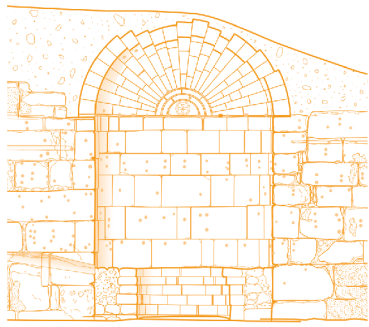
Methods of quantitative and qualitative analyses of ancient marble finds assemblages. The cases of early Byzantine Hawara, Porphyreon, and Philoxenite



Abstract: Quantitative and qualitative analyses of marble finds at ancient sites are rare, one of the reasons being the lack of standard measures enabling comparison of different assemblages. The paper discusses the applicability and limitations of various methods of quantitative and qualitative analyses, which were tested on datasets of marble objects and excavation results from three medium-sized early Byzantine settlements: Hawara, Porphyreon, and Philoxenite. The tests involved the comparison of volume measurement results obtained for different functional and material-based classes of objects. The analyses confirmed a significant variability among the assemblages, which seems to have been related to the diverse geographic location and socio-religious significance of the settlements. Besides proving the applicability of the methods used, the study has indicated their potential for use in reconstructing consumption patterns in various types of settlements and investigating their intra- and supra-regional diversity.

Keywords: marble, quantification, early Byzantine period, Eastern Mediterranean, Philoxenite, Porphyreon, Hawara, archaeological methods

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INTRODUCTION

Excavations carried out year after year at ancient sites in the Mediterranean yield a significant number of marble objects, yet the exact quantity of these finds remains unknown. Meanwhile, collecting such quantitative data would enable comparison of the levels of supply of this material to different sites and to entire regions, enriching our knowledge of the changing economic patterns, the scale of the trade, and the factors that affected it. Therefore, marble finds are presently not exploited to their full research potential. By comparison, the fraction of amphoras, fine wares, and coins found at various sites is also small compared to their total numbers in circulation, yet their analyses consistently reveal patterns permitting to draw broad conclusions about trade in Antiquity. Nothing prevents marble finds from playing a similar role.

This paper discusses methods of quantifying marble finds and comparing assemblages of objects made of material procured from different quarries with datasets comprising detailed information on finds from three early Byzantine sites, which are used here as case studies. All three sites are medium-sized settlements, which makes them ideal for comparison. Of key importance are also their geographic location and function, assumed to have an impact on the diversity of the marble assemblages discovered during excavations. None of these settlements had direct access to marble deposits and thus needed to import this material from distant regions.

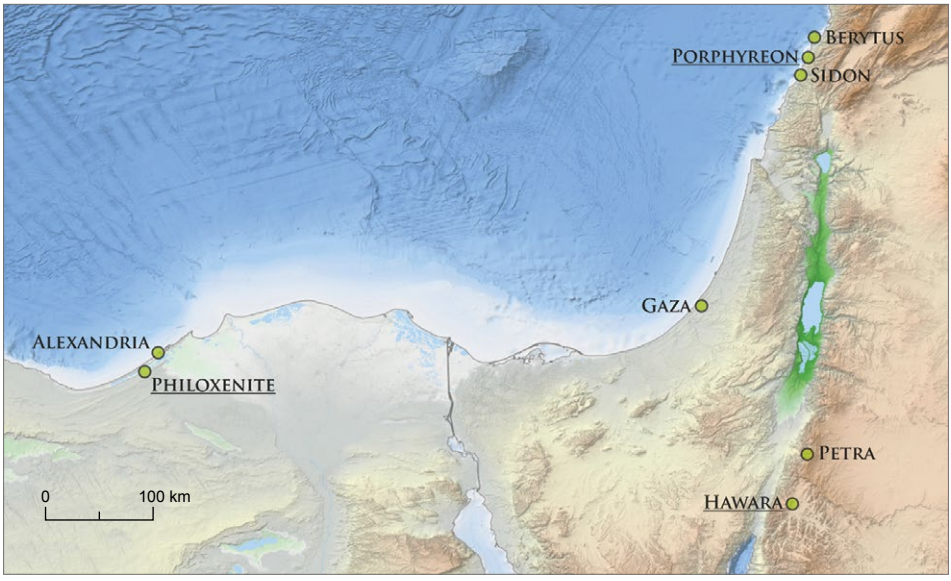


Fig. 1. Location of the sites of Porphyreon, Hawara and Philoxenite in the southeastern Mediterranean (Drawing M. Gwiazda)

The three sites under consideration are Hawara in Transjordan, Porphyreon on the Phoenician coast, and Philoxenite in the Mareotis region near Alexandria [*Fig. 1*]. Philoxenite stands out because it was established in the 6th century as a stop for pilgrims traveling to the Christian shrine of St. Menas. The other two settlements have a much longer history of permanent settlement stretching over a millennium.

The case studies presented in this paper are used to test the following hypotheses:

- Hawara had limited access to goods imported by sea due to its inland location. This should translate to a small number of functional classes of marble objects found at this site, the use of this material in few buildings, and a low level of diversity of its origins and colors.
- Porphyreon's location directly on the Mediterranean coast and near major port cities (Sidon and Berytos) is expected to have given its residents the opportunity to purchase larger quantities of marble due to low transportation costs. This privileged geographic location should have enabled access to marble products that are more diverse in terms of their form and origin.
- Philoxenite, although not located on the sea coast, was supplied with a large number of diverse marble products, most likely owing to the special socio-religious status of this settlement, which was frequented by Christian pilgrims.

Validation of these hypotheses will serve as confirmation of the usefulness of the methods of quantification and qualitative evaluation of marbles in analyzing their distribution. This, in turn, should lead to an increase in popularity of standardized quantitative studies on Mediterranean sites from the Roman and early Byzantine periods, thus enabling comparison of different assemblages.

METHODS

Three quantitative methods were applied in the analysis of the marble objects from Hawara, Porphyreon, and Philoxenite: fragment count, weight assessment, and volume assessment. The results obtained provide figures useful for presentations that focus on the qualitative diversity of the assemblages. The three quantification methods are simple enough to enable their widespread use. Some of them have been used in the past for marbles and other categories of archaeological objects (pottery, ceramic building materials, and bones).

FRAGMENT COUNT

A simple way to compare quantities of marbles from different sites is to count their fragments. The main problem with this method is the varying degree of fragmentation of marble objects at different sites and in individual archaeological deposits. For example, a column can break into hundreds of fragments or survive intact. Thus, depending on specific predepositional factors, the fragment count can lead to over- or underrepresentation of finds in a given assemblage. For example, a significant overrepresentation of broken objects can be expected at

multi-phase sites. One should also keep in mind that in Antiquity it was common practice to burn marble to produce lime for the construction of new buildings. This process involved crushing large objects into smaller pieces. The number of counted fragments also depends on the form of the marble finds: thin objects, such as wall revetment tiles, are likely to break into more pieces than thick ones like pavement slabs.

The fragment count is commonly used to quantify pottery sherds during archaeological surveys (see different chapters in Alcock and Cherry 2004). It primarily serves as a basis for identifying traces of settlements associated with different periods. Marble objects do not offer such a possibility due to the fact that they are rarely found on the surface and, in most cases, they do not constitute reliable chronological indicators. The fragment count has been used, alongside other methods, for quantifying different varieties of tiles from Piazza Armerina and Ravenna (Pensabene, González de Andrés, and Atienza Fuente 2015; Tůmová et al. 2016).

