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Polish Archaeology in the Mediterranean 23/2, 225-246

2014

VITREOUS BEADS FROM THE ULUBURUN SHIPWRECK

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Abstract: The Late Bronze Age shipwreck at Uluburun (late 14th century BC) was discovered off the southwest coast of Turkey in 1982. Thousands of beads of vitreous material were found at the site, including approximately 75,000 faience beads and 9,500 glass beads. This paper offers an introduction to the faience and wound glass beads found at Uluburun, with an emphasis on manufacture and their role aboard the ship. Bead forms and styles represented at Uluburun were relatively simple and quite common at archaeological sites throughout the Late Bronze Age Levant. There is evidence that several of the simpler types of the faience and glass beads were carried on the ship as items of trade. More complex forms, in contrast, probably represent the personal belongings of the crew or passengers aboard the ship.

Keywords: Uluburun, glass, faience, beads, Late Bronze Age

In 1982, a Late Bronze Age shipwreck was discovered off the southwestern Turkish coast at Uluburun near Kaş. It was excavated over 11 consecutive summer seasons, from 1984 to 1994, by the Institute of Nautical Archaeology at Texas A&M University (Bass 1986; Pulak 1988; Bass *et alii* 1989; Pulak 1998; 2001). This wreck yielded an extensive range of artifacts that suggested a late 14th-century BC date for the loss of the vessel, probably around 1320 BC (Manning *et alii* 2009). The ship's rich cargo, which included nearly 17 tons of raw materials as well as exotic luxury goods, appears to represent goods involved in Late Bronze Age palatial or elite gift exchange (Pulak 1998: 215; 2005: 306–309; 2008: 289).

The Uluburun shipwreck also yielded tens of thousands of beads. Due to their durability, ease of transport, and widespread use, beads were a valuable trade commodity during the Late Bronze Age. The Uluburun beads comprise a wide range of materials, including faience, glass, Baltic amber, quartz, ostrich eggshell, bone, agate, and carnelian (Pulak 1998: 206; 2008: 314–316, 325–326, 375–377). As argued below, while many of the different types of beads carried on the ship were items of trade, other types could represent the personal belongings of the crew or passengers aboard the ship. There were approximately 5,000 loose faience beads and 1,500 loose glass beads found at the site, with tens of thousands more trapped in concreted lumps.[1] Between 2002 and 2005, the author conducted a study of the Uluburun faience and wound glass beads at the Bodrum Museum of Underwater Archaeology, where the artifacts from the shipwreck are housed. This article is based on the MA thesis resulting from the study (Ingram 2005). In addition to providing a typology and identifying comparable finds throughout the Late Bronze Age Levant, the study also focused on the manufacture of the beads and their function as a trade commodity.

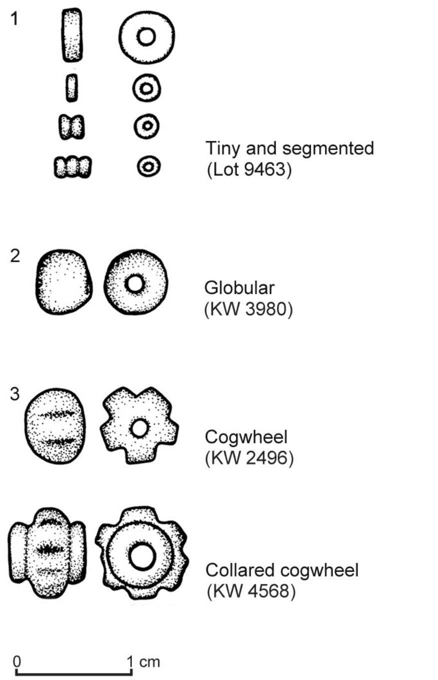
Beads, however, comprised only a fractional portion of the ship's original cargo, primarily raw materials but also luxury manufactured goods. The raw materials included copper and tin ingots, terebinth resin and glass ingots (Pulak 1998: 202; 2001: 18; 2008: 307–310, 313–314, 317–320). Upon remelting, the glass ingots could be formed into a variety of consumer products; chemical analyses of a limited number of these glass ingots indicate that they originated in Egypt (Brill 1999: 53–54; Brill, Stapleton 2012: 241–257; Jackson, Nicholson 2010: 298–300; Pulak 2008: 314). Luxury items from the shipwreck included gold and silver jewelry, elephant and hippopotamus ivory, ivory objects, ostrich eggshells, and African blackwood, known to the Egyptians as ebony (Pulak 1998: 203–206; 2008: 324–325, 328–340, 347–358; Lucas, Harris 1962: 434–436).

The Syro-Canaanite origin of several shipboard items, including lamps, balance weights, stone anchors, and the ship's gold-foil-clad bronze deity figurine, suggested a west Asian port of origin for the ship (Pulak 2008: 299, 306–307, 320–321, 345–346, 369–370). More specifically, petrographic analyses by Yuval Goren indicate that most of the ship's Canaanite jars, galley wares and stone anchors originated from along the Carmel coast of Israel (Goren 2013: 57–59).[2] Therefore, excavation director Cemal Pulak suggested a site along or just north of the Carmel coast as the origin of the ship's final voyage; Tell Abu Hawam, the port city just north of Mount Carmel, associated with the strategic inland site of Megiddo, is one possibility (Pulak 2008: 299). The high-status nature of the ship's cargo suggests directional trade at the palace level, likely in the form of gift exchange as described in the late 14th century BC Amarna letters (Pulak 2008: 298–299; Sherratt, Sherratt 1991; Pieniążek, Kozal 2014: 193, in this volume). Several artifacts of Aegean origin, including fine tablewares, weapons, razors, lentoid seals, and glass relief beads, suggested the presence of two members of the elite from that region, possibly Mycenaeans, aboard the ship.[3] Perhaps they had served as emissaries, members of the palace staff escorting this costly shipment to its destination, likely on the Greek mainland (Pulak 2005: 306–309; Bachhuber 2006).

