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Research Article

Microdebris Analysis of the Central Sewer and the Drainages of the Domus at Pompeiopolis

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ABSTRACT

In archaeological research, the discard behavior of domestic and industrial spaces can be mostly understood through the inspection of primary refuse contexts such as intra-site garbage pits, cesspits, last activity remains of fireplaces, activity floors, or extramural dumping areas as secondary refuse contexts. Other than these features and refuse contexts in the Late Antique / Early Byzantine period Domus at Pompeiopolis, the central sewer, and the drainage have the potential to provide alternative information related to the consumption, production, and discard behaviors of the households and the community in general. In this paper, microdebris samples taken from the street sewer, the drainage of the Domus, and a direct refuse link from a kitchen space adjacent to the street sewer were analyzed and discussed in consideration of the formation processes of the archaeological record.

Keywords: Refuse pattern, Late Antique, Early Byzantine, Black Sea, artifacts, ecofacts

Introduction: Theoretical and Methodological Background

The microdebris analysis aims to recover and screen artifactual and ecofactual remains either as whole elements or in fragments, originating from human activities such as production, consumption and discard behaviours, which are otherwise invisible in detection with the naked eye and hand collection[1]. On the other hand, it helps understand the contextual patterns and formation processes of the archaeological record and taphonomy of artifacts, where both various cultural and natural factors are effective.

While the aim of the technique is common, among scholars there is variety in the use of terminology and no standard size for the materials included in the analyses. The terminology for the technique appears as micro-artifacts, micro-debris, micro-artifact studies, or micro-archaeology (Rainville, 2012, p. 145; Parker et al., 2018, p. 59), however, the last refers mostly to the study of archaeological materials only possible with the aid of microscopes (i.e. stereotype, polarizing microscope- petrographic, SEM- scanning electron microscope). Even though there is no standard size in the application, the method includes materials from microscopic, under 1 mm up to 3cm in size, thus a better recovery method compared to dry sieving (Rainville, 2012, p. 145).

Microartifact materials are mostly categorized into groups such as ceramics, animal bones, shells, lithics, charred and mineralized macro botanical remains, metals, glass, and special small artifacts (also see Parker et al., 2018, p. 60). Especially, fish and bird bones, shells, and beads can only be recovered by sorting the heavy residue of the microdebris samples (also see Rainville, 2012, p. 156; Özbal, 2012, p. 329), otherwise, the data is lost. This results in the invisibility of small species such as fish, birds, and rodents within the taxa, while the larger bones are recorded through hand collection. Also, the vast majority of the micro bones could not be identifiable at the species level (see Rainville, 2012, pp. 156-157). Within the microdebris, due to their size, rodent and fish bones can be recovered in identifiable complete forms (also see Rainville, 2012, p. 158), as well as the fragments and other small parts of the middle-large size animals (i.e. ovicaprid sesamoids).

Microdebris studies aim to screen the micro-artifact densities or "cleanliness index" (see Özbal, 2012, p. 330) within the sample contexts for comparisons and to identify activity discards. Density comparisons are made through calculations of identifiable elements, either with fragment counts or taking weights of the artifacts (ceramics, metal, glass, coins, beads)

1 The technique was developed and widely used since 1960s when emerging concepts such as intrasite spatial analysis (Hodder & Orton, 1976; Clarke, 1977; Blankholm, 1991), interpretation of archaeological record (Binford, 2002; Schiffer, 1972; 1983; 1996; La Motta & Schiffer, 1999), contextual archaeology, behavioral archaeology (Reid et al., 1975), ethnoarchaeology, experimental archaeology, household archaeology (Wilk & Rathje, 1982; Allison 1999; Parker & Foster, 2012), environmental archaeology and use of statistics (Whallon, 1973; 1974) became a trend during the rise of the new archaeology (processual approach).

and ecofacts (bones, plants, egg, and sea-land shells) in grams in each sample volume per liter (see Rainville, 2012, p. 146).

At Pompeiopolis, microdebris samples were taken during the excavation of the Late Antique/Early Byzantine period Domus and its close environment. Samples were taken from the central sewer, the drainage, and a direct refuse link from a kitchen space adjacent to the street sewer, having the potential to provide alternative information related to the consumption, production, and discard behaviors of the households and the community in general through micro artifacts and ecofacts.

The preliminary results were also promising in showing some invisible insights for the socio-economic organization of the community, were useful in the interpretation of the contexts in a higher resolution, and enabled a better understanding of the processes effective in the formation of the archaeological record.

Context of the Study

During thirteen excavation campaigns between 2009 and 2021 (Musso et al., 2011; Brizzi et al., 2021; Summerer, 2008; 2012; 2013; 2014; 2016; 2017; 2018; Summerer & Çevik, 2015; Summerer & von Kienlin, 2009; Summerer et al., 2010), an Italian-Turkish team explored over 3000 m^2 of a housing unit on the north-eastern slopes of Zımbıllı Tepe (Taşköprü – Kastamonu district) already identified in the 19th century as the site of Roman colony of Pompeiopolis in Paphlagonia (Fourcade, 1811; Marek, 2001; Summerer, 2011) (Fig. 1). The excavation, documentation and restoration works are still in progress. In the sequence recorded so far, five main phases can be simplified as follows (Brizzi et al., 2021).

The Late Antique Grand Domus. Around the middle of the 3rd century AD, a grand domus was built on the edge of the ancient city, in an area developed by a system of perpendicular road axes (Fig. 2). The Domus occupies an entire block, is articulated on least two levels along the hillside, it is organized around a central open area originally with porticoes, and a reception court on the northern side which provides access to the residential part of the house around the peristyle and, through a monumental staircase, to a suite of representative rooms located on the higher level. On the southern side, along the main paved road climbing the hill, only service access is preserved, but more investigation is needed as regards the most ancient phases in this part of the house. The grandeur of the building and the richness of the decorations, mostly mosaic floors and marble revetments, are an indicator of the status of the owners of this residence whose rank was certainly at the top of the city.

The Transformation of the Domus. In the second half of the 6th century, a progressive transformation of the Domus is recorded (Fig. 3). The spaces of the house are divided into smaller rooms where there is evidence of craft activities and the setting up of storage facilities. The hypocaust heating systems are disabled and their elements are recycled in different ways. Also, the central garden is occupied by buildings while the infrastructures for the disposal, and/or collection of rainwater are rearranged. This transformation continued unsystematically and with disparities over the entire area of the house until the end of the 7th century when the disappearance of the original roofs and more radical changes to the wall structures testify to the total transfiguration of the building's identity.

The Early Byzantine hamlet. As result of these transformations, the townscape of this part of the site, outlined during the 2nd and 3rd centuries of the current era, since the 8th century became a rural landscape through different forms of housing and land use (Fig. 4). By recomposing the scarce evidence recorded during different excavation campaigns, it has been possible to reconstruct a settlement made up of isolated small buildings, likely developed in height, arranged around a central open area where large storing jars were installed. The buildings occupy indiscriminately what were public and private spaces of the previous urban organization, highlighting an administrative caesura from the earlier phases even if the massive works of leveling of the debris of the ruins attest to the presence of an authority still managing this territory.

The Middle Byzantine Chapel. During the 10th-11th century the hamlet was abandoned, perhaps after a violent destruction (Fig. 5). Right after, a quadrangular building was built in the area. The lime for the construction was produced on-site in a limekiln fed by the building elements of the surrounding ruins (see Fig. 5 for the spot of the limekiln on the architectural plan). Along the southern side of this building, about ten burials were built in stones and bricks, east to west oriented, some multiple, a couple with grave goods that have allowed them to be dated to the 11th-12th century. The building was intentionally destroyed. The presence of fragments of wall paintings found in its rubble and above all the presence of the small necropolis placed around have led to the acknowledgement of the religious character of this building.