In addition to quantitative data, the fragment count can also provide interesting information on the degree of fragmentation of the identified marble objects. In order to calculate it, each object is divided by the number of fragments it broke into. In such cases, however, the resulting data can only be compared between objects of the same form and size. What is more, such a calculation is rarely possible in the field, where reconstructions are carried out primarily for selected objects of significant artistic value (e.g. sculptures) or special historical significance (e.g. inscriptions). Nonetheless, the example of reconstructed wall revetments from houses in Ephesos shows that such assessments can be attempted for other categories of marble objects as well (İlhan 2014). A prerequisite for success in such cases is the discovery of all fragments that had formed part of the object, while it is much more common to find incomplete assemblages that had been looted in the past.

WEIGHT ASSESSMENT

Another method of quantifying archaeological objects is weighing them. This approach, used primarily in the studies of pottery and ceramic building materials (Tomber 1993: 149–150), is effective because it reflects the real state of the material and provides comparable values. There is, however, a technical limitation to its use: while weighing smaller objects should not pose problems during documentation work, determining the weight of large architectural elements, especially when they are an integral part of buildings (e.g. floors and columns) may be challenging or impossible. In such cases, the specific gravity of the stone variety in question can be used. Multiplying it by the volume of the object allows to calculate its weight. Still, one has to bear in mind that the result of this calculation is merely an approximation. Another limitation of this method is a lack of tables listing specific gravities of all varieties of marble used in Antiquity.

VOLUME ASSESSMENT

The volume of an object can be determined on the basis of its metric measurements. Volume, as a measure of

three-dimensional space, was used in Antiquity for calculating the quantity of material used in marble columns and ashlars (Didymus, *Mensurae marmorum* 2–3; Gerstinger, Öllacher, and Vogel 1932: 17, 23, 27). Notably, however, wall revetments were quantified by way of measuring their surface areas (Corcoran and DeLaine 1994).

Calculating quantities of marble using volume should take into account one important issue. Finds uncovered during excavations are usually finished objects rather than unprocessed materials or semi-finished products worked by stonecutters. At least some of the objects were delivered from the quarries already in finished form.[1] An example of this practice is the cargo of one of the early Byzantine shipwrecks discovered off the Syrian coast (Dennert and Westphalen 2004). To the recipient, the original amount of stone processed was of secondary importance, so inquiries on the subject are of limited significance. In any case, more reliable figures for extracted marble are obtained by conducting measurements in the quarries (e.g. Wielgosz-Rondolino et al. 2020: appendix A). Leaving this debatable issue aside, an important practical premise is that only finished objects are measured in order to keep the figures comparable. This strategy was employed, for instance, when calculating the volume of different varieties of marbles in the Piazza Armerina (Pensabene, González de Andrés, and Atienza Fuente 2015). Given the issues associated with counting fragments and weight assessment, volume can be considered the best choice for quantification purposes.

RECONSTRUCTED QUANTITY

The minimum number of complete objects —ceramic vessels, ceramic building materials or marble specimens— can be reconstructed on the basis of their fragments. This method involves counting rims, handles, and bases in the case of ceramic vessels, and corners of roof tiles or bricks when reconstructing the number of ceramic building materials. For example, 57 handles indicate the original presence of at least 28.5 amphoras, while a corner of a roof tile or brick is considered equal to a fourth part of the entire object (Orton 1989; Mills 2013: 18–19). The number of vessels can also be estimated by calculating the percentages of the preserved rims (Gadot and Adler 2016). Basic specimen counts used in zooarchaeology can also be helpful. The number of identified specimens and the minimum number of individuals (Lyman 2008: 21–82) may be successfully used for quantifying distinctive forms of marble objects. For example, mortars usually have three lugs and one spout. Therefore, from the quantitative perspective, a single lug represents a third part of a mortar, while the spout alone is enough to reconstruct an entire mortar. A similar solution can be applied for rectangular altars and chancel screens. One surviving corner can be counted as a fourth part of the entire object. In the case of columns, their top and bottom ends can each count as half of the whole column. This method, helpful as it may

1 It is estimated that when marble was quarried, only 20% to 30% of the stone was used in further processing, while the rest was waste. See Röder 1971: 269; Attanasio, Bruno, and Yavuz 2009: 326.

be in determining the number of whole objects of a given type, does not account for their different sizes. Even a single site can contain columns and capitals of different heights and diameters. Therefore, reliable comparisons of quantitative data must also take into account their weight or volume.

A reconstruction of the amount of marble used can also be based on architectural traces of columns, pavement slabs, or wall revetments. For example, imprints of columns on the stylobates allow for a reconstruction of their original number in the building. When at least one object of this type is preserved, its dimensions can serve as a basis for reconstructing the volume of the entire set of columns. In addition, the thickness of decorative tiles and the area they originally covered enable the calculation of the volume of stone used to decorate the floors or walls. Notably, reconstructed values should be presented independently of the volume of the objects discovered during excavations in order to avoid duplication of figures.

FUNCTIONAL CLASSIFICATION

A large proportion of marble finds discovered during excavations can be assigned to functional classes, such as columns, chancel screens, table tops, floor slabs, etc. When analyzing an assemblage from a single site, a comparison of the weight or volume of objects belonging to different classes, for example columns to mortars, does not provide relevant information. On the other hand, the use of weight or volume as a measure provides important results when comparing the same classes of objects at different sites.

When comparing assemblages of finds from various sites, it is also useful to indicate the number of object classes discovered. A higher diversity of objects may indicate the settlement's complex social structure, its population's material status, or its privileged location on trade routes. In addition, the unique administrative or religious significance of some settlements may have contributed to an increased import of goods.

A similar method was used for quantifying marble finds in quarries on the island of Prokonnesos. The number of objects was given according to their class, demonstrating some local specifics of marble production (Asgari 1995: 265, Figs 2, 3). It should be noted, however, that this approach is of limited use in the case of floors and wall revetments, which consisted of many elements of different sizes.

COLORS AND VARIETIES OF MARBLES

In Antiquity, marble was defined as any rock that could be polished, meaning that not only genuine marble, but also granites and porphyries were included in this category. Marble itself, although mainly gray or white, varied greatly in color. Marbles of different colors were used not only to make a variety of goods, but were also selected intentionally for sculpture and architectural décor. Thus, it is reasonable to divide the marbles found at different sites according to different color classes. Such a quantification would indicate the market availability of, and the purchasers' interest in, different types of stones. A necessary prerequisite in this approach, due to a considerable heterogeneity of marble varieties in terms of color,

is the use of a simplified color palette, which would allow the assignment of individual finds to a limited number of groups. Failure to do so would result in an excessive number of color classes, each represented by few finds.

It is worth noting that a limited color palette may lead to the assignment of marbles of similar color but from different quarries to the same class. Examples are *serpentino verde* quarried in Krokees and *verde antico* coming from Thessaly; both stones can be classified as green, as their name indicates, but the differences between them are discernible to the naked eye. This method can, therefore, be refined by using classes corresponding to specific quarries. This approach works especially well for marbles with a wide color spectrum. A good example is the marble from Chemtou, which came in numerous color varieties, the most common being yellow and pink.

