Ceramics as an indicator of building chronology at Kastro Apalirou: Preliminary observations.

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Abstract

Η χρήση της κεραμεικής, τόσο ως οικοδομικού υλικού (Ceramic Building Material ή CBM), όσο και υπό τη μορφή αγγείων στην κατασκευή των οικοδομημάτων στο Κάστρο Απαλίρου εξετάζεται με βάση την ανασκαφή της "Μικρής Εκκλησίας" που κατέρρευσε, καθώς και της μελέτης της επαναχρησιμοποιημένης κεραμεικής στη στεγάνωση των δεξαμενών. Οι τύποι και η λειτουργία της κεραμεικής ως οικοδομικού υλικού (CBM), καθώς και η υπόλοιπη κεραμεική, παρέχουν στοιχεία για τις λύσεις που βρήκαν οι χτίστες της πόλης, ενώ συμβάλλει στην κατανόηση των οικοδομικών της φάσεων. Ο κύριος όγκος της χρονολογούμενης κεραμεικής τοποθετείται στον 6ο έως 8ο αιώνα, ενισχύοντας έτσι τη χρονολόγηση της κατασκευής του χώρου. Ευρήματα από τα δάπεδα της εκκλησίας παρέχουν ένα *terminus post quem* για την κατάρρευση του ναού στον 11ο ή 12ο αιώνα, γεγονός που σημαίνει ότι παρέμεινε σε χρήση για μια περίοδο 500 ετών. Η απουσία ακέραιων πλίνθων και κεραμίδων υποδηλώνει εντατική επαναχρησιμοποίηση των υλικών παλαιότερων κτισμάτων, καθώς και της μεταφοράς κεραμεικών οικοδομικών υλικών (CBM) από άλλους οικισμούς. Για την κατασκευή υδραυλικών επιχρισμάτων στις δεξαμενές, χρησιμοποιήθηκε κονιάμα, που περιείχε κεραμεική ως πρόσθετο και αδρανές υλικό σε ποσοστό 50% του συνολικού όγκου του επιχρίσματος. Επιπροσθέτως, μια στρώση οστράκων αμφορέων είχε εντοιχιστεί στις εσωτερικές στρώσεις του κονιάματος σε εννέα από τις υπό μελέτη δεξαμενές. Αυτό, ωστόσο, δεν φαίνεται να συνέβαλλε στην υδραυλική στεγανότητα του επιχρίσματος και ο ρόλος του στρώματος αυτού στην κατασκευή παραμένει αδιευκρίνιστος.

Introduction

Over the past five years a Norwegian-Greek-British project has conducted a detailed architectural survey, an intensive pottery survey, and two minor excavations on and around the fortified hilltop settlement of Kastro Apalirou in southwest Naxos. Details of several of these are presented elsewhere in this volume.

During the field survey, which was carried out as part of the Apalirou Environs Project (AEP) between 2015 and 2017, pottery and other small finds were collected from the surface of the entire site and a substantial portion of the surrounding area. The data from this work, however, are still at an early stage of analysis and only broad statements about the chronology and use of the site can be made. The present chapter is a short overview of ceramic finds from architectural contexts and the first stratified excavations at Apalirou, focusing in particular on ceramics used as building material. Their function and the chronological information gained from this analysis will also be discussed.

Ceramics as building material

The structures in the settlement were constructed mainly from local limestone, presumably quarried on site, but some materials transported to the hilltop were also used, including marble, volcanic tufa, mortar and lining, and ceramics.[1] The general impression from the architectural survey is that bricks have not been used consistently in any building, but broken fragments of various types of tiles and bricks, as well as pottery sherds are seen in several of the buildings, particularly where mortar has been used.[2] The only Ceramic Building Materials (CBMs) used in the shape and purpose for which they were likely manufactured are ceramic water pipes, found in situ in the bath building[3] and in several of the standing cisterns (a good example being cistern 19, [**fig. 5**], which has two ceramic pipes leading in through the roof at approximately 45^0 angles towards the centre).

Like the local stone, most of the pottery is likely to have been readily on hand on the hilltop, having been carried up as containers for other goods, but the CBM must have been salvaged from the surrounding area and brought up as broken fragments. Either the CBM was found to be more available than quarried stone despite the effort required, or it was seen to add valuable structural functionality even in a fragmentary state.

