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# THE CONGLOMERATE QUARRY AT THE MYCENAEAN SITE OF VAPHEIO-PALAIOPYRGI IN LACONIA

## ABSTRACT

**Although many studies have been published on Minoan quarries, few details have ever been published on Mycenaean quarries. Here we present a conglomerate quarry discovered at the Bronze Age site of Vapheio-Palaiopyrgi in Laconia, best known for its tholos tomb. The quarry preserves many unusual features, including a column base in situ and curved cuttings indicating the removal of additional blocks of stone. It is proposed that the quarry should be associated with Late Bronze Age Mycenaean culture based on its topography, the importance of the Eurotas Valley in this era, and the material—namely conglomerate—that characterized and became symbolic of Mycenaean prestige architecture.**

## INTRODUCTION AND SUMMARY

In June 2006, Robert A. Bauslaugh of Brevard College discovered what appeared to be Mycenaean quarry cuttings in the Eurotas Valley of central Laconia (Fig. 1).[1] Bauslaugh identified the cuttings while walking with the authors from the Late Helladic (LH) IIB tholos tomb at Vapheio (famous for its gold cups and rich grave goods) to the associated hilltop habitation

1. Fieldwork was carried out August 3–8, 2011, under a permit from the Ephorate of Prehistoric and Classical Antiquities in Sparta (number Α2/Φ62/114624/3204/27-1-2009) and the Australian Archaeological Institute at Athens. The authors want to thank Alexander Cambitoglou and Stavros Paspalas of the Australian Institute for their assistance with the permit, Kyle Keimer for providing a pre-publication copy of his research, Kim Shelton for showing us the quarries at Mycenae, as well as the anonymous readers and Susan Lupack, Editor of *Hesperia,* for their many helpful comments and suggestions. In addition, we wish to thank those who assisted us in the field: Robert Bauslaugh of Brevard College, Nikos Vassilas of the Technological Educational Institution of Athens, and Brent Davis of the University of Melbourne. Thanks also goes to students Sofia Kalogeropoulos from the University of Melbourne and Yannis Dimitrakopoulos from the University of the Peloponnese. The study was carried out with support from the Institute for Aegean Prehistory, the Australian Research Council (Discovery Project Number 1093713), the Faculty of Arts of the University of Melbourne, the Tell es-Safi/Gath Archaeological Project, and volunteer donations. The writing of this report was partially funded by the National Endowment for the Humanities. The views, findings, conclusions, or recommendations expressed here do not necessarily reflect those we have acknowledged here, including the National Endowment for the Humanities. A preliminary report of these findings was presented at the 2012 meeting of the Archaeological Institute of America.

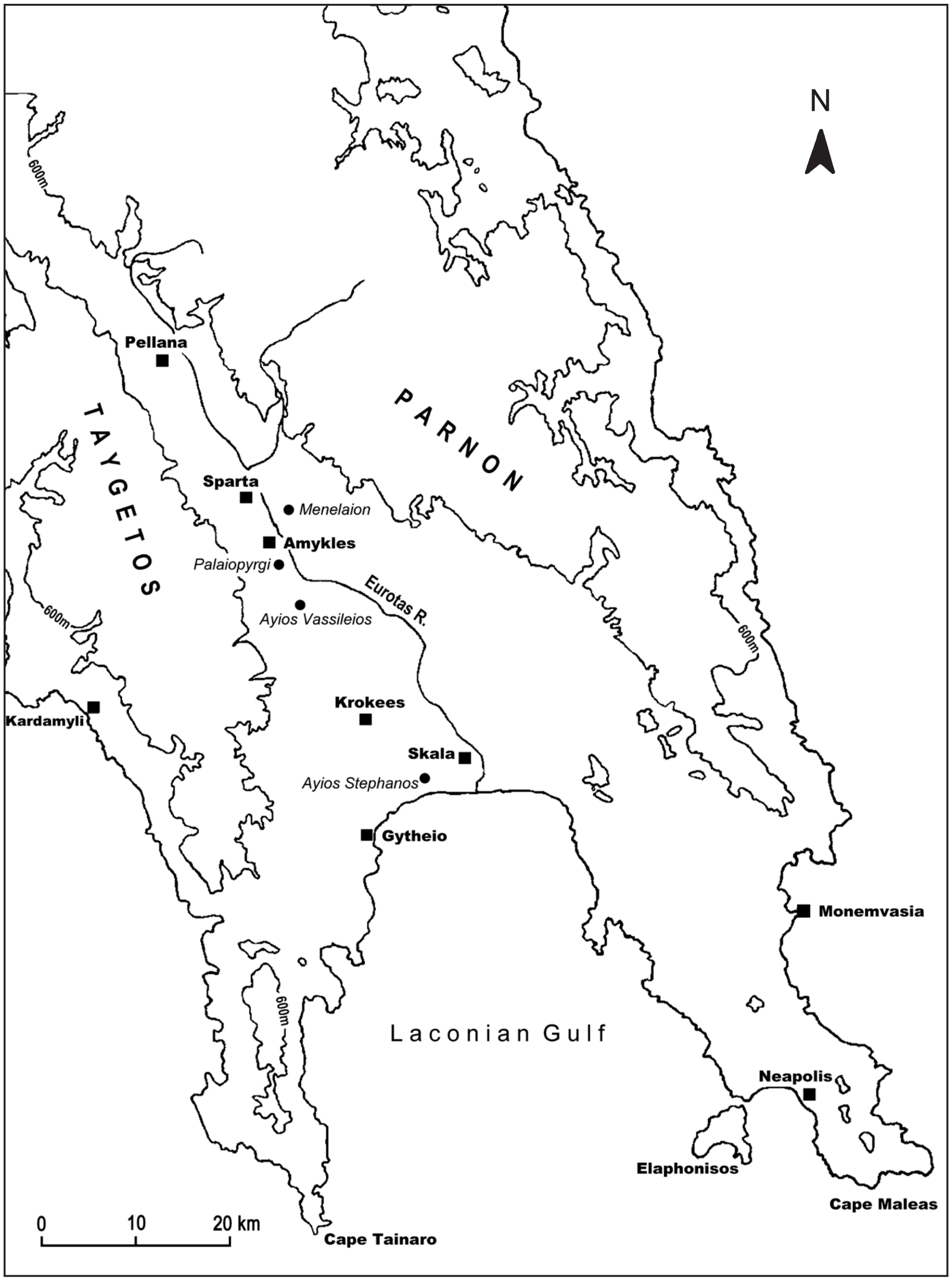


**Figure 1. Map of Laconia.** E. Banou

site of Palaiopyrgi (Fig. 2). The quarry cuttings are situated on a shelf of conglomerate stone approximately 200 m southeast of the Vapheio tholos tomb. Our attention was first drawn to the area by a rounded feature, very likely an unfinished Mycenaean column base, and semicircular cuttings to either side (Fig. 3). Further consultation with colleagues and research on quarries brought us to the understanding that these cuttings indicated that this site was a quarry, probably of Mycenaean date.