The late rural use. After the destruction of the religious building, probably coinciding with the Seljuk control of the site in the 13th century, all subsequent interventions are attributable to simpler works for terracing and/or delimiting plots of land arranged for agricultural use. Rare episodes of spoliation, especially for the reclamation of fired bricks from the old structures, are still recorded.

The samples examined in this paper come from contexts relating to the first three phases described above, contexts which will be individually described and critically interpreted (Fig. 6).

Methodology

Light fractions (LF) and heavy residues (HR) recovered from 15 flotation samples, having a total volume of 400 liters, were analyzed for this study, which represented refuse contexts both of the Domus and the settlement in general (Table 1). The sampling strategy was judgemental and no limit was defined for the amount of flotation samples. The contents of each sample were calculated in weights (gr) per liter to make an equal comparison among sampling contexts. Stratified contexts such as the sewer were sampled gradually in depth to distinguish the sewer floor and the fill covering the top of it.

The samples were washed through a siraf-type flotation barrel, which had two intakes: one from a water source and the other from an air compressor. The air circulation helps to resolve the soil easily and makes the light fractions float. The floated light fractions (LF) were collected in a 100-micron tulle cloth stretched on the top of a perforated bucket set, where the water ran off. The sunken heavy residue (HR) was collected in a 1 mm plastic mesh, which was spread inside the barrel. All soil samples were measured by a scaled bucket in liters before floating. So, the density of materials per liter could be calculated.

After the LF and HR were dried, all samples were sieved with 2 mm, 1mm, and 0.5 mm steel sieves. All the HR and LF over 2mm were sorted and the materials collected were identified. 1mm and 0.5 mm samples were kept for further study. Among the identified materials were glass, metal, tesserae, glass slags, metal slags, ceramics, animal bone fragments of middle-large species, birds, rodents, and fish bones, seeds of economic plants, and parts of cereals and grapes. All wild plant species were grouped as weeds.

Animal bones were evaluated in two groups: unidentifiable fragments of middle-large species and identifiable bones of small species, such as birds, fish, and rodents. Identifications were made generally at the species level as birds, fish, and rodents. Therefore, this study does not include the identification of genus, skeletal representations, NISP, and MNI calculations, which should be further conducted by a zooarchaeologist. This basic grouping of bones, calculated in grams per liter, aimed to show the contextual patterning and the potential of microdebris analysis for the recovery of small species.

Since the laboratory part of the study was performed during the excavation season, for the identification of plants, *Digital Atlas of Economic Plants in Archaeology* (Neef et al., 2012), *A Manual for the Identification of Plant Seeds and Fruits* (Cappers & Bekker, 2013), and *Jacomet's manual Identification of Cereal Remains from Archaeological Sites* (Jacomet, 2006) were used.

Identified plant seeds and parts were counted. Weights of artifacts and bone fragments recovered from the HR samples were taken in grams since the vast majority of the remains were fragments. Materials larger than 3 cm were not included in the analysis. All materials recovered from samples were calculated as gr/liter or count/liter (for plants).

Memorandum on the sampling contexts

Before analyzing the contexts in detail, it is necessary to reflect upon the process of forming the deposits inside the investigated channels, pipes, and drainages. It is reasonable to consider the deposit inside a water duct as the clue of its dismissal or in any case a phenomenon that characterizes the final part of the life of that infrastructure. But how long the burying of each drainage was and how much the disuse rather than lack of maintenance affected this process, are questions that cannot always be answered[2]. The unknown maintenance procedures of these structures, e.g. the periodical cleaning of the drainages, both public and private ones, their frequency and degree of effectiveness, surely affected the formation of the deposit, as it is plausible to expect that every intervention didn't result with a total reset of the internal dirt but even a small part of the materials remained in the drainages, mixing with previous and subsequent artifacts and ecofacts until the final abandonment. Other variables such as pressure and flow speed, also condition the formation of the sediment, but in this case, the technical characteristics of each drain, at least for the section investigated, can help our understanding. In any case, rather than the chronology of the construction of each feature, it looks important for the interpretation of their fillings to circumscribe the moment of their abandonment.

Furthermore, the stratification of these deposits may have been progressive, and protracted over a period that must be analyzed on a case-by-case basis, but apart from the observation of the microstratigraphy, it is very difficult to measure this period without turning to archaeometric measurements. This leads us to face the problem of dating which is not only of these contexts but of the whole site. Since the 6th century, the help of the pottery classes for the definition of the chronology is extremely reduced, the presence of recognizable coins is very rare as well, and the notorious problem of residuals which in poor assemblages and with few datable materials becomes an unsolvable variable. While proceeding through the quantitative analysis of the contents of each context, these considerations should constitute the preliminary framework for any interpretation.

Interpretation of Data

Artefactual remains

Samples 24, 25, 33, and 27-28 were significant respectively (Fig. 7a). Sample 24 had the vast majority of metal slag fragments with 1.119 gr/liter (Table 1). It was taken from channel

2 The lack of maintenance of the sewer does not mean that the area was abandoned and uninhabited, but the city lacked the organizational system for the cleaning operations (Also, for the case at Trajan Forum in Rome, see Meneghini, 2017, p. 24).

1480, very close to the sewer, and disengaged from the Domus across the street, which might have a mix of refuse disposal from a metal working space during the 6^{th}-7^{th} century (Period 2) (Fig. 7b).

Sample 25 was significant with metal (0.566 gr/liter), glass (0.198 gr/liter), and some metal slags (0.045 gr/liter) (Fig. 7a, Table 1). The sample was from the floor of the main sewer 1479 and this density of artifact fragments was expected due to its collecting role from various spatial units of yet unexcavated building blocks. Glass as the most fragile element among artifacts, was present almost in all samples, but the most density was in Sample 33, from the drainage 985 in the Domus (Period 2) (Fig. 7a, Table 1).

Ceramics were distinguished from other artifact data sets in comparisons, due to their abundance and high weights. Rather compared with bone fragments of middle-large size animals to see on which scale the main artifact and ecofact remains were dumped into the drainage. Ceramic fragments were present in all sample contexts but were most abundant on the drainage floor (Sample 25 with 4.269 gr/liter and Sample 19 with 3.475 gr/liter) (Fig. 7b, Table 1).

Ecofactual remains

Animal bone fragments of middle-large species were distinguished from the smaller species such as birds, fish, rodents, and shell remains. As stated above, rather compared with ceramic fragments to see the patterns in refuse contexts. A significant observation is that the animal bones were in almost all samples and more abundant than ceramics in the sewer and most drainage contexts. Particularly, the floor of the central sewer contexts (Samples 25 and 19), which were distinguished from the sewer fill during the sampling, had more animal bones than ceramic fragments (Fig. 7b). This indicated that the rate of animal food consumption refuses from the Domus and potentially from other building blocks along the road dumped into the central sewer was high.

Other than the bone fragments originating from middle-large species, small-size bones of birds, fish, shells, and rodent bones as intruding animals were found in the sample contexts (Fig. 7c) (Fig. 13). The first three groups were consumables. Among the four, birds were the most abundant in the samples. Sample 25 from the sewer was significant of bird bones with 0.2 gr/liter but also had 0.045 gr/liter fish and 0.037 gr/liter rodents (Fig. 7c), (Table 1).