However, identifying the origin of many colored stones can be problematic. A case in point is the *breccia corallina*, which is a pinkish calcareous breccia extracted in various parts of Asia Minor, but also in Egypt (Klemm and Klemm 1993: 189–190; Lazzarini 2002). The same is true for *pavonazzetto*-like stones, whose main mining site was Dokimeion, but a macroscopically similar material was also mined in Aphrodisias, Milas, Teos, and Skyros (Attanasio et al. 2015).

Quarry-based classification of finds also cannot be applied to most white, gray, and black marbles, as their origin can only be determined by petrographic and archaeometric analyses. Such analyses are, however, impossible to perform for all finds of this type due to their high cost and labor intensity. Moreover, the results of such analyses do not always provide clear answers concerning the origin of the material. Another problem is that new marble quarries continue to be discovered (Bruno et al. 2012). Admittedly, these are usually small quarrying sites used rather for local needs than for interregional trade. Nevertheless, one must take into account the possibility of misidentifications resulting from gaps in our knowledge.

In the above cases, one can only assign marble finds to color groups, bearing in mind that they do not reflect their true origin. In the case of white marbles, an attempt can be made to classify them according to grain size. This simple method of petrographic characterization allows to distinguish some marbles as originating from different quarries. Keeping its limitations in mind, this method reveals the diversity of the marbles in the studied assemblages, providing information that is less abstract than the classification by color alone.

CLASSIFICATION OF CONTEXTS

Marble finds may also be classified on the grounds of context of their primary use. Context in this case is understood as the type of building or space performing a specific function in the settlement under study. Contexts include, e.g., bath complexes with wall revetments, street porticoes with columns, and houses with marble utensils. The greater the number of different places where such objects are discovered, the more likely it is that the settlement

was large or boasted a high administrative and/or social status. Conversely, low diversity in contexts with attested marble use is rather characteristic of villages and other small settlements, with monasteries as distinct examples. This approach provides qualitative rather than quantitative information.

It should be noted that this method is better suited for cities of the Roman period, which mainly consisted of houses and temples. Although this is also true for the early Byzantine period, the Roman period is characterized by a significant number of public buildings like civic basilicas and buildings for entertainment purposes (e.g. amphitheater, theater, and hippodrome), the use and construction of which decreased significantly in later periods.

DENSITY QUANTIFICATION

Another quantification method applicable to marble finds is a modified version of the approach used in archaeological surveys. During a survey, the number of pottery sherds found in a specific area is used to identify or determine the size of sites (for a critique of this approach, see Leibner 2014). However, surface finds of marbles are too rare to be of such use. Instead, the volume of the unearthed marble finds can be considered in relation to the space excavated in each archaeological trench. Such a ratio indicates the saturation of different parts of the site with marbles. Additionally, this approach allows quantifying marble not only from places of its original use, but also from secondary deposits.

CASE STUDIES

HAWARA

The first case study is Hawara (modern Humayma), a settlement located in southern Jordan, about 55 km south of Petra and about 190 km from the nearest Mediterranean port near Gaza. It is a multi-phase site whose history began in the 1st century BCE, with the youngest layers dated to the Mameluk period. Traces of occupation in the form of houses, a Roman fort, and at least five churches are associated with the early Byzantine period. The churches, built around the 5th and 6th centuries CE, have provided most of the marble finds. In turn, the excavations have yielded no marbles associated with earlier occupation phases, which indicates that most of this material must have been imported during the early Byzantine period. Traces of looting of marble furnishings in churches, as well as their secondary use in early Islamic houses, have been identified on the site (Oleson and Schick 2013; Schick et al. 2013).

The assemblage of finds from the site is limited to fragments of chancel screens, chancel posts, ambos, small altar columns, altars, pavement slabs, and a small number of vessels and table tops. They were made only of white marble, some with gray veining. The assemblage has been published in detail, with metric measurements and weight provided for each find (Schick et al. 2013). The dataset created on the basis of this information is available online (Gwiazda 2023a). The number of fragments discovered at the site was 287 in all, with a total weight of 232.216 kg and a volume of 0.226284 m^3.

PORPHYREON

Porphyreon (modern Jiyeh), a large village in the northern hinterland of Sidon, was located directly on the Mediterranean coast, close to two major ports that provided important trade links between Phoenicia and other regions. The site was occupied from the Bronze Age to the Early Islamic period (Waliszewski and Gwiazda 2015; Gwiazda et al. 2021). The best-examined remains date from the early Byzantine phase and are associated with the residential quarter and one of the largest churches discovered in Lebanon so far.

The catalogue of marble finds from the site includes 1110 fragments with a total weight of 268.8242 kg and a volume of 0.171473 m^3. However, the largest finds, such as columns and capitals, are underrepresented due to looting, which has occurred on the site since the 2nd millennium CE. The dataset also lacks the measurements of objects discovered during excavations conducted at the site in the second half of the 19th and first half of 20th centuries CE.

In addition to columns and capitals, the assemblage consists of wall revetments, pavement slabs, table tops, mortars, and a small number of liturgical furnishings. These finds are primarily related to the clearing and excavation work carried out at the site in the early 21st century.[2] They were documented in detail in 2009–2011 by the author of this article, but so far the entirety of this assemblage has not been published. This documentation was used to prepare an online dataset available for analysis (Gwiazda 2023c). Certainly, the assemblage does not constitute the complete set of objects discovered in Porphyreon; however, given its diversity, it reflects well the extent of the supply of this settlement during the early Byzantine period.

PHILOXENITE

Philoxenite (modern Hawwariya) was a town established in the 6th century CE, on the pilgrimage route from Alexandria to the shrine of St. Menas, directly on the shore of Lake Mareotis, which allowed easy transportation of people and goods from/to the southern port of Alexandria. The primary function of this settlement was to accommodate Christian pilgrims. Although remains dating to the Hellenistic and Roman periods have been found on the site (Gwiazda and Wielgosz-Rondolino 2019 with further references; Gwiazda, Derda, and Barański 2022), no related marble finds have been uncovered. Marble objects began to be imported only in the early Byzantine period, when the first church was erected there (Babraj, Drzymuchowska, and Tarara 2020). No earlier than in the mid-6th century CE, it was replaced by a much larger basilica, and the settlement itself expanded significantly (Gwiazda and Derda 2021). Occupation at the site ended in the second quarter of the 8th century CE, following modifications to the early Byzantine buildings and partial looting of their furnishings.

Most of the marble objects found at the site are associated with churches, four of which have been studied so far. However, marble finds have also been

2 The research at Porphyreon was directed by Tomasz Waliszewski.

found in bath complexes and houses. The recognized assemblage is very diverse and includes architectural elements such as columns, capitals, and wall and floor decorations. Most importantly, various utensils in the form of table tops and mortars, as well as a small number of liturgical furnishings (altars, altar partitions and posts, and small columns), have been identified.

Although excavations at the site began in the late 1970s, systematic documentation of the marble objects has been prepared only recently.[3] The author of this paper was responsible for recording the marble finds in the 2014–2021 excavation seasons, but that documentation has not been published thus far. Parallel to the publication of this article, a catalogue of the material from the site has been made available online (Gwiazda 2023b).[4] The dataset, however, does not include finds from the largest church (the so-called Great Basilica) and the bath complexes, which were excavated using a less accurate approach.

