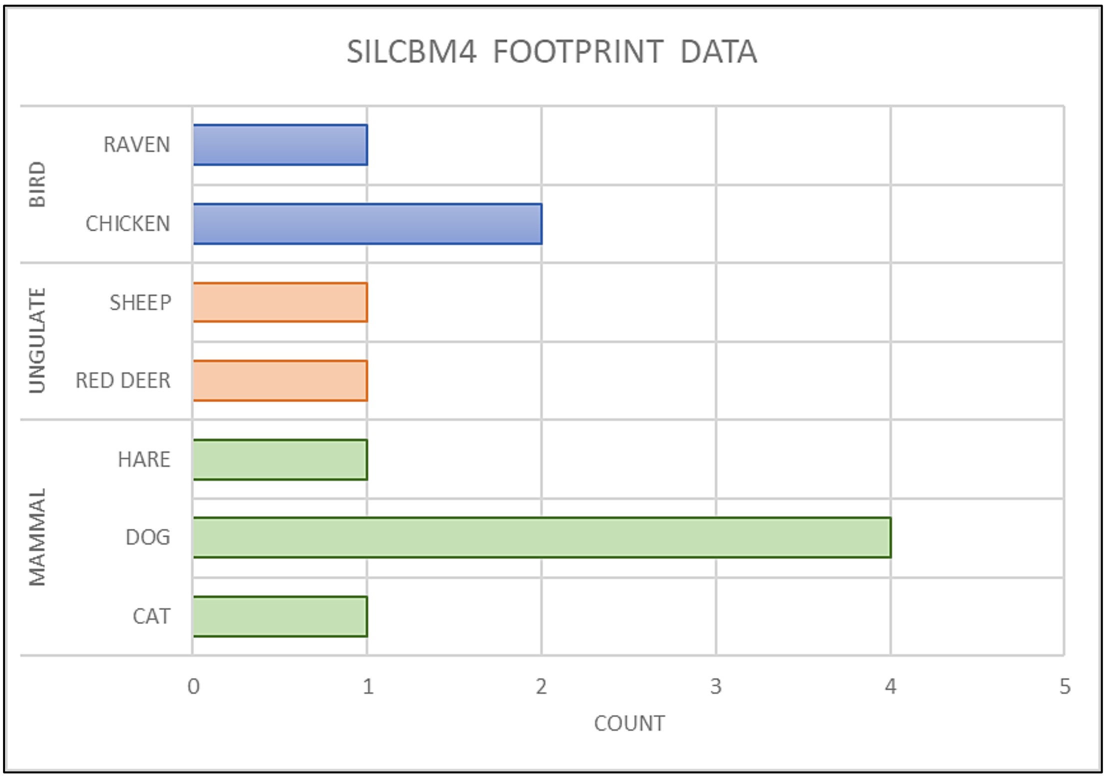


Figure 10.34: *Count and proportions of ungulate and mammal footprints on* ***SILCBM4*** *material (n=11)*

Ungulates

There is a single sheep footprint, which measures 46mm in length giving an approximate age of the animal of 29 months. A deer print, identified as having been made by a Red deer, measures 48mm in length and 39mm in breadth. As with the **SILCBM2** example, it was most likely made by a female or young deer as it is smaller than would be expected for a full grown Red deer stag.

Mammals

Of the six identified mammal footprints, four were made by dogs. One example was incomplete, one measured 52mm in breadth and the other two measured 45mm in breadth. These represent quite large dogs and coincide with the most common dog footprint sizes recorded on the other fabrics. There is a single cat footprint, measuring 38mm broad and 42mm long, which is one of the largest cat footprints in the assemblage. There is a single example impressed with hobnails.

There is also a single hare/rabbit footprint (Fig.10.35): a left fore-foot print measuring 40mm in length and is 28mm in breadth with five toes visible, as in 10.3.1 above, this print is narrower than a small matchbox and therefore is within the size range to have been made by a rabbit.

Figure 10.35: *Hare paw print (IX699 – A.2002.20 (2100)) –* ***SILCBM4***

<ins>Birds</ins>

Two chicken footprints have been identified with overall lengths of 77mm and 79mm. The example, IX347 (figure 10.36) features a bent fourth toe which may evidence a previous breakage of this digit but with sufficient rehabilitation following the injury to be able to walk across the tiles whilst laid out to dry.

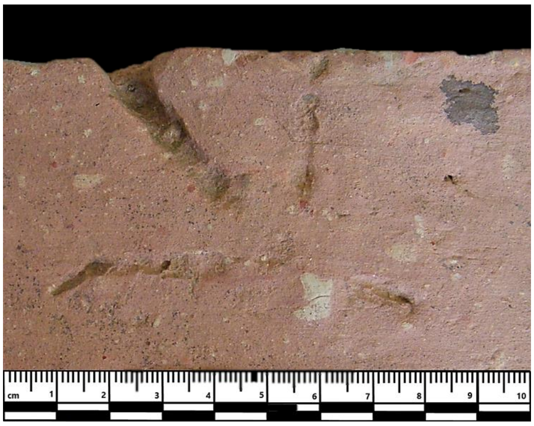


Figure 10.36: *Chicken footprint with bent fourth toe (IX347 – A.2007.35 (5154)) –* ***SILCBM4***

Figure 10.37: *Footprint of a raven (RM113: 1995.85.19). Fabric:* ***SILCBM4***

A raven made the only other identifiable bird print. The crow and raven footprints are morphologically very similar, differing only in size. Ravens are particularly frequent on Roman sites, they can be kept well in captivity, and, if taken young, willingly adopt the food, shelter and companionship of human hosts while flying freely (Parker, 1988, p. 209). Ravens and crow were typically avoided as a source of food, this is thought to be due to the fact that they were eaters of carrion (Serjeantson and Morris, 2011, p. 98). The raven usually frequent the outskirts of the settlements, scavenging for food there, they were therefore likely to benefit from the growth of towns being less sensitive to changes in farming and landscape than some other species (Parker, 1988, p. 218). Serjeantson & Morris (2011) discuss the importance of ravens and crow in the ritual action in the Iron Age and Roman period, evidenced by the widespread practice of their inclusions in burials. At Silchester, raven remains were recovered from Insula IX period four contexts (c.A.D. 200-250) where they are seen to have symbolic associations. One partial skeleton was recovered from a pit, underlying a context which produced the skeletons of two dogs and an ivory razor handle depicting a pair of coupling dogs (Ingrem, 2011, p. 268).