The other two samples significant for bird bones were Sample 24 (0.071 gr/liter) from duct 1480 and Sample 2 (0.053 gr/liter) from drainage 1345. The most significant content for fish remains was Sample 1 from the drainage 1345 context having 0.12 gr/liter (Period 1-final phase). Sample 2 from the same context and period had the only shell remaining (0.0125 gr/liter). While shell fragments were only seen in one case, birds, fish, and rodents were the characteristic elements of the central sewer and the drainage contexts (Fig. 7c), (Table 1).

Looking at the macro botanical patterns (for a sample of the species see Fig. 12), Sample 24 had only weed and richest among others (Fig. 7d), (Table 1). This sample from a duct across the Domus seems to have no plant food-related activity and the weeds might have been present as contamination. This sample context was also rich in metal slag fragments, thus supporting the suggestion of a possible workshop function nearby. However, it was a feature to bring clean water therefore the presence of slag remains might have originated due to post-abandonment formation processes, as well as the weeds even if not as contaminations.

Sample 30 from a latrine context had the most abundant cereals among all with 0.21 count/liter (Fig. 7d), (Table 1). Except for two central sewer samples (Sample 19 had 0.023 count/liter cereals, Sample 1 had 0.1 count/liter legumes) (Fig. 7d), (Table 1), no grains were found in the samples, but ash and charcoal remains were densely observed. Even though the evidence of whole grains was limited, fire-related refuse including food was dumped into the sewer. Also, it should be considered that the dynamic movement within the sewer might have affected the integrity of the charred grains, which are quite fragile.

Samples 27-28 were significant in terms of the variety of economic food plants, which were recovered from a manhole cover on the street having a direct refuse link from the Domus. The sample had 0.0853 count/liter cereals, 0.0213 count/liter cereal components, 0.0213 count/liter legumes, and 0.0426 count/liter grape remains (Fig. 7d) (Table 1).

Contextual patterns

Contextual observation of the samples aimed at three aspects: (1) to see the material density between the sewer floor and the sewer fill, thus the formation process during its operation (Fig. 10a-d); (2) to understand the refuse pattern and relation between sewer and the direct link from the Domus space (Fig. 11c); and (3) to define and compare the character of refuse disposal to the central sewer and the drainage system (Fig. 11a-b) as representatives of the Domus.

Samples 19, 20-21, 25, 26, 27-28, and 29 were combined and grouped as sewer floor, sewer fill, below drainage lid, and rubbish chute to drainage. The sewer floor significantly had the most density of metal, glass, and metal slags compared to other contexts having equal densities (Fig. 8a). The picture was similar in the ceramic vs bone density comparisons but the bone refuse to the sewer floor was higher than the ceramics (Fig. 8b). Small size animal bones were also highest on the sewer floor (Fig. 8c).[3]

At Pompeiopolis, while drainages have less micro-artifact densities, the central sewer, as more representative of the community, had more micro-artifact density.[4]

The presence of ceramics, bones, bird and fish bones under the drainage lid, and fish remains in the rubbish chute to the sewer confirms that this line was used to dump animal food refuse of the Domus to the sewer (Period 1-2). The presence of rodents in the sewer context was also something expected.

For the macrobotanical remains three significant suggestions can be made (Fig. 8d): (1) variety and amount of economic species such as cereals, legumes, and grapes were highest under the drainage lid, which represented the Domus refuse through the rubbish chute, (2) there was evidence of cereals in the sewer floor but in a lesser amount, probably due to the weathering conditions of the sewer stated earlier above, and (3) the sewer fill had the highest amount of weeds, where vast majority were mineralized due to its water logged condition. It is also considered that these might be later contaminants originating from the natural formation processes.

Artifacts were the most abundant in the central sewer compared to the drainages, with an exception for metal slags (Fig. 9a). However, they were recovered from a context extraneous from the Domus. The vast majority of ceramic, bone fragments, bird, fish, and rodent bones were also recovered from the sewer contexts (Fig. 9b, Fig. 9c). Very limited shell remains were found in the sewer.

The majority of the economic species such as cereals and grapes were found in the drainage contexts, which affected the weathering of charred remains less than in the sewer context (Fig. 9d). The presence of weeds was balanced in both contexts, and legumes were only present in the drainage.

3 A rich content of carbonized and mineralized seeds, eggs, shells and mostly fish bones were recovered through microdebris analysis conducted at Herculaneum Cardo V sewer system (1st century AD), which was turned into periodically cleaned long cesspit in the absence of an exit point and a running water source (Rowan, 2014, p. 62). For the description of the sewer system at Herculaneum, see Camardo, 2011. Even if the period, size and organization of the features and contexts are not directly comparable, there is potential at Pompeiopolis to further investigate sewer and drainage floors for the recovery of small size organic materials.

4 Özbal suggests that rooms are cleaner than respectively courtyards, trash deposits and streets at the Chalcolithic site of Tell Kurdu according to "cleanliness index" (Özbal, 2012, pp. 330-331). Sewer and drainage contexts at Pompeiopolis could be preliminarily compared following this behavioral assumption.

Discussion and Conclusions

At Pompeiopolis, a central sewer system was well-functioning from the 5th century up until the 6th-7th centuries. Well functioning of the sewer connected to the 6th-7th centuries drainage system (Samples 33 and 38) of the Domus, is an indication of the maintenance of the urban function in this period, even if the archaeological data represents the Domus, other spatial units of the yet unexcavated building blocks and the small part of the street contexts. Archaeobotanical data (Tatbul & Gürdal, 2022) indicate the beginning of the ruralization practices in this period based on the presence of parts of the cereals, such as cereal nodes and cereal straws in the Domus complex, but strongly ruralized in the 8th-10th centuries, as also stated by the excavations team based on the contextual observations (Brizzi et al., 2021). 6th-7th centuries could be seen as a transition period to rural practices but still the functioning of the urban features.

The manhole attests to the refuse channel connection from the Domus to the street sewer. This proves that the refuse disposal of the Domus goes immediately to the central sewer through this connection, which was supported by the microdebris analysis. While domestic food refuse such as animal bones macrobotanical remains and fragments of discarded artifacts enter into the sewer, the contrary side of the street, based on only very limited samples (Sample 24), had metal slags that might have represented industrial activity refuse. This observation might be used to question whether the spaces on the contrary side of the street were functioning for industrial purposes. But still needs more data to make secure suggestions.

During the soil sampling for the microdebris analysis, artifact sizes were almost very small, and only a few sherds and bones (over 3cm) were separated from the sampled soil. Based on this observation it can be suggested that the refuse disposal to the manhole was deliberately small in size. Therefore, large-size refuse must have been disposed of differently. An analogy can be made from the present day that what goes through the sink and latrine to the sewer and what goes through the garbage bin to the street container differs.

Another important question for the future study is where the sewer ends, does it have a collection pool or whether it falls into the river bed (Gökırmak), which runs not more than 1 km NE below the settlement and the street sewer goes towards as well.

At Pompeiopolis, the microdebris analysis enabled the recovery of micro-artifacts and an understanding of the formation of the archaeological record, which represents the sewer and drainage contexts. The small animal and macrobotanical species at Pompeiopolis could be recorded through microdebris inspection only. Small species such as birds, fish, rodents, and shells were otherwise invisible within the taxa. However, genus and skeletal representations have to be studied in detail further.

As stated earlier in the description of the sample contexts, we approach the microdebris data in caution whether they were formed as a result of cultural or natural formation processes. In case they represent any behavioral signature, they must have been formed during the final period of each phase before abandonment. The fill over the most secure bottom part of the sewer and drainages must have accumulated due to the post-abandonment natural formation processes. Also, the sewer could have been filled as a result of heavy floods during the occupation, but in that case, it must have been cleaned to maintain its operation. Comparison between sewer bottom and sewer fill proves that the vast majority of artifacts and bone fragments were found in the sewer bottom samples. Almost all wild seeds were found within the sewer fill context, which might attest to the processes of formation due to natural reasons.

