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THE GOLD NECKLACE FROM THE GRAVE OF THE GRIFFIN WARRIOR AT PYLOS

ABSTRACT

The Late Helladic II burial of the so-called Griffin Warrior, discovered at Pylos in 2015, yielded hundreds of precious artifacts. One find surpassed the others and exemplified the difficulties of the excavation: an elaborate gold necklace with two beads of agate and one of faience, the faience bead perhaps an Egyptian import. We describe the necklace here in detail, argue that it is of Minoan manufacture, and suggest that it had been worn as a badge of honor by warriors. Detailed chemical analyses appear in an attached appendix and support the identification of the central bead as faience.

One of the most spectacular finds from the grave of the Griffin Warrior, a Late Helladic II burial discovered in 2015 near the Palace of Nestor at Pylos, is a gold necklace (SN15-97) first uncovered in the southeast corner of the grave, near the right shoulder of the skeleton (Figs. 1, 2).[1] This necklace consists of a long gold loop-in-loop chain, three beads with granulated gold caps (two of agate and a central one of faience), gold repoussé finials, gold fasteners, and a piece of gold wire. In its composite form, the necklace is unique, even though the gold chain itself finds parallels for its method of construction at Mycenae, at Prosymna in the Argolid, on Crete, and

1. We initially announced the discovery of the necklace in the autumn of 2015 on our project's website (www.griffinwarrior.org), where low-resolution photographs can be found. For general assistance in the preparation of this paper, we express our gratitude to Eric Cline, Emily Egan, Christine Lilyquist, Denitsa Nenova, Marina Panagiotaki, and Tina Ross. We also thank Evangelia Militsi, Demosthenes Kosmopoulos, Evangelia Malapani, and Nikos Antonopoulos for their support in Kalamata; Kathleen Lynch for her help in Cincinnati; Tina Ross for drawings; and Jeff Vanderpool, Peter Gaul, Maria Kontaki, and Eleftherios Galanopoulos for photographs. We thank Maria Anastasiadou in the archive of the Corpus der minoischen und mykenischen Siegel (CMS) in Heidelberg and Konstantinos Nikolentzos and Vasiliki Pliatsika of the National Archaeological Museum in Athens for providing illustrations of the comparative material. Finally, we thank the major supporters of our work at Pylos, the Institute for Aegean Prehistory, the Louise Taft Semple Fund of the University of Cincinnati, Phokion Potamianos and his family, the Malcolm Hewitt Wiener Foundation, Jim and Mary Ottaway, Lawrence Stack and Loretta Cummings, Peter and Dorothea Goop, the Anglo-Hellenic League, the Kaplan Foundation, the Captain Vassilis and Carmen Constantakopoulos Foundation, the A. G. Leventis Foundation, the Elios Charitable Foundation, the National Hellenic Society, the Costopoulos Foundation, Bob and Dina McCabe, the Rust Family Foundation, and Robert and Nancy Stocker. Additionally, we are appreciative of the efforts of those who contributed to excavating the grave (see Davis and Stocker 2016, p. 628, n. 5, for individual acknowledgments).

Figure 1. The gold necklace (SN15-97) from the grave of the Griffin Warrior. Not to scale. Photo P. Gaul; courtesy Badisches Landesmuseum

elsewhere. The necklace is a welcome addition to the corpus of Aegean gold work, and the most elaborate example of its type to date.

This first scholarly presentation of the necklace and the context of its discovery gives us an opportunity to offer brief remarks on the significance of necklaces in martial contexts, both on Crete and on the Greek mainland during the first phases of the Aegean Late Bronze Age. We suggest that (1) the faience bead was most probably an Egyptian import; (2) the necklace was made on Crete and would have been worn in battle as a badge of honor; and (3) at some point, it may have been torn from a warrior's neck by his opponent. We include the chemical analyses of the faience bead presented by Andreas G. Karydas, Vasiliki Kantarelou, and Maria Kaparou in the Appendix that follows this discussion.

THE DISCOVERY AND EXCAVATION OF THE NECKLACE

Excavators first noticed the presence of the necklace on June 19, 2015, while cleaning around a nearby silver cup (SN15-18), but it could not be finally removed until three months later.[2] The first part to emerge was one of two gold sacral ivy/papyriform finials and part of the gold chain (Fig. 3:a), which ran under the edge of an enormous cover slab that had fallen into the grave, and was trapped beneath it.[3] In early July, when a truck jack was used to raise the cover slab to an upright position, more of the necklace was freed (Fig. 3:b). It soon became clear, however, that the remainder was pinned under a large bronze cup (SN24-26) that rested on the right shoulder and chest of the

2. The necklace was first uncovered by trench supervisor Alison Fields, who was assisted that day by Emily Egan. Fields wrote: "Emily continuing to clean around silver vessel to prepare it for removal. . . . to the N of the cup, immediately next to the stone was found part of a braided gold chain with a terminal in the shape of a sacral ivy! The chain seems to extend down under the stone and is being left in place for the moment." It was finally removed by Sharon Stocker.

3. Concerning the cover slab, see Davis and Stocker 2016, pp. 631–632.

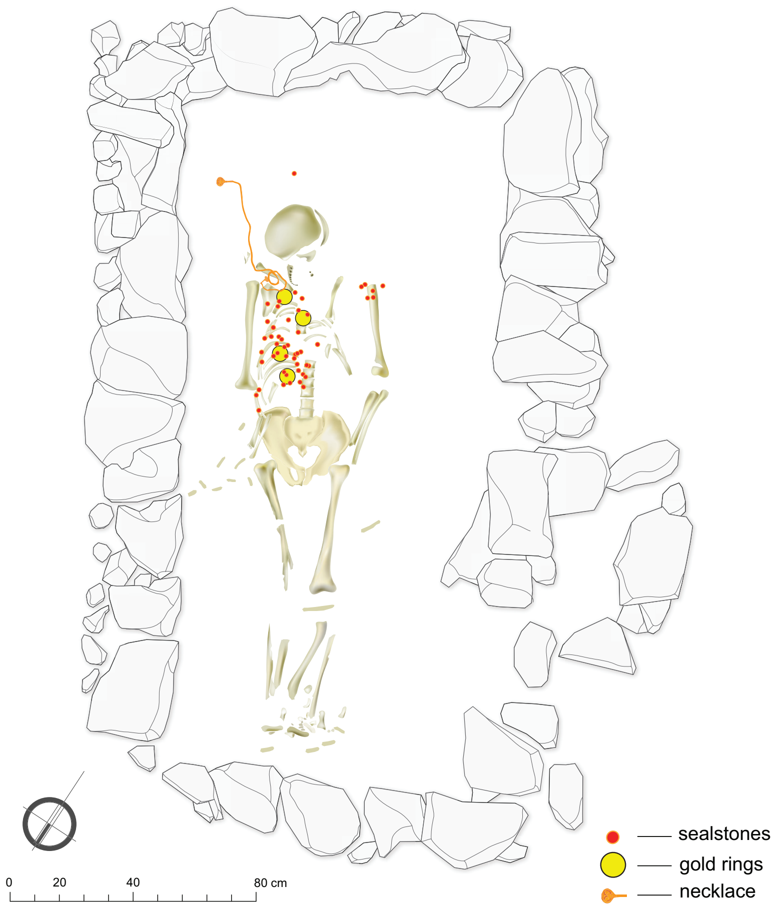


Figure 2. Plan of the grave of the Griffin Warrior, showing the location of the gold necklace (SN15-97) at upper left. Drawing D. Nenova; courtesy Department of Classics, University of Cincinnati

warrior (Fig. 3:c). It was only when the rim of the cup was removed that the necklace could be extracted on September 15, 2015 (Fig. 3:d).[4]