1 These figures represent the number of preserved beads recovered during the excavation of the shipwreck; more beads were likely carried aboard the ship but were not preserved.

2 In addition, analyses of pollen and terrestrial snails found in the ship's estimated one-half ton of terebinth resin indicate that the resin originated near the Dead Sea (Jacobsen, Bryant, Jones 1998: 80; Welter-Schultes 2008: 84–85; Pulak 2008: 295).

3 The number of elite Mycenaeans aboard the ship was identified based on the frequent occurrence of Mycenaean objects in pairs, including two pouring-and-drinking sets, two bronze swords, two glass relief-bead necklaces, and two lentoid steatite seals (Pulak 2005: 296–306).



Type	Category name	Quantity	Beck No.
1	Tiny and segmented	≈ 72,000	I.A–B.1–2.b XVII.A.1.a
2	Globular	≈ 1600	I.B–C.1.a–b
3	Cogwheel	≈ 800	XXIII.A.2.a
	Collared cogwheel	17	XXIII.A.2a, collared
4	Grain-of-wheat Subtype A	153	XXVI.A.3
	Subtype B	43	XXVI.A.3
	Subtype C	2	XXVI.A.3
5	Biconical Subtype A	52	XXIII.A.3.d
	Subtype B	2	XXIII.A.1.d
6	Grooved barrel	14	XXIII.A.1.a
7	Button	5	XXIII.A.2.e
8	Gadrooned spheroid	1	XXIII.A.3.a (oblate)

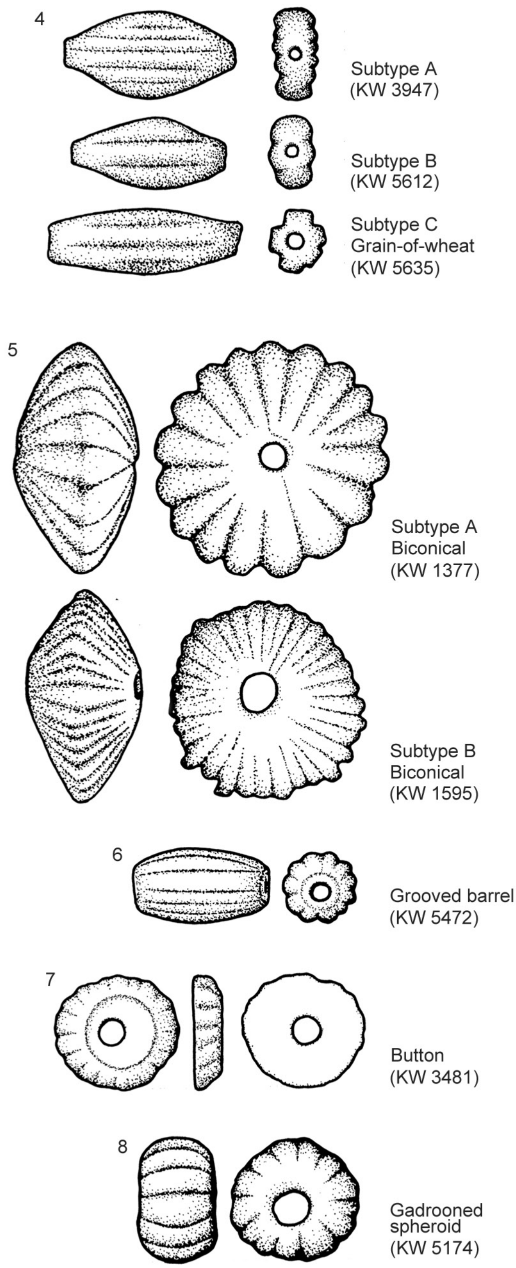


Fig. 1. Categories of faience beads found on the Uluburun shipwreck (inventory number of sample beads in parentheses); tabular presentation of bead quantities and reference to standard Beck typology

FAIENCE BEADS FOUND AT ULUBURUN: TYPOLOGY AND MANUFACTURE

Faience consists primarily of silica with small amounts of soda (from natron or plant ash) and lime; its use in beadmaking dates to the 5th millennium BC (Moorey 1994: 167–172; Nicholson, Peltenburg 2000: 186–187; Tite, Shortland 2008: 37–43; Vandiver 1983a: A18). Faience beads found at Uluburun vary in shape and, as will be demonstrated, represent both cargo and personal items. Due to the marine environment, the original glazed surface is completely eroded on the overwhelming majority of faience beads, leaving the beads with a pitted, granular, friable surface and giving the illusion of a gray or whitish color. Such erosion also increases a bead's porosity and consequently its susceptibility to staining resulting from copper or organic materials in close proximity. There are only a few exceptional faience beads with patches of preserved glaze, always bright blue in color.

There are eight general types of faience beads found at the site, some with subtypes representing beads exhibiting slight differences in decoration, proportion or technique of manufacture; the type label and approximate number of beads in each is shown in tabular form [see ***Fig. 1***]. The first three types, tiny/segmented, globular, and cogwheel, present the vast majority of faience beads found at Uluburun. Comparable beads of these three, relatively simple types have been found in abundance at Late Bronze Age sites throughout the eastern Mediterranean and Aegean. Close parallels for all three of these faience types — tiny/segmented, globular, and cogwheel — were found, for example, in Late Bronze Age contexts at both Lachish (Tufnell, Inge, Harding 1940: Pls 35–36; Tufnell 1958: Pl. 27) and Gurob (Brunton, Engelbach 1927: Pls 43, 45), among other sites.

Far fewer examples of the remaining faience types were found at the site. The grain-of-wheat type, with three subtypes found at Uluburun, is a Mycenaean bead form frequently found in LH III contexts.[4] Biconical faience beads with radial decoration, comprising the fifth faience bead type at Uluburun, are common in Late Bronze Age contexts in both the Aegean and western Asia but are rare in Egypt; such beads are frequently found in Mycenaean tombs and correspond to Type 15 at Mycenae (Xénaki-Sakellariou 1985: 294; Wace 1923: 354–355 No. 91 e–g, 357 No. 7, 382 No. 4540). The grooved barrel type, although less common than the grain-of-wheat type, is also prevalent in Mycenaean contexts; close parallels for the Uluburun grooved barrel beads were found in a LH III grave at Tiryns (Rudolph 1973: 59 Nos 14, 19, Pl. 32).