Although it is now badly eroded due to agricultural activity, the site of Palaiopyrgi and its surrounding settlement is estimated to be about 200,000 m$^2$,

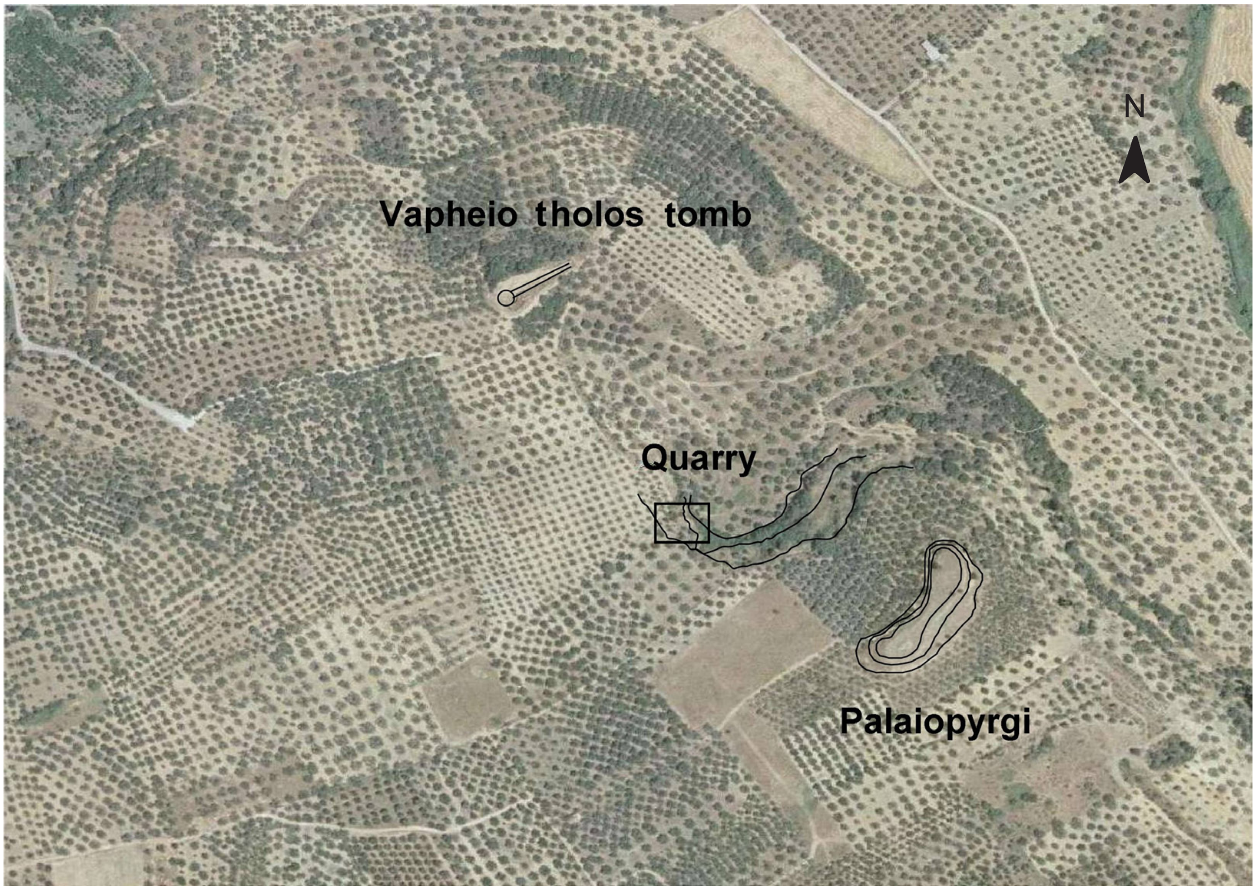


**Figure 2. Aerial view of Vapheio-Palaiopyrgi, indicating the locations of the Vapheio tholos tomb, the quarry, and the site of Palaiopyrgi.** Courtesy of Hellenic Cadaster. Drawing Y. Dimitrakopoulos and B. Davis

**Figure 3. View of the Vapheio-Palaiopyrgi quarry, featuring column base A prior to cleaning, from the southeast.** Scale is 1 m. Photo L. A. Hitchcock

making it one of the largest Mycenaean sites in the Spartan plain and, in fact, in all of Laconia.[2] Waterhouse and Hope-Simpson regarded it as the site of a Mycenaean palace or palatial center.[3] The neighboring site of Vapheio is home to one of the richest and earliest monumental Mycenaean tholos tombs, which provides important information about both the early links with Crete and the development of tholos tomb construction.[4] Survey of the area also suggests that Palaiopyrgi was probably the center of an extensive area of habitation during Mycenaean times, extending from north of the Amyklaion to the southern slopes of the Palaiopyrgi ridge, with the quarry lying midway between Vapheio and Palaiopyrgi.[5] We believe that the quarry dates to the mid–late 2nd millennium B.C. (during the Mycenaean period), based on the pottery found in the area, the extraction technology, its close proximity to well-known Mycenaean sites, the particular stone quarried, and the use of that stone in the Vapheio tholos tomb. In addition to adding to our knowledge of Vapheio-Palaiopyrgi, publishing this quarry will also supplement recent investigations and publications of the work in Laconia at Ayios Stephanos[6] and the Menelaion,[7] as well as recent discoveries of Linear B and other important Mycenaean remains at Ayios Vassileios.[8]

More broadly, the unusual composition of the Vapheio-Palaiopyrgi quarry, that is, conglomerate, its comparison to quarries at Mycenae, and its precise and careful documentation adds to our knowledge of the emergence of Mycenaean civilization and Mycenaean construction techniques. It also provides a comparison for what is already well known about Minoan quarries. As few studies have been yet made of Mycenaean quarries and quarrying techniques, as we discuss below,[9] the principal aim of our investigations was to fully document and describe the conglomerate quarry, with a column base and other cuttings preserved in situ, and to relate the quarry to other quarries in the general region of the ancient Mediterranean and to Aegean quarries in particular. Our interest in the quarry relates to Hitchcock's ongoing research[10] on the style, symbolism, and techniques used in east Mediterranean architecture; the material of the quarry, namely conglomerate; the general importance of the Eurotas Valley, an underexplored region in the Mycenaean period; and the early importance of the Vapheio tholos and the associated site of Palaiopyrgi. In investigating and documenting the quarry, we discovered additional cuttings not evident when it was discovered, which revealed that the site was more extensive than was initially apparent.

## RESEARCH OBJECTIVES AND QUESTIONS

Our study had three specific objectives: (1) to locate the quarry in relationship to Vapheio-Palaiopyrgi; (2) to document the quarry using appropriate methods; (3) to collect relevant comparative data on conglomerate quarries and architectural features in the Argolid.

Some specific questions have emerged from the study of the quarry: (1) Is the quarry Mycenaean? (2) What is the significance of conglomerate use in the Mycenaean world in general and Laconia in particular? (3) What is the quarry's relationship to Aegean (Mycenaean and Minoan) and other Mediterranean quarries and stone procurement strategies?

2. Waterhouse and Hope-Simpson 1960, pp. 76–78; 1961, pp. 164, 168, 173. Comparison of Palaiopyrgi today to earlier photos indicates that approximately 1 m has been removed from the top of the site. This is particularly evident at the benchmark. In addition, the slope of the mound has been terraced.

3. Waterhouse and Hope-Simpson 1960, p. 78; see also Hitchcock and Chapin 2010.

4. Banou and Hitchcock 2011.

5. Banou 1996, pp. 76–78, plan 3.

6. Taylour and Janko 2008.

7. Catling 1977, 2009.

8. Pullen 2009; Burns 2010, p. 108; Petrakos 2010, 2011.

9. Waelkens (1992, p. 11) commented on this and even called the lack of study "deplorable." This is discussed below (p. 80).

10. See Hitchcock 2000, 2003, 2005, 2008, 2009; Hitchcock and Chapin 2010; Regev et al. 2010; Banou and Hitchcock 2011.

## METHODS AND TECHNIQUES

We used standard methods of archaeological and architectural documentation. This included clearing brush and loose soil from around the quarry (Figs. 4, 5); locating it on a topographic plan of the region, taking multiple elevations of the quarry; producing publication-quality scale digital photographs in color and black and white; making a 1:20-scale topographic plan of the quarry; writing a detailed description of the quarry that includes detailed measurements of all of the exposed cuttings; comparing the stone in the quarry with the blocks of the Vapheio tholos tomb; undertaking a comparative study with quarries at Mycenae as well as with Minoan quarries; and situating the quarry within the broader context of understanding the emergence of Mycenaean culture in Laconia and its broader relationship to Mycenaean Greece.