For the most part, further identification of the ceramics still enclosed in the standing structures is difficult, as is the secure connection of surface finds with identified buildings. However, the building collapse uncovered during one of the excavations, and the practice of adding a layer of pottery sherds to the lining of cisterns, each offer an opportunity to look at the ceramics used as building material in more detail.

The 'Small Church'

Within the framework of the Norwegian survey at Kastro Apalirou, parts of a newly recorded double-aisle church close to the southern peak of the hill were excavated over three short seasons from 2014 to 2016.[4] During the work, all ceramic objects were collected and brought to the museum depository — a total of 747 sherds, which based on the recorded feature sherds belonged to a minimum of 158 vessels. Due to the nature of the collapse, no stratigraphic division was made in the collection of the material from 2014 and 2015, but the finds were registered by date found. The layer right above the floor level excavated in 2016, however, was clearly below the collapsed building material, and has been recorded as such.

Collapse material

Approximately one third of the sherds have clear signs of mortar or plaster attached to them, indicating that a large part of the material found had been used in the building of the church. In the collapse, more than 75% of the feature sherds have mortar, against very few from the surface and from the floor level. There are few examples of joining sherds in the collapse material, suggesting that they were probably used in the construction as broken fragments, or entered the assemblage as individual sherds. A large part of the feature sherds is made up of amphora handles and handle roots, but larger wall fragments of

1. See Hill, this volume.
2. See Hill, this volume.
3. Excavated by the Ephorate of Antiquities of the Cyclades, forthcoming.
4. See Ødegård, this volume.

beehives are also common. The two well-preserved vessels (2015-039 and 2015-040) (**fig. 1**), have been identified as Spatheion 3 amphorae (Keay 26). These 'miniature amphorae', less than 50 cm in height and containing up to 3 litres, have been dated to the mid-6th to end of the 7th century, with the main production centre in Tunisia.[5] Both were found close to the floor level in the south-eastern part of the excavated area, and have mortar attached to their exterior surface. While it is possible that the bases and lower parts of the vessels are in the un-excavated part of the church, it seems more likely that only the upper parts were used in the construction as there are no non-joining sherds belonging to them in the rest of the trench. Thirty-eight sherds (2015-041) (**fig. 1**) of a Late Roman Amphora 1 (LRA1), constituting the rim and upper handle, a lower handle attachment and several larger pieces of the body, also had mortar attached and must have been used as building material. The amphora has an approximate date in the 5th to mid-7th century.

In addition to the use of sherds and fragments as wall material, larger semi-complete vessels could also be incorporated into the construction as lighteners or, simply, shelves, as is seen e.g. in the Middle Byzantine church of Agios Georgios Dorgana in Kastro Koskinas on Ikaria (**fig. 2**).[6] It is possible that some of the larger parts of beehives and amphorae found in the excavation served this purpose (e.g. 2015-041).

The collected material includes 342 fragments (a third of the total count) of CBM in the form of tile (tegulae and imbrices) and brick. The most striking feature of the CBM is the large variation in shape and fabric (**fig. 3**). Differently shaped roof-tiles do not work well together on a single roof cover, as the tegulae and imbrices are produced to fit together. In combination with the frequent occurrence of mortar on break surfaces, and the lack of complete tiles or bricks even when joining has been attempted, it must be concluded that the CBM is in secondary use in the church, in much the same way as the broken pottery, and that the presence of roof-tiles cannot indicate a tiled roof. The large variation in the CBM fabrics could indicate that Naxos, as other areas of the Roman and Early Byzantine empire, imported a major part of the tiles used.[7] A further petrographic analysis of the tile types could provide interesting details on the CBM trade reaching the island, even if it might not be directly linked to the construction of Kastro Apalirou.

Floor level

On the floor level (**fig. 4**), below the collapse, were two glazed sherds belonging to different vessels. One (2016-060) is a part of a pedestal foot in fine white fabric with green glaze (varying darker and lighter areas) on the exterior, on the resting surface, and on the lower part of the interior. The type parallels Hayes' Type 17 of Glazed White Ware II (GWW-II) from Constantinople,[8] which are stemmed lamps or small bowls most common in the 11th and 12th centuries, but also existing in the 10th. The other (2016-061) is a body-sherd from an open vessel in medium-fine pinkish fabric with few reddish-brown inclusions, which has a clear glaze with spots in green on both interior and exterior surfaces. This is probably a slightly later form of GWW-II, dating to the 11th or 12th century.[9]

Fragments of two glass vessels were also scattered on the floor level in the eastern part close to the apse. One vessel (2016-066) consists of nine fragments forming the bottom and lower walls of what was probably a chalice or a lamp; a break surface in the centre of the base shows that the vessel had a stem.