The warrior was not wearing this gold necklace at the time he was buried. He was, however, wearing a necklace of amethyst beads, which were found above, below, and at the sides of his neck.[5] Well more than a thousand other beads of carnelian, amethyst, gold, faience, ivory, and amber were found in the grave, the majority at the warrior's right side, in the area where most of the sealstones and the four gold rings were also recovered.[6] It is not clear how many of these were also from necklaces. From their random distribution in the grave, it appears that at least some of the smaller gold, faience, and carnelian beads may have been woven into a cloth cape or similar garment, in which case their presence may be indicative of a ritual, in addition to a military, role for the Griffin Warrior.[7]

4. Stocker wrote in her diary on September 15, 2015: "We began the day with high stress levels because of the chain and the remaining fragment of the basin rim. . . . the basin cut the face and was solidly wedged against the bones of the face, the skull, and pieces of silver. It was a real mess. . . . ca. 10:00 A.M. I removed the necklace. It has been tormenting us for months now, but couldn't come out until the basin rim was removed."

5. We do not present the amethyst necklace here, as it has not yet been studied in full.

6. The faience beads include the so-called "grain-of-wheat," spherical, amygdaloid, and drum types. See Panagiotaki 2000 regarding Minoan faience more generally.

7. For the possibility that gold and beads of other materials were woven into fabrics at Troy and elsewhere in prehistoric times, see Barber 1991, pp. 171–172. For capes worn by men in ritual contexts, see Lenuzza 2012. See also Papadopoulos 2012, p. 652, and Konstantinidi 2001, p. 38, in reference to single pins in graves that may have served to secure such a male garment. There was one bronze pin in the grave of the Griffin Warrior (SN10-23), found by his pelvis and right leg, concreted by corrosion to a bronze mirror (SN10-7; the mirror is depicted in Davis and Stocker 2016, p. 651, fig. 14).

a

b

c

d

Figure 3. The necklace in situ: (a) as first seen in the grave; (b) as exposed, and straightened, after moving the fallen cover slab into an upright position; (c) shown pinned beneath rim of the bronze cup (SN24-26); (d) held by Sharon Stocker moments after its removal from the earth on September 15, 2015. Courtesy Department of Classics, University of Cincinnati

THE NECKLACE

SN15-97 Fig. 1

Necklace. Chain, finials, beads, bead caps, fasteners, and wire. L. chain 74.5, chain and fasteners 75.6, finials 1.6 cm; W. chain ca. 0.3 cm^2; Diam. central faience bead 1.76, smaller agate beads 1.52 cm.

The chain for the necklace is fashioned from 365 gold links. Each finial consists of two repoussé plaques (Fig. 4) decorated with a hybrid sacral ivy/papyriform motif (Furumark motif [FM] 12, Late Helladic IIA variants with papyriform filling).[8] In addition to vase painting, the motif is represented in Minoan Neopalatial seal carving (Fig. 5), and a very close repoussé parallel on gold plaques was found by Christos Tsountas in Chamber Tomb 91 at Mycenae (Fig. 6).[9] The papyrus stems are formed by small ovals set between the volute spirals of the sacral ivy. Small ovals also outline the papyrus heads.

8. See Furumark 1941, fig. 35.

9. For the design, cf. seal impressions *CMS* II.7, no. 104A (Kato Zakros) and *CMS* II.8, no. 137 (Knossos) in Fig. 5, below. The grave of the Griffin Warrior has ivory beads with representations of the *waz*-lily (SN10-168, SN10-169), but no beads of any sort with the sacral ivy/papyriform hybrid. For the primary publication of the gold plaques from Mycenae, see Xenaki-Sakellariou 1985, p. 255, no. 3191, pl. 125; see also the discussion in Laffineur 2012, p. 6, pl. III:b.

Figure 4. Front and back views of the finials. Scale 1:1. Photos J. Vanderpool; courtesy Department of Classics, University of Cincinnati

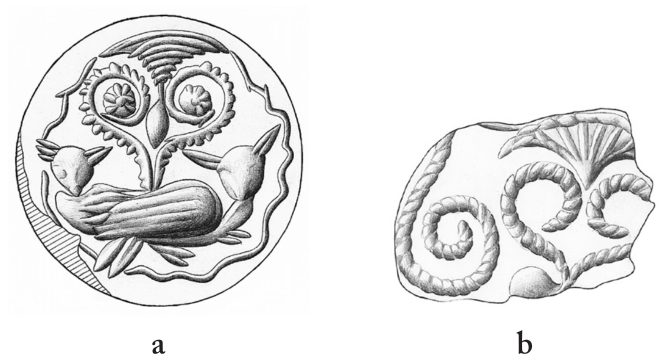


Figure 5. Sealstones with similar sacral ivy/papyriform motif: (a) from Kato Zakros (*CMS* II.7, no. 104A); (b) from Knossos (*CMS* II.8, no. 137). Not to scale. Courtesy Corpus der minoischen und mykenischen Siegel, Heidelberg

Figure 6. Repoussé gold plaque from Chamber Tomb 91 at Mycenae. Athens, National Archaeological Museum P 3191. Not to scale. Photo M. Kontaki; courtesy National Archaeological Museum, Athens, Department of Prehistoric, Egyptian, Cypriot, and Near Eastern Antiquities; © Hellenic Ministry of Culture and Sports/Archaeological Receipts Fund

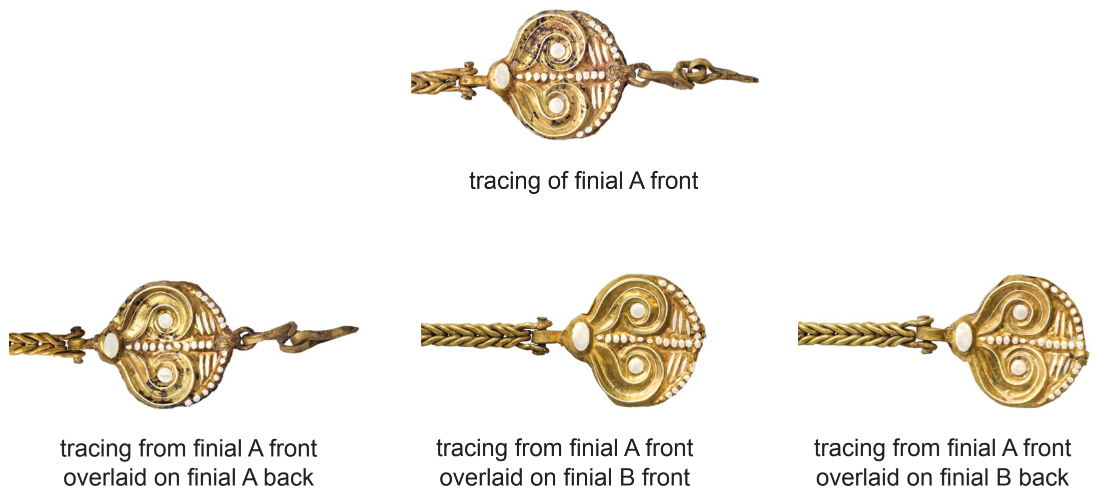


Figure 7. Four faces from the same mold. When a vector line tracing of the most prominent parts of the front of finial A (top) was overlaid on the other three faces, the alignment of the vector tracing and the finial features showed that all four plaques were made from the same mold. Scale 1:1. D. Nenova; courtesy Department of Classics, University of Cincinnati

Two identical plaques were soldered together at their edges to form each finial, and the cavity formed between them was probably filled with sand (Fig. 7).[10] The finials were attached to the chain by fasteners, which consist of thin gold bands, rectangular in section, that have been folded over to form a loop at one end (Figs. 8, 9). The sharpened ends of the fastener were inserted into a hole in the finial at the apex of the sacral ivy leaf where there is an oval bulb; the fastener was then welded into place. A short gold bar, round in section, was passed through the loop at the end of the fastener, after which the two loops formed by the last link in the chain were set over the ends of the bar. Finally, the ends of the bar were hammered flat so that the loops would pivot on the bar and not slide off it.