APPLICATION OF THE QUANTIFICATION METHODS TO THE MARBLE ASSEMBLAGES

RECONSTRUCTED QUANTITY METHOD

Excavations at Hawara do not provide sufficient data to reconstruct the amount of marble used on the site. This is primarily related to the lack of architectural remains and the dominance of broken chancel screens among the finds. Like at the other two sites, the fragmentary state of preservation of these objects makes it impossible to reconstruct their sizes. It is also unclear how many partitions were used in each church. In addition, the pavement slabs, present in large numbers, left no traces on the floors, hindering reconstruction of the surfaces they covered.

In the case of Porphyreon, it is possible to determine the approximate original area of the marble wall revetments in the presbytery of Basilica Q. The very good state of preservation of this part of the church is rare for the Levantine coast (Gwiazda 2015). Usually, the remains of such buildings are limited to the lower parts of the walls or their foundations. This is also largely true for the basilica in Porphyreon; however, its eastern wall, including the apse, was preserved almost in its entirety and reached 4.66 m above the level of the original floor. That wall also contains numerous impressions of attachments of marble wall revetments, permitting to determine the extent of this decoration [*Fig. 2*], which was 3.36 m high and covered the entire width of the eastern wall. The use of wall revetments is also attested inside the apse, but it is unknown whether the *synthronon* located in its interior was also decorated in this way. In addition, wall revetments were located on two east – west oriented walls that

3 This research is funded by the National Science Centre, Poland (grant no. 2017/25/B/H3/01841), and is headed by Tomasz Derda.

4 Finds at this site were not weighed.

delimited the presbytery on the northern and southern sides.

The total area of the marble-decorated walls in Basilica Q was 54.4 m² [*Table 1*]. Finds of marble tiles with holes for mounting hooks provided a basis for determining the thickness of the material used as wall cladding. The thinnest panels were 1.4 cm thick, and the thickest measured 3.8 cm. For the eleven tiles with extant hook holes, the average thickness was 1.9 cm. Thus, multiplying the decorated area of the walls by the average tile thickness yields a volume of the tiles used equal to 1.0336 m³. This value, however, was only a fraction of the total volume of the wall revetments used in the settlement, as indicated by the discovery of imprints from hooks on the walls in one of the rooms located on the southern side of the church. The room has not been excavated in its entirety, so it cannot currently be included in the reconstructions.

The assemblage discovered during excavations includes 523 fragments of wall revetment tiles with a total volume of 0.058737 m³. In addition, the assemblage of finds from Porphyreon includes 392

Table 1. Surface of the walls clad with marble wall revetments in Basilica Q in Porphyreon

Church part	Decorated surface (in square meters)
Presbytery, eastern wall – northern part	11.54
Presbytery, eastern wall – southern part	11.46
Apse	6.55
Presbytery, northern wall	12.76
Presbytery, southern wall	12.09
Total surface	**54.4**

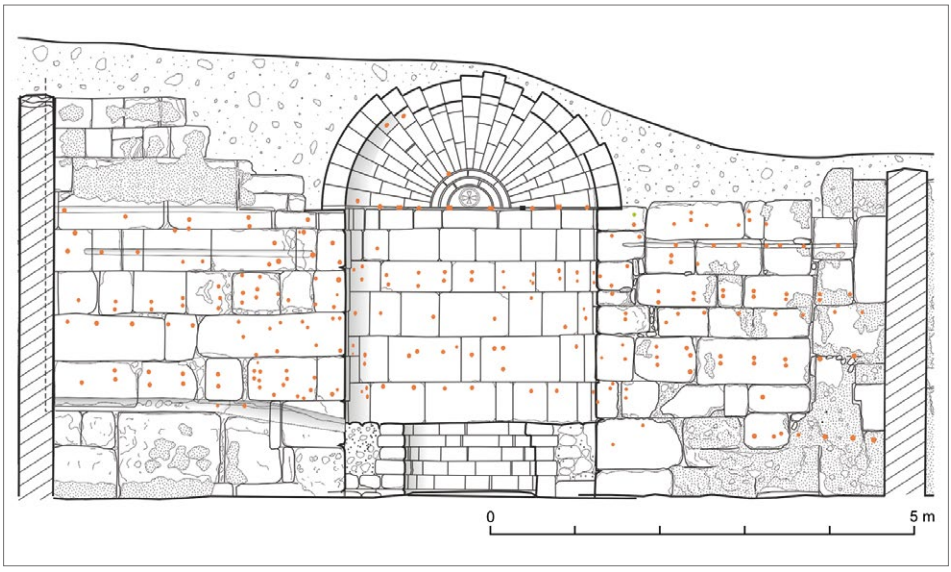


Fig. 2. Presbytery wall of Basilica Q in Porphyreon with the holes for wall revetment fasteners indicated with orange dots (PCMA UW | drawing M. Puszkarski and M. Gwiazda)

more fragments of uncertain function with a volume of 0.019409 m³. These could have been fragments of wall revetments, but they may as well have been remains of floor slabs. Nevertheless, these two figures indicate that the material recovered during the excavations constitutes no more than 5.7–7.6% of the original wall decorations in Basilica Q.

Another element of Basilica Q's furnishings that can be reconstructed with a high degree of probability in terms of quantity are columns and their capitals. The original presence of these elements is indicated by discoveries made during excavations of Georges Contenau (1920: 296, Fig. 92) and mentions in descriptions left by travelers visiting Porphyreon in the 18th and 19th centuries CE (Rekowska 2019–2020: 207). Fieldwork carried out on the site in the 21st century uncovered 24 fragments of columns. Their reconstructed dimensions indicate that they were parts of columns measuring 0.40 cm in diameter.

Most of the columns and capitals from the basilica were reclaimed for secondary use, a fact attested by the presence of at least three columns and one early Byzantine capital in a mosque located near the site [*Fig. 3*]. The columns reached a maximum height of 251 cm and measured about 42 cm in diameter, indicating a volume of 0.347746 m³ per column. Given that the church had three aisles, each with a length of 39 m, the columns would have been arranged in two rows of 14. Thus, the total volume of the columns would have been equal to 9.736888 m³. The capital from the mosque, in turn,

Fig. 3. Capital of an early Byzantine column reused in the mosque in Jiyeh, ancient Porphyreon (PCMA UW | photo M. Gwiazda)

had a volume of 0.151164 m^3. This value, multiplied by the reconstructed number of columns, gives a total of 4.232592 m^3. It follows that marble amounting to at least 15.00308 m^3 (=columns with capitals 13.96948 m^3 + wall revetments 1.0336 m^3) was used to build the Basilica Q in Porphyreon. Thus, the total volume of all objects included in the Porphyreon dataset (0.171473 m^3) represents about 1.1% of the minimum quantity of marble used in the settlement during the early Byzantine period.

In the case of Porphyreon, it is also possible to quantify various marble vessels, table tops and mortars. They include several distinctive types characterized by particular rim shapes (Gwiazda 2014). As for the quantity of small vessels, one rim and one base were identified, giving us a minimum value of one. Table tops represented three different forms, and the variants of their rims make it possible to identify at least 12 objects of this class. As for mortars, the minimum number of pieces of this type of utensil was two.