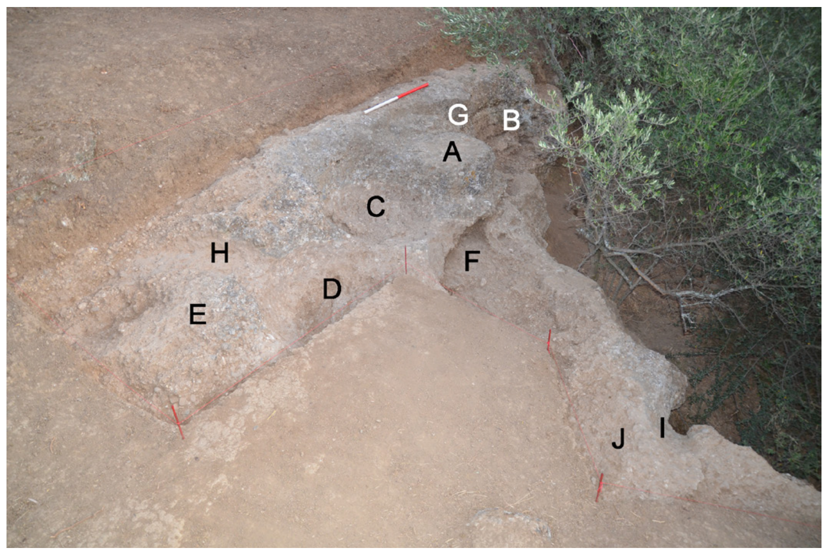


**Figure 4. View of the Vapheio-Palaiopyrgi quarry after cleaning, with features labeled, from the southeast.** Scale is 1 m. Photo L. A. Hitchcock


**Figure 5. View of the Vapheio-Palaiopyrgi quarry after cleaning, with features labeled, from the northwest.** Scale is 1 m. Photo L. A. Hitchcock

## RESULTS

Removing the brush and clearing the loose soil—which seemed to be wash sloping down onto the conglomerate shelf from the west, northwest, and south—exposed a 7.2 m north–south × 2.0 m east–west area of the quarry. In addition, an irregularly shaped, angled area consisting of two designated sections was cleared to the east. These consisted of a larger trapezoidal section, which measured 2.4 m east–west × 2.0 m north–south, and a smaller trapezoidal section to the west, which measured 1.4 m southeast–northwest × 1.8 m southwest–northeast. Cleaning the area of the quarry exposed at least seven semicircular vertical cuttings as well as other tool marks associated with the column base: two semicircular cuttings to the north of the base, three to the south of it, and two to the west of it. Beginning with the column base, each of the features will be described below.

The shallow deposit of soil above and around the quarry was densely compacted, giving it a hard, brick-like texture. In addition, a dense concentration of wild onions was growing in the soil. Shepherds regularly drive their sheep across the area; this activity must have further compacted the soil. This practice may also explain the absence of visible debitage in the immediate vicinity of the quarry. The area was otherwise obscured by brush and a filling of earth in the cuttings, and would not normally have attracted the interest of the casual visitor. A survey and an excavation permit would be needed to undertake a thorough investigation of the area, as well as to source any architectural elements that may have been taken from the quarry.

Palaiopyrgi, the associated hilltop site, is badly eroded. About 1 m of soil seems to have been leveled off the top of the site, and there is evidence for intensive terracing on the slope. This suggests that any Mycenaean architectural remains associated with the quarry are likely no longer in situ.

### Siting the Quarry

As measured with a theodolite, the quarry cuttings lie 201.49 m southeast of the Vapheio tholos tomb and 165.58 m northwest of the top of Palaiopyrgi (Fig. 2), in the region of central Laconia. These were straight-line measurements taken from the benchmark at the summit of Palaiopyrgi to the quarry and from the quarry to the center point of the Vapheio tholos.

### Geologic Context

The Vapheio-Palaiopyrgi quarry is developed on a flat-lying shelf of interbedded, 0.3–0.4 m thick Pliocene-Pleistocene marls and brown, clast-supported conglomerates.[11] Although boulder-sized clasts may be present in some portions of the conglomerates, the abundance and size of clasts diminishes to a conglomeratic sandstone in other parts.

The conglomerate that constitutes the quarry consists of waterworn and waterborn pebble- and cobble-sized clasts. Pebble sizes measure 0.3–3 cm, and the matrix is composed of well-rounded, medium-grained sand particles of limestone and quartz with minor lithic fragments. The cement is

11. Higgins and Higgins 1996, pp. 51–52.

predominantly calcite. The matrix easily disaggregates after application of a 10% HCl solution. Clasts in the conglomerate vary from angular to well rounded and are predominantly white and pink limestones and dark phyllite, but marble and chert or quartzite are also present. Carbonate and phyllite clasts are sourced in the nearby Taygetos Mountains to the southwest.

Conglomerates are distinguished from breccias by clast shape: conglomerate clasts are rounded, while those in breccias are angular. The difference between the two is a function of transportation distance: breccias are locally sourced while conglomerates are more rounded because they were transported farther.[12] The presence of subangular phyllite clasts suggests that they were not transported a great distance. Well-rounded chert/quartzite pebbles were probably transported from distant source areas to the northwest by the Pliocene Eurotas river system and deposited on the floodplain prior to being incorporated into the conglomerate.

Because the conglomerate is interbedded with marl, suggesting a carbonate lacustrine or near-shore marine environment, the strata were probably deposited in the distal portion of an alluvial fan delta, derived from the Taygetos Mountains, the nearest phyllite exposure. The conglomerates were swept into a quiet lake or sea, where marls were normally deposited, during flash floods from the mountains.

## Pottery

In contrast to some quarries on Crete, where sherds were sometimes collected from quarrying channels,[13] the pottery from the Vapheio-Palaiopyrgi quarry was sparse. Just 25 small, worn sherds were collected, mainly from the eastern and southern areas of the quarry. Fourteen were possibly Mycenaean, based on the clay fabric (e.g., Fig. 6:a), six were Early Helladic (EH) and appear to be of the fabric commonly used for bowls or sauceboats (e.g., Fig. 6:b), one was a possible Middle Helladic (MH) Dark Minyan sherd (Fig. 6:c), and one was medieval (Fig. 6:d). There was one sherd (from a tripod vessel?) of micaceous fabric from the southwest corner of the quarry, and two more of oatmeal type (Fig. 6:e). The last three sherds especially show the influence of Minoanizing wares on inner Laconia, probably via Ayios Stephanos and the island of Kythera.[14]

12. Boggs 1995, pp. 173–177.

13. Shaw 2009, p. 29.

14. These were handed over to the Ephorate in Sparta on 8 August 2011 (receipt number 3264). In addition, three shotgun shells were noted but not collected. The presence of EH sherds comes as no surprise since EH pottery from the wider area of Palaiopyrgi has been collected by Waterhouse and Hope-Simpson (1960, pp. 76–78, fig. 4) and is also present among sherd material from Palaiopyrgi kept in the collection of the American School of Classical Studies at Athens (Coulson 1992, pp. 91–92), which is currently under study by the authors. Sherds of similar date have also been observed by the authors in the immediate vicinity of the quarry to the northwest of Palaiopyrgi. As far as the sherd of micaceous clay is concerned, this is indistinguishable from sherds of the so-called Red Silver Micaceous Ware from Ayios Stephanos, corresponding to the Micaceous Minoanizing ware of Rutter, dated from the MH II to the LH I period (Zerner 2008, p. 206), as well as from the so-called Red Micaceous ware of Kythera (Kiriatzi 2003, pp. 125–126), which appears early in the Neopalatial period on the island. The sherds of oatmeal type correspond to the Oatmeal Minoanizing ware of Rutter and Rutter (1976, pp. 10–11). All three sherds show the influence of Minoanizing wares on Laconia, already attested at coastal sites, with a few examples present inland as well (Banou 2000, pp. 189–196). For the operation of interaction networks in the southern Aegean during the MH and the beginning of the LH period, as detected through pottery traditions and innovations, see most recently Kiriatzi 2010.