The button type, labeled as such due to its similarity to the base of Mycenaean shanked campaniform buttons (Blegen

[4] Close parallels for the Uluburun faience grain-of-wheat beads were found in significant numbers in LH III contexts at both Dendra (Persson 1931: 30, Tholos Tomb No. 18; 39, Pit 1 No. 5; 106, Chamber Tomb 2 Nos 47–48, Pl. 35; Persson 1942: 86, Chamber Tomb 10 No. 32b) and Mycenae (Wace 1923: 382, Tomb of the Genii, No. 4539), and similar examples of this type of faience bead have been found at numerous other archaeological sites throughout the Aegean (Konstantinidi 2001: 22).

1937/II: 147, Fig. 602), is represented by just five beads at Uluburun. Exhibiting significant deterioration, these beads, with a buff-colored body and lacking any trace of blue coloration, differ from the other faience beads found at the site.[5] Close parallels for the Uluburun button type are unknown, although a somewhat similar bead of probable LH III date, unique at the site, was found at Elateia-Alonaki (Nightingale 1996: 146–147 No. T LXVI/10s), and another, of Nineteenth Dynasty date, was found at Beth Pelet (Tell el-Farah (S)) (Starkey, Harding 1932: Pl. 72 No. S-50). Finally, the faience gadrooned spheroid comprising the eighth type of faience bead is unique at Uluburun; this form, however, enjoyed widespread popularity during the Bronze Age, and faience examples are known from archaeological sites throughout the Aegean and eastern Mediterranean.

One of three glazing methods may have been used for these beads: application, efflorescence, or cementation. Application glazing entails the manual application of glaze to the faience body, through dipping, pouring, or painting, prior to firing (Vandiver 1983a: A27–A29). Efflorescence and cementation glazing are self-glazing techniques. In efflorescence glazing, the alkaline salts in the faience body effloresce and are converted to a powdery white surface layer upon drying; this powdery layer melts when fired and fuses with the surface of the object, thereby forming a glaze (Vandiver 1983a: A31–A33). In cementation glazing, the dried faience body is deposited in a dish containing a glazing powder; this entire dish is then fired, causing the glazing powder to melt at the surface of the object, resulting in an even layer of glaze (Vandiver 1983a: A33–A38).[6] Determination of which faience glazing method — application, efflorescence, or cementation — was used on the Uluburun faience beads is complicated by the fact that the outer glaze layer has not been preserved on these beads. Nevertheless, a few features may point toward the use of cementation glazing for the globular and tiny beads, which are the most common faience types.

One clue to the glazing technique of the beads is the formation of fused clusters of beads within the globular and tiny bead types [*Fig. 2*]; this fusing of beads was not observed in any of the other faience types. Such clusters are both anomalous and rare. They may be in the form of stacks, cascades, or simply a jumble of beads.

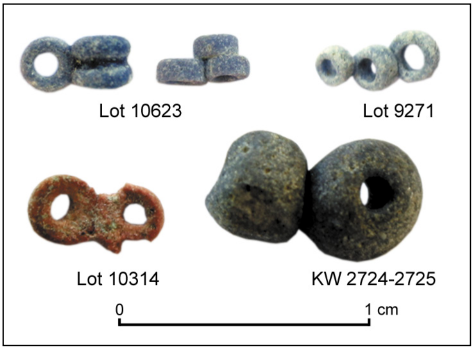


Fig. 2. Fused clusters of tiny and globular faience beads from the Uluburun shipwreck (All images R. Ingram)

[5] It is possible that the button-type beads may be of a material other than faience; future chemical analyses may help clarify the nature of these beads.

[6] This powder consists of soda, lime, and copper, the proportions of which are variable; Vandiver notes that any number of combinations of these three elements will produce a suitable glaze.

That there is no variation in the type and color of the beads in any given cluster is evidence that such clustering occurred during manufacture. Had such clustering occurred after the ship sank, one would expect variation within the clusters, due to the mixing of different types and colors on the site. Additional evidence that this clustering occurred during manufacture is the slight deformation to some of the clustered beads. Traces of surface glaze may at times be visible between the conjoined beads.

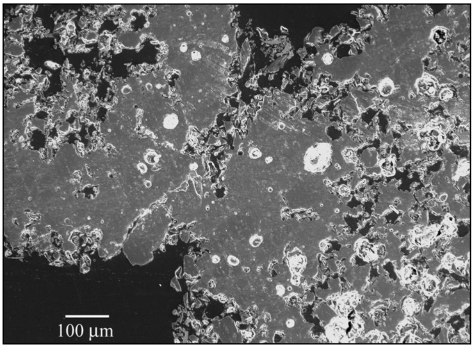


Fig. 3. Globular faience bead from Uluburun Lot 11299, with adhering fragment. Line scale is equal to 100 µm; magnification 100 x on JEOL 6400 Scanning Electron Microscope at 15 KeV and 48 mm WD

In addition to these clusters, several of the globular beads have a fragment of another faience bead of the same type adhering to one side, or a large pit from which such a fragment might have broken. SEM analysis of one such bead with an adhering fragment shows that the bead and fragment have fused together at a melted outer layer, suggesting that the clustering occurred during the firing process [***Fig. 3***]. The fragmentation, therefore, is caused perhaps by the breaking apart of beads which had become joined during firing, as might result from the "Qom process" of cementation glazing. The Qom process, observed in an existing faience bead