Similar reconstructions are also possible for Philoxenite. The most significant in this regard is the Grand Basilica. In this case, it is possible to calculate the original volume of the *opus sectile* floor in the narthex and of the columns with

Table 2. Functional class count in Hawara, Porphyreon, and Philoxenite assemblages

Class group	Class	Hawara	Porphyreon	Philoxenite
Liturgical equipment	Altar	+		+
	Ambo	+		
	Chancel screen	+	+	+
	Chancel post	+	+	+
	Column (small)	+		+
	Column base (small)		+	
Utensils	Table top	+	+	+
	Mortar		+	+
	Vessel	+	+	
	Pestle		+	
	Varia		+	
	Weight		+	
Decorations	Wall revetment		+	+
	Opus sectile		+	+
	Pavement slab		+	+
	Intarsio		+	+
	Plaque		+	+
Architectural members	Capital		+	+
	Column		+	+
	Column base			+
	Total	7	16	14

capitals from the church interior. The number of columns was 40, as indicated by impressions left on the stylobates separating the aisles. However, during excavations carried out in that building, only about a dozen columns and three capitals have been found (Jastrzębowska 2018–2019; Babraj, Drzymuchowska, and

Table 3. Marble varieties in Hawara, Porphyreon, and Philoxenite

Marble variety	Provenance	Hawara	Porphyreon	Philoxenite
Africano	Teos, Turkey (Ballance 1966)			+
Alabastro cotognino	Nile Valley, Egypt (Harrell 2016)		+	+
Breccia corallina	Turkey and Egypt (Lazzarini 2002)		+	+
Cipollino rosso	Iasos, Turkey (Berti and Peirano 2023)		+	+
Cipollino verde	Karystos, Euboea, Greece (Lazzarini, Masi, and Tucci 1995)		+	+
Fior di pesco	Chalkis, Greece (Lazzarini et al. 2002)			+
Giallo antico	Chemtou (Simitthus), Tunisia (G. Röder 1988)		+	+
Granito rosso	Aswan, Egypt (Klemm and Klemm 1993)			+
Greco scritto	Annaba, Algeria, and Ephesos, Turkey (Pensabene 2002; Attanasio et al. 2012)			+
Occhio di pavone rosso	Kutluca, Turkey (Borghini 1997)			+
Pavonazzetto	Dokimeion, Turkey (Pensabene 2002)		+	+
Porfido rosso	Gebel Dokhan (Mons Porphyrites), Egypt (Lucci 1964)			+
Portasanta	Chios, Greece (Borghini 1997)			+
Rosso antico	Mani Peninsula, Greece (Lazzarini 1990)			+
Serpentino verde	Krokees, Greece (Zezza and Lazzarini 2002)		+	+
Verde antico	Thessaly, Greece (Lazzarini 2007)		+	+
Unidentified white, gray and black	Possibly Dokimeion, Prokonnesos, Thasos, Ephesos, etc. (Pensabene 2002)	+	+	+
	Total	1	9	17

Tarara 2020: 12). The others were probably removed during the abandonment of the building in the early Islamic period. The columns were about 216 cm high and 35 cm in diameter, giving a total volume of 0.207816 m^3. As for the capitals, their volume is estimated at 0.077273 m^3. Thus, the total volume of the columns with capitals used in the Great Basilica equaled 11.40356 m^3.

The marble floor in the narthex, made of triangular and octagonal tiles, is preserved in fragments. Nevertheless, knowing the area of the room in which it was located, it is easy to determine the volume of the material used for its construction. The area is equal to 198.93 m^2 and the tiles averaged 2.4 cm in thickness, therefore the quantity of marble used for the narthex floor was equal to 0.477443 m^3. Similar calculations can be performed for marble floor surfaces in different parts of the N1 church [*Fig. 4*]. Such pavements were identified in the presbytery, in the auxiliary room behind the apse, and in a part of the baptistery.

Table 4. Occurrences of marble in different building types

Building type	Hawara	Porphyreon	Philoxenite
Church	+	+	+
Monastery			+
House		+	+
Bath			+
Total	1	2	4

Fig. 4. N1 church in Marea with remains of marble floors in the presbytery, baptistery, and auxiliary room behind the apse. A view from the west (Marea Archaeological Project | photo M. Gwiazda)

The total area of these spaces is equal to 25.9 m², which translates into approximately 0.06216 m³ of material used to cover them.

Thus, the reconstructed minimum volume of the marble used in Philoxenite adds up to 11.943163 m³, while the dataset of finds from Philoxenite represents 3.19% of that figure. One should bear in mind that two bath complexes identified in the settlement (el-Fakharani 1983; Szymańska and Babraj 2008) also made large-scale use of marble decoration (floor slabs and wall revetments). However, in their case, a reconstruction of the volume of marble used in the interiors was impossible due to insufficient architectural documentation prepared during the excavations. In addition, five table tops and one mortar were distinguished in Philoxenite. Each of these objects represented a different form.

QUANTIFICATION OF FUNCTIONAL CLASSES

A division of the finds from the three sites into functional classes demonstrates that assemblages discovered at Porphyreon and Philoxenite were more diverse than in Hawara [*Table 2*]. This confirms