A second fastener was inserted into a hole at the top of the papyrus stem in each finial and likewise welded in place. The tops of the papyrus stems on both finials show evidence of repairs where the fasteners had once pulled loose in antiquity. They had been reinserted and the two halves of the finial were pulled together with short gold bands (Fig. 10). Even this extreme measure did not succeed in holding the fasteners in the finials. By the time the necklace was excavated, one had again pulled loose—fortunately so, since that happy accident provided us with greater insight into the way in which the fasteners were crafted.[11]

About halfway between the two finials, two round agate beads flank a larger round, fluted "melon" bead (Figs. 11, 12), which would originally have been a translucent blue.[12] The results of chemical analysis have determined that the bead

Figure 8. Detail of the fastener still attached to finial A, pulled loose from finial B. Scale 1:1. Photo J. Vanderpool; courtesy Department of Classics, University of Cincinnati

10. We thank Denitsa Nenova for her demonstration that all four plaques were made from the same mold. She describes (pers. comm., 2018) the method she followed in reaching this conclusion: "Schematic vector line tracing was applied on the most prominent parts (positives) of one of the four sides of the two finials of the necklace. The model aimed to account for the dimensions, shape, and distances between the elements of the motif. The semi-transparent tracing that resulted was then directly overlaid on the other three sides, resulting in a complete overlap with the positives on each, with only minor biases in execution: e.g., such as a 7-degree rotation of the motif from one side of finial A (the unbroken example) to the other in comparison to finial B (the broken example), where the designs on the front and back align perfectly." Systematic studies of the repoussé technique are surprisingly few, given its widespread use in the early phases of the Late Bronze Age of Greece. One exception is a study by Christine de Vree, who used a digital microscope to measure gold owls from Tholos IV at Pylos, Kakovatos, and Peristeria; she argues in her forthcoming dissertation (Univ. of Freiburg) that all were made from the same mold. See also Laffineur 2012, pp. 5–6, for further discussion of the repoussé technique in reference to Aegean goldwork. On sand as filler, see n. 23, below.

11. It seems to us most likely that the fastener pulled loose when the cover slab fell into the grave.

12. See the Appendix, below, for a description of the present condition and color of the "melon" bead.

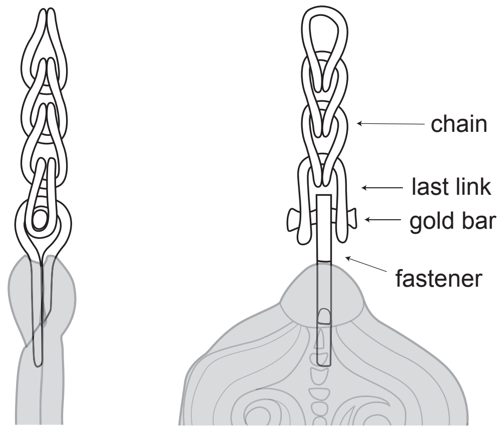
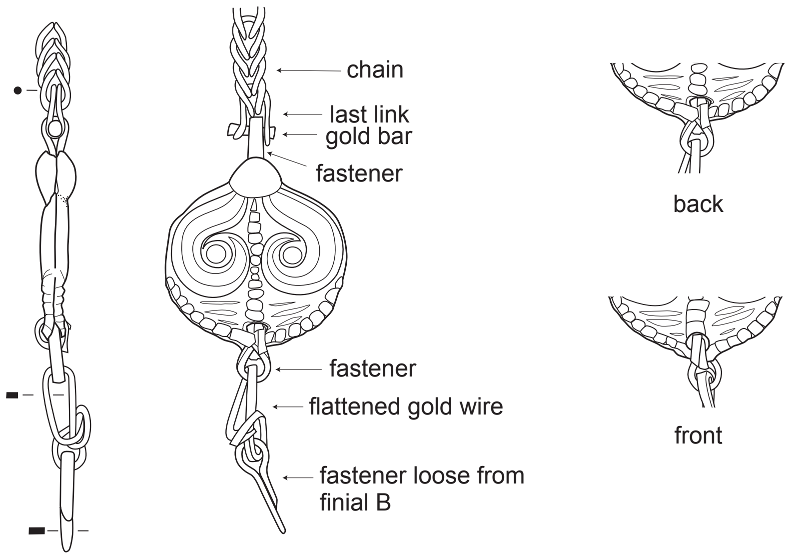


Figure 9. Schematic diagram showing how the pin attaches to the finial. Not to scale. Drawing T. Ross; courtesy Department of Classics, University of Cincinnati

a



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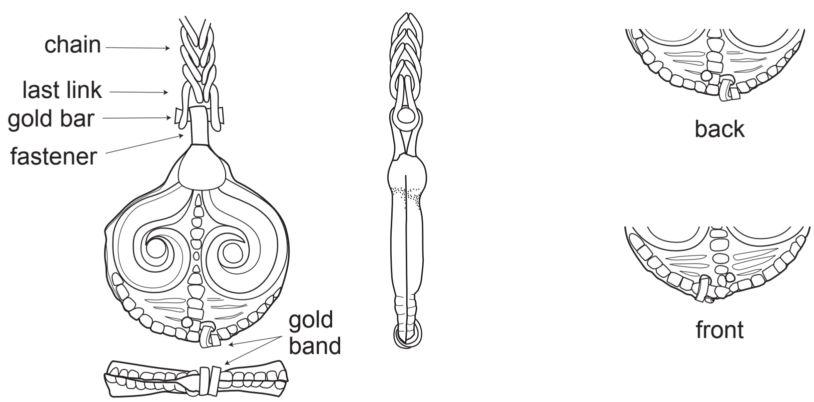


c

Figure 10. Securing the fastener: (a) finial B showing the hole from which the fastener pulled loose, as well as the gold bands used for the repair; (b) diagram of finial A, showing the fastener still inserted, the fastener pulled loose from finial B, and the wire tying the fasteners together; (c) diagram of finial B, showing the hole from which the fastener pulled loose, as well as the gold bands used for the repair. Scale 3:2. Photo J. Vanderpool, drawings T. Ross; courtesy Department of Classics, University of Cincinnati

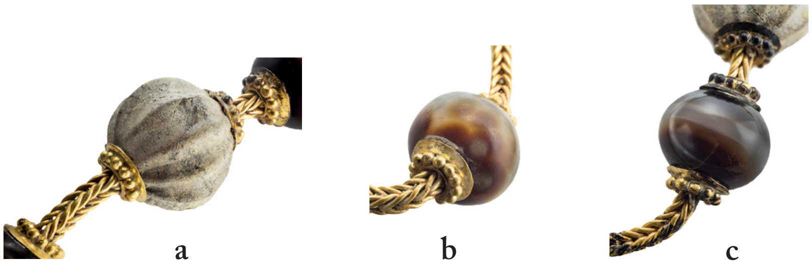


Figure 11. Detail of the beads from SN15-97: (a) central faience bead; (b) agate bead farthest from the faience bead; (c) agate bead nearest to the faience bead. Scale 1:1. Photos J. Vanderpool; courtesy Department of Classics, University of Cincinnati