5. Bonifay (2004), pp. 127-29.
6. Note that the church is heavily restored; see also Ousterhout (2008).
7. Mills (2012) pp. 573-94 esp. pp. 578-80.
8. Hayes (1992), pp. 28-29.
9. Hayes (1992), pp. 18-19.

The lower part has been pinched in six places, creating a star-like pattern of ribs. Fifteen fragments, mostly tiny, belong to 2016-067, but less of its shape has been reconstructed. The vessel has a narrow rim and neck, and a rounded base, which seemingly also has a break surface that could suggest a stem. Neither of the glass vessels have been typologically determined or dated.

Cisterns

Close to sixty cisterns have been recorded inside the walls of the settlement, exhibiting a large range in shape and capacity (**fig 5**).[10] In order to retain the weight of the water, the cisterns are generally well built using ample mortar, and are thus in far better condition than most other structures at Apalirou.[11] Additionally, to keep them watertight, the interior is clad with one or more layers of hydraulic lining. Throughout the cisterns at Apalirou, this inner lining is pinkish in colour, which suggests the addition of crushed ceramic dust, and ceramic fragments up to approximately 5-10 mm are visible macroscopically. There is, however, considerable variation in the chroma of the matrix colour and in the size and density of the aggregate ceramic fragments. This variation is seen both between cisterns and within single cisterns. In part, it should be attributed to different intended functional properties, with one or more coarser base layers covered by a finer and paler finishing layer of lining, but it is also likely to represent more coincidental variation between batches of lining mixture, and potentially chronological developments. No petrographic or chemical analysis has been carried out on the mortars or linings from the cisterns at Apalirou.

Of the 59 inspected cisterns, nine were found to have used a layer of pottery sherds in part or all of the wall lining. Twenty-six cisterns did not have traces of a sherd layer, despite being in a condition where this should have been visible, while the remaining 24 were either inaccessible, had little lining preserved, or had few or no breaks in the lining (**fig. 5**). All nine are located in the northern part of the site, which holds a greater number of non-domestic institutional structures,[12] but the technique is used in both large, potentially communal cisterns (6, 7, 27 and 28), and in small free-standing ones (1, 31, 35 and 36). In cistern 1, only the lining in the lower NE corner has pottery sherds inserted. There is also a visible difference in colour and composition between this part of the lining and that covering the remaining parts of the inner walls. It is probable that this corner constitutes an earlier layer, and that the other parts were later repaired, but the stratigraphical relationship between the two layers is not obvious.

Hydraulicity

The addition of ceramic dust and fragments to cements and linings intended for rough and humid environments is well attested in the Roman period, both archaeologically and textually (cf. *cocciopesto*, *opus testaceum*, and *opus signinum*),[13] and the technique seen at Apalirou is similar to Roman and Byzantine cistern linings found elsewhere in Greece.[14] A study of mortars used in the water supply of Constantinople found the ratio of ceramics to lime and sand to average around 1:1 for the water channel lining;[15] the proportion of ceramics in the Apalirou lining mortar might well be similar.

The purpose of the lining was to achieve a durable and watertight barrier. Crushed ceramics con-

10. Hill, this volume.
11. See Roland, this volume.
12. Hill, Roland and Ødegård (2017), pp. 281-92.
13. Peña (2007), pp. 261-68.
14. Doherty (2002), pp. 290-92; Stefanidou *et al.* (2014) pp. 571-80.
15. Snyder (2012), pp. 175, 215-16.