10.4 Discussion

As discussed in Chapter 6, it is probable that bricks and tiles in **SILCBM3** and **SILCBM4** were produced at the same tileworks. Therefore, for comparison of footprints assemblages the results from these two fabrics have been combined. The presence of wild and domestic animal prints in each of the main fabric assemblages are compared (Fig.10.38). All mammal print assemblages are dominated by domestic species with only few examples of wild animals represented. The ungulate footprints on **SILCBM1** and **SILCBM3** are dominated by domestic species, whilst **SILCBM2** sees a more even split between the domestic and wild examples. The 63.6% of the **SILCBM1** bird prints were made by wild species compared with 42.9% of **SILCBM3/4** bird prints.

Domestic mammals, dogs, and cats, were kept alongside livestock, which was predominantly young animals. A lack of footprints or differences in the footprint evidence could reflect different infrastructures at each production site, the presence of covered or exposed drying areas would allow or restrict access to different animal species (Warry, 2012, p. 54).

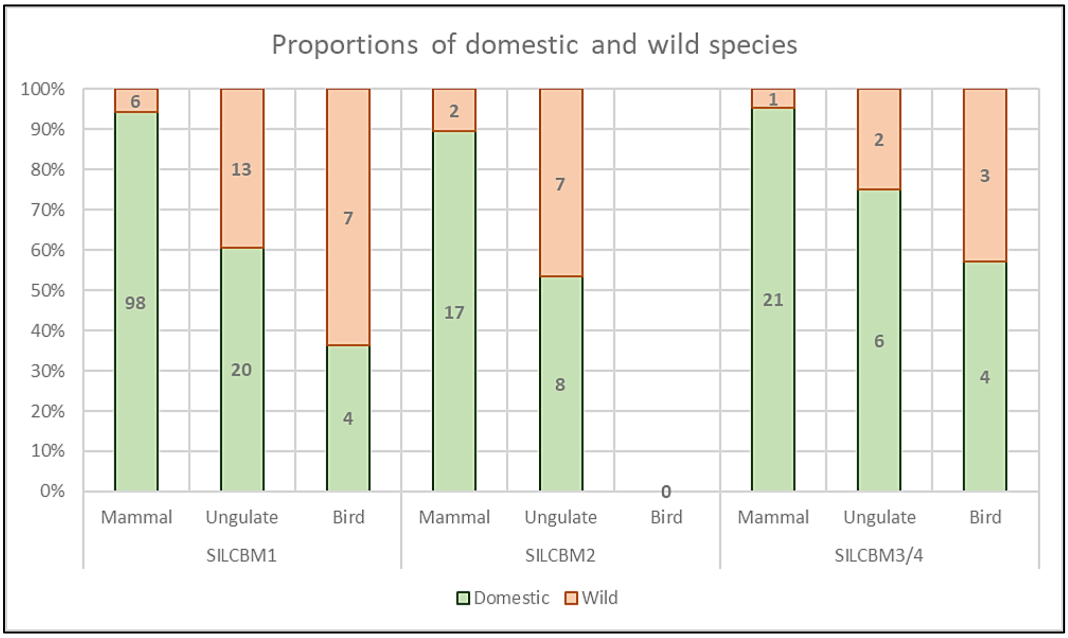


Figure 10.38: *Proportions of wild and domestic species by main fabric groups*

The conspicuous presence of dog prints, along with their ubiquity in the skeletal record, raises the question of their purpose. Were they being kept as pets, as working animals, for skinning or for food? Evidence from art and literature show that dogs played a significant part in the ritual of Celtic and Roman religion and were sometimes sacrificed (Henig, 1984, pp. 29–30). The variability in size and morphology of dog bones from Roman town sites in Britain implies some deliberate selection of characters was being practised, through the term 'breed' cannot properly be used to describe the different variations (Harcourt, 1974). From the **SILCBM** fabrics 1-4 the breath of dog pawprints ranges from 24mm to 78mm, with a mean breath of 45.10mm and standard deviation of 9.79mm. These results are consistent with those from Cram's study of dog varieties in Roman Britain (2000b).

Figure 10.39 illustrates the size ranges present in the dog paw prints recorded on **SILCBM1-4** fabrics. The breadth of a dog pawprint, however, gives no indication of the age of the animal (Cram, 2000b, p. 173). The overall distribution of paw print breadth for all fabrics takes the form of normal, symmetrical distributions with peaks in the 41-45mm range. The wide range of footprint sizes is consistent with the range of estimated dog shoulder heights (Clark, 2011, p. 277) and reflects the variability in the sizes of dog breeds in Roman Britain. The range of print sizes for **SILCBM3/4** is more restricted with a lowest value of 28mm and highest of 64mm. This fabric was identified as being most prevalent in the early assemblages from Silchester and its production centre at Little London, associated with the production of the Nero-stamped tiles would confirm this. The pawprint data therefore appears to evidence a more restricted range of dog sizes in the early Roman period, later becoming more diverse. It also confirms the introduction of the lap or house dog that would have been too small to have served any useful purpose as guard or hunting dogs and would have required human shelter and protection (Harcourt, 1974, p. 164). The pawprints in the smallest size range, 21-25mm only appear on the **SILCBM1** and **SILCBM2** bricks and tiles, which probably belong to a later date of production. O'Connor warns of risk of labelling the function of domestic dogs too precisely, though it seems that the different morphotypes kept in Roman Britain would have had rather different relationships with their co-existing humans (1992, p. 110).