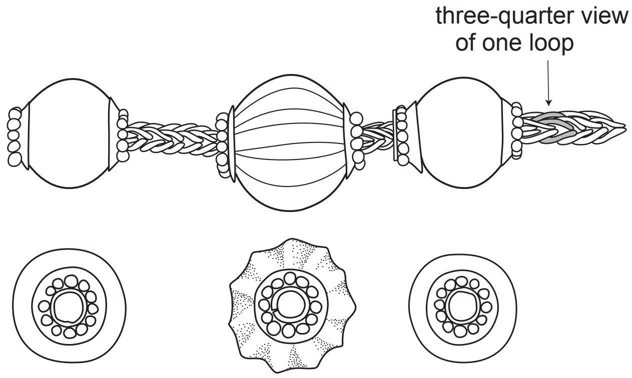


Figure 12. Detailed drawing of the two agate beads and the single faience "melon" bead from SN15-97. Scale 1:1. Drawing T. Ross; courtesy Department of Classics, University of Cincinnati

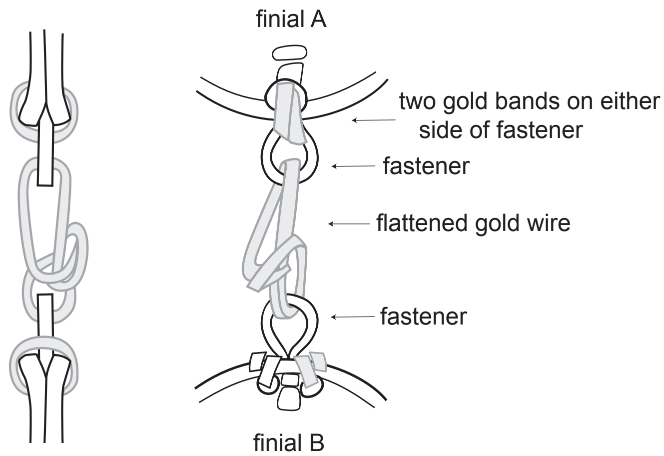


Figure 13. Simplified drawing showing how the finial pins were tied together. Not to scale. Drawing T. Ross; courtesy Department of Classics, University of Cincinnati

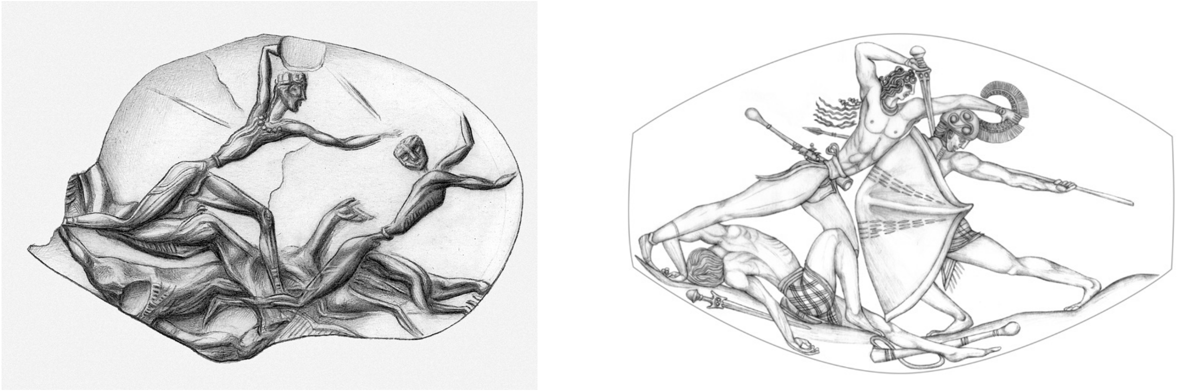
is made of faience; its style looks to Egypt for models, if it is not an actual import to the Aegean from there.[13]

The agate beads are not equidistant from the central bead. Had the necklace been broken and then repaired with some loops missing (assuming, of course, that the beads were arranged symmetrically in the first place)?[14] All three beads have gold collars edged with gold granulation, which obscure the points of their attachment to the chain. The beads do not slide along the chain, and it seems unlikely that the chain passed through them. More probably, it was somehow secured to bronze or gold rods inserted into holes drilled through the beads—rods of the sort used to attach caps to sealstones.

The necklace was closed with a piece of flattened gold wire, inelegantly twisted around the fasteners that projected from the tops of the papyrus stems in order to tie them together (Fig. 13).

13. See, e.g., Lilyquist 2003 for Egyptian examples, and Panagiotaki 2000 for Minoan faience. We are grateful to Eric Cline, Christine Lilyquist, and Marina Panagiotaki for commenting on illustrations of the bead.

14. The points at which the fasteners are attached to the finials are the weakest points of the necklace (see below). It is unlikely that the chain itself would have broken, but links may have been lost.



a b

Figure 14. Sealstones depicting warriors wearing necklaces in combat scenes: (a) from Ayia Triada (*CMS* II.6, no. 15); (b) the Combat Agate from the grave of the Griffin Warrior at Pylos (SN-18-112). Scale (a) 4:1; (b) 2:1. Drawing (b) T. Ross; courtesy (a) Corpus der minoischen und mykenischen Siegel, Heidelberg; (b) Department of Classics, University of Cincinnati

WARRIORS AND NECKLACES IN THE EARLY MYCENAEAN PERIOD

Considerable attention has been given to the study of jewelry worn by women in the time of the Minoan New Palace period, particularly in reference to the wall paintings from Akrotiri, but much less to that worn by men.[15] Yet it is clear that necklaces were frequent accessories to male dress, and we do not find it odd that the Griffin Warrior was buried with necklaces.

Kilian-Dirlmeier has described the relevant kit of a warrior in the period of the Shaft Graves at Mycenae and in the Cretan New Palace period.[16] She makes the point that

> in the choice of means of representation or prestige both the Mycenaeans and the Minoans preferred the same items: necklace, armlet, bracelet, seal and weapon. Given the chronological priority of Crete it may be argued that it is a Minoan fashion willingly and purposefully adopted by the Mycenaeans. It seems rather significant that this happened in the formative stage of Mycenaean society, when differentiation of status groups and a very complex ranking system were established.[17]

Notably, the necklace is a component of this kit, a point that can be underscored with reference to representational art and burial assemblages from warrior graves.

A warrior depicted in a seal impression from Ayia Triada wears a necklace (*CMS* II.6, no. 15), as does the hero-victor on the Pylos Combat Agate (SN18-112) that also was found in the grave of the Griffin Warrior (Fig. 14). In the former, a kilted warrior is about to plunge his sword into the neck of a fleeing opponent.[18] He wears a necklace of six large spherical beads. In the latter, the victorious warrior wears a necklace wrapped twice around his neck; beads attached to its two ends flow behind him, above the locks of his hair.[19] Further evidence of aggressive males wearing necklaces comes from the so-called Chieftain Cup of steatite found at Ayia Triada.[20] Both kilted men wear necklaces; while one bears a sword, the other carries a staff and has a dagger strapped at his waist.[21]

Actual necklaces are distinctive components of assemblages from the so-called warrior graves at Knossos.[22] There, from Tomb 4 at Sellopoulo,

15. For Minoan-Mycenaean jewelry in general, see Higgins 1980, pp. 53–85, and now also Nosch and Laffineur 2012. See also Younger 1992 for representations of jewelry in Minoan-Mycenaean art, and Vlachopoulos and Georma 2012 for Akrotiri in particular.