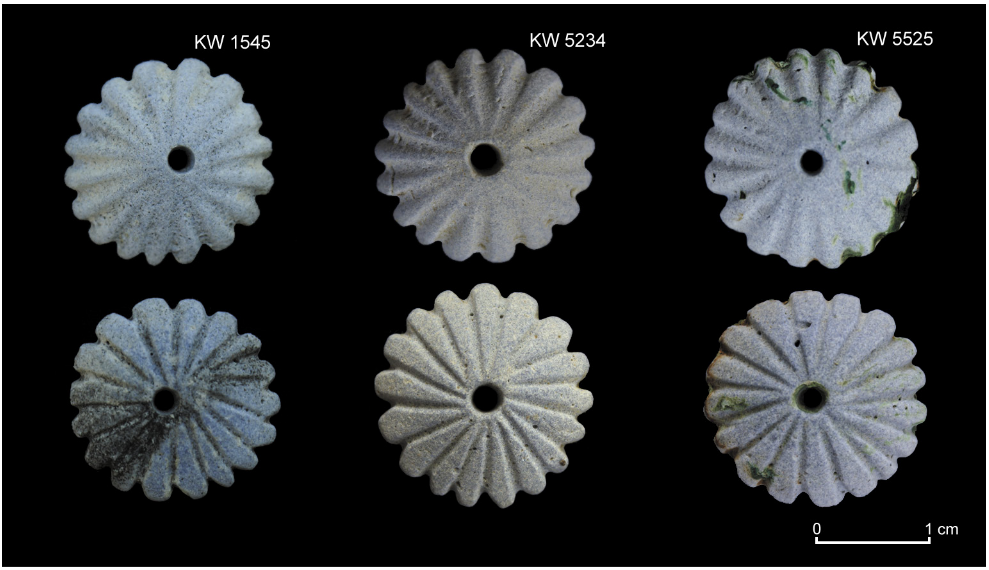


Fig. 4. Biconical subtype A faience beads from Uluburun, views of both faces

factory in Iran, entails mass production of beads, up to 40,000 at a time (Wulff, Wulff, Koch 1968: 101–102). Once the glazing dish containing beads is fired, its entire contents is thrown on the floor and broken apart by workers stepping on it. Although the Qom beads are much larger than those found at Uluburun, cementation glazing and a similarly rough extraction process might account for both the clustering and fragmentation of some of the globular and tiny beads from Uluburun. While the glazing method used on the other types of faience beads found at the site remains unclear, a self-glazing technique, either efflorescence or cementation, would seem the most efficient method for such small and relatively simple objects (Tite, Shortland 2008: 208).

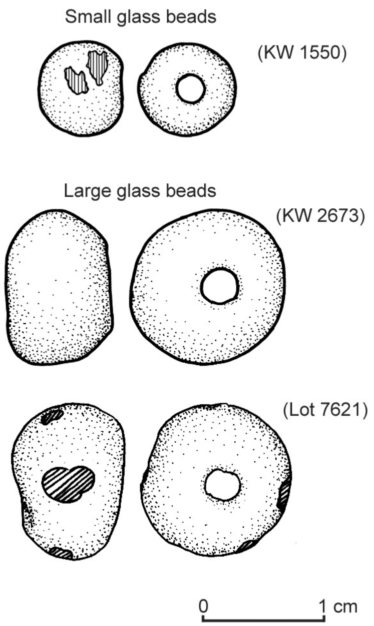
The vast majority of the Uluburun faience beads were hand-formed. All of the faience beads have a round perforation that is approximately straight, suggesting that the beads were formed on a straight wire or reed. Modern experiments reveal that the firing of faience beads on a metal wire results in difficulty in removing the bead from the wire and a residue within the perforation (Beck, Stone 1936: 210–211). It is therefore likely that these beads were either formed on a metal wire and removed prior to firing, or were formed and fired on a combustible reed (Kiefer, Allibert 1971: 110). A grooved wood or stone tool may also have been used to create fluting and segments in the cogwheel, segmented, and perhaps grain-of-wheat types; a similar tool was suggested for segmented faience beads found in Britain (Beck, Stone 1936: 210).

Only one type of bead, the biconical Subtype A, is molded [see ***Fig. 1***]. These 52 beads possess the somewhat unusual number of 17 gadroons of varying width on one face [***Fig. 4***]. For those beads that are sufficiently well preserved, analysis of relative width and orientation of each segment showed that all such beads were created in the same open-faced mold. The opposite face, only slightly convex in contrast to the molded face, was shaved down and then incised by hand to mimic the segments of the molded face. These incised lines may be imprecise, with lines that might cross and with two beads exhibiting only 16 rather than 17 incised lines. The author is unaware of any published, close parallel for these gadrooned biconical beads, molded on one face and incised on the other.

GLASS BEADS FOUND AT ULUBURUN

WOUND GLASS BEADS

Two broad categories of glass beads were recovered at Uluburun: wound glass beads and glass relief beads. The 17 glass relief beads from the shipwreck, originally dark blue in color, are of two designs: one decorated with spirals (12 beads), the other adorned with figure-of-eight shield motifs (five beads) (Pulak 2005: 303–304, Pl. 70.b; Pulak 2008: 375–376, Fig. 239). Glass relief beads, which were cast in stone molds, are usually found in Mycenaean contexts (Hughes-Brock 1999: 287–289). Due to their complexity, the 17 glass relief beads found at Uluburun have not been included in this study. The excavation yielded a large number of wound glass beads, which are divided into two different types based on size (small and large) [***Fig. 5***]; in form, both types are generally spheroid. Due to the deterioration of the glass beads, many disintegrated in the process of excavation, some leaving only impressions in encrustations (Pulak 1991: 6). As a result, it is impossible to state with certainty the actual number of glass beads carried on the ship at the time it sank; nevertheless, surviving artifacts suggest that at least 9,500 glass beads were on board, and the actual number carried was probably much higher.