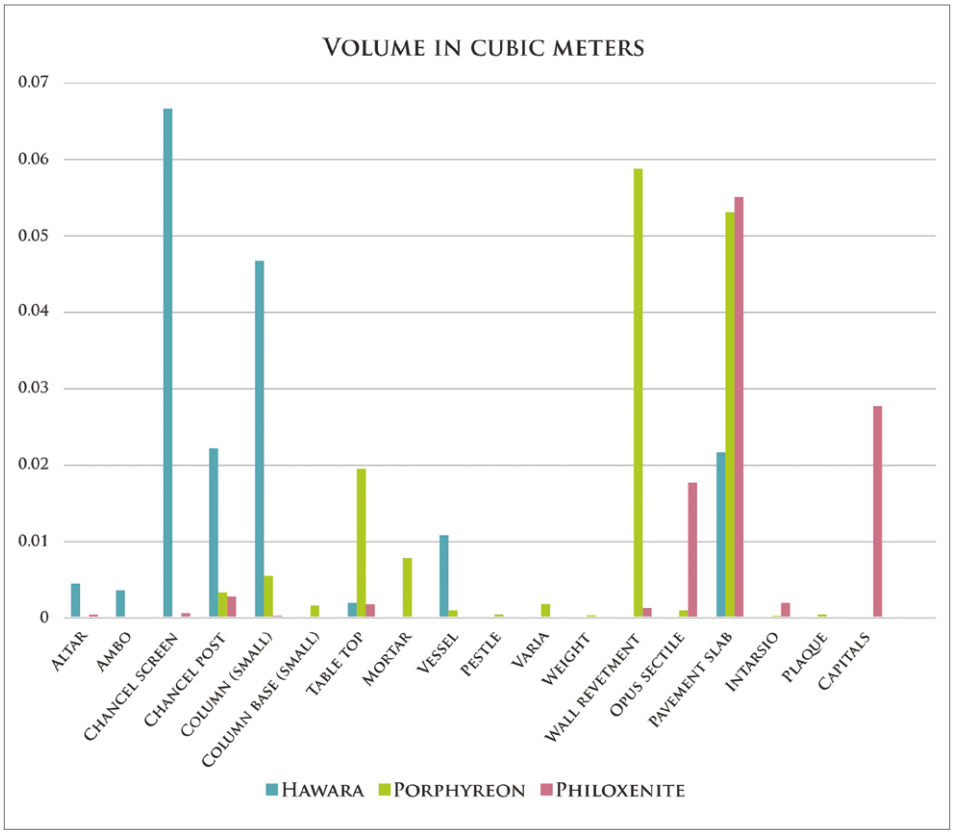
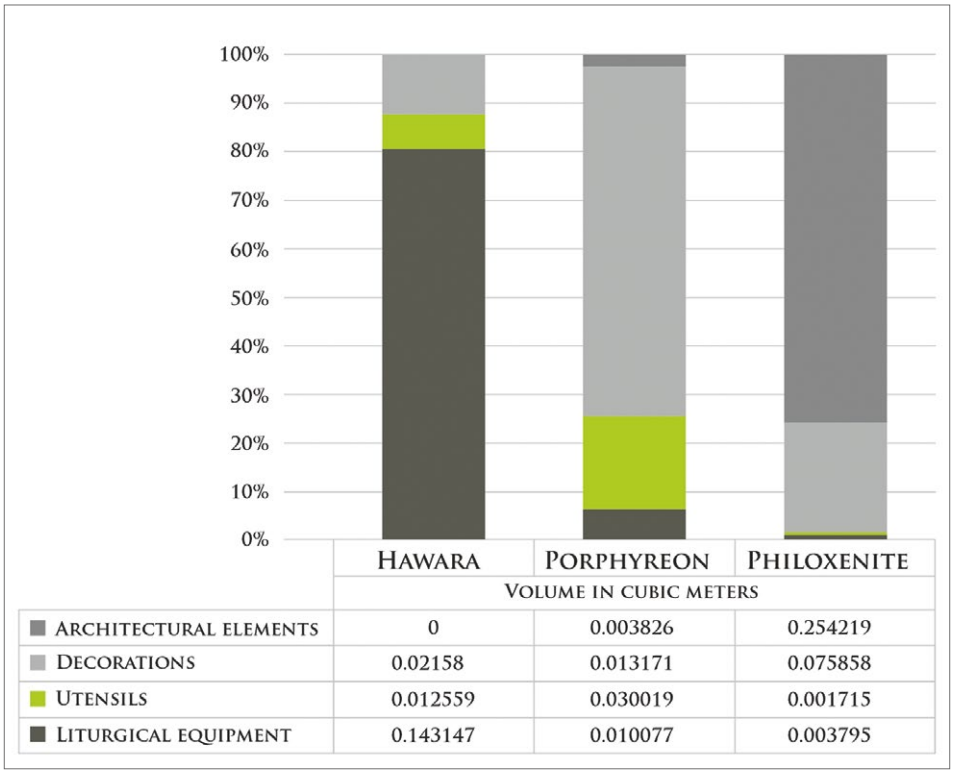


Fig. 5. Volume of different classes of functional objects in the assemblages from Hawara, Porphyreon, and Philoxenite. The volume of columns is not included (M. Gwiazda)

the hypothesis that pilgrimage sites and settlements located on the Mediterranean coast had better access to marble products than inland areas. In addition, *Table 2* shows that pieces of liturgical furnishings were found at all three sites. The use of marble in wall and floor decoration and architectural elements was also common in Porphyreon and Philoxenite. Of note is also the much greater diversity of utensils in Porphyreon. Some of them were certainly used outside the church, in the large residential quarter.

The quantitative analysis of the volume of marbles from the three sites taking into account their division into functional classes provides unexpected results. A much larger number of chancel screens were found in Hawara than in the other two settlements [*Fig. 5*]. This is related to the discovery of numerous churches in Hawara, each of which contained a relatively large number of such objects. On the other hand, in the case of Porphyreon, the liturgical furnishings of Basilica Q are definitely underestimated due to the long history of unsystematic excavations at the site. In Philoxenite, in turn, the majority of such objects were most likely looted and used for lime production. This hypothesis is confirmed by the discovery of at least two lime kilns within the settlement (Derda et al. 2021: 133). The same fate likely befell many architectural ele-



	Hawara	Porphyreon	Philoxenite
	Volume in cubic meters		
Architectural elements	0	0.003826	0.254219
Decorations	0.02158	0.013171	0.075858
Utensils	0.012559	0.030019	0.001715
Liturgical equipment	0.143147	0.010077	0.003795

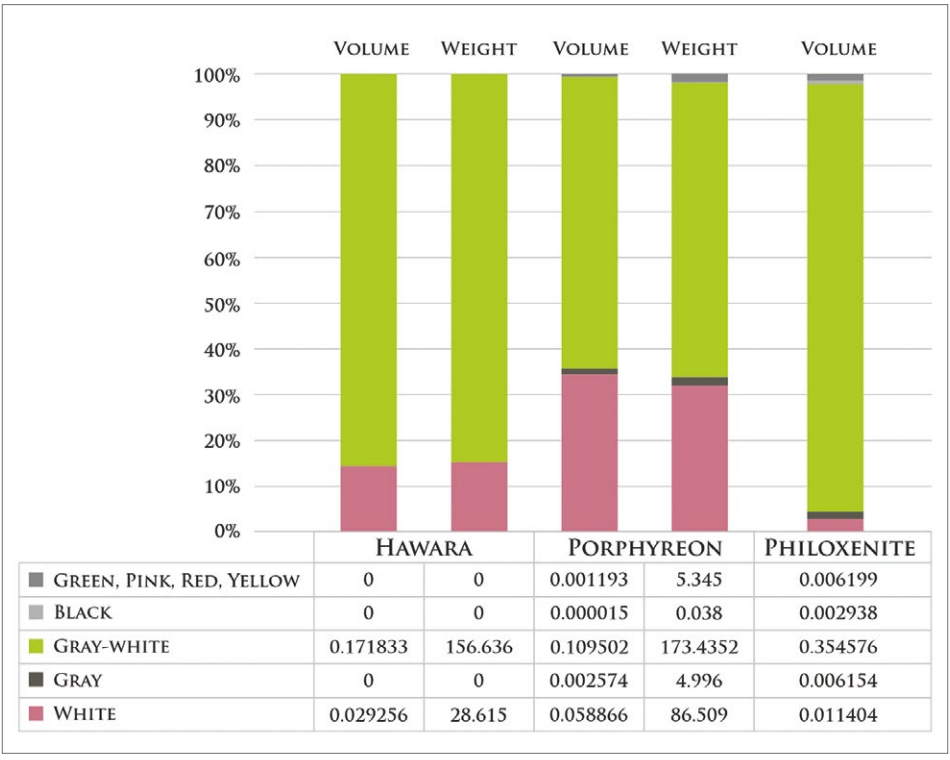
Fig. 6. Percentage distribution of the volumes of different functional class groups in the assemblages from Hawara, Porphyreon, and Philoxenite (M. Gwiazda)

ments such as columns and capitals. The number of tiles used as wall revetments is also certainly underestimated in the case of Philoxenite. In this case, the difficulty lies in distinguishing them from the small and large tiles used for floor decoration.

Each analyzed dataset provides a different percentage distribution of objects between class groups [*Fig. 6*]. In the case of Porphyreon and Philoxenite, as noted above, this distribution is unreliable due to the underestimation of the largest objects (their volume was reconstructed in the previous section). Despite this fact, these two settlements show a much higher proportion of architectural elements and decorative tiles than Hawara.