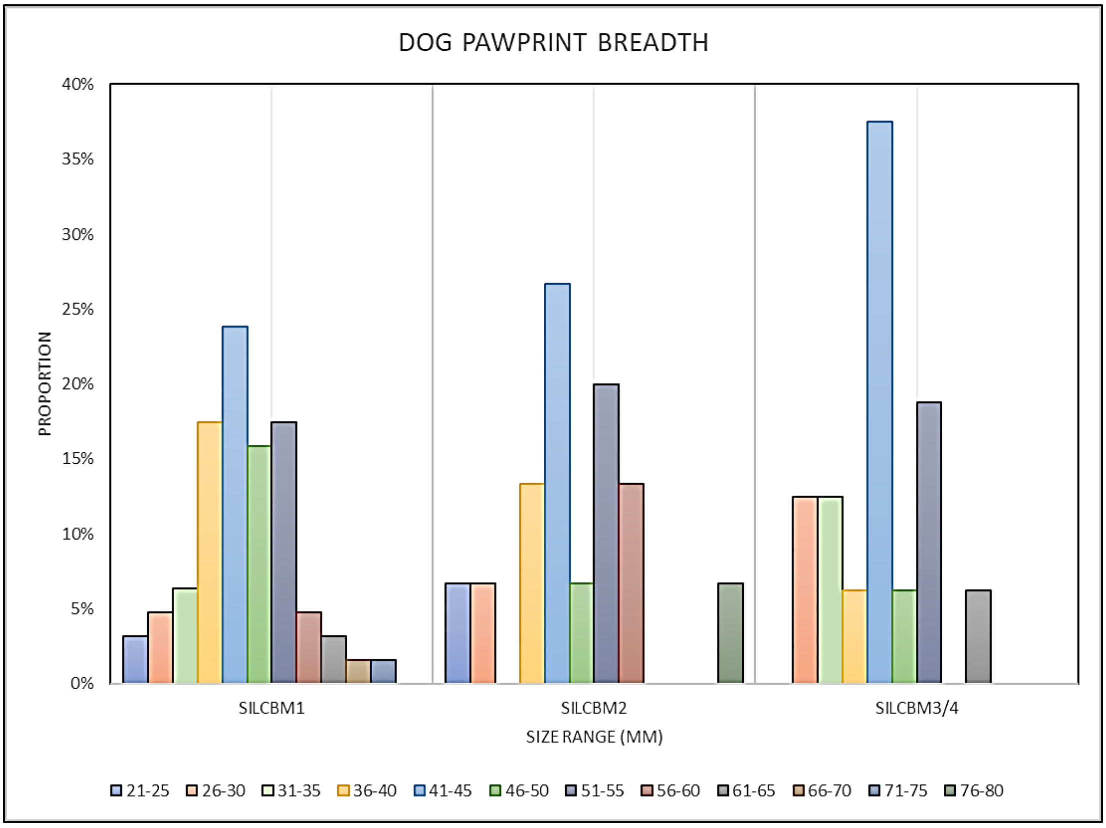


Figure 10.39: Range of pawprint breadth measurements

10.5 Conclusions

By considering the footprint assemblages, we can establish a picture of the environment and infrastructure surrounding the production of CBM, including the access to raw materials and seasonality of the production cycle. The skeletal evidence from the urban centres cannot be compared directly with the footprint evidence from the tilery. The footprints evidence the animals inhabiting the environs of the production centre whilst the skeletal remains from towns are evidence of the meat consumed, secondary products made, and livestock kept in the urban centres. The footprints of cattle and sheep in the bricks and tile in the Silchester assemblage are dominated by prints made by young, even neonate animals, indicative of an involvement in animal breeding (Grant, 2004, p. 380). The older age of the skeletal remains suggests herd maintenance for secondary products whilst the hoofprints evidence the presence of young animals and breeding for dairy products as well as meat. Dairy production was widespread throughout the Classical period, milk was used to produce cheese which was widely used and of considerable economic importance (Harden, 2013, p. 146). The footprints of goat/sheep indicate that a tilery was integrated with or at least located close to a farmyard or pasture. Typically, in Roman agricultural practice the later Roman period saw a shift to beef production which was supplemented by pork, lamb, and mutton with a relatively small contribution from chickens. It is almost inevitable that cattle became the major component of the urban meat supply as increased investment in raising these animals was vital to the expansion of cereal cultivation, and cattle for food is increasingly viable to feed growing concentrations of people living together (Grant, 2004, p. 377). Fully grown cattle were preferred for slaughter for their larger meat yield and bigger hides for tanning. Typical Roman urban zooarchaeological remains show cattle were slaughtered between four and eight years-of-age and therefore old enough to have produced young and be used as dairy herds (Maltby, 2010). Another factor for the transition to cattle rearing could be the later Roman inclusion of livestock in the *capitatio*, which would have encouraged the raising of stock with relatively more meat per head (King, 1978).

No amount of ditches, fences or hedges would prevent the access of wild or domestic birds into the drying space of the tilery. Most urban Romano-British contexts include small numbers of wild bird remains that may have provided protein when other sources were in scarce supply (Grant, 2004). The Romano-British rural landscape was this a mixture of arable, meadow and pasture land, dotted with small settlements and farms with some evidence of woodland clearance. Conditions in Roman Britain certainly offered scope for a mixed avifauna, even though the extent of 'wild' areas was probably not significantly greater than it is today (Parker, 1988, p. 206). Native game animals, red and roe deer, boar and hare, may have been hunted for sport or for their meat, but were not extensively exploited (Grant, 2004).