16. Kilian-Dirlmeier 1988.

17. Kilian-Dirlmeier 1988, p. 165.

18. For the impression from Ayia Triada, see *CMS* II.6, no. 15.

19. Stocker and Davis 2017, pp. 591–592, fig. 12.

20. Koehl 1986. More recently, see Koehl 2016 for the argument that the cup depicts a male rite of passage.

21. See Koehl 2016, p. 115, fig. 9.2:a.

22. Popham, Catling, and Catling 1974, pp. 211–214. For a later, more comprehensive discussion, see Alberti 2004.

Popham, Catling, and Catling published relief beads of gold and faience that they believed came from three or four necklaces. The beads in gold consist of two repoussé plaques soldered together, like the finials of SN15-97.[23] One type of faience bead, decorated with a *waz*-lily/papyrus motif, recalls the finials of SN15-97.[24]

We are not the first to suggest that a necklace was a badge of honor for a warrior, although our discoveries substantially bolster past claims. Laffineur, for example, has noted the relationship between military prowess and rank that we believe to be attested in the grave of the Griffin Warrior, stating that "burials with a complete set of offensive weapons are accompanied by precious vessels and rich jewelry, including diadems and necklaces."[25] Even more closely aligned with our own conclusion is Papadopoulos's suggestion that warriors depicted wearing necklaces and bracelets are being set apart for special distinctions in the early phases of the Late Bronze Age, according to a custom that was Minoan in origin, but did not continue to be observed by later Mycenaeans.[26]

WHERE WAS THE NECKLACE MADE?

More gold loop-in-loop chains have been found in graves of the Early Mycenaean period than elsewhere in the Aegean in excavated contexts, but we are nonetheless inclined to think that SN15-97 was made on Crete.[27] The necklace was likely imported to Pylos, damaged before or after its arrival, and repaired in ways that we have already noted, before finding its way to the grave.[28] Is it too fanciful to imagine that it had been broken in battle when ripped off the neck of a previous owner?

The chain is arguably the finest example of loop-in-loop construction ever found in a prehistoric Greek context. The loops are, in fact, so tightly drawn that it is easy to confuse the technique with plaiting or braiding (Fig. 15).[29] The construction of the chain of our necklace has an old Aegean

23. For the gold repoussé beads, "dark 'sand' was used to fill the hollow interior, so protecting their fragile character and giving them added weight" (Popham, Catling, and Catling 1974, p. 213). See also Higgins 1980, p. 83, where the material is identified as magnetite sand.

24. Popham, Catling, and Catling 1974, p. 212, fig. 11:K. The grave of the Griffin Warrior contains gold beads identical to the one from Sellopoulo (Popham, Catling, and Catling, p. 212, fig. 11:H).

25. Laffineur 2012, esp. pp. 15–16. Younger (1992, p. 275) in his fundamental review of images of jewelry did not, however, note any particular connection between jewelry and warriors: "Most people wear jewelry, men and women, but not usually in battle or on the hunt."

26. Papadopoulos 2012, pp. 650–651. Regarding warrior status on Crete, see also Marinatos 1995, p. 581, n. 39 (in reference to necklaces), and Kostantinidi 2001, pp. 237–238 (in regard to warriors and jewelry, including necklaces).

27. There are no exact parallels as yet known from Crete. Beads of agate and faience find parallels on Crete, and the gold caps embellished with granulation are present on sealstones found in Minoan contexts, although they are more common on the mainland; see Krzyszkowska 2005, pp. 240–241; Stocker and Davis 2017, p. 600. The challenge of distinguishing between Mycenaean and Minoan art of the Early Mycenaean period has fascinated, inspired, and bedeviled Aegean prehistory since its beginnings: see the comments in Higgins 1967, pp. 76–79; Hood 1978, pp. 23–24; Betancourt 1981; Dickinson 1997; and see, in particular, Vermeule's (1975) and Davis's (1974, 1977) intellectually engaging, if not always conclusive, attempts to do so. Although we have favored a Minoan origin for the gold rings, the Combat Agate, and now also the gold necklace in publications thus far, we will argue for mainland manufacture for other finds from the grave in future publications.

28. On repairs to Aegean jewelry, see Phillips 2012, esp. p. 484.

29. As we ourselves did, in fact. Higgins (1980, p. 16) commented on "the remarkably square section" of such chains and adds that from "a structural point of view, they may be said to have two principal faces and two sides."

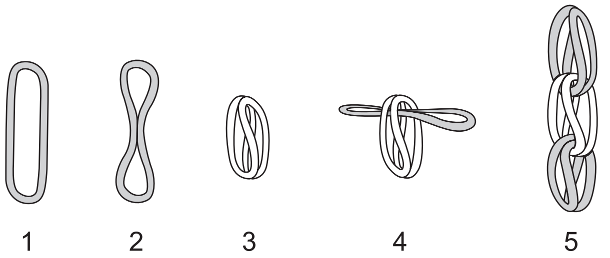


Figure 15. Drawing illustrating the loop-in-loop construction method used to create the gold chain. Drawing T. Ross; courtesy Department of Classics, University of Cincinnati

Figure 16. Gold chain from Chamber Tomb 55 at Mycenae. Athens, National Archaeological Museum P 2882. Not to scale. Courtesy National Archaeological Museum, Athens, Department of Prehistoric, Egyptian, Cypriot, and Near Eastern Antiquities; © Hellenic Ministry of Culture and Sports/Archaeological Receipts Fund

pedigree, one that is likely Minoan in origin.[30] The closest parallel to the chain of the Pylos necklace is an example found by Tsountas in his Tomb 55 at Mycenae, which measures 60 cm long (Fig. 16).[31] Like SN15-97, the Mycenae chain was fashioned from gold loops, tightly compressed, with the ends of the final loop at each end of the chain attached to the loop of a pin-like fastener formed from a thin gold band. In the Mycenae case, the ends of the pins were inserted into the ends of a gold cylinder. The method of construction is clear, since one pin has pulled loose from the gold cylinder. A much smaller, and much looser, chain, ca. 10 cm long, was discovered by Blegen in Tomb III at Prosymna (Fig. 17).[32] The final link on each end of it has been left open; these links may have been attached to a fastener like the Mycenae example, or they may have pivoted on a bar as did that from Pylos. Other loop-in-loop chains, more crudely made with welded repoussé finials, come from the so-called Aigina Treasure, purchased by the British Museum in 1892, and from Shaft Grave III at Mycenae.[33]

30. See Higgins 1980, p. 16, fig. 3, for the simple form of the loop-in-loop chain; see also Evely 2000, pp. 409–410, on Minoan chains and their manufacture. A short loop-in-loop chain was found by Xanthoudides (1924, p. 111, pls. XV:484, LVII:484) in an Early Minoan vaulted tomb at Platanos in the Messara; see the discussion of it in Hickman 2012, pp. 527–528, pl. CXXXVI:b–d.

31. Xenaki-Sakellariou 1985, p. 172, no. 2882, pl. 70.

32. Blegen 1937, p. 184, figs. 460, 578.

33. See Fitton, Meeks, and Joyner 2009. The loop-in-loop construction technique was used for several items of jewelry in the Aigina Treasure but in no case were a pin and bar employed to attach the chain to finials. For Mycenae, see Karo 1930–1933, pl. XXII, no. 78, with repoussé pendants attached to loose, loop-in-loop chains. Repoussé pomegranates (no. 77) from the same grave were also made by welding two halves together.