Category name	Quantity	Beck No.
Small glass beads	≈ 9000	I.B–C.1.a (spheroid)
Large glass beads	≈ 500	I.B–C.1.a
Large glass beads with spot or crumb decoration	Estimated 2/3 of all large glass beads	

Fig. 5. Categories of glass beads found on the Uluburun shipwreck (inventory numbers of sample beads in parentheses); tabular presentation of bead quantities and reference to standard Beck typology

Due to their extended period underwater and the leaching out of various elements by seawater, the present color of these beads no longer accurately reflects their original color. There are, however, at least two small glass beads (labeled KW 1550) that retain a bright blue color, although these were found concreted to a bronze arrowhead, this seemingly affecting their preservation. Because many of the glass beads, especially the larger ones, are heavily deteriorated, bead diameter can be an unreliable means of classification. The bead cores in both categories, though, are generally better preserved, and their diameter and length may therefore be used as the basis of categorization.

Although often poorly preserved, parallels for the wound glass beads from Uluburun have been found in Late Bronze Age contexts throughout the eastern Mediterranean. For example, small and large glass beads from Stratum V at Tell Abu Hawam (1400–1230 BC) appear to be very similar to those recovered at Uluburun (Hamilton 1935: 61–62 Nos 385, 392, 394-395, and 399). The glass beads found on the Uluburun shipwreck have been identified as wound beads, which are created by trailing melted glass around a wire or mandrel. This identification was made based on three main features. The first and most prominent feature is the opaque, beige perforation deposit visible on both the small and large glass beads (Moorey 1994: 204) [*Fig. 6:A*]. Pamela Vandiver noted a similar feature on beads at Nuzi, suggesting that a copper rod had been coated with calcite and clay to facilitate extraction of the bead upon cooling (Vandiver 1983b: 242). Secondly, wound glass beads exhibit striations that encircle the bead axis; this feature was noted on some of the Uluburun glass beads (Karklins 1985: 97) [***Fig. 6:B***]. Thirdly, wound glass beads may have a peak at one end, marking where the glass thread that was trailed onto the mandrel was severed (Beck 1928: 60; Petrie 1894: 27). Such peaks are common on the large glass beads at Uluburun and are at times quite distinct [***Fig. 6:C***].

SIMPLE SPOT GLASS EYE BEADS

About two-thirds of the well-preserved Uluburun large glass beads are recognizable as eye beads, which are beads possessing spots or eyes of a different color of glass applied to the original glass matrix [***Fig. 7***]. This type of bead may have served as an amulet for protection against the evil eye (Gifford 1958: 67–68). Although eye beads can be manufactured using a number of different materials and methods, most of the Uluburun eye beads are simple spot glass eye beads, in which a spot or drop of glass was applied to the matrix or bead body, then marvered smooth or heated to lie flush with the bead surface (Beck 1928: 42, No. XLVI.A.2.b(1); Eisen 1916: 4–5).

The spots or eyes on each eye bead vary in number from one to four, although these spots may sometimes be irregular, seemingly formed of two drops of glass. The spots are always located on or near the bead equator and may be any shade of off-white or yellow, although it is unknown how well this represents the original color of the glass decoration. Surface devitrification and discoloration often obscure the presence of spots or eyes. It is not clear, therefore, whether or not all large glass beads found on the Uluburun shipwreck are eye beads, although this is certainly a possibility; it can only be definitively stated that some of the large glass beads are eye beads.

Glass eye beads of Late Bronze Age date have been found at archaeological sites throughout the eastern Mediterranean. Beads found in LB II–III tombs at Lachish provide perhaps the best parallel for those found at Uluburun, being of similar form and dimension and possessing eye spots that are irregular and overlapping (Tufnell 1958: Pl. 29 No. 48). In Egypt, eye beads and pendants are relatively common, but Egyptian eye beads tend to possess stratified rather than simple spot eyes, thus differing from those at Uluburun.[7]

Although simple spot eye beads have been found at Late Bronze Age sites in the Aegean, they are relatively uncommon, and few thereof provide close parallels for those found at Uluburun. One close parallel, a LH IIIB bead from Midea, is nearly identical to the Uluburun eye beads in form and dimension; the Midea bead is decorated with a large spot of white glass, as well as splashes of red glass (Demakopoulou *et alii* 2008: 13–14, 22–23).[8] If the cargo of the Uluburun ship was originally destined for an Aegean port, it is surprising that more eye beads have not been found there. However, because glass beads in this region suffer significant deterioration due to the environment, most often obscuring

7 Simple, flush-spot glass eye beads are known in Egypt; see, for example, those recovered from New Kingdom tombs at Qau and Badari (Brunton 1930: 16–17, Pl. 32 Nos 45–46, 57), although these differ slightly from the Uluburun beads in form and size.

8 A glass bead found in a LH IIIC context at Tiryns, bearing two light spots, may also be a parallel for the Ulubrun eye beads, although this is less certain (Haevernick 1981: 404 No. 6).

the beads' original surface, flush-spot eye beads may have been found in larger numbers than publications suggest, but may simply not be recognizable as eye beads due to poor preservation.

Color alone, however, is not the sole means of identifying an eye bead. Discussing eye-ring beads dating from the 9th to the 5th centuries BC, Gustavus Eisen noted that many impressed rings

Fig. 6. Features identifying production technique of large glass beads: A – perforation deposit; B – striations; C – peak at bead end