11. Discussion: Silchester CBM in context

This chapter reviews the results of the analyses on the Silchester ceramic building material. It brings all the results together to create an overview of the CBM collections and a picture of the supply of brick and tile to the town and of the industry that served the changing levels of demands. The production and consumption of CBM in the provincial capital at London, where a fabric series is maintained and used for all excavated materials, is considered to identify potential similarities between the changing supplies to two urban centres. The discussion considers the successes and limitations of the methods used and the potential of retained, largely residual assemblages. The movement of material from the production centre to the consumer is discussed along with a re-evaluation of the idea of specialist producers.

11.1 Fabric analysis

A wide range of scientific techniques are available for the analysis of ceramic materials, which are widely used in the study of pottery, but rarely applied to the study of bricks and tiles. A comprehensive scientific analysis of the fabric series can be completed during the post-excavation process whilst a macroscopic analysis of the materials on site should be sufficient for initial fabric groupings to be made and enable a draft fabric series to be created. As shown in this study, the larger number of macroscopic fabric groups originally identified in hand-specimen were refined and combined into the final fabric series following geo-chemical and petrographic analysis. During excavation, where CBM is found in context within structures that are not to be demolished, portable XRF analysis can also be used, alongside the macroscopic descriptions, to enable this material to be included in statistical analyses without the need for destructive sampling.

The hand-specimen analysis of the material allowed for initial fabric groupings to be established and this facilitated the inclusion of the Reading Museum collection into the study where analysis by petrographic thin section or portable XRF was not permitted. Macroscopic descriptions requires knowledge of the composition of ceramic artefacts to enable sufficient detail of the fabric to be recorded and allow meaningful groups to be established. Once the appropriate training has been undertaken, the use of pXRF for the analysis of brick and tile is a quick method to record the geo-chemical composition of a large number of samples in a short space of time and allow for comparison of fabrics within a large collection. As discussed above (Chapter 3.4) the heterogeneity of CBM fabrics means that the method is semi-quantitative, at best. Whilst not ideal if used in isolation, the pXRF results allow for an objective verification of fabric groups established by petrographic and hand-specimen analysis. The process is non-destructive, therefore facilitating its use on in-situ materials on site and on museum collections where destructive techniques may be prohibited. Thin section petrography has been invaluable for characterising the mineralogical composition of the fabric groupings. It is a destructive technique and a time-consuming process for the preparation and analysis of the slides. However, the data provided by the textural and compositional analysis have facilitated highly detailed descriptions of the fabrics. Along with the geo-chemical data from the pXRF analysis, this has enabled matches to be made with a high degree of confidence between the Silchester collection, production centres, and clay samples.

By comparing the fabric series with samples of local clay resources it has been possible to ascertain the geological formations that were exploited to produce the ceramic building materials. The largest proportion of the material is made of **SILCBM1** fabric which has been identified as being made from *London Clay Formation* sources, which dominate the clay geology around Silchester. Sub-groups within **SILCBM1**, fabrics A & B, reflect natural variation within the clay or the addition of quartz-sand temper. There was clearly a tilery based on the *London Clay Formation* that was producing **SILCBM1** building materials from c.A.D.80 to produce the bricks and other building materials for the early timber forum-basilica. Bearing in mind that the collection in this study is from excavations covering less than 1% of the area of the town, along with the relatively small and highly selective assemblage from the Society of Antiquaries investigations, it is probable that there was more than one tilery based on the *London Clay Formation*, supplying ceramic building materials throughout periods **FBIX3** and **FBIX4** (A.D. 80-300). This covers the period of establishment of the Roman layout of the town and the construction of a large proportion of the urban infrastructure thereby generating a high demand for building materials. The CBM from the forum-basilica Period 5 (c.A.D. 80-125) includes a large proportion of bricks of **SILCBM1** used in the flooring in the entrance-hall of the timber basilica (Chapter 8.4.2). These bricks, large *Lydion* forms, measuring one Roman foot in width and one-and-a-half Roman feet long, are one of the few examples of CBM in their primary context. These may have been made to order for the construction of the forum-basilica at this time, which, even though of timber, was floored with ceramic bricks and almost certainly roofed with tile.

Local potential tile-making sites, typically identified by the discovery of waster material, and confirmed kilns sites were included in the project analysis, along with material from production centres which are known to have or believed to have exported tiles over long distances. This has provided some direct matches between the Silchester CBM fabric series and the products of individual tileries and has allowed for the mapping of a network of suppliers to Roman Silchester. Those tileries that have been confirmed through the fabric analysis are Little London (**SILCBM3/4** – Chapter 7.4), Minety (**SILCBM2 -** Chapter 7.10) and Eccles (**SILCBM8** – Chapter 7.11). The site at Latchmere Green is a potential tile-making site, and its location on the *London Clay Formation* also makes it a potential supplier of **SILCBM1** products (Chapter 7 3).

Figure 11.1: Map of confirmed and potential CBM suppliers to Silchester

A comparison with the CBM supply to the Roman provincial capital, Londinium, was only possible due to the existence of the Museum of London Archaeology fabric series which is maintained and referenced for all new excavations taking place. The dating of the fabrics is based on the best stratified examples that have been recorded. However, the series is only founded on macroscopic fabric identification during post-excavation analysis. It typically does not involve on-site in-situ analysis of materials, unless exceptional structures are uncovered, or analysis of discarded material. Moreover, there have been no petrographic or geo-chemical analyses of the fabric series to define the collection objectively.

11.2 Re-use, recycling, and residuality

Ceramic building material can have a complex history of use, re-use, repair, and disposal. All CBM, even unstratified material, can impart useful information. The lack of stratified or in-situ material from primary structural contexts is an obstacle to making definitive statements about the supply of building materials at particular points in time. There are only a small number of samples that can be presumed to have been recovered from primary contexts. All other material must be considered to be recycled, re-used or residual. There has been no practice of recording the fabric of the materials that are found in-situ in structural remains. However, the lack of primary context for the majority of this assemblage does not negate any of the results derived from it.