Figure 17. Gold chain from Tomb III at Prosymna. Athens, National Archaeological Museum P 6424. Scale 4:3. Photo E. Galanopoulos; courtesy National Archaeological Museum, Athens, Department of Prehistoric, Egyptian, Cypriot, and Near Eastern Antiquities; © Hellenic Ministry of Culture and Sports/ Archaeological Receipts Fund

We find it difficult to believe that chains as sophisticated as those from Pylos and Mycenae could have been produced outside the compass of a palatial workshop, for which there is as yet no evidence in the Early Mycenaean period at Pylos or elsewhere on the Greek mainland. The other individual components of the necklace also seem compatible with Minoan manufacture. Both agate and faience beads were used in the production of jewelry of the Neopalatial period, while the technique of welding together matching repoussé halves is known from Crete.[34] The hybrid sacral ivy/ papyrus motif is found both in Neopalatial wall painting and vase painting. We conclude that the absence of close parallels from Crete itself is to be explained by the scarcity of published Neopalatial graves.[35]

THE NECKLACE AND THE GRIFFIN WARRIOR

Finally, presentation of necklace SN15-97 encourages us again to remark on an extraordinary feature of the assemblage of objects interred with the Griffin Warrior: namely, the way in which representational imagery echoes actual objects. In publishing the four gold rings from the grave two years ago, we also wrote that "we can already say with certainty that there is a structural logic to the arrangement of objects in the grave."[36] There we mentioned the presence of a bronze mirror (SN10-7) that references a representation of a mirror being held by a seated goddess on our fourth gold ring (SN24-736), and also the depiction of a bull on the second gold ring (SN24-30) that parallels a bronze bull's head designed as a finial for a staff (SN24-151).[37] The necklaces from the grave of the Griffin Warrior constitute half of another pair of associations because they echo the necklace worn by the warrior on the Pylos Combat Agate.[38] The fact that so many such references exist not only demonstrates the special attention paid to the selection of grave goods, but also suggests that mainlanders of the Early Mycenaean period had come to understand the meaning of iconography that is fundamentally Minoan in origin. In the present case, the most basic conclusion is that in the warrior society of Early Mycenaean Pylos, a necklace was a mark of particular distinction, and it was a victor who wore it.

34. Evely 2000, pp. 424–426; see also the parallels from Sellopoulo cited in n. 23, above.

35. See Murray 2016, p. 60, fig. 3.18, for a color illustration of the motif on a kilt in the Procession Fresco from Knossos; see Banou and Betancourt 1999, p. 135, no. BQ1, fig. 14, pl. 19A, for a version of the motif in Late Minoan IB pottery.

36. Davis and Stocker 2016, p. 649.

37. Davis and Stocker 2016, pp. 652, 652, fig. 15.

38. See also Stocker and Davis 2017, p. 602.

APPENDIX

ANALYSIS BY PORTABLE X-RAY FLUORESCENCE OF THE CENTRAL BEAD

The original surface color of the central bead in SN15-97 macroscopically appeared not to have been preserved. The body of the bead is gray with slight turquoise to bluish hues in scattered locations, but the color of the surface, as we perceive it, has been considerably altered from its original state by corrosion.

The bead was analyzed using two different portable X-ray Fluorescence (pXRF) spectrometers with complementary analytical features. In particular, the two pXRF spectrometers have significantly different spatial resolutions (beam footprint) and respectively permit measurements in areas with a size of either a few tens of micrometers (micro-pXRF) or a few millimeters (milli-pXRF). In an attempt to understand the complex burial environment and its spectroscopic XRF fingerprints, several samples of soil were also measured in a few locations. The soil samples had been collected at different depths within the grave, including that of the burial itself.[39]

From this study, the material of the bead has been identified as vitreous because of the existence of a glassy phase related to faience. The original color most probably was a translucent bright blue.

EXPERIMENTAL METHODOLOGY

The Micro-pXRF Spectrometer

The micro-probe XRF analysis was carried out in the Museum of Messenia, Kalamata, using a customized version of an Artax (Bruker Nano Analytics) spectrometer. The spectrometer includes an X-ray microfocus rhodium anode tube,[40] and a polycapillary X-ray lens as a focusing optical element (Institute for Scientific Instruments GmbH [IfG]), with a focal distance of about 21.2 mm and spatial resolution within the range of 50–100 μm depending on the X-ray energy of interest. The X-ray detection chain consists of a thermoelectrically cooled 10 mm^2 silicon drift detector (X-Flash, 1000B), with 146 eV FWHM at 10 kcps coupled with a digital signal processor. A color charge-coupled device (CCD) camera (with ca. ×13 magnification) combined with a dimmable white LED and a spot

39. These included samples S4-11, S10-92, S9-37, S18-37, S23-2, and S30-46.

40. For the tube, the electron beam was focused at 50 μm, with 50 kV, 1 mA, and 30 W maximum voltage, tube current, and power consumption, respectively, and with a 0.2 mm beryllium window thickness.

laser beam assures reproducible positioning of the measuring probe, as well as visualization and documentation of the analyzed area. Three stepping motors coupled with the spectrometer head allow three-dimensional movement for elemental mapping and precise setting of the analysis location at the focal distance of the polycapillary lens.

The bead was measured by employing a filtered and unfiltered exciting beam; the use of a composite filter made from titanium (23.6 ± 0.2 μm) and cobalt (17.7 ± 1.3 μm) improves the detection limits for trace elements, whereas the use of an unfiltered exciting beam makes the detection of light elements as low in the periodic table as silicon (Z = 14) possible. Measurement conditions were set respectively at 50 kV and 600 μA for the tube's high voltage and current.

For the quantification of the micro-pXRF measurements (i.e., determination of the concentration of the sample's constituent elements), custom software was employed that has been developed in reference to the so-called fundamental parameters approach in XRF analysis.[41]

The Milli-pXRF Spectrometer

The portable milli-XRF spectrometer (built in-house) includes a side-window low-power X-ray tube with a rhodium anode (75 μm Be window).[42] Analyses were performed utilizing an unfiltered exciting beam generated at 15kV high voltage and a filtered one with the tube operating at 40 kV. The filter was composed of nickel (42.5 mg/cm^2) and vanadium (33.0 mg/cm^2) foils interposed in the line of the excitation beam path. The beam size at the sample position is ca. 2.7 mm. The characteristic X-rays emitted from the sample are detected by a Si-PIN diode X-ray detector placed at 45° from the normal of the sample surface.[43] Two laser points coupled on the head of the spectrometer were aligned in such a way as to ensure the placement of the analyzed area on the reference plane. The quantification of the milli-pXRF measurements was based on the PyMca toolkit, which utilizes incident beam energy profiles optimized through comparison of experimental scattered spectra and simulated ones.[44]

The quantification procedures employed by both the milli-pXRF and micro-pXRF spectrometers were validated with respect to certified National Institute of Standards and Technology (NIST) Standard Reference glasses. The relative difference of measured versus certified concentration values of major, minor, and trace elements was generally found to be less than about 10%.