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Illustrations

Fig.1: Map showing the location of the site

Fig. 2: The Domus in the mid-5th century AD

Fig. 3: The Domus in the mid-7th century AD

Fig. 4: The area of the Domus in the mid-9th century AD

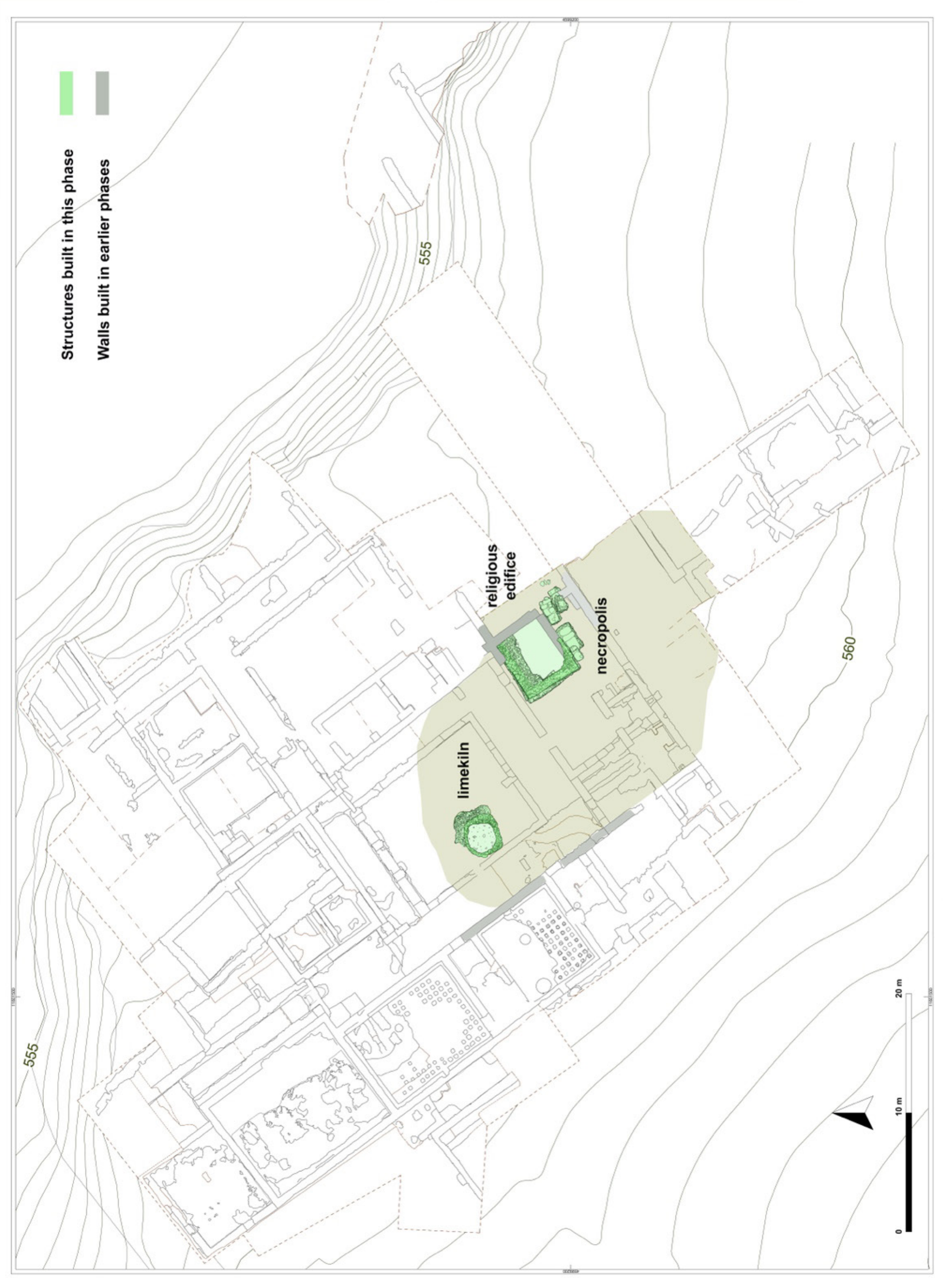

Fig. 5: The area of the Domus in the mid-11th century AD

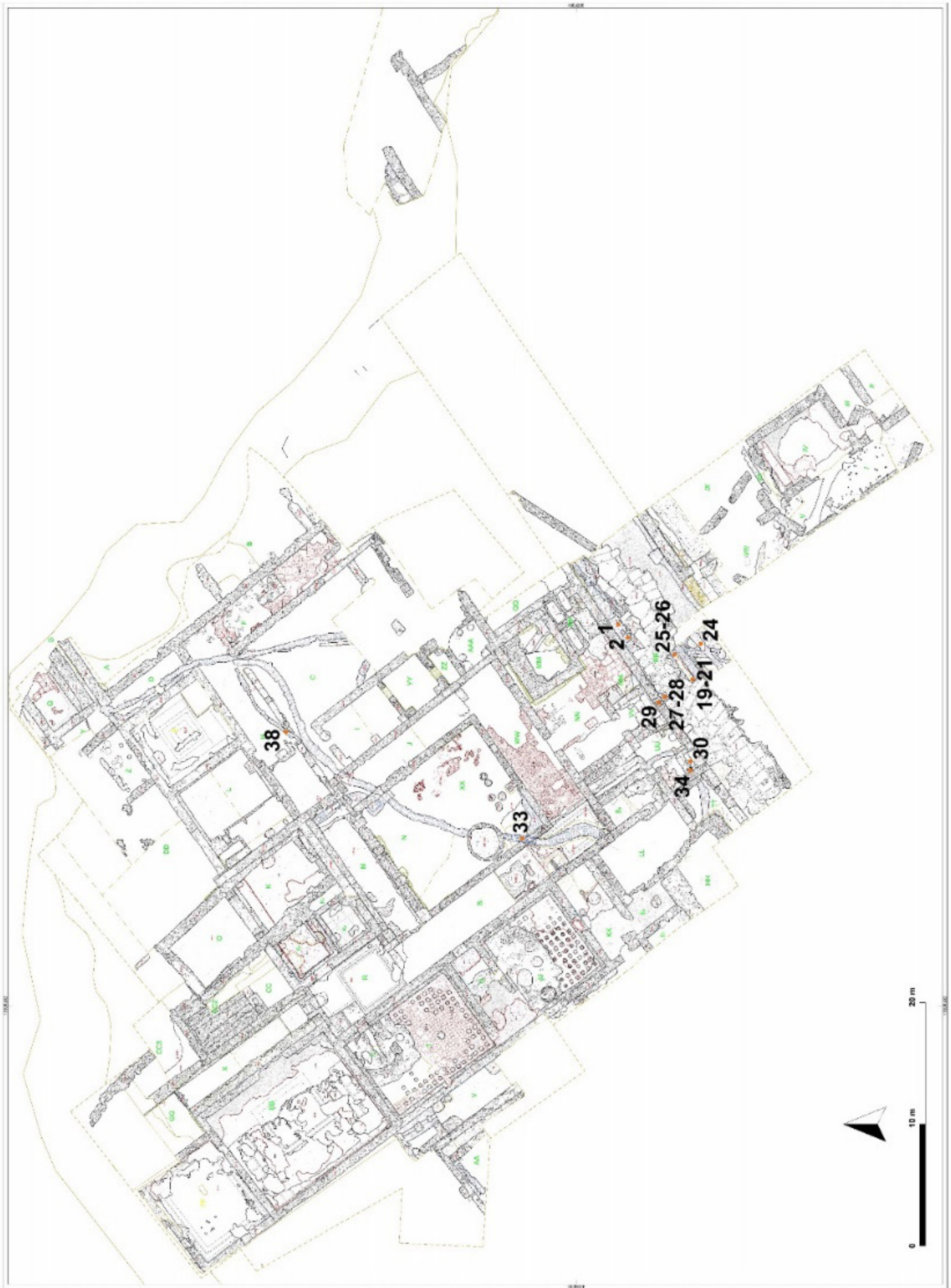

Fig. 6: Sample locations

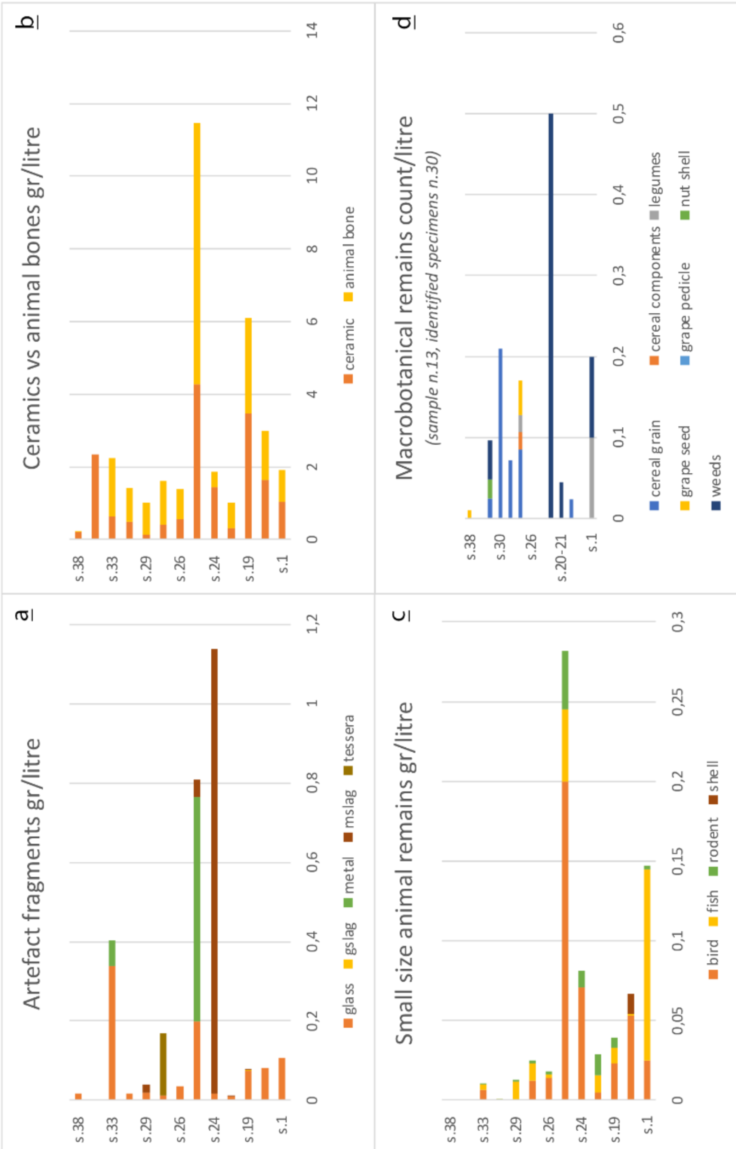