Despite this, what has been shown is that there was a reliance on local building supplies throughout the c.400 years of Roman Silchester (SILCBM1 and SILCBM3/4). The presence of other imported fabrics during phases of the town's chronology shows that additional supplies were sought from elsewhere when local tileries were unable to meet demand or a particular building project warranted the importation of materials from further afield. This confirms Warry's conclusions (Warry, 2012), based on metrical analyses of *tegulae*, that multiple tileries were used to supply the Roman town at different times.

Whilst a shift in the sources of some of the Roman tile used in London around the mid-2nd century has been identified, this is not reflected in the CBM collection from Silchester. The ubiquity of the *London Clay Formation* in the area around Silchester sees the CBM made from these sources dominating the assemblages from c.A.D.80 onwards. Up until this date the largest proportion of bricks and tiles were obtained from the local tilery at Little London, with *London Clay Formation* sources representing less than 20% of the material from this period. In London, early CBM supplies were apparently dominated by material from tileries situated in or near to the urban area, supplemented by some tiles from more distant sources, in particular north Kent. Around the mid-2nd century these tileries local to London appear to have fallen out of use to be replaced, in part, by more distant rural tileries. This may have been the result of a more general fall in demand for new tile in south-east England from the mid-2nd century onwards and the increased availability of material for re-cycling. Conversely, Silchester sees an increase in the use of SILCBM1 with the other fabrics present in smaller quantities as a result of the re-use of existing building materials.

Whilst most of the material is not stratified in primary contexts, the analysis of the fabrics over the period of occupation of the town provides a sequence of occurrence of each fabric and a broad framework for the incidence and duration of each fabric. Assuming that the production of the Nero-stamped tiles represents the earliest production at the tilery at Little London, it would be assigned a a *terminus post quem* of A.D.54. Based on the occurrence of the SILCBM3/4 fabrics at both the forum-basilica and Insula IX an end date for the production of this fabric can be estimated to around the turn of the 1st and 2nd centuries, with a clear reduction in its occurrence after A.D.125. The later phases of the town see the increased use of stone for roofing along with the majority, if not all, of the CBM is likely to have been re-used from earlier contexts. Building materials for incidental repairs were most likely sourced from intra-mural supplies left over from previous developments within the town (Fig.11.2). The prevalence of stone-built 'channelled' hypocausts which are also more common in the later Roman period (Williams, 1971, p. 183) would have also impacted on the overall demand for new CBM production, or could be a reaction to the lack of CBM supply available. There is no evidence of a CBM industry continuing to supply Silchester into the 4th century.

Figure 11.2: Pictorial interpretation of the evolution of MB3 – Insula IX Period 4 (After Fulford and Clarke, 2011, p. 336 Fig.149)

11.3 Long-distance movement

Contrary to the traditional view of only very localised production and consumption of CBM with long-distance movement restricted to specialist products, such as flue-tile, this project has shown that long-distance movement of all forms of ceramic building material was taking place. There is evidence for the supply of building materials from several production centres and the potential co-ordination of supply for large scale building projects. There were evidently networks in place between major production centres and towns to facilitate the movement of building material over long distances.

The analysis of the Silchester material has clearly shown some long-distance movement of CBM from production centres to the town. Research into the movement of the material and connections between finds and production centres has tended to focus on featured material, i.e. stamps or relief-patterns. This study has established the movement of building materials by examining at the clay used to make the tiles and identifying a raw material source or probable production centre. Nearly one-fifth of the total assemblage (18.30%) has been shown to have been supplied from the production centre at Minety (**SILCBM2**) demonstrating that the long-distance movement of material was perhaps more prevalent than previously considered. There are no examples of this fabric in the forum-basilica assemblage until Period 5 (A.D. 80-125/150) which saw the construction of the Flavian timber basilica, with a continued presence of **SILCBM2** in the forum-basilica material after this date. This fabric is present in the Insula IX assemblage from the earliest Roman phases with its proportion declining to less than 10% in Insula IX-Period 2 (A.D.80-125), increasing again to approximately 25% in Period 5 (post A.D.300), though mostly residual. The corpus of products in **SILCBM2** shows the greatest diversity amongst all the fabrics, with nearly 40% of forms being types used for the construction of hypocausts. There are examples of relief-patterned flue-tiles, keyed with die 39 (Chapter 9.3.4), which are also present in the collection in fabric **SILCBM3**. There are also stamped tiles, including one stamped DIGNI and another with LHS, the presence of which reinforces the conclusions that Minety is the source of this fabric. The route from Minety to Silchester has been proposed to be via a potential builders' merchant located at Wanborough (Warry, 2017, p. 103), again supported by the presence of the relief-patterned tiles at, more distant, Lower Wanborough keyed with die 39 in both SILCBM2 and SILCBM3 fabrics.

Long-distance movement of material has also been confirmed by the presence of bricks and tiles at Silchester identified as having originated from the tilery at Eccles, Kent (SILCBM8), albeit only 0.29% of the retained assemblage (Chapter 7.11). The movement of ceramic building material from Eccles into London has been recognised for some time and has been linked to the transportation of Kentish ragstone from quarries in the Maidstone area for large building projects in London (Betts, 2017, p. 371). Kentish ragstone has been identified in London in the foundations of walls that pre-date the Boudican destruction of c.A.D.60-61. The late 1st- to early 2nd centuries A.D. saw a period of great expansion in London during which time Kentish ragstone was extensively used in public buildings such as the basilica, forum, and public baths (Marsden, 1976, p. 57). It has been suggested that tiles were being imported into London even when more local CBM supplies available because the 1st-century city was expanding so rapidly that the local kilns had insufficient capacity to meet demand (Betts, 2017, p. 372). The importation of Kentish Ragstone (Hassocks Greensand) is also evidenced at Silchester with the presence of large column bases in this material identified from the 2nd -century forum-basilica, as a coping stone for the possible nymphaeum (Fulford *forthcoming*) and the discovery of a large, potential threshold stone, from the 2017 excavations of the temple complex in Insula XXX(K. Hayward *pers. comm.)*.