tain aluminiosilicates, which display a character similar to volcanic pozzolan ash when mixed in lime-based mortars.[16] Reactions in the points of contact between the ceramic additives and aggregates, and the hydrated lime create calcium-silicate and calcium-aluminate, strengthening the bonding of the mortar, lowering its permeability by filling voids, and enabling it to harden even in wet conditions.[17] It is, however, assumed that the small size and angular shape of the ceramic aggregates is beneficial for the hydraulicity by providing a large contact area with the bonding agent.[18] This is clearly not the case in the sherd-lined cisterns at Apalirou. Baronio, Binda and Lombardini have shown that a pozzolanic reaction can take place between the hydrated lime and larger ceramic inclusions (e.g. brick fragments or sherds), but only on the surface area of the fragments.[19] The reaction and the carbonation process of the mortar is very slow, lasting up to 30 days in their experiments.[20] In a separate study, Baroni and Binda tested the pozzolanicity of ceramics fired at different temperatures, and found that high-fired ceramics (above 900°C) lost their pozzolanic properties.[21] Based on this, Snyder suggests that under-fired brick wasters would have been the primary ceramics used in mortar.[22] The slow pozzolanic reaction of aggregates would not be a major problem in the dry and stable conditions at Apalirou, but larger fragments would have added little to the hydraulicity of the lining. It is further likely that the amphora sherds used would have been fired at too high a temperature to retain any pozzolanic properties. Thus, the functional role of inserting a layer of sherds in the cistern lining is not apparent.

Chronology

Only body sherds were used to build up the pottery layer of the lining, so the amount of visible diagnostic features is limited. The majority are of medium thickness (5-10 mm) and had come from medium or large closed vessels (probably amphorae); however, many display spiral grooving, bands of fine combing, and slipped external surfaces. The spiral grooving is typical of the upper body of the Late Roman Amphora 2 (LRA2), generally dated 5th-7th century, and of later Byzantine globular amphorae of the 7th and 8th century.[23] Although the technique is also found on other closed Late Roman and Early Byzantine vessels,[24] several of the sherds, especially in cistern 7, can also macroscopically be connected with the LRA2 type (**fig. 7**). These amphorae are not uncommon in the Apalirou survey material, but are far more frequent on Late Roman sites surveyed elsewhere on the island.[25] The type of straight or wavy bands of fine combing seen on many of the sherds became common towards the end of the Late Roman period,[26] but has remained in use on larger closed vessels up until modern times,[27] and cannot in itself contribute much to the dating of the structures. Combined, however, with the high proportion of LRA2 sherds, the prevalence of fine, high fired fabrics, and the lack of identifiable later vessels, it points towards a possible early (6th-7th or 8th century) date for the use of this lining technique, which may mean that the affected cisterns would have been built by this time.

16. Snyder (2012), pp. 27-28.
17. Doherty (2002), p. 291; Stefanidou *et al*. (2014), p. 572.
18. Baronio, Binda and Lombardini (1997), pp. 33-40, p. 33; Stefanidou *et al.* (2014), p. 572.
19. Baronio, Binda and Lombardini (1997), pp. 35.
20. Baronio, Binda and Lombardini (1997), pp. 35.
21. Baronio, Binda and Lombardini (1997), pp. 41-46.
22. Snyder (2012), pp. 46-47.
23. Hayes (1992), pp. 62-71; Gabrieli, Jackson and Kaldelli (2007), pp. 793-94; Didioumi (2014), pp. 169-80.
24. Robinson (1959), p. 6.
25. Author's observation.
26. For a 7th-8th century amphora example, see type 32 in Hayes (1992), p. 71.
27. Robinson (1959), p. 6.

Conclusion

The presence of ceramics in the architecture has been observed in all parts of the settlement, particularly in structures built with bonded masonry. The investigation of the 'Small Church' offered a better understanding of the types and function of the ceramics used for building purposes.

The church has clear evidence of secondary use of broken pottery vessels and of broken CBM as construction material. Although it seems that most of the ceramics have been incorporated in the walls or roof in a 'brick-like' way, it is likely that some of the less fragmented objects were used as lighteners, shelves or in some other function as semi-complete vessels. This reuse would allow for a date of the church construction based on the chronology of the pottery. Unfortunately, however, at present only a few of the ceramic objects have been securely dated, and a corresponding date for the church must be treated with caution. Still, the two Spatheion 3 amphorae and the Late Roman Amphora 1 could indicate that the Small Church was built in the 7th or 8th century, potentially as early as the late 6th century.