Fig. 7: a.Glass, metal, and tessera fragments within the HR samples; b.Ceramic vs animal bones within the HR samples; c.Small size animal bones within the HR samples; d.Plant remains identified within the LF samples

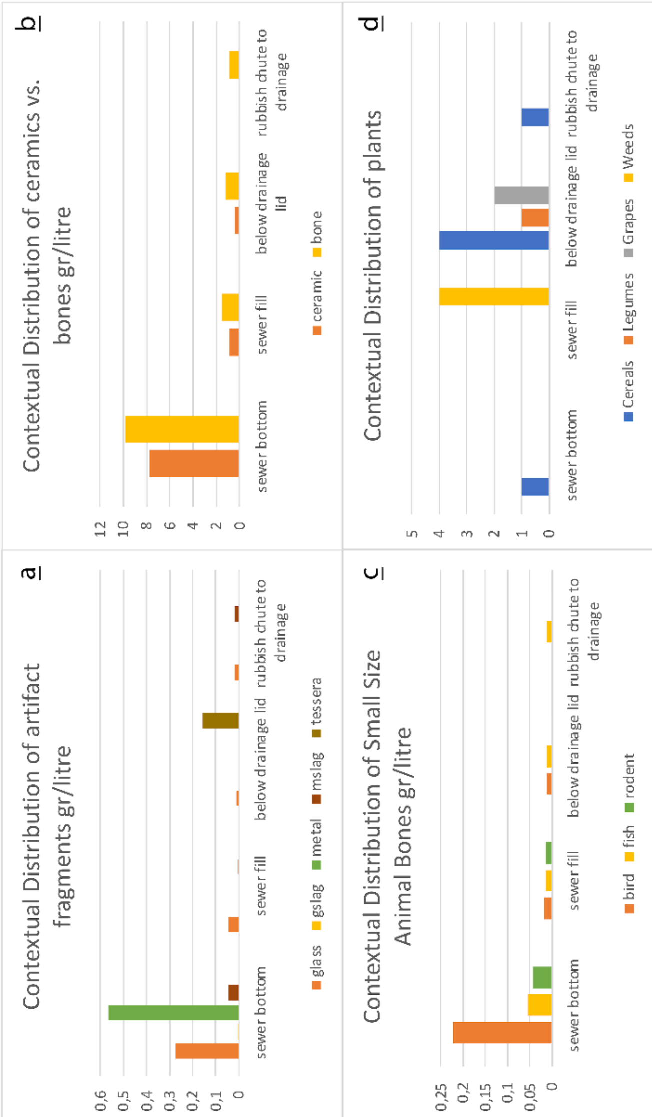

Fig. 8: a.Contextual distribution of artifacts; b.Contextual distribution of ceramics vs animal bone fragments; c.Contextual distribution of small-size animal bones; d.Contextual distribution of macrobotanical remains