The examples of SILCBM8 in the retained assemblage from Silchester are from contexts dating to the later Roman period. They were all recovered from secondary contexts, potentially sourced from the demolition of earlier buildings. The occurrence of this fabric is restricted to the Insula IX material with a single example in FBIX4 and the remainder in FBIX5 (late Roman period). This does not negate the possibility of earlier importation of this material for a specific building project. The movement of SILCBM8 to Silchester was perhaps part of a bulk consignment for a specific building project which could not be fulfilled by tileries local to Silchester, for example, the Hadrianic-Antonine masonry forum-basilica. The only example of this fabric in a secure, but undated, context is referred to as a distinctive white tile used as a quoin in the south-western corner of a building in Insula XXXIV, described as a most uncommon variety as regards *Calleva* (Hope, 1907, p. 436). The Eccles tiles are of good quality, being hard and well-fired, and would undoubtedly have been highly desirable if needed for reuse in later structures or as hardcore. The fabric is very distinct from all the others in the SILCBM collection, such that any roof or building that incorporated these cream/white tiles would have stood out against the orange hue of the other ceramic building materials. It has been suggested that these distinctive tiles were used in London to create patterned roofs alongside the locally-made red tiles. In Beirut, Lebanon in the early Hellenistic/Ptolemaic period important public buildings were picked out in yellow tiles whilst the rest of the city was roofed in red tiles (P. Mills, *pers comm*.)

Unlike the fragmentary examples at Silchester, the Eccles material in London includes complete tiles destined for a building project. It is possible that the presence of this fabric at Silchester, in such small proportions, is evidence for the existence of reclamation yards with the material arriving as part of a bulk delivery for levelling or for minor repairs or renovations (P. Warry, *pers comm.).* However, if you consider that the assemblage for this study is from the areas of the forum-basilica and Insula IX excavations which together represent less than 1% of the whole area of the Roman town, the scale of the use of the Eccles fabric could potentially be highly under-estimated. As with the presence of Eccles fabric in London, it is perhaps more likely that the material was imported for a specific building project, probably in the late 1st century., (I Betts, *pers comm.*)., In London the presence of material from Eccles is thought to have originated from an early phase of production at the tilery dating to the second half of the 1st century A.D. (Betts, 2017, p. 371), however excavations at the tilery itself dated production to c.A.D.180-290 (Detsicas, 1967, p. 174). The movement of material from Eccles also confirms that it was not just exceptional or specialist items that were moved long distances. The assemblage of **SILCBM8** at Silchester comprises roofing material, including *tegulae* and *imbrices*, as well as basic brick forms.

Some tiles would have been delivered direct from the kiln to the building sites, but some may have been stocked and distributed by builders' merchants. Bricks were made in standard sizes, thus allowing builders to mix bricks from different suppliers in the same building without changing working patterns. This removed a potential supply bottleneck inherent in masonry construction, where an important factor controlling building rates is the output capacity of the tilery or quarry supplying the relevant materials (Wilson 2008, p.401). The marketing of the tilery products may sometimes have involved 'middlemen' who maintained stocks of tiles brought from one or more kiln-sites, perhaps for their own use, or to sell on to others for building projects. Fabric analysis has demonstrated the complex nature of the relief-patterned tile industry with the die 39 (Chapter 9.3.4) being found on tiles of two different fabrics. The proposed builders' merchant at Lower Wanborough could possibly have co-ordinated the collation of the relief-patterned flue-tiles for a large-scale building project in the *civitas* capital at *Corinium*. There are several relief-patterned tiles, amongst other types of CBM found at Lower Wanborough, these have been interpreted as evidence of a builders' merchants with reclamation yard. The likely location would be on the fringes of the town at Wanborough, evidenced by a selection of stamped tiles as found in Insula IV (Warry, 2017).

11.4 Specialist production centres?

Warry (2012, p. 74) suggested that Silchester obtained ceramic building materials from a number of kiln sites, and which focussed on the production of particular forms of CBM such as roofing material, floor-tiles or flue-tiles (Warry 2012, p.74). What this study has shown is that all the major fabric groups include basic brick forms, roofing material i.e. *tegulae* and *imbrices*, and all include some forms used in hypocaust construction (Chapter 6.4). As already discussed, the forms present in the **SILCBM3** & **SILCBM4** assemblages support the hypothesis that the tilery at Little London was established for an imperial-sponsored public building project, which included the *Opus Spicatum*, recovered from the public baths, antefixes and the Nero-stamped *tegulae*. These fabrics also include box-flue tiles, including relief-patterned examples, square *pilae* (*bessales*) along with basic brick and roofing tile assemblages.

The results of the fabric analysis of relief-patterned flue tiles confirm that these tiles were made of the same clays as other types of tiles. This calls into question whether the production of box-flue tiles was a specialist activity. The ubiquity of these forms in all the fabrics and production centres assemblages suggests that they were part of the standard corpus of materials produced. Craftsmen who were, to some extent, itinerant, produced box-flue and other tiles using their distinctive roller-design to mark out their products, as an alternative keying mechanism to scoring or combing found on other flue-tiles. The example of die 39 at Silchester is also paralleled by tiles keyed with die 5a found at Beddingham, East Sussex. These are found to be made of two different fabrics, one from the Hartfield kiln and the other from an unknown source (Middleton & Cowell 1994, p.17).