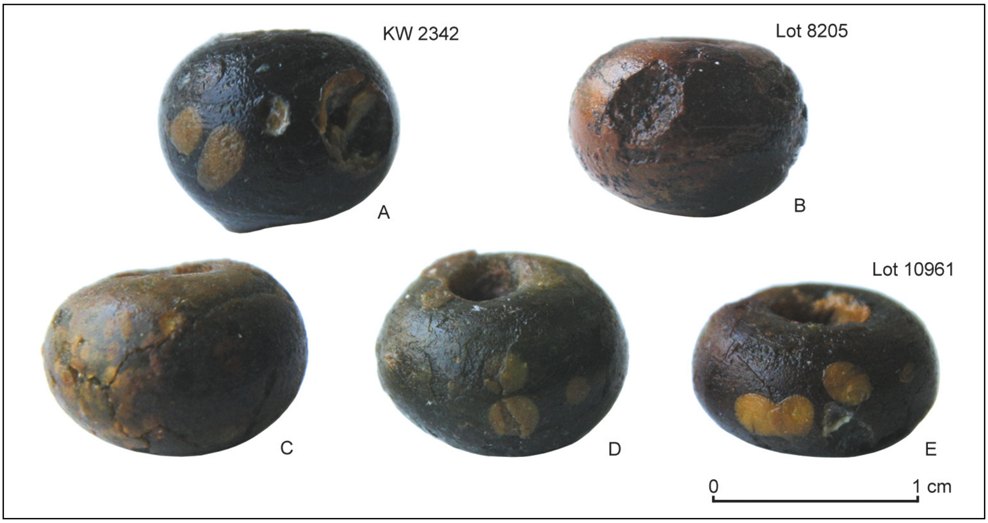


Fig. 7. Large glass beads: A – spot eye bead; B – bead with a pit from an eye spot that has dropped out of the glass bead body; C – crumb bead; D, E – beads possessing characteristics of both crumb beads and simple spot eye beads

had dropped out of the bead, leaving a hollow imprint where they had once been (Eisen 1916: 12).[9] The same phenomenon may be observed in some of the eye beads found at Uluburun [*Fig. 7:B*]. Some beads do not retain eyes but possess pits approximating the size and shape of eye spots; other beads possess both eyes and pits, the pits occurring in approximately the same size and location as the eyes on complete beads. Although Eisen attributes this phenomenon to poor manufacture, it may more appropriately be attributed to differing coefficients of expansion of the colored glasses used.

GLASS CRUMB BEADS

Some of the glass eye beads may more accurately be labeled glass crumb beads, exhibiting flush, yellow and white spots that are both smaller and more angular than those of the typical spot eye bead [*Fig. 7:C*]. Horace Beck classified such crumb beads as a form of simple glass eye bead (Beck 1928: 42, No. XLVI.A.2.d). To create a flush glass crumb bead, a hot glass bead is either rolled in, or sprinkled with, glass crumbs of one or more colors, then rolled on a marver to press the crumbs into the bead matrix (Beck 1928: 62–63). This method of manufacture frequently results in smaller, overlapping spots with irregular corners in contrast to the rounded spots of a glass spot eye bead. Amongst the Uluburun eye beads, though, there does not seem to be a clear demarcation between the simple spot and crumb beads, with some beads seeming to exhibit characteristics of both [see *Fig. 7:D,E*]. Published examples of comparable flush glass crumb beads of 14th-century BC date are rare, although, as with the spot eye beads, this simply may be the result of poor surface preservation.[10]

ROLE AS CARGO

One of the most noteworthy aspects of the Uluburun beads is that most of them were part of the ship's cargo and therefore an element of palatial or elite trade. While the quantity of beads in any given type may not necessarily be proof of that type's status as cargo, there are several other factors that aid in making that designation. The clearest evidence that these beads were trade items is the presence of two encrusted lumps of beads: one of small glass beads and one of tiny faience beads.[11] The glass bead concretion (KW 8), estimated to include nearly 8,000 beads, was found inside a small, broken Canaanite jar [*Fig. 8*, left]; based on the capacity of similar jars (6.7 liters), the jar may originally have carried approximately 26,000 glass beads.[12] The other concretion (KW 76) includes approximately 69,000 tiny faience beads [*Fig. 8*, right]. This lump of beads was not associated with

[9] An eye-ring bead is one in which a ring of glass of a different color is impressed into the glass matrix.

[10] Flush glass crumb beads, similar in form and dimension to those at Uluburun, were recovered from LH IIIA2/LH IIIB Tomb 2 at Pylona on Rhodes (Karantzali 2001: 74 No. 695 a–c) and from Room S of the Late Bronze Age treasury at Kāmid el-Lōz (Miron 1990: 107 No. 492).

[11] Sample measurements and formulas used to determine the number of beads in each concretion are provided in Ingram 2005: 206–209.

[12] Future petrographic analysis of the KW 8 jar may suggest an origin for this Canaanite jar, although this does not necessarily reflect the origin of the glass beads it contained.

any ceramic, suggesting transport in a perishable container, perhaps a cloth bag, which eventually disintegrated but allowed the mass of beads to retain its present form.

For both KW 8 (small glass beads) and KW 76 (tiny faience beads), the jumbled orientation of the beads within the concretion strongly suggests that these beads were carried loose in their containers. There is evidence that luxury textiles were carried on the ship, allowing for the possibility that some of the tiny or discoid faience beads found loose at the site may have been sewn onto cloth or garments originally (Pulak 2008: 296–297; Wachsmann 1998: 306). There is, however, no direct evidence of this, and while it remains a possibility, it can be said with certainty that many such beads were not incorporated into textiles.

A second indication that some bead types were an element of cargo is the fact that, due to manufacturing flaws, a few of the beads could not be strung. Such flaws include incomplete perforations, which, although uncommon, were observed on both small and large glass beads. The fused clusters of some tiny and globular faience beads, mentioned previously as potential evidence of cementation glazing, resulted in some beads with blocked perforations, which also precluded their having been strung.

Fig. 8. Concreted masses of beads: left, approximately 8,000 small glass beads in a broken Canaanite jar (KW 8) and right, approximately 69,000 tiny faience beads (KW 76)

Third, distribution of the various types of beads on the wreck site helps to indicate their role aboard the ship, although this is not as definitive as the two previous indicators. In order to study their distribution, the various types were plotted in an overlay of the wreck's site plan, producing a graphic display that facilitates comparison of the different types. The ship came to rest on a steep, rocky slope, with its bow pointing downward and a list to starboard. This resulted in a scatter of artifacts in these two directions, around a large rock outcrop, as illustrated in site plans (Bass 1986: 273, Fig. 3; Bass *et alii* 1989: 3, Fig. 2; Pulak 1988: 3, Fig. 2; 1998: 192, Fig. 4; 2008: 290–291, Figs 91–92).