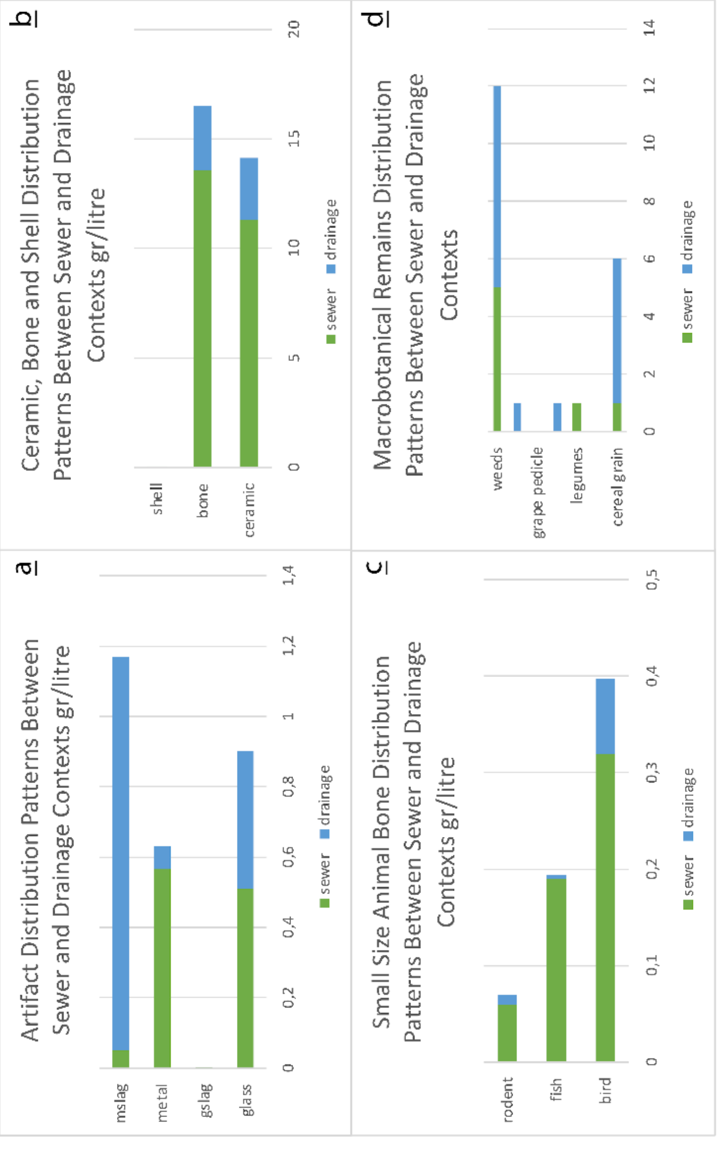

Fig. 9: a.Artifacts between sewer and drainage; b.Ceramics, animal bone fragments, and shells between sewer and drainage; c.Small size animals between sewer and drainage; d.Macrobotanical remains between sewer and drainage

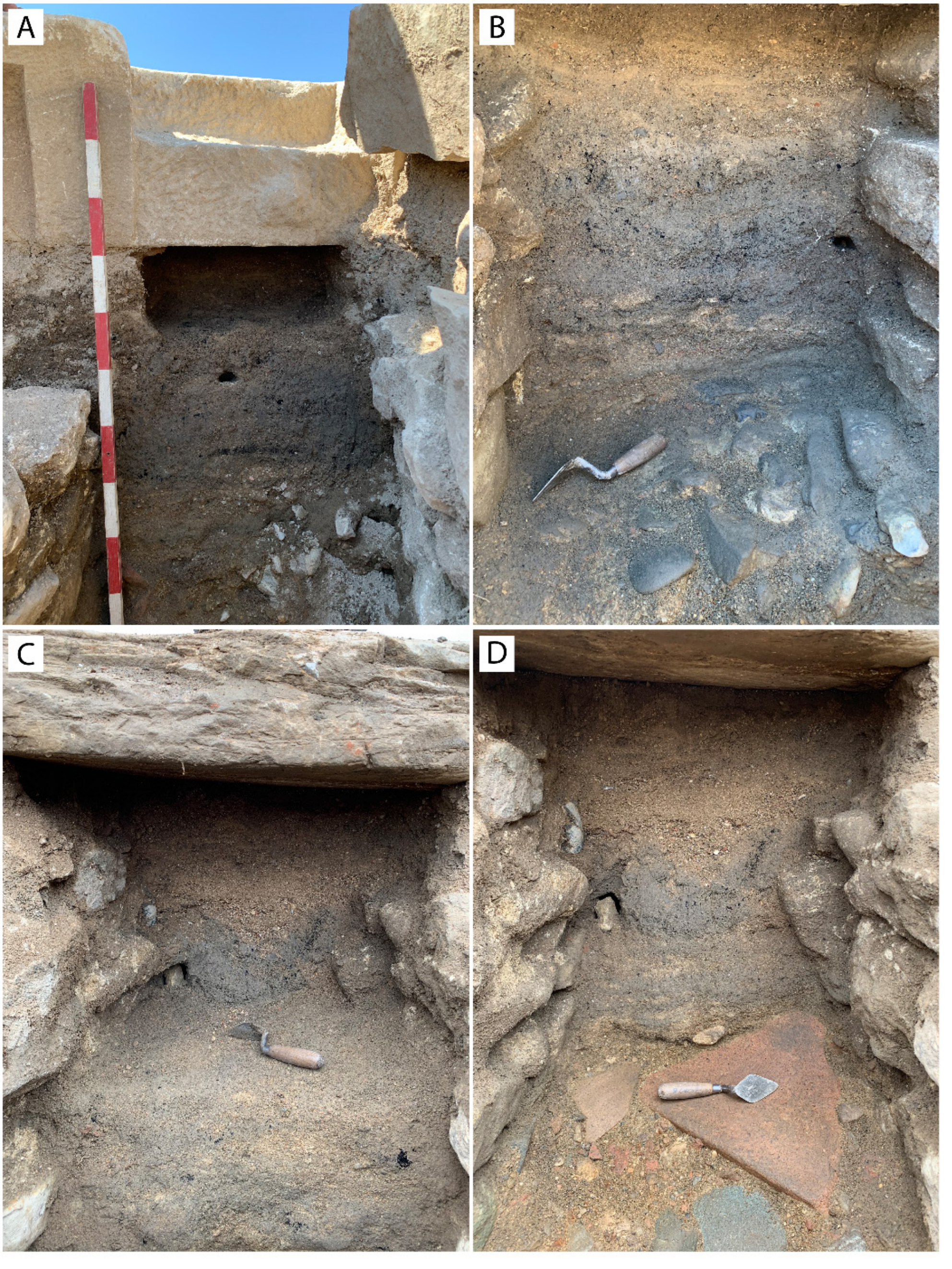

Fig. 10: Sewer upper part: a.Sewer fill; b.Stone base under the cocciopesto floor revetment which was eroded in time due to water stream; Sewer lower part: c.Sewer fill; d.Tile base under the cocciopesto floor revetment which was eroded in time due to water stream

Fig. 11: a.Sampled drainage; b.Closed context of drainage top covered; c.Rubbish chute from the Domus kitchen to the sewer