This analysis of an existing archive has shown the potential of understanding the range of fabrics present at one site, the types of CBM produced in each of the fabrics, thereby characterising the range of forms associated with a particular production centre. The Little London tilery has always been believed to have been established to produce building materials for a large-scale public building project, evidenced by the production of the Nero-stamped tiles at the site. This PhD project has provided a catalogue of forms in the **SILCBM3/4** fabrics which support the theory that the tilery was established for, at least, the construction of the early Roman public baths complex located in Insula XXXIII (Fulford *forthcoming*). The presence of relief-patterned tiles in fabric **SILCBM3** at Cirencester serves to prove that materials were also exported from Little London to Gloucestershire.

11.5 Artisan tilemakers, part-timer farmers, or both?

A typical interpretation of the animal footprints found on the surface of the bricks and tiles is that tile-makers were farmers as well as specialist artisans, who undertook brick and tile production alongside agricultural practices and stock rearing. Some tilemaking processes would almost certainly have been seasonal. Whilst the drying of the tiles and firing of the tiles is likely to have been carried in the summer months. The footprint evidence has included young lambs confirming a dry season starting in the spring. The extraction of clay was done in the autumn, with the clay left to weather over the winter months before forming. The collection of wood for the firing of the kiln was also best undertaken in the winter months, when the trees were bare of foliage (Warry, 2012, p. 54). At Silchester, ten species of bird have been identified from their footprints, along with six mammal species and a further six ungulate types. The footprint evidence from the Silchester assemblage does not point to large-scale farming activities taking place alongside tile production. As discussed in Chapter 10.2, the footprint-impressed tiles from the forum-basilica represent less than one per cent of the recorded assemblage. The domestic species identified from the footprints suggest small-scale animal husbandry which would not be incompatible with the time-consuming practice of tile production. The keeping of some livestock would be more manageable than maintaining arable crops where the seasonality of crop management and tile production would invariably clash. The scale of some of the production centres with multiple kilns operating, such as the Reigate complex, and the amount of work that would have been necessary for the construction, maintenance, and operation of the tilery would make any supplementary time-consuming activities improbable. The knowledge of how to build such a kiln, and acquire the skills necessary for its proper usage, makes it likely that the tilers were professional craftsmen. Some tile-makers were, it seems, engaged in farming activities albeit on a smaller scale than typically assumed and perhaps only to meet their own subsistence needs.

An impression of the landscape and environment surrounding the tileries can also be derived from the footprint evidence. Unsurprisingly, it shows that tileries were situated close to wooded areas and water sources, both key resources needed for the large-scale production of building materials. There has been no large-scale study of the incidence of footprints on tiles which are typically only referenced in the CBM reports within site reports. The selective nature of CBM assemblages invariably leads to an over-representation of footprints in existing collections. The tiles with footprint impressions from the civic tilery at St Oswald's Priory, Gloucestershire were dominated by cat footprints, with only a single example of a dog print (Heighway *et al.* 1982, p.76). By contrast, the material recorded at the tilery at Great Cansiron Farm, Hartfield, East Sussex was dominated by dog footprints (Rudling *et al.* 1986, p.82). The footprint assemblage from the tilery at Crookhorn, Hampshire, is dominated by dog prints and those of sheep/goat with an absence of pigs, cattle, horses, and wild animal footprints. This has been interpreted as a deliberate separation of other animals from the proximity of the drying tiles. Pigs may have been secured in enclosed woodland or in sties. Cattle and horses would have been pastured in fields enclosed with ditches and fences or hedges and enclosing of the tilery itself would have protected it from some larger wild animals (Soffe *et al.* 1989, p.83). Altogether, the footprint evidence therefore suggests there was a lack of security and open drying sheds at some of the tileries supplying building materials to Silchester.

11.6 Summary

This project has employed detailed and multidisciplinary scientific analysis to investigate a large urban ceramic building material assemblage. It has demonstrated the potential of existing CBM collections to add to site narratives by illustrating the variability within areas of the Roman town, between public and private building projects and throughout its Roman history. Fabric analysis has allowed for intra- and inter-site comparison of fabrics, along with comparison with material from production centres. The next and final chapter revisits the aims and objectives of the thesis, summarising the key results and considers recommendations and directions for future work.

Chapter 12: Conclusions

By studying a large-scale urban assemblage, this project has reconsidered aspects of the CBM industry previously mis-understood or mis-interpreted. The results have shown the need to analyse an assemblage as a whole, rather than just focussing on the items that are distinctive or unusual. The results reflect the potential of the material to inform site narratives and to provide a wider understanding of the construction industry within which its production was situated.

The main results of the study are:

- The Silchester Roman CBM collection is comprised of nine fabric groups.
- Long distance movement of CBM to Silchester of all forms of ceramic building material is demonstrated from Minety, Wiltshire and Eccles, Kent.
- Potential raw material sources for each of the fabrics have been identified.
- Differing fabrics also show that an array of producers was needed to meet the demand of large scale construction projects when local tileries had insufficient capacity.
- The footprints of young animals and birds provide evidence of the seasonality of the tile-making process and give insights into the environment around the tileries and the occupation of the tilemakers.
- Movement of relief-patterned tiles and/or the tilers who made them shows the complexity of the trade of these goods.
- The distribution of material from production centres to consumers highlights the potential for builders' merchants to co-ordinate large-scale orders for materials where one production centre was unable to meet demand.

CBM was a new technology introduced within the first decade of the Roman conquest of Britain and was a very visible sign of Roman influence. This project shows that the ubiquitous brick and tile, too long neglected, can provide a wealth of interesting data.