The presence of 11th or 12th century glazed pottery on the floor gives a clear *terminus post quem* for the collapse of the church, and shows a probable use-life of more than 500 years. The pedestal vessels in glazed white ware and the two glass vessels, both of which could be either lamps or chalices, may well have belonged to the equipment of the church.

In all cisterns on the site, crushed ceramics have been used as an aggregate acting as a pozzolanic agent in the hydraulic lining. This reuse of ceramics is common, and is to be expected in an area where volcanic pozzolana is not readily available. The practice of building up a single layer of pottery sherds inside the hydraulic lining, however, is not consistently applied, and is found mainly in the northern part of the town. This technique does not seem to be well documented elsewhere, and its exact function is not clear. It is possible that the layer was perceived to form a better water barrier, and that readily available amphora sherds could replace some of the hydraulic lining, thus saving work and materials.

The sherds can only securely give a *post quem* date for the lining of the cisterns, which based on the LRA2 sherds is between the 5th and the 7th century. The apparent chronological coherency, however, together with the limited application of the technique, might indicate that it was used only at a certain period during the early phases of construction of the fortified settlement, and that the cisterns where the sherd layer is preserved should be dated to this period.

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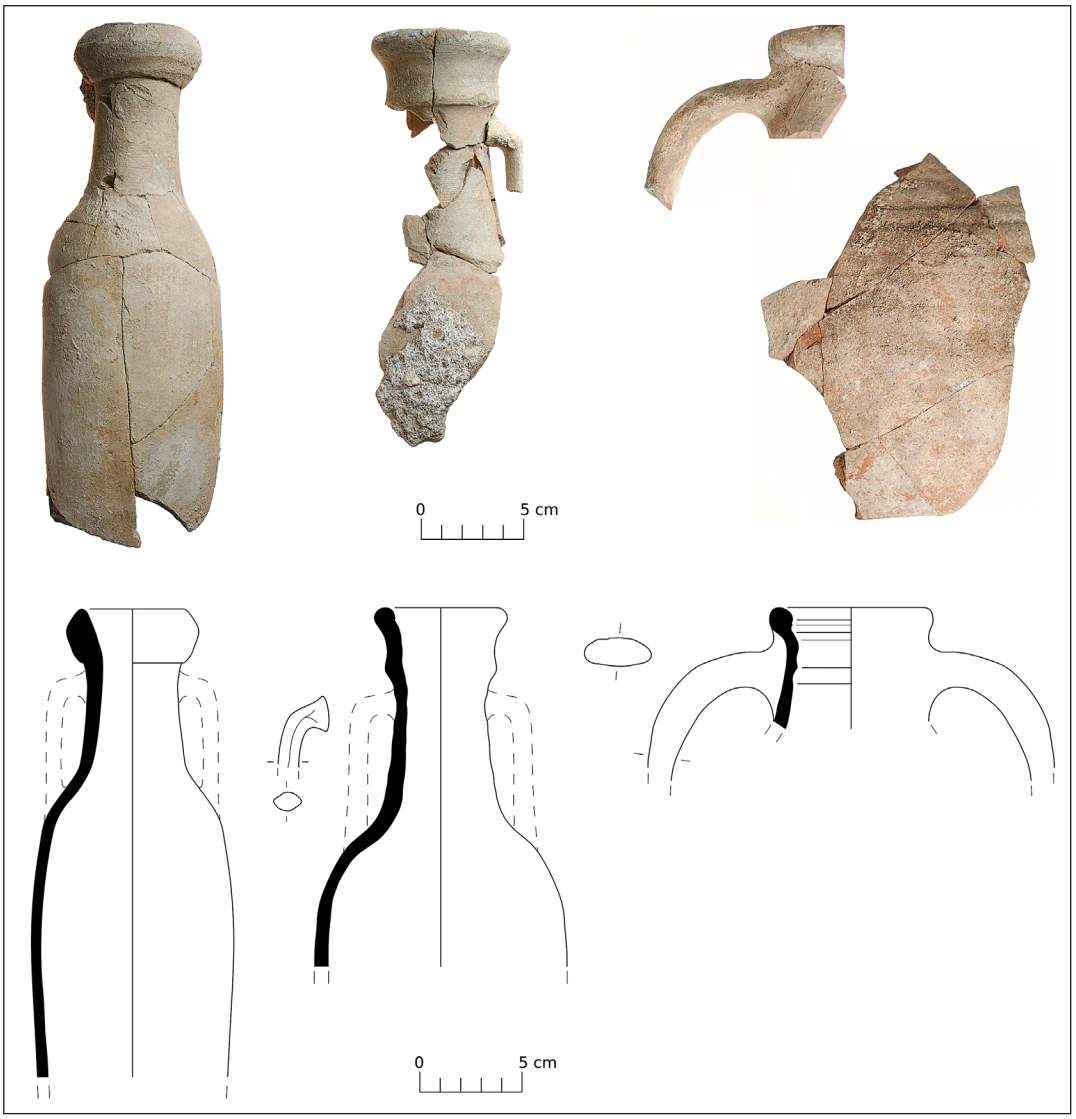