**Figure 6. A sample of the ceramics found at the quarry: (a) probable LH sherds; (b) probable EH sherds; (c) MH sherd; (d) medieval sherd; (e) sherd of micaceous fabric and two sherds of oatmeal fabric.** Scale 2:3, except where indicated. Photos E. Banou

## DESCRIPTION OF QUARRY FEATURES

Column base A (Figs. 7–9) appears to be a cylindrical column base; it is approximately three-quarters complete. The eastern side has been hewn away, providing excellent definition of that side of the base, but the depth of quarrying becomes increasingly shallow toward the western side of the base, where only an edge is visible. The top surface has a shallow 0.05 × 0.30 m groove extending northeast to southwest along the south third of the base. The column base has a slightly oval shape and sits on an angular plinth with three sides. The plinth is slightly undercut on its northeast, east, and southeast sides, where the conglomerate is less well cemented. These undercuts may be the result of erosion, or they could preserve cuts made in preparation for separating the base from the quarry. The diameter of the column base is 0.80 m north–south × 0.76 m east–west. From the top of the plinth, the column base reaches its maximum diameter of 0.84 m and its maximum height of 0.35 m. The plinth is 0.10–0.16 m in height. It is 0.20 m wide on the north, 0.08–0.16 m wide on the east, and 0.10 m wide on the west. The southwest angle of the plinth remains unfinished and only an edge of the column base is visible.

Column base cutting B (Figs. 4, 5) is a semicircular cutting in the conglomerate shelf located to the north of column base A. The east half of this cutting is lost either because of further quarrying or erosion. The diameter of the back quarry cutting extending north–south is 1.60 m. What appears to be a removed column base is visible as an outline at the

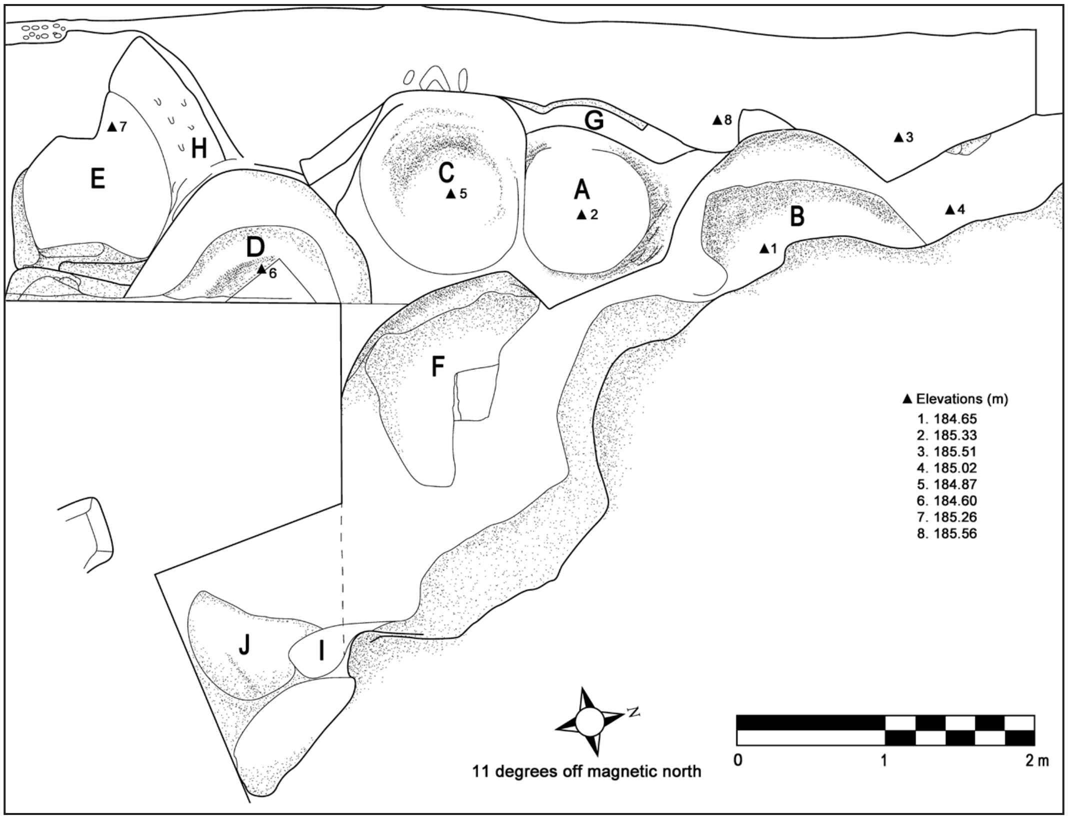


**Figure 7. Plan of the Vapheio-Palaiopyrgi quarry.** Drawing L. A. Hitchcock, K. Giofches, and E. Banou


**Figure 8. Column base A, from the southwest.** Scale is 12 cm. Photo L. A. Hitchcock

bottom of the pit created by the cutting. The north–south diameter of this cutting is 0.88 m. The height is 0.80–0.99 m, and the height of the lower west edge is 0.60 m. Three possible pry holes or chisel marks are visible on the upper ledge of the conglomerate.

Column base cutting C (Figs. 7, 10) is a semicircular cutting immediately to the south of column base A. A circular surface of uneven stone at

**Figure 9. Possible chisel marks above and west of column base A.** Scale is 12 cm. Photo L. A. Hitchcock and A. P. Chapin

the bottom of the pit defined by the cutting suggests that a column base (slightly ovoid in shape) was removed. The rough and uneven surface of the conglomerate suggests that a column base was separated from this space.[15] This cutting has the best quality of well-cemented conglomerate, with pebble clasts averaging 0.04–0.05 m in size but ranging up to 0.09 m in length. The north–south diameter of the quarry cutting is 1.13 m at the top, 1.09 m at the midpoint, and 0.96 m at the bottom. The north–south diameter of the negative space created by removal of the column base is 0.72 m, and the east–west diameter is 0.63 m. The cuttings are 0.55–0.79 m in depth.

Shallow striations in the conglomerate matrix, faintly visible on parts of the back (west) end of the semicircular space, could be tool marks. Some pebble clasts in the vertical surface of the conglomerate matrix appear to have been cut through. The back (west) cut flares and becomes straighter on its south end. Similar flaring is also evident on the south end of column base cutting B. There appear to be at least four, and possibly as many as seven, pry holes at the top of this cutting. The innermost surfaces of the pry holes are 0.03–0.04 m wide and 0.07–0.09 m long. At their outermost edges, the pry holes are 0.09 m wide and 0.14–0.20 m in length.

Semicircular cutting D (Figs. 4, 5, 7, 11) is located to the south and slightly east of column base cutting C.[16] It is composed of an uneven surface of conglomerate at the bottom of a pit with a raised angular area in the center, which suggests the removal of a squared stone block, probably by wedging or prying, as indicated by the uneven horizontal surface measuring 0.34 × 0.50 m. The maximum diameter of the quarry cutting is 1.49 m at top, 0.90 m at bottom, both taken north–south. The cutting is 0.54 m deep. Some of the pebbles in the cutting are cut in half.

Curved cutting E (Figs. 4, 5, 7), a semicircular surface at the south end of the exposed part of the quarry, runs southwest to northeast, and is partially defined by channel H on the north. This surface forms a portion of a circular feature, perhaps a column base. The top surface of cutting E is uneven. It is possible that this surface is defined by the separation and

15. For example, Shiloh and Horowitz 1975, p. 37.

16. As our permit was only for cleaning, the cutting is only half revealed.

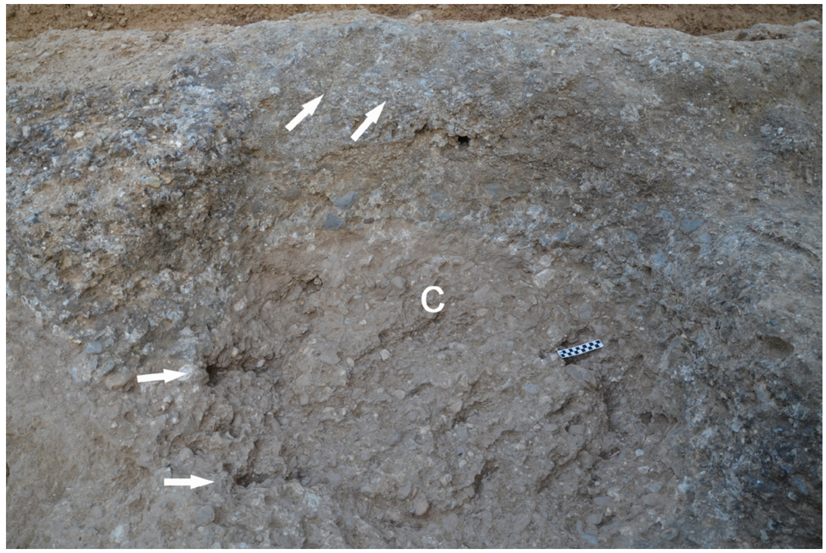


**Figure 10. Column base cutting C, showing possible pry marks, from the west.** Scale is 12 cm. Photo L. A. Hitchcock and A. P. Chapin