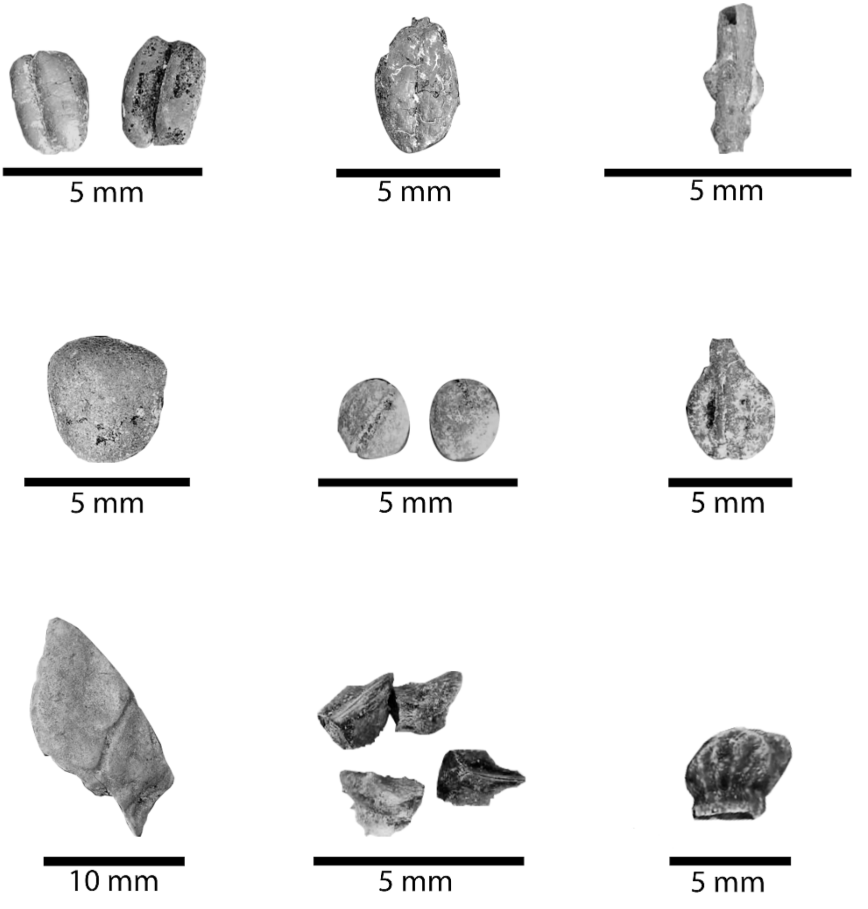

Fig. 12: Macrobotanical remains recovered from the microdebris samples, top to the bottom respectively: *Triticum sp., Hordeum sp., Cerealia rachis, Lathyrus sativus, Vicia sativa, Vitis vinifera, Juglans regia, Echium sp., Anchusa sp.*

Fig. 13: Small size animal bones, top to the bottom respectively: bird phalanges, bird carpometacarpus, fish vertebrae, fish opercular, fish pharyngeal, fish opercular, rodent tibia and femur bones, rodent mandibular, shrew (nonrodent) maxilla and mandibular

Table 1: Microdebris data table

sample no.	**1**	**2**	**19**
unita stratigraphica	1266	1265	1414
context	Drainage	Drainage	Sewer bottom L1
phase	Period 1 - final phase	Period 1 - final phase	Period 1 - Period 2 (Road III)
TPQ	5th c.	Late 5th – 6th c.	5th c.
function	Drainage	Drainage	Sewer
sample volume (litre)	10	8	43
artefacts gr/litre			
ceramic	1.05	1.6525	3.475
glass	0.107	0.08125	0.075
glass slag			0.0028
metal			
metal slag			0.0026
tessera			
animal bones gr/litre			
bone fragment	0.862	1.35	2.63
bird	0.025	0.053	0.023
fish	0.12	0.00125	0.01
rodent	0.002		0.006
shell		0.0125	
plant remains (count/litre)			
triticum spp.			0.023
hordeum spp.			
cerealia			
rachis			
spikelet fork			
culm node			
straw			
vicia sativa			
lathyrus	0.1		
vitis vinifera			
grape pedicle			
juglans regia			
weeds	0.1		

Table 1: (continues)

sample no.	**20-21**	**24**	**25**
unita stratigraphica	1413	1426	1414
context	Sewer fill L1	Drainage	Sewer bottom L2
phase	Period 1 - Period 2 (Road III)	Period 2 (Road IV)	Period 1 - Period 2 (Road III)
TPQ	5th c.	6th - 7th c.	5th c.
function	Sewer	Drainage	Sewer
sample volume (litre)	89	10	16
artefacts gr/litre			
ceramic	0.303	1.435	4.269
glass	0.011	0.017	0.198
glass slag			
metal			0.566
metal slag	0.0022	1.119	0.045
tessera			
animal bones gr/litre			
bone fragment	0.71	0.435	7.2
bird	0.005	0.071	0.2
fish	0.011		0.045
rodent	0.013	0.01	0.037
shell			
plant remains (count/litre)			
triticum spp.			
hordeum spp.			
cerealia			
rachis			
spikelet fork			
culm node			
straw			
vicia sativa			
lathyrus			
vitis vinifera			
grape pedicle			
juglans regia			
weeds	0.045	0.5	

Table 1: (continues)

sample no.	**26**	**27-28**	**29**
unita stratigraphica	1413	1445	1444
context	Sewer fill L2	Manhole cover	Connection from VV to main drainage
phase	Period 1 - Period 2 (Road III)	Period 1 - Period 2 (Road III)	Period 1
TPQ	5th c.	5th c.	4th c.-5th c.
function	Sewer	Below drainage lid	Drainage
sample volume (litre)	91	47	14
artefacts gr/litre			
ceramic	0.564	0.407	0.133
glass	0.0364	0.012	0.02
glass slag			
metal			
metal slag			0.021
tessera		0.156	
animal bones gr/litre			
bone fragment	0.818	1.21	0.88
bird	0.014	0.0123	
fish	0.0025	0.011	0.012
rodent	0.0014	0.0017	0.0007
shell			
plant remains (count/litre)			
triticum spp.		0.064	
hordeum spp.			0.0714
cerealia		0.0213	
rachis		0.0213	
spikelet fork			
culm node			
straw			
vicia sativa		0.0213	
lathyrus			
vitis vinifera		0.0426	
grape pedicle			
juglans regia			
weeds			

Table 1: (continues)

sample no.	**30**	**33**	**34**	**38**
unita stratigraphica	1443	1439	1446	1515
context	Catch pit of the latrine flushed by channel US1526	Drainage	Drainage	Drainage
phase	Period 1	Period 2	Period 1	Period 2
TPQ	4th c.-5th c.	6th-7th c.	Mid-3rd c.-4th c.-5th c.	6th-7th c.
function	Latrine	Drainage	Drainage flushing if the latrine	Drainage
sample volume (litre)	19	42	1	10
artefacts gr/litre				
ceramic	0.5	0.65	2.35	0.225
glass	0.017	0.34		0.018
glass slag				
metal		0.064		
metal slag				
tessera				
animal bones gr/litre				
bone fragment	0.92	1.588		0.01
bird		0.0067		
fish	0.0005	0.0036		
rodent	0.0005	0.0002		
shell				
plant remains (count/litre)				
triticum spp.	0.21	0.024		
hordeum spp.				
cerealia				
rachis				
spikelet fork				
culm node				
straw				
vicia sativa				
lathyrus				
vitis vinifera				0.1
grape pedicle				
juglans regia		0.024		
weeds		0.048		

Appendix: Description of the sampling contexts

Stratigraphic Unit 1266 (sample n. 1)

Sand and silt within drainage 1345, downstream of closure 1346. Drainage 1345 was set up along the northern edge of the roadway, abutting the southern perimeter wall of the Domus. Its walls are built with mortared bricks and the bottom, sloping to the east, is made of large tiles where preserved, and the cover is made of slabs of local stones summarily dressed. It was built to receive the wastewater coming from the ducts arranged inside the Domus. A stretch of the drainage was disabled by blocking the duct with stones and fragments of bricks. Upstream of this block, a breach was opened in the southern wall of the drainage to allow the waste to flow towards the central sewer of the road. Downstream of the block, the duct is filled with sand and silt 1266 which probably mixes with a deposit already present in the channel and is then covered by a new penstock. Above all, this diversion highlights the disuse of drainage 1178 which likely conveyed the waters of an ‘overflow’ from the Domus to the outside, revealing a reorganization of the Domus’ water collection and disposal at this stage. The terminus post quem provided by the pottery found in the context can be traced between mid-6th and mid-7th century AD.

Stratigraphic Unit 1265 (sample n. 2)

Sandy silt within drainage 1345 (see above), west of closure 1346. The context fills a part of the structure where the cover is missing after the spoliation of the slabs of the road. Compared to the fill 1266 this layer has a higher percentage of silt and a lower presence of artifacts reduced to minimal dimensions. It has been interpreted as the sediment of the waste from the western part of the Domus passing through the drainage addressed to the street sewer following the closure described in the previous context, therefore later than 1266.