The tiny and globular beads, both determined to be elements of cargo based on one or both of the first two indicators, formed a concentration towards the center of the ship, with drift downslope and to starboard [*Fig. 9:A*]. The cogwheel beads formed a similar pattern, and this, coupled with this type's relatively simple form and its widespread distribution at archaeological sites throughout the eastern Mediterranean, indicates that these beads were also an item of trade.

The pattern of distribution of other, less common, types of faience beads differs significantly from that of the faience trade beads [*Fig. 9:B*]. The wide scattering of the two biconical subtypes at the stern of the ship aligns well with the distribution of the grooved barrel beads, suggesting that these two types were carried together and possibly strung together. The small number of beads within these two types, along with their somewhat more complex design, indicates that these beads are more likely the personal possessions of one of the ship's crew or passengers.

Similarly, the grain-of-wheat beads [see *Fig. 9:B*] had a unique pattern of distribution that avoids the concentration of cargo beads amidships. These beads were found in one concentrated area towards the bow of the ship, but also seemed to exhibit a counterintuitive upslope scatter. This, combined with an uneven distribution of subtypes, suggests that the grain-of-wheat beads were carried in at least two separate groups, perhaps strung on two necklaces. Since the grain-of-wheat style is a Mycenaean bead form frequently found in Late Helladic III contexts, it is tempting to speculate that two such necklaces might be associated with the two Mycenaean emissaries believed to have been aboard the ship based on other finds, including pottery, weapons, relief beads, and seals (Pulak 2005).

The glass beads exhibited a distribution as would be expected of beads transported in bulk: they occurred on the site in concentrated pockets, with drifts downslope and to starboard [*Fig. 9:C*]. The small glass beads, including those in the Canaanite jar (KW 8), seem to have been stowed toward the ship's stern and drifted forward and downslope from this location. The large glass beads formed pockets toward the stern and just forward of midships, with the starboard drift reflecting the heeling of the ship after sinking. Perhaps the most interesting aspect of the distribution of the large glass beads is the overlap of spot- or crumb-decorated beads. This concurrence of patterns suggests that the two groups were intermixed or transported together and provides tentative support for the theory that all large glass beads found at Uluburun are, in fact, spot- or crumb-decorated beads, although some may no longer be recognized as such due to poor preservation.

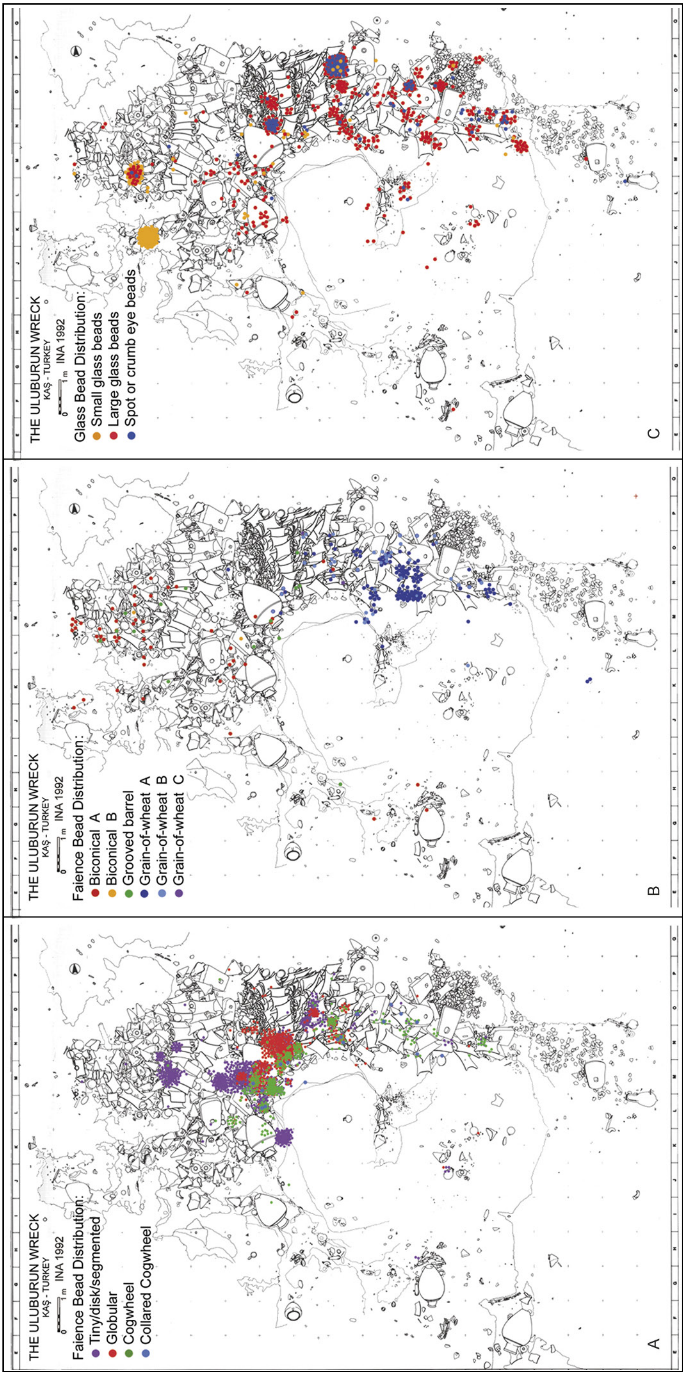


Fig. 9. Distribution of beads on the wreck site: A – tiny, globular and cogwheel faience beads; B – other categories of faience beads; C – glass beads (Image R. Ingram, after Pulak 1998: 192, Fig. 4)

CONCLUSIONS

In summary, concreted lumps, manufacture flaws, and distribution at the site indicate that the wound glass beads and three types of faience beads (tiny, globular, and cogwheel) were being carried as items of trade on this Late Bronze Age merchant vessel. These beads were unstrung and carried loose in bags or ceramic vessels; the homogeneity of the concreted lumps confirms that, as expected, the beads were separated by form and, perhaps, color. As with any bulk good, a few flawed or damaged beads found their way into the shipment. Based on the finds from this ship, the types of beads being traded were simple forms that may be found at Late Bronze Age sites throughout Egypt, the Syro-Canaanite Coast and the Aegean.