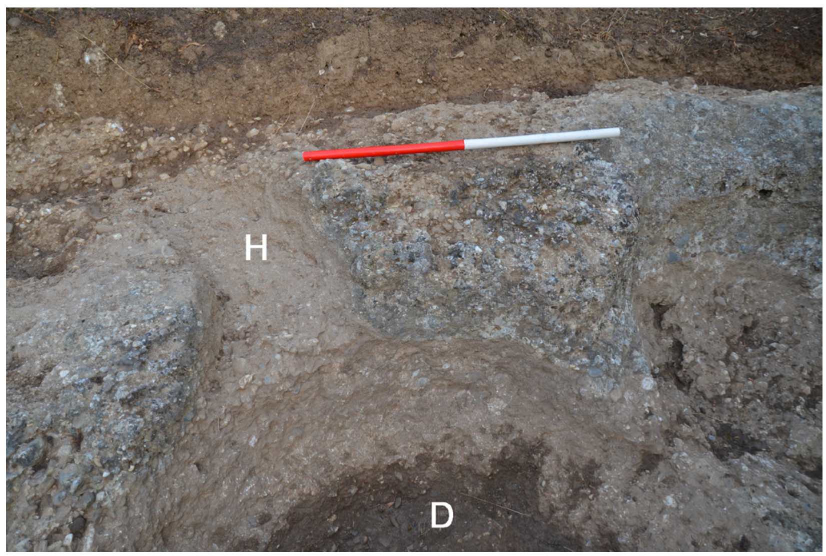


**Figure 11. Semicircular cutting D, south separation channel H, from the east.** Scale is 1 m. Photo L. A. Hitchcock and A. P. Chapin

removal of another column base, or that work was begun here and discontinued due to the poor quality of the conglomerate to the south, which appears to be less well cemented and subject to erosion. The maximum preserved diameter is 0.60 m. The maximum height is 0.17 m on the northeast side, decreasing to 0.06 m on the northwest side. The remaining edges of the quarry feature on the south and east are broken and uneven. Short, shallow striations (tool marks?) are faintly visible in the conglomerate matrix along the north edge of curved cutting E.

Curved cutting F (Figs. 4, 5, 7) is located southeast of column base A. Quarrying is usually done in steps,[17] and this cutting is stepped down to a lower level in the quarry. A portion of the rounded cutting was cleared, but cleaning did not reveal the entire feature. The north edge of this feature is defined by the south edge of the plinth associated with column base A.

17. Shiloh and Horowitz 1975, p. 37.


**Figure 12. North separation channel G and column base A, from the north.** Scale is 12 cm. Photo L. A. Hitchcock and A. P. Chapin

While it is possible that a column base with a plinth was quarried from this area, or that some other type of block was removed, no trace of a circular column base is in evidence at the bottom of the pit created by cutting F. In addition, the pit itself is not as rounded as the others. Below its edge, a shelf appears. The conglomerate at the bottom of the cutting is of poor quality, with many small stones in a loose matrix. The preserved diameter of the cutting as cleared is 1.40 m. Its maximum depth as measured from the top of the plinth of column base A is 0.39 m.

North separation channel G (Figs. 7, 12) is a semicircular separation channel visible to the west of column base A, where the base remains attached to the rock. The channel was worked downward from north to south toward the center of the column base. Work started at the south end of this channel but did not progress around its entire circumference. The channel is 0.12 m wide and 0.02 m deep at the east–west axis of the column base. It widens to 0.30 m on the north where the base was being shaped and narrows to 0.08 m at the bottom of the channel. The south portion of the quarrying channel is 0.13 m wide. The north angled cut is 0.80 m long and reaches a maximum height of 0.30 m at the north end, then diminishes to a height of just 0.11 m. There is a slightly curving cut measuring approximately 0.30 × 0.11 m.

South separation channel H (Figs. 7, 11, 13) is a shallow, curving channel running southwest to northeast. Its south edge defines a portion of curved cutting E. It measures 0.84 × 0.30 m at the west end, widening out to 0.44 m at the east end. The depth of the channel is 0.17–0.06 m. Possible chisel marks may be seen on the lower surface of the quarrying channel. The pattern of these marks seems consistent with chiseling from east to west (deeper to shallower), with a narrow to medium width,[18] indicating the use of a chisel, adze, or axe.[19] However, it is also possible that the marks are from pebble clasts popping out of the conglomerate matrix.

18. Blackwell (2011, pp. 41, 118) classifies tools with a cutting edge of 1.6–2.9 cm in width as Category 3, placing them between narrow and broad.

19. For an example, see Blackwell 2011, pp. 33–41.

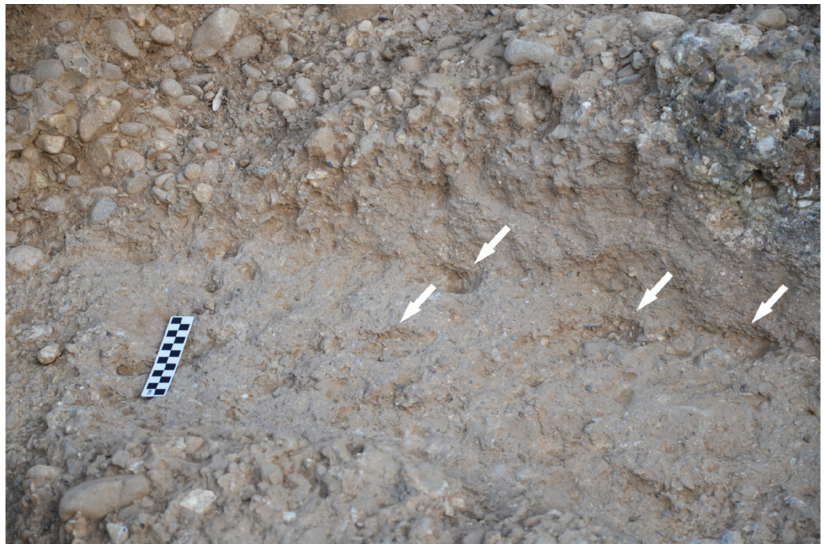

**Figure 13. South separation channel H, with possible chisel marks, from the south.** Scale is 12 cm. Photo L. A. Hitchcock


**Figure 14. East separation channel I and semicircular surface J, from the south.** Scale is 12 cm. Photo L. A. Hitchcock

East separation channel I (Figs. 7, 14), which was found to the east of semicircular surface J, appears to be the remnant of a quarrying channel. However, it is highly eroded and ends at the edge of the conglomerate ledge. It has a maximum length of 0.50 m, a width of 0.32–0.34 m, and a depth of 0.26 m.

Semicircular surface J (Figs. 7, 14), at the east end of the exposed shelf of the quarry, is a semicircular surface whose northeast half is missing, either broken away or eroded, and is defined on the north by separation channel I. This may represent where another column base was separated from the stone, or it may preserve evidence for an unfinished column base, only half of which is delineated (presumably the east half broke from the conglomerate shelf). The southwest edges are worn; the maximum diameter is 0.94 m and the maximum width is 0.34 m.

