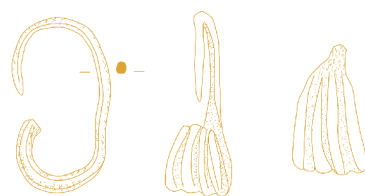


A group of Bronze Age gold jewelry and archaeometric analysis



Abstract: Jewelry, with a historical lineage as ancient as humanity itself, is an object that can be crafted in different forms using a variety of materials and techniques and worn on various parts of the body. Frequently utilized forms include bracelets, necklaces, rings, fibulas, diadems, earrings, and chain breast ornaments. Among these, earrings and rings are the most common. This article focuses on two earrings and a ring made of gold alloy, acquired by the Burdur Museum. These are categorized as jewelry for the head and hands. The first earring is shell-shaped, while the second is crescent-shaped. The ring has a simple hoop design. Wire, solid sheet, and hammering techniques were employed in the production of these artifacts, which were widely produced during the Bronze Age. Three analytical techniques were applied in the archaeometric examination: P-EDXRF, X-ray radiography, and μ -PIXE. The investigations revealed the use of pure gold and gold ore, color variations due to copper and silver alloys, and the chemical composition of the alloys. This information contributes to understanding the relationship between Bronze Age jewelry technology, production methods, forms, and, in this context, the quantity and function of alloys.

Keywords: Bronze Age, gold earrings and rings, archaeometric analysis

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INTRODUCTION

The first known examples of jewelry, valued for their religious significance, aesthetic appeal, and personal desirability, were made from stone, bone, ivory, and shells (Türe and Savaşçın 2000: 25; Meriçboyu 2001: 16–23). With the advent of mining, jewelry crafted from bronze, gold, silver, and electrum became increasingly common (Bingöl 1999: 13). Jewelry is a distinctive accessory that can be worn on various parts of the body. Usage preferences indicate that jewelry is predominantly worn by women, whereas men initially show less interest but tend to adopt it over time (Tekin 2018: 163). Jewelry created for both religious and secular purposes sometimes reflect a connection between the two. Early usage was shaped by beliefs in amulets and magic; in later periods, jewelry also served as offerings to deities, funerary gifts, symbols of status, tokens of affection, markers of wealth, and enhancements of beauty (Bingöl 1999: 13). Commonly utilized forms include necklaces, rings, fibulas, diadems, earrings, bracelets, and chain breast ornaments. These objects, which require care and attention, have been in demand for thousands of years.

Earrings are among the most common forms of jewelry. In temple records and ancient writings, earrings are designated with the Latin term “*inaurēs*” (Riddle 1838: 238). 17 different terms are recorded in Greek in the 2nd century AD. Among them are “*βότρυς*”, “*ελικτήρος*” and “*πλάστρα*” (Liddell and Scott 1901: 289, 454, 1221). The earliest examples of earrings made of gold appear in the 4th millennium BC (Anlağan 2002: 69; Pa-

pageorgiou 2003: 213, No. 3, 215, No. 7). In the 3rd millennium BC, simple hoop-shaped, crescent-shaped, and shell-shaped earrings made from wire or metal sheets using hammering techniques began to be produced (Duchene 1995: 1–9; Golani 2013: 235, Fig. 8). In the Middle Bronze Age, crescent-shaped earrings had semi-circular, closed bodies (Woolley 1934: 241, Pl. 138; Ziffer 1990: Figs 27, 68; Türe 2009: 26, No. 15; Golani 2013: 235, Fig. 8). In shell-shaped examples, the hoop is sharply bent upward, and the tip of the hook lies close to the upper part of the body. The number of wires used in the body is usually small (Zimmermann 2016a: 318). Crescent-shaped earrings were common in the Late Bronze Age (Maxwell-Hyslop 1971: Pls 101, 197–198, 201, 213–215), with the slender end curved to secure the earring to the earlobe (Gal and Muqari 2002: Fig. 9, No. 7–8; Panitz-Cohen, Mullins, and Bonfil 2013: 39–40). In shell-shaped earrings, the wire used for the semicircular body is shorter, bending upward to form a “C” shape that tapers at the end (Biran and Ben-Dov 2002: Fig. 2, No. 135). Crescent-shaped earrings made from thin wire during the Iron Age were semicircular or C-shaped and granulation decoration was widely used (Golani 2013: 235, Fig. 8; Daguet 2017: 51, Fig. 3.6:c). In shell-shaped earrings, thin wire is coiled onto the body, forming a small ellipse, while a thicker wire is used for the convex body (Starkey and Harding 1932: Pls 19, 48). More elaborate and delicate items appear in the Archaic and Classical periods (Marshall 1911: Pl. 33, No. 1906; Higgins 1961: 12; Williams and Ogden 1994:

57, No. 9, 76, No. 31, 87, No. 38). In the Hellenistic period, more splendid examples were created, incorporating precious stones and complex decorative patterns (Higgins 1961: 160–168; Hoffmann and Davidson 1966: 94, No. 18a, 95, No. 19a, 98, No. 21a; De Juliis 1984: 164–166, Nos 78–80). The typology of earrings from the Roman period displays great diversity in form, production, and decoration, reflecting political and economic developments (Marshall 1911: Pl. 52, Nos 2412, 2417; Stern 1990: Pl. 30, No. 696; Facsády 2008: 240, Fig. 5; Albani 2010: 194, Pl. 3; Bollók 2010: 182, Pl. 2, No. 2; Langó 2010: 372, Fig. 2, No. 1d; Müller 2010: 345, Taf. 98, 131/1–13, 135/24; Dánová 2013: 49, No. 1: a–b; Milovanović 2018: 116, Figs 10–11; Germanà 2019: 3, Fig. 3; Schulze-Dörrlammm 2020: 24, Abb. 19, Kat. 16, 31, Abb. 26, No. 18).

Many rings made of various metals—including gold, silver, lead, iron, and bronze—as well as materials such as ivory, bone, faience, natural stones, and glass, have been discovered in archaeological excavations. Rings of gold, silver, electrum, copper, bronze, and lead are attested in the 3rd millennium BC (Golani 2013: 248–258). The bezel of the ring is oval in shape, and the engraving technique was used for decoration (Boardman 1967: 5). From the 3rd to 2nd millennium BC, the production of hoop-shaped rings with overlapping and open ends began (Tite, Freestone, and Bimson 1983: 17; Sparavigna 2009: 10; Lansing 2012: 2; Matin and Matin 2012: 763; Golani 2013: 249; Tajeddin 2014: 50). In the 2nd millennium BC, the use of simple hoop-shaped rings increased (Spier 1992: 17, No. 13; Zimmermann

2016a: 318, 320, Fig. 19). In the 1st millennium BC, metal rings were often crudely fashioned and adorned with gemstones (Spier 1992: 17, No. 13). Rings produced between the 7th and 5th centuries BC featured thin hoops and circular cross-sections (Williams and Ogden 1994: 50). Ring sizes began to increase in the 4th century BC (Williams and Ogden 1994: 95, No. 48, 105, Nos 58–59, 205, No. 136, 211, No. 143, 253, Nos 194–196). The “D”-shaped cross-section ring, originating in the Hellenistic period, was more widely used during the Roman period (Marshall 1907: 231; Whitehouse 2003: 64).

This study examines three gold artifacts from the Burdur Museum collection, which received the “Museum Worth Visiting” award in 2008 (Sop, Yeşiltaş, and Soslu 2019; A. Soslu 2024a: 5). No documented information exists regarding the provenance or context of the artifacts, which were acquired through purchase. For this reason, a typological evaluation was first conducted, followed by a comparison with analogous examples to determine their respective periods. In this context, examples from museum and private collections obtained through archaeological excavations were also considered. Archaeometric analyses of the artifacts were conducted using three methods: P-EDXRF, X-ray radiography, and μ -PIXE. The P-EDXRF method was selected for its ability to perform surface measurements and identify the chemical constituents of the artifacts (Potts and West 2008). XRF analysis elucidated and quantified the chemical composition and alloying elements of the artifacts. The alloys and their structural images were examined using X-ray radiography

(Schreiner et al. 2004), which provided insight into whether the alloys affected the color and manufacturing technique of

the artifacts. The μ -PIXE method was employed to determine sub-trace elements (Halden, Campbell, and Teesdale 1995).