Figure 1. Amphorae with mortar from the collapse in the 'Small Church'. 2015-039 (left), 2015-040 (centre), 2015-041 (right).

Figure 2.
Beehive as shelf in Agios Georgios Drogana, Ikaria.

Figure 3. A selection of different tegula types from the collapse of the 'Small Church'.

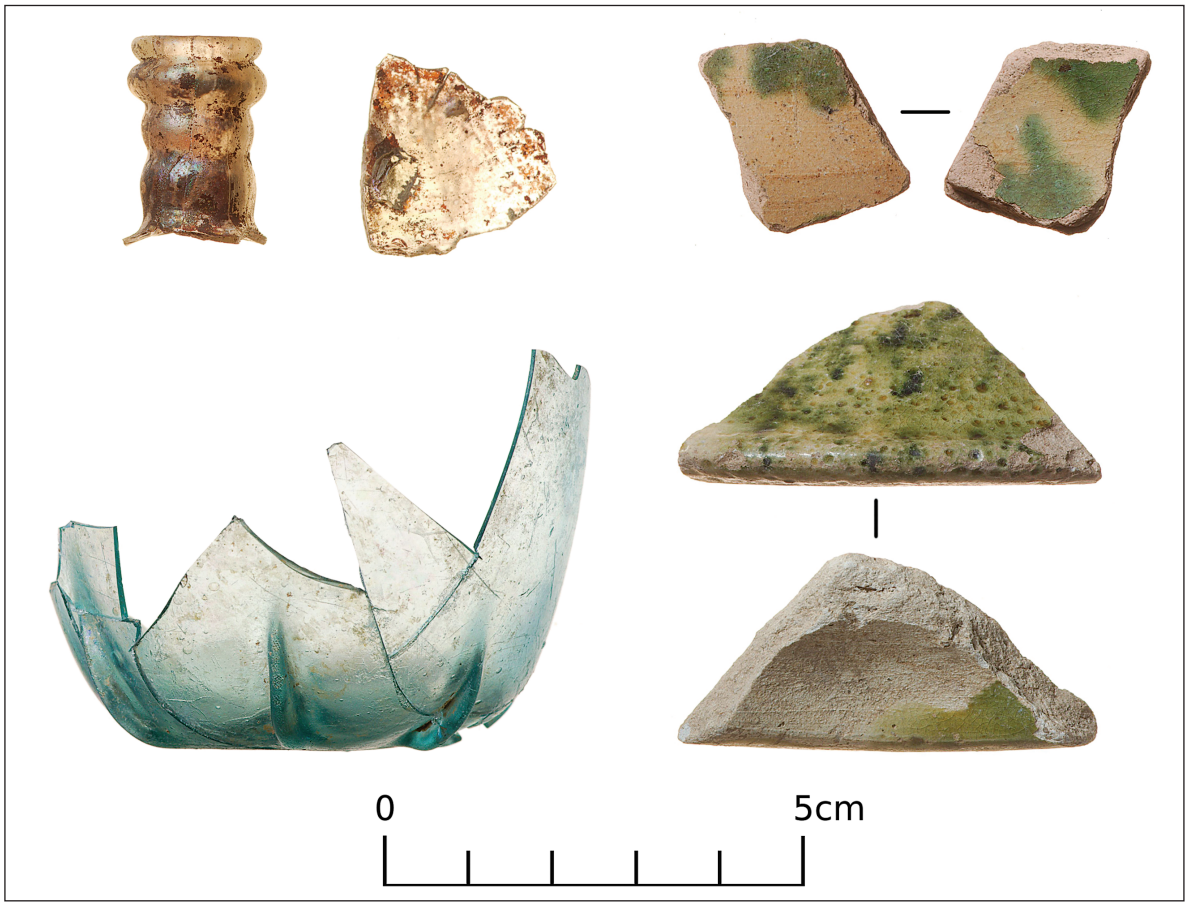

Figure 4. Finds from the floor level of the 'Small Church' excavation. 2016-067 (top left), 2016-061 (top right), 2016-066 (bottom left), 2016-060 (bottom right).