QUANTIFICATION OF COLORS AND VARIETIES OF MARBLES

A comparison of the origins of marbles discovered at the three sites provides another illustration of the diversity of these assemblages [*Table 3*]. The table differentiates between colored marbles identifiable without archaeometric analysis. The material is the most diverse for Philoxenite, where the number of attested quarries almost doubles that of Porphyreon. Notably, the study sample for Philoxenite is almost half the size of the sample for Porphyreon in terms of the number of fragments. This difference is, therefore, not coincidental and indicates that Philoxenite was by far the more richly supplied site. The situation



	Hawara		Porphyreon		Philoxenite
Green, Pink, Red, Yellow	0	0	0.001193	5.345	0.006199
Black	0	0	0.000015	0.038	0.002938
Gray-white	0.171833	156.636	0.109502	173.4352	0.354576
Gray	0	0	0.002574	4.996	0.006154
White	0.029256	28.615	0.058866	86.509	0.011404

Fig. 7. Percentage distribution of the volumes (in cubic meters) and weights (in kilograms) of different color classes (M. Gwiazda)

is completely different for Hawara, where no colored marble fragments have been found thus far.

However, great caution should be exercised when considering such calculations. For both Philoxenite and Porphyreon, the share of colored stones is negligible compared to that of unidentified white, gray, and black stones [*Fig. 7*]. This indicates that not only Hawara but all three sites were dominated by stones in the color spectrum between white and gray. Varieties in shades of green, pink, red, and yellow were used very rarely, primarily for the production of various types of tiles.

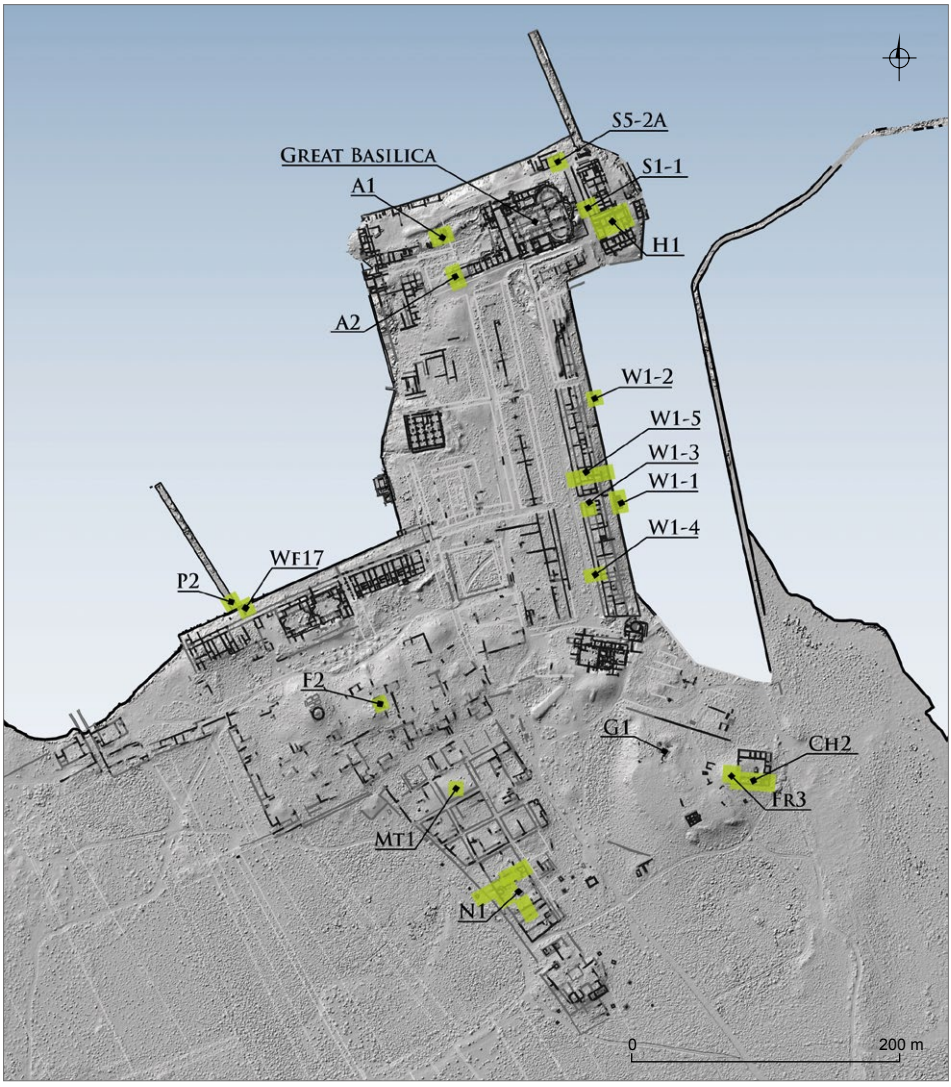


Fig. 8. Plan of Philoxenite indicating the locations of the excavations considered in the density quantification (Marea Archaeological Project | drawing M. Gwiazda, A.B. Kutiak, and M. Łuba)

CONTEXT TYPE COUNT

As noted above, focusing on the diversity of contexts of marble use in early Byzantine settlements is of limited use. Nevertheless, some regularities are apparent for the three sites. *Table 4* shows that in Philoxenite, compared to the other two sites, marble was used in more functionally diverse spaces. While in most settlements from the early Byzantine period marbles can be expected to be found primarily in churches, in Philoxenite they were also attested outside sacred spaces, including baths complexes, where the use of this material is attested on a massive scale. This demonstrates the unique nature of this settlement and its privileged place in the supply network.

DENSITY QUANTIFICATION

Of the assemblages at our disposal, the Philoxenite finds are best suited for density analysis, as they were collected during excavations in functionally diverse parts of the site. The most accurately inventoried marble material comes from excavations in streets, houses, trash dumps, and churches [*Fig. 8*]. Disregarding the largest church in the settlement and the bath complexes, which were not thoroughly documented, by far the largest number of marble finds is associated with the N1 church [*Fig. 9*]. In contrast, a much lower density of marble objects was recorded in trenches W1-5, H1, and W1-3, featuring structures with a residential function. The lowest number of finds