EARRINGS EXHIBITED IN BURDUR MUSEUM

In antiquity, earrings were widely worn by women, men, and children. An individual's desire for social acceptance, fashion preferences, personal ambitions, and religious convictions were notably influential factors in their use. These motivations have continuously sustained public interest in jewelry. The earliest materials used in jewelry production include stone, bone, ivory, and seashell (Türe and Savaşçın 2000: 25; Meriçboyu 2001: 16–23). The advancement of metalworking led to the growing prevalence of jewelry crafted from bronze, gold, silver, and electrum (Bingöl 1999: 13). When the preferences for objects worn on various parts of the body are considered, it becomes evident that jewelry was valued and worn by both men and women, regardless of gender (Tekin 2018: 163). Beliefs related to magic and amulets are thought to have significantly influenced the earliest use of jewelry, which later evolved to serve diverse functions, including offerings to deities, symbols of status, funerary gifts, expressions of wealth, tokens of affection, and adornments of beauty (Bingöl 1999: 13).

Detailed examination of the earrings in the Burdur Museum identified two stylistic types: shell-shaped (K.65.87.85) and crescent-shaped (K.87.35.89).

The shell-shaped earring was acquired by the Burdur Museum through purchase on 27 September 1989. It is housed in the museum's artifact storage under inventory number K.65.87.85. The piece is made of gold, consists of a single component,

and is in good condition. Wire and hammering techniques were employed in its production. The earring was formed by soldering four thick wires together and shaping one end into a hooked configuration. The thick wire hook attached to one end of the body was hammered into a hoop; one end of the wire extends downward to hang below the earlobe. The extremities of the body are thickened, and the hoop is elliptical in form with an open end. The thick, elongated hoop rises upward and is undecorated. Dimensions: length 1.7 cm; hoop thickness 0.1 cm; diameter 0.6 cm; thickness 0.2 cm.

The crescent-shaped earring was acquired by the Burdur Museum through purchase on 6 December 1985. It is housed in the museum's artifact storage under inventory number K.87.35.89. The piece is made of gold, consists of a single component, and is in good condition. Wire, sheet, and hammering techniques were used in its production. The body was formed by joining two convex sides of a thin gold sheet. A thin wire hook attached to one end of the body was hammered to form a hoop. One end of the wire extends downward to hang below the earlobe and bends slightly over the body. The body terminates in a slightly tapering tip. The cross-section of the ring is circular, and is open-ended and undecorated. Dimensions: length 1.5 cm; hoop thickness 0.1 cm; diameter 0.7 cm; thickness 0.4 cm.

SHELL-SHAPED EARRING (K.65.87.85)

One of the earrings examined in the study is referred to as the “shell-shaped earring” (Bass 1966: 35) [Figs 1, 2]. This type of earring is made by soldering a minimum of two wires, either thin or thick, and shaping the end into a hook shape. The thin wire hook attached to one end of the body is elongated by hammering to form a hoop shape; one end of the formed wire is made longer or shorter to hang down from the earlobe (Zimmermann 2016a: Fig. 15). When examining the development of shell-shaped earring form, early examples were identified in the 3rd millennium BC (Bingöl 1999: 56; Reade 2003: 123, No. 72b). The wire used in the body of Early Bronze Age earrings was thick, composed of four, five, or six strands. Alongside undecorated specimens, globular embellishments crafted using the granulation technique and spiral decorations produced with wire were also employed (Bass 1966: 35; Allen 2003: 267, No. 171). The production and use of shell-shaped earrings were not common during the Middle Bronze Age (Petrie 1934: Pls 18, 79). The wire forming the hoop is thin; the hoop ascends, and the hook end terminates at the upper section of the body. Two or three wires were used

in the construction of the body. In the Late Bronze Age, the wire length of the semicircular form became shorter and curved upward only slightly. The hook end terminates close to the body; thick wire was used in constructing the body. The body bends upward, taking a “C” shape, and tapers toward the end (Biran and Ben-Dov 2002: Fig. 2, No. 135). In the Iron Age, thin wire was bent into a small elliptical hoop attached to the body. The wire forming the hoop is thin and long, while the body was shaped in a convex form using thick wire (Starkey and Harding 1932: 914, Pl. XLVIII, No. 19). At the end of the Archaic period and the beginning of the Hellenistic period, the thin metal sheet forming the body took the shape of a “C.” The body was bent upward, with both ends slightly thinned; spherical embellishments created using the granulation technique appear around the body. The wire forming the hoop became thin and flat, and the hook end is close to the body. Two thin disks are present where the hoop meets the body (Gal and Muqari 2002: Fig. 9, Nos 7–8).