Stratigraphic Unit 1414 (samples n. 19, 25)

Sandy silt within sewer 1479. The sewer is made up of parallel side walls 55 cm thick in limestone blocks. It is 50 cm wide and 60 cm high. The surface of the sliding bottom was covered by waterproof mortar almost entirely eroded by the flow of water. The cover of the sewer is made of the paving slabs of the road, selected with regular shape and wider size. The sewer was built together with the paving of the road still in situ which has been dated based on pottery and coins found in the preparatory layers, to the first half of the 5th century AD, therefore about two centuries after the first construction of the Domus. As seen for the 1479 drainage, other drainage systems probably pre-existed this central sewer, adapting to it after its construction. Other inlets from the buildings along the road were built at the same time as and later than the setup of the sewer. The dimensions of the walls and the conditions of the bottom show that the sewer was not only used for urban wastewater but also for the disposal of rainwater. It has been exposed and investigated for a stretch of about 3 m. The lumen of the sewer is entirely occupied by a fill-in and five different stratigraphic units have been identified. Above a layer that fills the removal of the bottom composed mainly of pebbles and sand, a sequence of three levels of sandy silt has been identified, sealed at the top by a sandy layer that reaches the top of the channel, completely blocking the duct. The grey-brown silt layer 1414 is a horizontal deposit 8-10 cm thick above the layers 1415 and 1416, deposited when the conduit was still almost entirely free. Its formation can be rightly placed during the lifetime of the sewer, which as mentioned above was built during the 5th century AD. The samples have been collected at the eastern and western ends of the portion investigated.

Stratigraphic Unit 1413 (samples n. 20, 21, 26)

Brown sandy silt and scattered gravel overlaying layer 1414 in the sewer 1479. The layer is 25-30 cm high, the surface is flat sloping to the east. It contains few ceramic fragments of minute dimensions spread not homogeneously. It has been interpreted as the filling of the sewer in the absence of regular maintenance, lasting for a duration difficult to evaluate and at a time equally difficult to pinpoint, probably between the end of the 6th and the 7th century. The samples have been collected at the eastern and western ends of the portion investigated.

Stratigraphic Unit 1426 (sample n. 24)

Brown-yellow silty sand filling the duct 1480. Unlike sewer 1479, conduit 1480 was built for the supply of drinking water to an unknown facility further downstream. It has been excavated for a length of about 3.60 m. For the installation of this infrastructure, the paving slabs of the southern half of the road were probably raised and a trench dug down to the bedrock where the conduit was built. The duct is 15 cm wide and 20 cm high, built with parallel walls in limestones and mortar, set over a row of tiles, entirely coated by waterproof mortar. The cover is also made of stones and mortar to carefully seal the water duct. The trench was refilled with a compact sandy layer in which unfortunately no dating materials were found. In the excavated section, the installation of the conduit cut and disabled drainage whose mouth in the central sewer was closed with bricks and mortar, therefore the conduit is later than the sewer but it was built when the last one was still working and kept under maintenance. However, there are no clues as to when the duct stopped working. The internal sediment 1426 is very homogeneous, it almost fills the internal space of the duct, as if the occlusion had occurred in a limited period. A section of the layer of about 40 cm, corresponding to the uncovered part of the channel, was sampled.

Stratigraphic Unit 1439 (sample n. 33)

Silty sand and gravel fill the drainage 985. This meandering drainage (985=1736=11) was built on the earth floor laid over the mosaics of corridor S1 and crosses the Domus from

SW to NE in the transformation that we have described as the second period of the building. Pottery and numismatic finds from its construction cut date this infrastructure to the second half of the 7th century AD. It is not yet clear what the source of the water was in room LL where the drainage starts. It likely ended in a collecting cistern to the northeast of the Domus, in an area not yet investigated. The drainage was built with large arched terracotta slabs aligned to form the bottom, while the side walls were built with reused bricks bonded with clay and covered with stone slabs of various kinds. This drainage very well expresses the transformation of spaces and functions inside the Domus, opening breaches in at least five walls to pursue the objective of collecting and storing water, likely rainwater, in an area different than the infrastructures used in the earlier phases of the Domus. The sample has been taken from the part of the drainage at the very west of area XX.

Stratigraphic Unit 1515 (sample n. 38)

Sandy silt filling the drainage 9. Drainage 9 is a stretch 8 m long of channel investigated in the northern corridor of the peristyle, cut both upstream and downstream by the larger and later drainage 11 which probably replaced the smaller 9 in the second half of the 7th century. The dating of the drainage 985=1736=11 therefore chronologically frames the sampled silt filling the drainage 9. The latter is built by placing a row of reused curved kalypteres in a trench cut in the earthy floors; both side walls are built with cobbles and fragments of bricks bound with mortar, covered with recycled square bricks placed at the level of the floor. Given the way it was covered, it is possible that part of the sampled deposit was not only the residue of the water passing through the drainage but that part of it was infiltrated from the outside.

Stratigraphic Unit 1443 (sample n. 30)

Sand, silt, and gravel in the latrine 1745. The latrine is a quadrangular pit, 1.25 m long, 0.40 m wide, and 0.50 m high, built with mortared stones and the bottom with large tiles, close to the southern perimeter wall of the Domus. Two phases of this facility have been recognized: the first is probably equipped with seats and a running water system for washing, in the second the latter is diverted directly into the pit which was covered with simpler perforated stone slabs. The pit originally had an inlet of water through a pipe coming from the road whose origin is unknown, while it drained downstream to the east, probably through a channel linked to the road drainages which has not yet been investigated. The sample was taken from the bottom of the pit after the removal of other sandy sediments that covered it.

Stratigraphic Unit 1446 (sample n. 34)

Silty sand deposited in the hydraulic structure 1466. The latter was built in the refurbishment of the latrine in 1745 with the arrangement of perforated stone slabs above the pit. The running water for washing, previously passing through the small channel cut into the limestone blocks of the earlier phase, was blocked by this structure built around a new circular cut in the stone and directed towards the mentioned slab. The deposit fills this cut and part of the small collection structure built around it. This phase of the Domus has been dated to the 4th century AD.

Stratigraphic Unit 1444 (sample n. 29)

Incoherent ashes, charcoal, and sand in the drainage 1430. This drainage was built by opening a breach in the southern perimeter wall of the Domus and building a chute with bricks that dumps into an inspectionable manhole with cover in the paving of road 1339. The manhole is connected via drainage to the central sewer 1479 of the road (see above). The drainage 1430 can be understood together with the evidence of a large structure for firing immediately north of it. This structure identifies this room of the house as a kitchen for preparing food, equipped with a hob 1.50 m long. The drainage is therefore a feature for cleaning the kitchen, into which food waste and combustion residues were probably dumped during its use. Although this area of the Domus was arranged as a kitchen in the 4th century, the later cut in the wall and above all the unity of this arrangement with the construction of the central sewer and the paving of the road, move the dating of the structure to the 5th century AD. On the other hand, it is much more difficult to date its dismissal. There is no evidence of major transformations up to the early Byzantine fillings, therefore it is likely that the kitchen and drainage continued to be used throughout the 6th until the 7th century.

Stratigraphic Unit 1445 (samples n. 27-28)

Incoherent ashes and sand in the manhole 1533. The manhole collects the waste from drainage 1430 (see above) and from here it is directed to sewer 1479 in the middle of the road, where the outlet has been identified, built at the same time as the central sewer. As with the drainage 1430 that fed it, this manhole may have worked for a long time. Given its location, it is likely that it also collected surface water flowing along the road.