## COMMENTARY

The in situ column base A is ca. 0.80 m in diameter and the semicircular vertical cuttings range in size from 1.1 to 1.8 m in diameter. Thus, it is comparable in size to column bases found on the citadel at Mycenae. For example, the remaining two of the four conglomerate bases in the megaron are 0.57 m in diameter, as are the five conglomerate column bases that form the colonnade for the court in the House of Columns.[20] The two conglomerate column bases that support the porch in room F of the megaron in the House of Columns are 0.75 m in diameter.[21] A column base identified as amygdalite, but which was probably amygdaloidal basalt, measuring 0.68 m in diameter, was found in the well of room Pi at Petsas House.[22] Finally, the diameter of the limestone column base found east of the Erechtheion on the Acropolis of Athens and believed to come from the Mycenaean palace ranges from 0.76 to 0.81 m.[23]

The vertical cuttings in the quarry range in depth from 0.36–1.10 m. At the bottom of some of the cuttings are uneven circular surfaces, suggesting that column bases were separated from these positions. The best preserved of these, C, directly to the south of column base A, is 0.72 m in its maximum diameter. Column base A itself is 0.35 m high on the east, but just 0.15 m high at the northwest end. At the southwest end, the base remains unfinished, and where its edge is visible, it is flattish. Where the edge of the column base has begun to be hewn on the west, there is a 0.12 m wide groove that widens to 0.30 m on the north as the base was being shaped (Fig. 12). The base appears to emerge from what may be a trapezoidal-shaped plinth. While some Mycenaean column bases do sit on plinths, these are frequently rounded. Here, however, the surrounding cuttings define the plinth: its north side is formed by the flaring end of the cut made for column base B and its southeast side is part of curved cutting F.

The ledges around the column base have smooth vertical faces, and some of the clasts appear to have been cut in half. Visual inspection reveals faint striations cut into some parts of the quarried conglomerate matrix. These features may preserve evidence for tool use (chisels or pick adzes?), but further investigation is needed.[24] There appear to be pick marks or pry holes above the cutting south of the column base A, and chisel or pick marks in the south separation channel (Figs. 8–10). In several of the cuttings, the circular trace of a quarried column base is wholly (C) or partially (B, D, E, F, J) preserved. The undercut plinth of unfinished column base A suggests the possibility that wooden poles were used to separate the blocks from the quarry, which then could have been moved by being dragged or slid on rollers, as Shaw has suggested happened on Crete.[25] Ward-Perkins notes that quarrying was a craft more dependent on skills that were handed down generationally than on elaborate tools or equipment.[26] Nevertheless, it is possible that the tools included a combination of pick-adzes and/or chisels. Evidence for hammers, mallets, and/or hammer stones is elusive: no hammer stones were observed at the site, but marks made by hammering could have been lost to erosion or obscured by the rough surface of the conglomerate.[27] Pendulum saws, which were used to cut anta and threshold blocks at Mycenae, Tiryns, and Gla,[28] and also to shape parts of the Lion Gate relief at Mycenae,[29] are not indicated by the cuttings visible

20. Wace 1949, pp. 77, 93.

21. Wace 1949, p. 93, fig. 33. Wace (Wace et al. 1921–1923, p. 211) also reports two unusually large conglomerate column bases from Mycenae, no longer in situ, which measure 1.10 m in diameter and 0.40 m in thickness.

22. Iakovides 2002, p. 18, table 12:b.

23. Iakovides 2006, pp. 190–192, figs. 30, 31.

24. On carpentry and masonry tools in the Aegean Bronze Age, see most recently Blackwell 2011, pp. 129–193. Keimer (2014) notes that quarrying picks might be pointed at one or both ends. Minoan picks or pick-adzes published by Shaw (2009, p. 250, pl. 37:a, b; see also Blackwell 2011, p. 176) show only one pointed end.

25. Shaw 2009, pp. 28–30.

26. Ward-Perkins 1972, p. 24.

27. Cf. Shaw 2009, pp. 41–52.

28. Küpper 1996, pp. 16–21, 22–24; Wright 2006, p. 34.

29. Blackwell 2014, pp. 452, 454–455, 457, 460, 462.

**Figure 15. Phaistos quarry, Crete, from the west.** Photo A. P. Chapin

at the Vapheio-Palaiopyrgi quarry. Likewise, evidence is lacking for the use of the tubular drill, which was a hollow, sometimes bronze, cylindrical cutting tool that used sand or emery as an abrasive. The tubular drill was used extensively to carve the Lion Gate relief at Mycenae and might have been used in the quarrying of the original stone itself.[30] Further study incorporating microscopic inspection of the preserved stone surfaces might shed more light on the question of tool use.

The curved cuttings are unusual. Many early quarries—particularly those of the historical era—preserve evidence for straight cuts used to extract cubic blocks of stone. At the Vapheio-Palaiopyrgi quarry, however, the cuttings are consistently rounded, even when the uneven surface at the bottom of the pit suggests that a noncylindrical block of stone was removed (D, F). Deep, curved quarry cuttings, probably made by picking, can be seen near the Minoan palace at Phaistos on Crete (Fig. 15). One of these, a curved channel that outlines an unfinished ashlar block,[31] suggests to us that prehistoric quarriers may have used curved separation channels to

30. Casson 1933, pp. 23–25; Blackwell 2014; pers. comm.

31. Pictured in Shaw 2009, p. 247, fig. 25.

roughly delineate the trapezoidal shape characteristic of Minoan ashlar.[32] At Vapheio-Palaiopyrgi, however, all blocks but the unfinished column base A were removed. The evidence instead suggests that the curving cuts were used to remove blocks more efficiently. For example, the back cut of column base cutting B forms an edge for the plinth for column base cutting A, thus minimizing the quarrying of excess stone. Altogether, the preservation of the cuttings and assorted tool marks at Vapheio-Palaiopyrgi makes this quarry unusually interesting and important for the study of Mycenaean stone extraction techniques.[33]

## INTERPRETATIONS

Although we recognize that it is notoriously difficult to date surface architectural features rendered in stone such as quarries and walls, we nevertheless regard the quarry to be Mycenaean. We base this interpretation on its roughly equal proximity to two important Mycenaean sites (Vapheio and Palaiopyrgi), the importance of the Eurotas Valley in the Mycenaean era, the nature of the quarry cuttings, and most importantly, on the material, namely conglomerate, which served as a symbol of Mycenaean prestige architecture in LH III.[34]

An extensive bibliography presenting detailed studies exists for Minoan quarries,[35] and recent investigation throws new light on Hittite quarries and quarrying techniques,[36] yet little is published on Mycenaean quarries[37] beyond brief mentions of their existence[38] and anecdotal evidence shared through personal communication. This is surprising given that quarries form part of the socially constructed industrial[39] and symbolic landscapes[40] of the Mycenaean world. One notable exception is the brief discussion of a quarry at Mycenae taken from Frick's "Notes and Translation of 'Karten von Mykenai' by von Steffen."[41] Frick suggests that a feature in one Mycenae quarry is a column base, based on the bulk of the stone and its flattened top, characteristics also evident in the Vapheio-Palaiopyrgi quarry. Frick's feature represents the best comparandum for column base A at the Vapheio-Palaiopyrgi quarry, but unfortunately, its precise location was not documented. Other quarries at Mycenae include the limestone quarries at Batsourorachi (Fig. 16), which preserves vertical face cuttings

32. For discussion of the quarry at Phaistos and further bibliography, see Shaw 2009, pp. 32–33, figs. 25, 26, but Shaw does not specifically discuss the curving path of the quarrying channel.

33. Cf. Langdon 1988, p. 77.

34. Fitzsimons 2006.

35. See Shaw 1971, pp. 30–35; Soles 1983; Karniejew-Grebarow 1992; Papageorgakis, Mourtzas, and Orfanoudaki 1992; Betancourt 2001; Whitley 2004–2005, pp. 107–109; Shaw 2009, pp. 28–38.