Fig. 1. Shell-shaped earring from the Burdur Museum (K.87.35.89) (Photos A. Soslu)

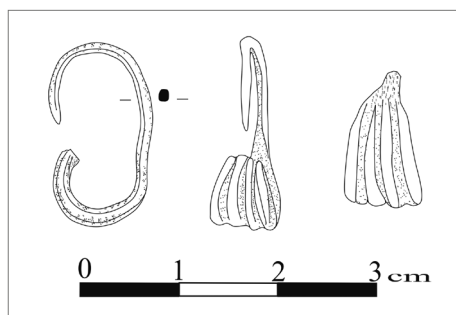


Fig. 2. Drawing of the shell-shaped earring from the Burdur Museum (K.87.35.89) (Drawing A. Soslu)



Fig. 3. Comparative examples of shell-shaped earrings from the Burdur Museum (Plate A. Soslu)

Comparable examples to the Burdur Museum artifact are represented by finds from Anatolia and regions beyond. This type of earring is not frequently encountered in archaeological excavations or surface surveys. Similar forms to the gold earring in the Burdur Museum are found mainly among contextual finds in Anatolia [Fig. 3].

Artifacts comparable in form to the Burdur Museum example were discovered at Eskiyaar (Çorum) (Bingöl 1999: 56, Nos 18–19) in Anatolia, as well as at Troy (Çanakkale) in Treasures “A” (Schliemann 1875: 336, Pl. XX, No. 278; Sazcı 2002: 70, No. 4.), “D” (Bass 1970: Pl. 86, Fig. 8, No. 15; Tolstikov and Treister 1996: Nos 134, 151–152; Sazcı 2007: 221, Fig. D-2), and “J” (Sazcı 2007: 262, Fig. J-S2, 263, Fig. J-S16). Treasures from western Anatolia and Poliochni (Schliemann 1881: No. 831; Numrich et al. 2023: Fig. 1, No. 4333) in the Aegean region are dated to the Early Bronze Age. Silver (Eskiyaar) and gold wire were used. The Troy treasures exhibit distinctive characteristics; some, such as “A,” “F,” and “R,” include semi-finished items and raw materials. Significant evidence of metalworking—such as crucibles, chisels, and casting molds—was uncovered at Troy, indicating the presence of a specialized metalworking center in the mid-3rd millennium BC (Sazcı 2007: 365). The examples described above show close similarities to the Burdur Museum specimen; the wires were soldered, and the tip was formed into a hook. A thick solid wire was used in the semicircular section, which extends upward and bends. The hook end tapers toward the upper part of the body. Four to six thick solid wires were used in the

body, either decorated or undecorated.

Earrings found at Tell el Ajjul, Palestine (Petrie 1934: Pl. 18, No. 79) in the Levant; Lanrivoare, France (Hawkes 1961: Pl. II, No. 5) in western Europe; and southern Britain (Smith 1959: Figs 2–3) in northwestern Europe date to the Middle Bronze Age. Bronze (southern Britain) and gold wire were used. These examples resemble the Burdur Museum artifact in that the wires were soldered together, the end was turned into a hook, a thick solid wire was used in the semicircular form, and the body was undecorated. They differ, however, in that the semicircular wire is thinner, and only two or three thin wires are used in the body.

Gold earrings found in the Beth-Pelet Necropolis, Israel (Starkey and Harding 1932: 914, Pl. XLVIII, Nos 18–19), Tel Dan, Israel (Layer VIIB; Biran and Bendov 2002: Fig. 2, No. 135), and Wadi el-Makkuk, Israel (Golani 2013: 235, Fig. 8, No. 28) in the Levant region date to the Late Bronze Age. Electrum (Wadi el-Makkuk) and gold wire were used. These examples resemble the Burdur Museum earring in that the wires are soldered together, the tip was made into a hook, and the body was undecorated. They differ in that the semicircular wire is shorter, the hook tip is slightly bent upward and ends close to the body, three thick wires were used in the body, the body bends upward in a “C” shape, and the tip tapers.