A few clarifications are necessary to facilitate evaluation of the validity of the obtained results. First, the measured concentrations represent "effective" values reflecting the average concentration of each respective element within its individual critical penetration depth.[45] Since, for each analyte, the measured signal emanates from a different depth,[46] it is obvious that if the analyzed volume (up to about 150–200 μm thickness) exhibits a severe lack of homogeneity, the obtained concentrations would be rather inconsistent—in other words, they will not be representative of the same sample "phase." Moreover, in the case of the presence of a surface layer of

41. Kantarelou and Karydas 2016.
42. Karydas 2007.
43. X-ray detector: Amptek XR-100CR, with 165 eV FWHM at MnKα, 500 μm silicon crystal thickness and 12.7 μm Be window.
44. Solé et al. 2007; Schoonjans et al. 2013.
45. Janssens 2013, p. 102.
46. For depths lower than ca. 15 μm for elements up to Z = 14, ≤ ca. 35 μm up to Z = 20, and greater depths for elements with a higher atomic number, see Janssens 2013, p. 102.

contamination above a homogeneous body—including elements introduced from an environment external to the object—the XRF analysis will generate false qualitative and quantitative results because it will detect elements inconsistent with those characteristic of the sample in the first case and show significant deviations from the true elemental concentrations of the sample in the latter. It is widely accepted that surface-sensitive techniques like XRF have very limited reliability when used to analyze corroded or altered surfaces of archaeological samples.

ANALYTICAL RESULTS

The elemental concentrations deduced by both pXRF spectrometers for the central bead are presented in Table 1. Analyses of 15 different locations (A1–A8 by micro-pXRF and B1–B7 by milli-pXRF spectrometers) produced similar results, despite significantly different sizes of the locations and/or different hues of the areas analyzed. In a few specific cases (copper at location A4 and iron at location B3), concentrations were relatively enhanced.

In our view, the evidence suggests the existence of a glassy phase pointing to either faience or glass (and we present evidence below that has led us to favor faience over glass). Not all XRF concentrations presented in Table 1, however, are indicative of a pattern of chemical composition that is entirely consistent with either a glassy matrix or a faience body. The alumina concentration is elevated, silica is low, and calcium and iron are very elevated; various other minor/trace elements that are typical components of soil are also either elevated (titanium, vanadium, and chromium) or display significant inhomogeneity (rubidium and zirconium). The consistent presence of silver, also identified in one soil sample, further suggests that the surface of the bead has been significantly contaminated. In addition, we consider minimum amounts of cobalt (ca. 100–150 parts per million [ppm]) not detected consistently, in only a few locations, and slightly above the respective minimum detection limit,[47] to suggest most probably a nondeliberate addition associated with contamination from the cultural objects deposited in the burial.

The detection of elevated amounts of copper in all locations examined by both pXRF spectrometers suggests that it was used as a colorant within a glassy phase. Despite expectations that random quantities of copper from the burial environment would have contaminated the surface of the bead, the constant appearance of copper (except at location A4) within a restricted range of concentrations (ca. 0.15%–0.40%) cannot be considered accidental.

Furthermore, in all locations on the bead measured by both spectrometers, the rather unusual, systematic presence of silver was revealed with a signal showing only 20% relative variability, indicative of a more or less constant presence. In addition, gold peaks were also detected, but at a significantly lower intensity. It is noteworthy that the XRF examination of the soil samples showed the presence of silver in only one sample (S23-02), whereas in all the other samples, in addition to silicon, elevated amounts of aluminum, calcium, iron, and copper were systematically detected along

47. Minimum detection limits are estimated to be 28 ppm for 100 seconds measurement time and 68 ppm for 300 seconds for the micro-pXRF and milli-pXRF spectrometers at 15 kV operating condition.

TABLE 1. XRF-BASED ELEMENTAL CONCENTRATIONS OF THE CENTRAL BEAD*

Locations Analyzed	*A1*	*A2*	*A3*	*A4*	*A5*	*A6*	*A7*	*A8*	*B1*	*B2*	*B3*	*B4*	*B5*	*B6*	*B7*
Macroscopic Hue of the Analyzed Area	Slight turquoise/ bluish	Slight turquoise/ bluish	Blue	Slight turquoise/ bluish	Slight turquoise/ bluish	Gray	Gray	Gray	Slight turquoise/ bluish	Slight turquoise/ bluish	Slight turquoise/ bluish	Gray	Gray	Gray	Gray
Compounds (% w/w)															
Al_2O_3	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	5.8	7.8	7.5	8.6	8.6	6.2	8.9
SiO_2	49	27	46	44	47	36	33	45	27	27	29	29	35	26	35
SO_3	0.79	0.25	0.53	0.38	0.17	0.20	0.14	0.21	0.28	0.11	1.8	0.29	0.076	0.33	0.014
Cl	0.11	0.097	0.071	0.065	0.067	0.082	0.067	0.077	0.0098	0.0031	0.064	0.018	0.041	0.022	0.021
K_2O	1.7	1.1	0.91	0.51	1.7	0.84	0.87	1.3	1.1	1.4	2.0	1.4	2.3	0.5	2.4
CaO	14	28	16	18	15	15	17	16	19	21	16	20	23	22	21
TiO_2	0.19	2.1	0.14	0.45	1.1	0.42	0.62	1.4	0.45	0.55	0.62	0.59	0.91	0.41	0.78
Elements (ppm)															
Vanadium (V)	224	205	196	350	129	230	292	147	106	191	81	215	205	130	133
Chromium (Cr)	68	81	113	120	120	120	122	144	220	220	158	204	209	167	130
Manganese (Mn)	48	240	140	95	65	85	83	84	124	140	64	118	195	80	94
Iron (Fe)	1,130	2,370	1,820	1,490	518	3,100	3,700	2,940	1,230	1,130	11,700	1,600	1,460	1,370	1,250
Cobalt (Co)	bdl	bdl	70	bdl	bdl	bdl	bdl	bdl	~dl	~dl	bdl	167	~dl	~dl	~dl
Nickel (Ni)	58	147	12	10	15	18	28	25	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Copper (Cu)	3,650	23,000	2,310	1,850	1,310	2,140	2,300	4,470	1,570	1,060	1,450	1,220	1,830	1,750	1,350
Zinc (Zn)	165	196	397	37	61	29	31	138	47	bdl	65	19	69	bdl	29
Arsenic (As)	122	bdl	60	23	bdl	63	61	bdl	35	12	14	24	30	26	21
Bromine (Br)	15	bdl	15	32	43	bdl	bdl	bdl	12	15	bdl	bdl	bdl	16	bdl
Rubidium (Rb)	37	153	16	23	17	bdl	bdl	48	bdl	17	17	12	30	bdl	22
Strontium (Sr)	189	308	221	83	47	41	79	77	47	41	42	41	45	40	52
Yttrium (Y)	bdl	bdl	bdl	bdl	111	bdl	bdl	bdl	14	21	12	14	21	17	20
Zirconium (Zr)	220	127	118	187	bdl	199	bdl	bdl	109	103	120	124	150	129	143
Lead (Pb)	594	nd-DP	780	188	bdl	69	180	238	171	131	150	111	117	100	51
Thorium (Th)	bdl	bdl	bdl	bdl	bdl	790	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Uranium (U)	bdl	bdl	bdl	bdl	bdl	3,250	bdl	bdl	bdl	bdl	bdl	34.5	bdl	34.7	bdl

* These concentrations were obtained by means of two portable XRF spectrometers: locations A1–A8 by micro-XRF and locations B1–B7 by milli-XRF analysis. The reported concentrations should be considered with great caution. Since the surface of the central bead is corroded and altered from its original state, the elemental concentrations shown in this table should be considered as average ones over the respective critical penetration depth from which each characteristic X-ray line emanates, but with pronounced contribution of their near surface abundance (especially for $Z \leq 20$). The uncertainty of the results is estimated to be within 10%–25%. The presence of gold (Au) and silver (Ag) in all XRF spectra has not been quantified, because both elements have been considered as contaminants of the burial environment. Elements are ordered by atomic number of the detected element, from lowest to highest.