The CBM requirements at Roman Silchester were met by a small number of production centres supplying most of the building materials, with four fabric groups accounting for almost 90% of the material. Long distance movement of materials has been identified from the production centres at Minety, Wiltshire and Eccles, Kent, demonstrating the long-distance trade of standard bricks and roofing material as well as specialist products in the form of relief-patterned flue tiles. The results have shown no evidence for specialist production centres, as suggested by Warry (2012), with each fabric including a wide corpus of forms. There is some evidence of co-ordinated distribution of materials with the same relief-patterned die found in two different fabrics at both Silchester and Lower Wanborough.

The Silchester materials show variation in terms of the consumption of different fabrics over the life of the town. However, even in the early phases of the development of sites, in this case Silchester, there is the potential for the re-use of material. The small number of samples from primary contexts restricts the chronological interpretations that can be made about the use of the fabrics (Chapter 8.8). However, as this study has shown, there is important information that can be derived from these collections. The use of portable XRF was essential as destructive analyses is not always permitted or possible. It was most successful in defining groupings within the relief-patterned flue tiles confirming which samples were made of the same raw materials. However, thin section petrography allowed for the mineralogical characterisation of the fabrics which facilitated connections to be made to clay raw material sources.

Footprints on bricks and tiles are typically interpreted as evidence of agricultural practice alongside part-time tile production. The results have shown it is more likely that tile-making was a full-time occupation, accompanied by small-scale subsistence farming. It has also been shown that the movement of material was not restricted to specialist items, and the idea of the specialist production centre has been called into question. The items typically referred to as such, e.g. relief-patterned tiles, were made in the same fabrics as the roofing materials and bricks. This suggests that production centres were able to supply building material of all types, depending on the requirements of the construction project.

The chronology of fabrics at Silchester challenges the chronology devised by Warry (2005) with the lower cutaways on the *tegula* made in the SILCBM3&4 fabrics, confirmed to have originated from the tilery at Little London, being solely C5 types, dated by Warry to A.D.160-260. This has also proved to be the case following initial analysis of the *tegula* recorded during the 2017 excavation of the Little London tilery. The connection of the Little London tilery with the Nero stamped-tiles gives a date for the start of production in the second half of the 1st-century AD. This would therefore negate the use of the lower cutaway forms as a reliable dating tool.

Framework for CBM studies

The methods described here, as applied to the ceramic building material collections from Silchester, provide a framework for very detailed post-excavation analysis of ceramic building materials. The lack of consistency applied to the recording and retention of material has led to concerns when using the material for further interpretation of the site in question. Subjective retention policies have resulted in the over-representation of stamped or marked material in CBM collections at the expense of the commonest types. However, as a sample of a production, this does not negate the value that this material can add. Distinctive patterns and prints tend to guarantee the retention of this material and, especially in the example of relief-patterned flue-tiles, these provide a corpus of material across a number of sites that can be compared to illustrate the movement of tilers and/or tiles. This study has shown the potential of CBM to illustrate the supply of building materials to an urban centre, the movement of material from producers to consumers, and the environments in which the production centres are situated.

The establishment of a fabric series in the early days of an excavation project is recommended. This would allow all recorded material to be assigned to the fabric series, rather than just the retained samples. This could include the recording of fabrics in-situ, where structures are exposed but not demolished. This would be especially useful in on-going projects, where sites are re-visited over a number of years. The retained assemblages can then be interpreted and discussed with knowledge of the proportions of each fabric present in the assemblage recorded on site. More detailed post-excavation analysis would allow for the testing of the fabrics series before any rationalisation of the collection. There is then the opportunity for formal characterisation of the fabrics with geo-chemical or petrographic analyses.

The use of a fabric reference collection allows for the pattern of the consumption of CBM to be established and its sources to be identified. The reporting of CBM recovered from excavations in London clearly benefits from a fabric series that has been established, maintained, and continually updated but it has not yet been formally tested or characterised. This fabric series provides a reference point for all CBM reporting from London and the key production sites and date ranges assigned to each fabric are invaluable when assessing the range of material recovered from each excavation. However, with several contractors reporting on excavations within London, there is a need to ensure that replication of the fabric series is consistent across all units covering the same geographical area. There is clearly a case for creating regional fabric series across Roman Britain, akin to the Roman fabric reference collection available for pottery (Tomber and Dore, 1998), this has now been done for Silchester.

A research framework for CBM is needed. Museums are under increasing pressure to rationalise their existing archives with bulky items like building materials, stone and CBM, typically top of the list for disposal. A research framework and methodology would increase the understanding of the potential of these materials and, it is hoped, encourage further research on existing collections.

Recommendations for future work

It has been shown that Silchester exploited CBM supplies from both local and regional production centres. Was this typical of other Romano-British towns, do they show the same mixed dependence on local and regional suppliers for their ceramic building materials? In addition, to what extent did the rural settlements and villa sites produce their own building materials, import material from urban suppliers, or rely on builders' merchants to source the required bricks and tiles? Similarly, were military sites, e.g. legionary fortresses, self-sufficient in the production of ceramic building materials or did they seek civilian products to supplement their own?

When considering Silchester and its location within the Atrebatic territory, further work could include an investigation of the role of the settlements at Winchester and Chichester, and how the CBM used at these sites compares with the fabric series that has been established for Silchester.

A full characterisation of the production centre at Minety would be most beneficial. A detailed survey of the site would initially assist in understanding the scale of production at what is thought to be one of the largest Roman brick and tile production centres in the province. The investigation of a production centre would provide details of the corpus of products and allow for a comprehensive fabric series for the production centre to be established. This would then facilitate the mapping of the distribution of products from the centre would highlight the range of movement of the products.

Products of the Little London tilery, in the form of relief-patterned flue-tiles, have already been identified at Winchester, Rockbourne villa, Littlecote Park villa, and the roadside settlement at Lower Wanborough. Once a fabric series for the production centre at Little London has been established, this can then be compared with assemblages of CBM from other settlements in their entirety, including Cirencester, to understand the complete range of the movement of products and the proportion of material that was sourced from Little London.

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