36. Summers and Özen 2012.

37. See comments in Waelkens 1992, p. 11; Fitzsimons 2006, p. 176, n. 577.

38. For example, see Iakovides et al. 2003, pp. 25, 40–42, 54, figs. 20, 21.

39. Bloxam 2011, esp. p. 157.

40. Chapin et al. 2014; Davis et al. forthcoming.

41. Frick 1990.

**Figure 16. Batsourorachi quarry, Mycenae.** Photo A. P. Chapin

**Figure 17. Palaiogalaro quarry, Mycenae.** Photo A. P. Chapin

from the excavation of stone, and Asprokhoma, which preserves horizontal separation channels showing where the stone was split from the rock. Other documented conglomerate quarries include the Palaiogalaro, or Longaki, quarry (Fig. 17), the Kharvati quarry,[42] and the Monastiraki (formerly Priphtiane) quarry (Fig. 18). Additional rounded quarry cuttings, as well as a curved channel, probably for the transportation of quarried material, are present at Kambi, Zakynthos (Figs. 19, 20), within the area of the LH IIIA–B cemetery excavated there.[43]

42. Iakovides et al. 2003, pp. 42, 60.
43. Agallopoulou 1973. No mention of the cuttings is made in the publication of the cemetery, although they might have been visible then.

**Figure 18. Monastiraki quarry, Mycenae.** Photo L. A. Hitchcock

**Figure 19. Kambi quarry, Zakynthos, showing cuttings.** Photo E. Banou

**Figure 20. Kambi quarry, Zakynthos.** Photo E. Banou

## Symbolic Associations of Conglomerate

The conglomerate composition of the quarry at Vapheio-Palaiopyrgi is of critical significance to our understanding of it. Although little has been written on Mycenaean quarries, much has been written on the popularity of conglomerate masonry in Mycenaean prestige architecture. Wright observed that the use of conglomerate stone was first introduced in tholos tomb construction in LH IIA in the Tomb of Aigisthos, that its use outside of Mycenae is exceptional, and that it was typically employed for "special monumental constructions."[44] Such constructions include the facing blocks of walls, the dromoi of important tholos tombs, and other highly visible structures that also functioned as liminal or transitional zones, such as the walls around the Lion Gate. In addition, conglomerate stone was used for specific and highly visible architectural fragments, such as lintel blocks, threshold blocks, pillar bases, and column bases. Wright has written on the symbolic properties of conglomerate,[45] tracing its increasing use at Mycenae and arguing that its presence in various monuments, including the Lion Gate and surrounding tholoi, enabled these monuments to reference each other through their intervisibility within the landscape.

Fitzsimons has made a detailed study of the history of ashlar construction in conglomerate at Mycenae,[46] carefully documenting its increased use, which came to characterize LH IIIB tholos tomb architecture, as well as the appearance of certain elements such as threshold blocks, which he sees as characteristic of the later palace. He takes this argument even further,[47] suggesting that in mimicking the Lion Gate, the Treasury of Atreus and the Tomb of Clytemnestra created a physical and emotional link between the living power of the state and the inherited grandeur of the past. He also notes the symbolic value of conglomerate as the primary material used in these tombs and remarks on its greater density, which makes the stone relatively challenging to work. Wace commented on the structural weakness of conglomerate, that it concealed flaws that only showed up later in the process of hammer dressing, and that it was subject to cracking and disintegration.[48] Thus, it is tempting to speculate that, in addition to its variegated appearance, the skill required to work with this difficult material also enhanced its desirability and prestige value.

The practice of quarrying stone, as opposed to collecting it or cleaving it from outcroppings, implies specialized knowledge and access to tools.[49] Techniques for working conglomerate included saw cutting, hammer dressing, and abrading.[50] Its documented use in the Argolid was not limited to Mycenae; it is also evident in the threshold and gateway at Tiryns and in the lintel, presumably of the gateway, at Argos.[51] According to Crouwel, Wace used the composition of conglomerate as the basis to identify a lintel block built into the southeastern part of the inner enceinte of the Byzantine fortification wall on the Larissa hill at Argos as specifically Mycenaean. Crouwel argues for the importance of Mycenaean Argos[52] as part of a greater kingdom of Ahhiyawa, based on the size (3.85 m in length) of the block as well as its conglomerate composition, and he argues that the use of conglomerate was deliberate in order to create a symbolic link to Mycenae and Tiryns. In her study of portable luxury objects of the 14th–13th centuries B.C., Feldman has argued that their rendering in an

44. Wright 1978, pp. 134, 229–235.
45. Wright 1987.
46. Fitzsimons 2006.
47. Fitzsimons 2011, p. 110.
48. Wace 1949, pp. 135–136.
49. Cf. Fitzsimons 2006, p. 176.
50. Wright 1978, pp. 231–232; Shaw 2009, p. 25.
51. Wright 1978, pp. 234–235.
52. Crouwel 2008, pp. 267–269, fig. 4. Crouwel does not provide a reference for Wace, but provides numerous other references for Wace's observation.

international *koine* and display by elites was used to promote supra-elite regional identities of a brotherhood of kings, possessing special knowledge of and access to such objects.[53] It is quite possible that the exploitation and display of conglomerate in monumental buildings operated in a similar way for Mycenaean elites.[54] Finally, decomposed conglomerate might also be used as the bedding for a finer surface, as in the lime cement floor used in the House of the Columns at Mycenae.[55] Just as a foundation deposit attains new symbolism through its burial, the use of decomposed conglomerate may have had symbolic value for the patron despite not being visible.

Use of conglomerate on Crete was rare and unusual. When it occurs it was used mainly for column bases, as at Knossos and Mallia.[56] Joseph Shaw does not believe it was systematically quarried, a practice limited to gypsum, poros limestone, and sandstone.[57] Shaw notes three unworked slabs of conglomerate beneath the floor of room 63 in the east wing at Kato Zakro, one of which served as the covering slab for a drain. Painted dadoes and painted floors from Kommos on Crete depicted conglomerate veneering and floors. However, Maria Shaw regards the creation of conglomerate revetment to be difficult, if not impossible, due to both its loose texture (presumably of the sedimentary matrix) and excessive hardness (presumably of the clasts).[58] She suggests that the painted conglomerate floor pattern may have imitated the terrazzo floors that are well known from Kato Zakro.[59] She also suggests that the inspiration for these Minoan frescoes, which she dates between late Middle Minoan (MM) IIIA and Late Minoan (LM) IA, may have been stone vessels made of conglomerate.[60] She cites additional depictions of conglomerate in nature scenes from the Minoan and Mycenaean periods, including a seascape depiction in the Flotilla fresco from Akrotiri, the Caravanserai fresco from Knossos, and the lyre player fresco from the palace at Pylos.[61] Likewise, portions of the Monkeys and Blue Birds fresco from the House of the Frescoes at Knossos depict egg-like pebbles, which Evans believed were derived from the imitation of cut conglomerate,[62] and the border of the Taureador fresco from Knossos includes an imitation of conglomerate.[63] Rodenwalt discusses depictions at Tiryns of what he terms "Breccia-Imitation."[64] Some of these depictions combine rounded and subangular inclusions (pl. III.18), while others, which are rounded only (pl. III.14, 15), are best described as conglomerate.[65] Additionally, a fresco fragment of a variegated dado from the northwest slope at Pylos imitates the pebble inclusions of conglomerate,[66] as does the "Easter egg" conglomerate decorating dado fragments from the Ramp House at Mycenae.[67]

53. Feldman 2006, esp. pp. 25–26.

54. Inspired by Feldman, Hitchcock (2009) argues for an international style of architectural forms in her analysis of the basin building at Hala Sultan Tekke on Cyprus.

55. Wright 1978, p. 104.

56. Shaw 2009, pp. 25, 245, fig. 18.

57. Shaw 2009, p. 28.

58. M. C. Shaw 2006, pp. 222–223, 229.

59. Shaw 1971, pp. 218–221, fig. 250.

60. M. C. Shaw 2006, pp. 223, 255, n. 111. For stone vessels made of conglomerate and breccia, and the painted imitation of conglomerate and breccia on ceramics, see Warren 1969, pp. 127–128, 130, 172–173, with further references.

61. M. C. Shaw 2006, p. 255, n. 109, with references.

62. *PM* II.2, pp. 450–451.

63. *PM* III, p. 213, fig. 144, pl. XXI.