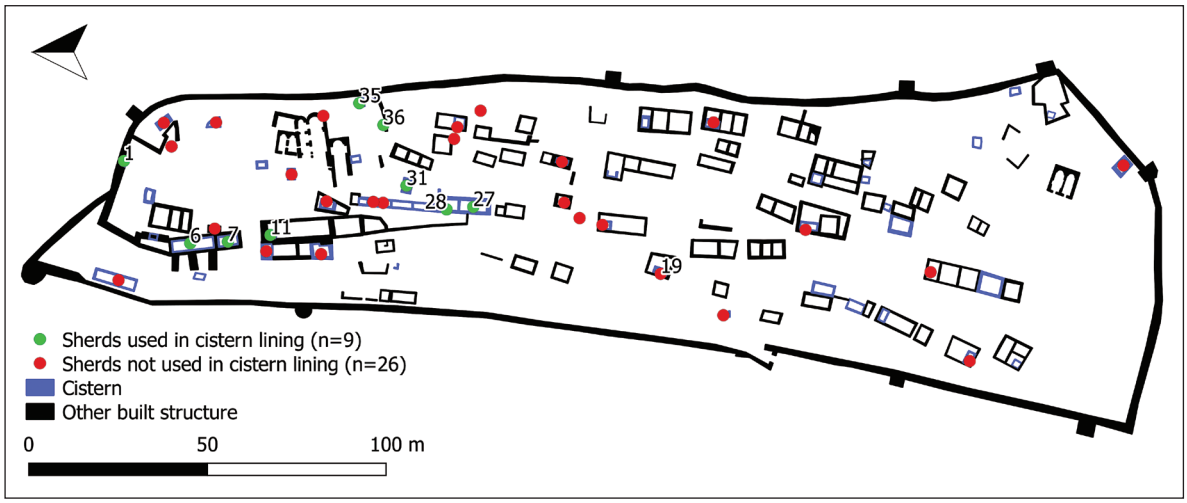

Figure 5. Cisterns at Kastro Apalirou where pottery sherds have been used in the lining. Those that are unmarked denote the instances where preservation and/or visibility did not allow for a determination.

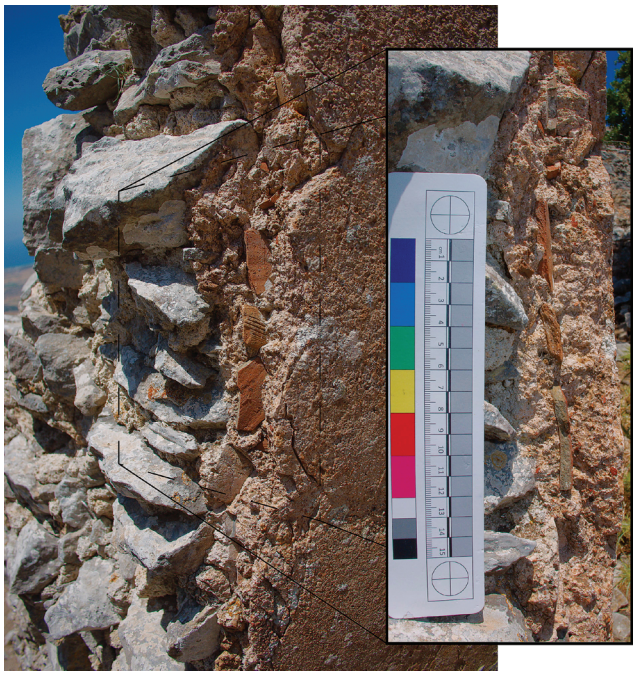

Figure 6.
Layering of the lining including sherd layer on the west wall of cistern 6.

Figure 7.
Sherd layer, including LRA2 sherds, visible in breaks of the lining in cistern 7.