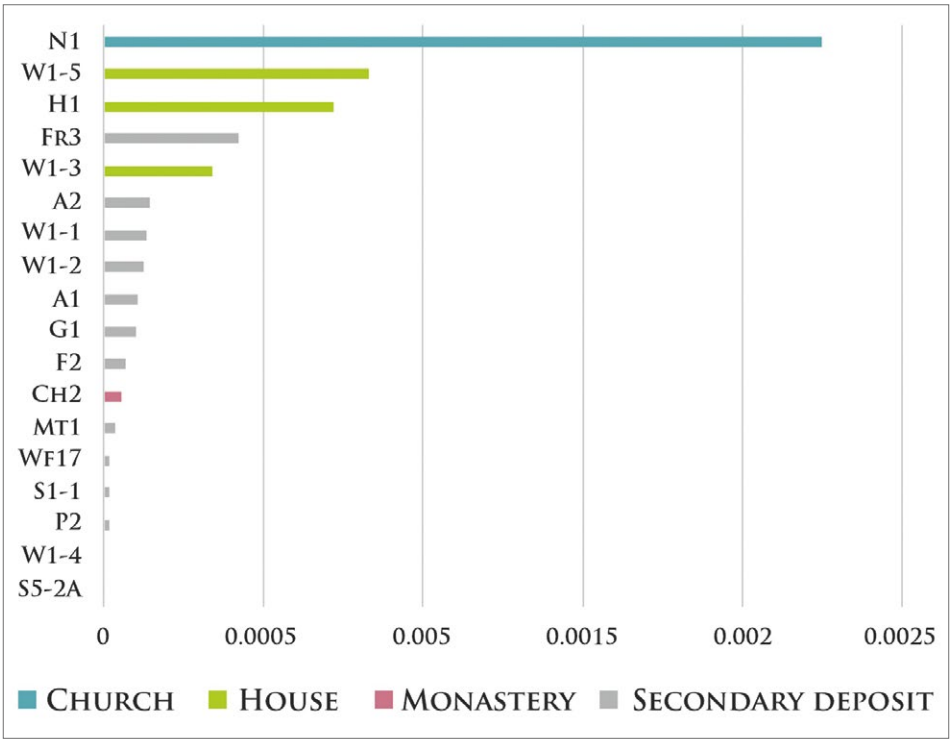


Fig. 9. Ratio of the volume of marble object finds to the volume of the total material excavated in Philoxenite (M. Gwiazda)

came from a trash disposal site recognized in trenches FR3, A2, W1-1, W1-2, A1, and MT1. Additionally, the CH2 monastery, located on the outskirts of the settlement, yielded a small number of marble finds. Philoxenite therefore emerges from the analysis as the place with the highest density of marble finds from trenches located in the places of their primary use. Although large-scale looting of marbles at that site during the early Islamic period has been confirmed, it was not associated with a concentrated secondary deposition. A similar situation occurred in Hawara, where most of the marbles were discovered in churches where they were used originally. This pattern distinguishes marble objects from pottery, which is usually found in large quantities in secondary deposits rather than at the places of their original use.

DISCUSSION

The quantitative and qualitative analyses of assemblages of marble finds from three sites of similar size and chronology have revealed the limitations of some of the applied methods. Firstly, the fragment count distorts the real quantities of different groups of objects. Instead, the use of weight and volume as measures is recommended for quantifying marbles. Importantly, only the latter measure can be used systematically for large assemblages collected during excavations. Volume may be used not only in analyses of recovered objects, but also in attempts to reconstruct their quantity based on architectural evidence.

The use of volume as a measure and a means of qualitative assessment permitted to verify the hypothesis as to the differences in supply of medium-sized settlements with different geographic locations and social importance. The analytical approaches used indicated the presence of marble assemblages more diverse in terms of form and material at sites located closer to the Mediterranean coast. Philoxenite was in an especially privileged position, as it was founded as a settlement linked to Christian pilgrims.

At the same time, the functional classification shows that a wider range of objects was available in Porphyreon. Most importantly, this was evident in the greater variety of discovered utensils that the residents of the settlement had used in their homes. This is also confirmed by the volume of the objects in this group, which is significantly larger in Porphyreon than in Hawara or Philoxenite. Both Porphyreon and Philoxenite showed, in turn, a much greater use of marble as architectural décor.

In Philoxenite, marbles generally occurred much more widely. Their use was not limited to the decoration of churches, as was the case in Porphyreon and Hawara, but also included bath complexes and houses. This pattern reflects the different characteristics of the settlements and the way they functioned. At the same time, it may be noted that of all the categories of buildings identified in the studied settlements, only churches invariably had marble furnishings. After the Roman period, they became the focus of pious donations and socially motivated investments.

Such observations can be particularly useful for sites with poorly recognized functions, permitting to reconstruct the consumption patterns of the associated communities. At the same time, one should bear in mind that the three examples discussed herein are not sufficient to reproduce a universal pattern characteristic of settlements of the early Byzantine period. To achieve such a goal, an analysis of a much larger number of assemblages is required, and the conclusions obtained on their basis will certainly have to take into account many exceptional cases.

In the case of Philoxenite, the method of calculating the ratio of the volume of the marble finds to the volume of the excavated trench space has provided precise information about the hierarchy of different spaces in the settlement. It indicates that the largest volume of marble was found in churches, followed by residential buildings and garbage dumps. At the same time, it is important to remember that the number of marble objects does not always have to be a simple indicator of the costs incurred. This material was available in different qualities and had a range of values, as indicated by Diocletian's Price Edict (*Edictum Diocletiani de Pretiis Rerum Venalium* 33.1). Thus, without archaeometric identification of the origin of the material, one must be cautious when drawing conclusions on the basis of such data.

Consideration of color diversity and origin of the marble material in the qualitative assessment indicates their widest range in Philoxenite. However, these results again come with a caveat. At all three sites, objects made of white, gray, or gray-white marbles account for more than 90% of the total volume of the assemblage. Determination of the origin of this type of stone also requires archaeometric analyses. The remaining stones, whose origin can be determined in many cases without laboratory methods, make up a much smaller portion of these assemblages. At the same time, it should be noted that, unlike at the other two sites, in Hawara no colored stone finds were recorded at all.

In the case of Philoxenite and Porphyreon, the use of a reconstructive approach taking architectural evidence into account permitted to determine the approximate minimum quantity of imported marble. The respective figures for these sites were 11.943163 m^3 and 15.00308 m^3. This helps imagine the orders of magnitude that should be taken into consideration in discussions of the quantities of marbles imported to settlements in the Eastern Mediterranean during the early Byzantine period.

For both Porphyreon and Philoxenite, the estimated recovery percentages for marble objects are slightly over 1%. This is a relatively high rate, considering that the representativeness of pottery finds in the archaeological record is estimated at less than 1% compared to the information provided by written sources (Allan 1983: 44). Nevertheless, even such incomplete assemblages can be considered meaningful, especially when they provide reproducible quantitative ratios for particular groups of objects at different sites.

Reconstructions of the quantities of material used at the sites allow to greatly expand the subject of analysis. This approach also helps to partially eliminate factors associated with the secondary use of marble, which was common in Antiquity,

but its scope is often difficult to determine. Reconstructed quantities should be considered separately from the values obtained for the objects discovered during excavations, but they also provide a means to assess the representativeness of the studied datasets.

The dominant approach in the study of ancient marbles to date has been to analyze their form, style, or iconography. Over the past four decades, laboratory analyses seeking to determine where the stone material was quarried have gained popularity. These two research spheres provide a solid foundation for a larger-scale development of another approach, which relies on the methodical quantification of marble objects. Previous efforts in this field have usually been limited to analyses of the number of finds from individual sites or individual buildings, and no attempt has been made to compare assemblages from different sites. Consequently, the recognition of the impact of various factors on the occurrence of marble on a given site was limited, as it was rarely founded on a measurable, and thus reliable, basis.

The absolute values obtained for the volume of marbles discovered during excavations can serve as a basis for meaningful comparisons. They could also be a point of departure for diachronic studies, which have not been attempted so far. At the same time, the presented marble quantification methods show that no single method is perfect. Quantitative and qualitative assessments should be used in parallel to achieve a more reliable picture of the past.

The use of the quantitative approaches described above makes it possible to more accurately measure the scale of imports of goods in different socio-cultural and geographic contexts. It represents a departure from simplistic quantifications that consider only the number of pieces of objects of each type disregarding their different sizes and fragmentary preservation. These methods can be used not only in micro scale, to compare assemblages from individual buildings or sites, but also in macro scale, to collect similar information from different regions.

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