The wide variety of raw materials and luxury goods carried on the ship suggests that this shipment represented gift exchange between two Late Bronze Age palatial centers (Pulak 1998: 220). However, the precise role of glass and faience beads within this context remains unclear, as there is some debate on the status of faience and glass jewelry in the Aegean (Sherratt 2008: 219–223). Identical bead forms were often created in both gold and vitreous materials such as glass or faience (Nightingale 2000: 159), leading some to speculate that the latter were cheap substitutes for the former (Blegen 1937: 1:253; Konstantinidi 2001: 249; Wace 1932: 206). Faience or glass beads covered in gold foil at several Mycenaean sites seem to confirm this view (*Das Kuppelgrab*... 1880: 24; Persson 1931: 105; Wace 1923: 380). Due to the proliferation of faience and glass beads in LH IIIA–B graves, they are assigned a low status index by Kazimierz Lewartowski in comparison with other bead materials (Lewartowski 2000: 35). Furthermore, the earliest items of glass and faience in the archaeological record seem to have been made in imitation of precious stones, most notably lapis lazuli, and a view of faience and glass as a substitute for more costly materials is reinforced by Mesopotamian texts.[13]

However, Georg Nightingale notes that although faience or glass may have been substitutes for lapis lazuli or other stones, they could never be mistaken for gold (Nightingale 2000: 163). Furthermore, both materials were frequently combined, as in the faience bead with gold caps found at Hala Sultan Tekke (Åström *et alii* 1983: 177) or the gold and glass bead necklaces recovered intact at Asine (Frödin, Persson 1938: 398–399). The presence of faience and glass beads in several high-status Mycenaean graves further refutes the theory that these objects represent purely lower status goods.

It is clear, then, that faience and glass, although less costly than gold, were valuable

[13] A. Leo Oppenheim's analysis of such cuneiform texts (including economic records, letters, and Sumerian and Akkadian word lists) reveals a strong link between early glass and precious stones (Oppenheim 1970: 9–14). The Akkadian term for lapis lazuli is *uqnû*; a distinction, however, is made between *uqnŭ kŭri*, "lapis lazuli from the kiln", and *uqnŭ šadĭ*, "lapis lazuli from the mountain". A distinction between the two is seen in Assyrian texts as early as the second half of the 2nd millennium BC and also occurs with agate and obsidian (Oppenheim 1970: 14–15). A similar distinction is seen in the Amarna letters, where lapis lazuli, believed to represent glass, stands in contrast to "genuine" lapis lazuli, the precious stone (Oppenheim 1970: 11; Moran [ed.] 1992: 73).

in their own right (Foster 1979: 156; Hughes-Brock 1999: 285; Nightingale 2000: 163–164; Sherratt 2008: 214). This being the case, a shipment of faience and glass beads is not inconsistent with the valuable raw materials and luxury goods found on the Uluburun shipwreck. Such beads, however, do not represent a finished product; rather, they were shipped in bulk, meant to be strung and transformed by Mycenaean craftsmen into a finished product, perhaps one uniquely associated with the palace (Bennet 2008: 155, 161). The remains of a jewelry workshop in association with the Mycenaean palace at Thebes confirm a link between the palace and the production of beaded jewelry in the Aegean (Symeonoglou 1973: 63–72). The association of beaded jewelry with the palace, and redistribution thereof to elites, would have been a small part of the palace's attempt to control resources and monopolize external trade (Sherratt, Sherratt 1991: 359, 365–366, 370–373). As such, this bulk shipment of faience and glass beads is not unlike the raw materials that formed the primary freight of the vessel (Pulak 2008: 291–292, 295).

Regardless of their intended use or indication of status, the beads found on the shipwreck at Uluburun comprise an important contribution to the archaeological study of beads for the mere fact that they may be dated by provenance alone to around 1320 BC. For the trade beads, this is furthermore their approximate date of manufacture. Their presence on the ship also provides direct evidence that glass and faience beads were being imported into the Aegean in the late 14th century BC, despite the existence of local industries capable of producing such objects. Perhaps these local industries preferred to focus on the production of uniquely Mycenaean objects such as molded glass relief beads or faience grain-of-wheat beads. Simpler, more generic beads of faience or wound glass may more easily have been imported, as the Uluburun shipment seems to indicate.

ACKNOWLEDGMENTS

I am grateful to Prof. Cemal Pulak, director of the Uluburun project, who generously granted permission for the study of the faience and wound glass beads from the Uluburun shipwreck for my MA thesis at Texas A&M University, upon which this paper is based. Prof. Pulak's assistance and advice are greatly appreciated. Thanks also to the conservators and staff of the Institute of Nautical Archaeology's Bodrum Research Center and the Museum of Underwater Archaeology in Bodrum, Turkey, especially museum directors Oğuz Alpözen and Yaşar Yıldız. INA Bodrum director Tuba Ekmekçi and conservator Dr. Edith Trnka kindly facilitated access to the artifacts. Funding for the initial study was provided primarily by Prof. Pulak, with additional support from the Institute of Nautical Archaeology, Prof. C. Wayne Smith, and Texas A&M University. Valuable advice was provided by Dr. Kalliopi Nikita. I thank my colleagues from the Nautical Archaeology Program who read drafts of this paper and provided advice. Many thanks also to the two anonymous reviewers; this paper is much improved as a result of their comments and questions. A version of this paper was originally delivered at a workshop on beads and personal ornaments at the 7th International Congress on the Archaeology of the Ancient Near East in April 2010.

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