Abbreviations: bdl = below detection limit; ~dl = detection limit; nd-DP = not determined because of spectral interference due to the presence of diffraction peak; ppm = parts per million (μg/g); w = weight.

with a minor presence of potassium and titanium, and trace amounts of vanadium, chromium, manganese, strontium, zirconium, and lead.

It is also of interest that in one location on the surface of the bead, A6, the micro-pXRF analysis identified significantly elevated amounts of uranium (ca. 3,250 ppm) and thorium (ca. 790 ppm). Both elements were identified from the presence of their respective L-lines, but, since the U-Mαβ characteristic lines also could be observed, this clearly indicates that the respective U/Th-rich mineral phase is located very close to the surface (< ca. 30 μm). No any other element seems associated with the presence of these two elements. The milli-pXRF analysis confirmed the presence of uranium at locations B4 and B6, with apparent concentrations of ca. 34 ppm, further suggesting a nonaccidental presence. Thorium was not detected in either location since its concentration is four times lower, below the minimum detection limits of the spectrometer. The two orders-of-magnitude difference in the concentration values between the two pXRF spectrometers is justified by the respective difference in their spatial resolution and the micrometer scale dimensions of the U/Th mineral phase, which is "diluted" within the milli-pXRF analyzed area. Speculation as to the meaning of this unusual finding is beyond the scope of this report. Elevated uranium contents have been reported at impurity levels in ancient glass of a later date, and these have served as determinants of an alkaline source.[48] The possibility of external contamination cannot be excluded; nonetheless, given the scarcity of relevant micro-XRF analyses, further analytical investigation is needed to shed light on the matter.

Another technical issue that needs clarification and should be considered in the evaluation of the data is that the micro-pXRF spectrometer is much less sensitive than the milli-pXRF spectrometer to the detection of light elements such as aluminum, although both spectrometers operate in an air atmosphere with the X-ray detector located at almost the same distance from the sample. This is owing to the fact that the micro-XRF focusing element (the polycapillary X-ray lens) has a very low transmission efficiency for the anode Rh-L lines. On the other hand, in the case of the milli-XRF spectrometer that operates without a lens, the source Rh-L lines play the dominant role in the excitation of light elements.

THE MATERIAL OF THE BEAD

In considering the possibility of the original existence of a glassy phase associated with the artifact, what must be taken into account is that degradation mechanisms result in surfaces of an artifact being depleted of various elements within a burial context; this is due to the fact that the stability of a surface is primarily affected by the burial environment, the raw materials, and the manufacturing technique. In all archaeological glasses, the corroded layer that is formed tends to be low in alkalis, high in silica, and lacking in cohesion.[49] Additionally, the current state of preservation of the bead, its even porosity, and the existence of patches of what appears to be a glaze are not consistent with the characteristics of glass objects from this period.[50]

On the other hand, in assessing the possibility that the bead is of faience, we have taken into consideration the fact that an uncorroded faience

48. Dussubieux et al. 2008.
49. Artioli 2010, p. 296; Jackson, Greenfield, and Howie 2012, pp. 489–490.
50. Kaparou 2017, pp. 142–156.

artifact has a glazed layer on the surface and a silica-rich body with an intermediate interaction layer. The glazed and the intermediate layer, as well as the interparticle glass in the body, may be expected to exhibit features (thickness, morphology, chemical composition) that depend on the faience manufacturing technique.[51]

More often than not, the composition of a faience body consists of 92%–99% silica (e.g., SiO_2), 1%–5% lime (e.g., CaO), and 0%–5% alkali, the latter deriving from soda (e.g, Na_2O) or potash (e.g., K_2O).[52] Raw materials for the glaze consist of more or less the same components as the body but with the addition of a metallic oxide, typically copper and/or cobalt as coloring agents, sometimes with added calcium.[53] In the case of the bead considered here, the scarce, but minimum amount of cobalt, points to the presence of copper (generally detected in concentrations more than about 0.15%) as the sole coloring agent. The latter can yield a multitude of colors, ranging from shades of blue to green, depending on the extent of its oxidation, its coordination chemistry, and any possible coexistence of other metallic cations (such as within the glazed layer). Although the original glazed layer has almost entirely disappeared owing to corrosion, remaining traces of turquoise to bluish hues visible on the surface suggest that cupric Cu^{+2} ions most likely were included in the glassy phase, and that the surface originally had a blue translucent appearance,[54] owing to the absence of any opacifier agent, such as calcium antimonate.[55] The current gray color of the body is probably the result of the presence of iron ions, which were originally present in the glassy phase, or deposited onto the bead surface layer from the burial environment as amorphous or poorly crystalline oxides, after the glassy phase was lost to weathering.

Only a few analyses of faience glazes have been reported.[56] The majority point to rather significantly elevated amounts (several percent) of copper (for glazes colored with copper cations) that are indicative of a gradient change in the copper content from the glaze into the interaction layer dependent on the manufacturing technique.[57]

The method of glazing usually can be determined by examining faience for drips of glaze, signs of the use of a brush, fingerprints, and marks from drying or firing, but in the case of this bead it is impossible because the initial glazed surface is not visible macroscopically.[58] Nevertheless, we suggest that efflorescence was the method of glazing employed, likely also because of the small size of the bead.[59] When efflorescence is used, faience contains extensive interparticle glass, owing to alkali salts that fail to reach the surface; the body is thus rendered tougher and more durable. This effect is most pronounced when coarse-grained quartz is used for the body, the result being that the faience consists almost entirely of quartz embedded within a continuous matrix of glass.[60] Efflorescence glazing offers the advantage that, in combination with molding, it provides an efficient method for large-scale production of objects, which is beneficial in the production of beads. Indeed, the precision in the execution of this faience bead suggests that it would have been fashioned in a mold, rather than modeled and scraped,[61] and then tipped out of the mold to dry. The hole through the bead was most likely filled with a metal wire during glazing to ensure

51. Kaczmarczyk and Hedges 1983; Vandiver 1983, 1998; Tite and Bimson 1986; Tite 1987; Panagiotaki et al. 2004; Tite, Manti, and Shortland 2007; Rehren 2008. See also Smirniou and Rehren 2013.

52. Vandiver 1983, p. A18.

53. Vandiver and Kingery 1987; Andrews and van Dijk 2006, pp. 263–269.

54. Shortland 2002, p. 518; Artioli 2010, pp. 292–293, table 3:13.

55. Shortland 2002.

56. Tite, Manti, and Shortland 2007; Tite and Shortland 2008.

57. Tite, Freestone, and Bimson 1983; Tite and Bimson 1986; Tite, Manti, and Shortland 2007, p. 1581.

58. Vandiver 1983, pp. A27–A31.

59. Tite and Bimson 1986.

60. Tite, Freestone, and Bimson 1983, pp. 21–24.

61. Vandiver 1983, pp. A21–A26.

the precision of the perforation and prevent alteration of its intended size in the process. The alternative to efflorescence is application glazing, which is particularly appropriate for objects such as tiles and inlays that require glazing only on one side.[62] In that case, however, the coloring agent enters the body minimally; it would not have been detected in such levels as we have found in the body of the bead.

62. Tite, Freestone, and Bimson 1983; Tite and Bimson 1986; Tite, Manti, and Shortland 2007, p. 1581.

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