64. Rodenwalt 1912, pp. 26, 171, pl. III:14, 18.

65. Ulrich Thaler (pers. comm.); Rodenwalt 1912, pl. III:14, 15, 18.

66. Lang 1969, pp. 165–167, 173–174, pls. 99, Q, fragment (14 D nws).

67. Lamb 1919–1921, pp. 197–198, pl. X:26, 27.

**Figure 21. Conglomerate block from the Vapheio tholos tomb.** Photo A. P. Chapin

## Architectural Associations

It seems likely, based on the numerous semicircular cuttings we detected, that the column base left in situ in the quarry at Vapheio-Palaiopyrgi was one of several intended for a monumental Mycenaean building. It also seems likely that large conglomerate blocks found lying on the dromos of the Vapheio tholos tomb, which were probably used for its lintel, may have come from this quarry or a similar one nearby (Fig. 21).[68] Although shallow, circular cuttings could also indicate the quarrying of disks for tabletops in the Byzantine period,[69] marble seemed to be the preferred material for such objects, and we do not believe a later use can be sustained in this instance. Rotary querns and millstones left shallow circular depressions; sometimes olive millstones did as well. However, we observed no indication of such stones in the immediate area.

The earliest use of the Vapheio tholos is dated to the transition from late LH IIA to LH IIB, based on a decorated goblet with an elliptical shape and ogival canopy decoration.[70] Use of the tomb continued into the LH III period, an era when the conglomerate quarry may have again been tapped to enhance a palace, palatial structure, propylon, courtyard, or other important building, perhaps at Palaiopyrgi or elsewhere. It is unlikely that the column bases from the quarry were used in connection with a tomb, as preserved examples of columns from tombs take the form of decorative, engaged columns, as known from the Treasury of Atreus and the Tomb of Clytemnestra. Although the bases for the columns at the Treasury of Atreus are of conglomerate, they are stepped and square, not round, while the bases for the engaged columns in the Tomb of Clytemnestra are semicircular.[71]

With regard to column bases, it is important to note some general observations that prevent us from making specific comments about the column bases from the quarry. There is no clear evidence for a set order, canon, or standard size for column bases in the Aegean world. In addition, there is no set formula for calculating the base-to-height ratio for columns. Shaw observed that column height in Minoan Crete ranges from five to eight times the base diameter.[72] Moreover, the diameter of the column was typically less than that of the base itself.[73] Graham has also commented on the problems

68. Conglomerate shelves are visible both on the east slope of the Palaiopyrgi ridge and to the northwest of the Vapheio tholos tomb, but they seem to be of poorer quality than that of the quarry studied. Conglomerate had also been extensively used for the construction of the south terrace wall of the Amyklaion exposed during the renewed excavation of the site.

69. Langdon 1988, pp. 82–83, fig. 9.

70. Banou and Hitchcock 2011, p. 11, fig. 9.

71. Wace et al. 1921–1923, pp. 359–360.

72. Shaw 1971, p. 146, n. 1.

73. Shaw 1971, p. 152.

**Figure 22. Conglomerate column base, House of the Columns, Mycenae.** Courtesy Mycenae Excavations. Photo L. A. Hitchcock

in arriving at a standard base-to-height ratio on fresco representations in his discussion of the enormous column base in room 25 at Phaistos, but notes that the ratio can be as great as nine times, based on the columnar shrine depicted on the Grandstand fresco from Knossos.[74] Holland attributes differences in the base-to-height ratio to the amount of load that columns bore.[75] Wace[76] and Holland[77] reconstruct the height of the columns in the palace at Mycenae at 4.5 m using a 1:8 base-to-height ratio for the 0.57 m conglomerate bases, based on the amount of space to be spanned. At Mycenae, the engaged columns in the Treasury of Atreus are eight times the width of the base, while those at the Tomb of Clytemnestra are 13 times the diameter of the base.[78]

In the Aegean, column bases may be thick or thin, include a larger plinth that might be buried, sit on foundation stones, sub-bases, or a foundation of pebbles (also evident in the Philistine "temple" at Tell es-Safi/Gath), or not include a plinth at all.[79] The plinths may be round, rounded, or irregular in shape, as seen at Mycenae. Shaw has shown that column bases found in prehistoric Cretan porticoes range from 30 cm in diameter at Tylissos to 70 cm in diameter at Mallia, but most of them measure in the range of 40–50 cm.[80] Even within the same architectural setting, the rendering of column bases does not necessarily show uniformity, as demonstrated in the House of Columns at Mycenae (Fig. 22), where the bases in the porch are substantially wider than those in the colonnade, as noted above. The Mycenaeans did not seem to follow the Minoan practice of setting the column base into a stylobate, a Minoan practice that continued in the Mycenaean period on Crete.[81]

It is likely that the column bases taken from the Vapheio-Palaiopyrgi quarry were roughed out in the quarry and that any finishing took place in situ. This is standard practice, so that if any damage occurred to the architectural fragment en route to its final destination, the loss in terms of time spent by the mason would not be so great. We know, for example, from later historical accounts that the quarrying and transportation of stone accounted for a substantial amount of the cost of a building.[82] McEnroe has made some useful estimates of the labor required to construct Minoan

74. Graham 1956, p. 155, n. 38; 1987, p. 197; also Hitchcock 2000, p. 142.

75. Wace et al. 1921–1923, p. 279.

76. Wace 1949, p. 77.

77. Wace et al. 1921–1923, pp. 276–277.

78. Wace et al. 1921–1923, p. 278.

79. J. W. Shaw 2006, pp. 93, 1037–1038, pls. 1.136:a–i, 1.137.

80. J. W. Shaw 2006, pp. 94–95, table 1:4. It is worth mentioning in this respect that the rounded cuttings observed at Kambi, Zakynthos range between 0.45 and 0.50 m in diameter.

81. McEnroe 1979, pp. 277–278; see also Shaw 1971, esp. pp. 113–115.

82. Camp and Dinsmoor 1984, p. 9.

buildings of various sizes and levels of quality, which indicate that up to one-third of the time spent on construction is involved in the quarrying and transportation of stone.[83] Dressing the blocks can add as much as 40% to the time required for constructing a building. For domestic structures without such features, the amount of labor is considerably reduced.[84] In an overview of Near Eastern quarrying practices, where we have textual evidence including biblical references, Keimer observed that quarrying teams in Old and New Kingdom Egypt numbered in the thousands, with a ratio of supervisors to workers of approximately 1:22 or 1:25.[85] Although the numbers may be inflated, the information on the different categories of workers and on ratios is instructive. In addition, the quarrying activities are differentiated between quarrymen who hew the stone, masons who build and shape it, and the laborers who transport it.[86] Among these three categories of worker, the laborers moving the stone were the most numerous. Thus, it is almost certain that any column bases removed from the quarry were smaller in diameter than the size of the cutting they came from, as the cuttings taper inward as they approach the bottom. And it is likely that there was some variability in the diameter, thickness, and presence of a plinth in the bases, as such variability is evident in the bases both in the palace and in the House of the Columns at Mycenae.

## CONCLUSIONS AND FURTHER WORK

While we cannot entirely rule out the possibility that the quarry at Vapheio-Palaiopyrgi postdates the Mycenaean era, we believe that the cumulative evidence related to the use of conglomerate stone in the Mycenaean world argues for the use of this quarry in LH III, the era of the Mycenaean palaces. Additional investigation of the possible tool marks identified in this study could shed light on prehistoric methods of stone extraction. Undertaking a new survey may provide further understanding of the context of the quarry and the context of the excavation of the sites of Vapheio and Palaiopyrgi. The Mycenaeans showed a preference for the variegated appearance of conglomerate when they rendered special elements of prestige architecture. This is seen in the execution of column bases in varying diameters and thicknesses, both with and without plinths. Following the comments by Crouwel (p. 83, above), we believe it is possible to argue for a symbolic link between Vapheio-Palaiopyrgi and the Argolid, possibly with the Vapheio tholos setting the trend for the use of conglomerate stone.

83. McEnroe 2010, p. 22.

84. McEnroe 2010, pp. 96, 149.

85. Keimer 2014, with further references. Since this article underwent revision, please see Devolder 2013 on archaeological energetics on Crete, recently critiqued by Fotou (2016).

86. This is also noted in the Old Testament, as detailed in Keimer 2014. Lehner's experiments in Giza suggest a minimum of 1,200 workers (1997, pp. 206–209).

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