An earring found at Tell el-Far’ah, Israel (Starkey and Harding 1932: 914, Pl. XLVIII, No. 19, Tomb 914) from the Iron Age was made of silver wire. It resembles the Burdur Museum example in that the thin wires were soldered together, the

tip was shaped into a hook, and the body was undecorated. It differs, however, in that a thin wire was bent onto the body

to form a small elliptical shape, and three thick wires were used in the convex-shaped body.

CRESCENT-SHAPED EARRING (K.87.35.89)

One of the earrings examined in this study is crescent-shaped. This form is one of the important symbols representing the “eye” (Black and Green 1992: 17, No. 10, 55, No. 47, 135, No. 111; Köroğlu 2018: 175, Figs 9–10). Jewelry made in this manner was designed to provide protection against epidemics, witchcraft, the evil eye, and both physical and mental ailments. Such objects appeared both as domestic goods used in daily life and as personal adornments, continuing in use over time (S. Soslu and A. Soslu 2023a: 189). Amulets produced for apotropaic purposes were widely used in Mesopotamia, Egypt, Greece, the eastern Mediterranean, and Anatolia (Petrie 1914; A. Soslu 2023: 85; S. Soslu 2023: 520; S. Soslu and A. Soslu 2023b: 74, 82). These amulets were made in various forms—such as earrings, hairpins, rings, and necklaces—using materials including gold, silver, bone, faience, and glass (S. Soslu 2023: 528–529, Figs 1–2; S. Soslu and A. Soslu 2023a: 190, Figs 2–4; 2023b: 91–94, Nos 1–6; A. Soslu 2024b: 52). The richest assemblage of high-carat, high-quality jewelry from the Bronze Age consists of crescent-shaped earrings crafted from electrum and gold (Steinert 2019: 88, Figs 4–6). These earrings, often referred to in the literature as “sandal earrings” because of their form, were made from solid castings in smaller examples, while larger ones consist of two pieces soldered together (Golani 1996: 25–26). The crescent/

half-moon/sandal-shaped earrings, which originated in Sumerian culture in Mesopotamia during the early 3rd millennium BC, are associated with rites connected to the Moon god Sin (Black and Green 1992: 67; Steinert 2019: 88, Figs 4–6). The Sumerians venerated Sin because they believed the movements and positions of celestial bodies were closely linked to human fate and destiny (Atan 2002: 10). Sin was said to travel from one location to another using a “boat” (Kramer 2002: 158). In Anatolia, Sin acquired religious significance in Lydia and Ionia, where he was associated with the three phases of the moon within the sacred triad of the Goddess Artemis (crescent=young girl, half-moon=woman, full moon=mother) (Türe 2009: 28). In the Pisidia region, the deity Men was connected to Sin. Sacred sites and small finds associated with Men have been identified in the region. The first is the “Treasury Buildings” in the sacred precinct of Men at Pisidia Antioch (Özhanlı 2022). Another is the sacred area and relief of Men in the city of Keraitai (Dörtlük 1976; 1988: 69–70; A. Soslu 2022: 317; S. Soslu 2024). An important piece of evidence is a glass ring stone featuring a lion depiction, housed in the Burdur Museum (A. Soslu 2022: 317, No. 390).

The development of crescent-shaped earrings reveals that early examples were identified in the Royal Tombs at Ur in Mesopotamia during the 3rd millennium BC (Woolley 1934: 241, Pl. 138). During the

Middle and Late Bronze Age, this form of earring was particularly prevalent in the Levant region (Petrie 1934: Pl. 18, No. 85; Woolley 1934: 241, Pl. 138). In addition to undecorated specimens, earrings featuring notched or globular decorations made with the granulation technique are also attested (Zimmermann 2016a: 318). Toward the end of the Middle Bronze Age, the earring form typically became half-moon or semicircular-shaped and closed (Ziffer 1990: Fig. 27, No. 68). In the Late Bronze Age, examples were produced in silver, gold, and copper (Maxwell-Hyslop 1971: 101, 197–198, 201, 213–215; S. Soslu and A. Soslu 2024: 40, No. 1); their bodies are short (Nicolaou 1990: Pl. XXVa). The hook tip was thinned and slightly bent downward toward the body to fasten the earring to the earlobe (Panitz-Cohen, Mullins, and Bonfil 2013: 39–40; Serrano 2022: 8, Nos 16, 180, 484, 561). Crescent-shaped earrings produced from thin wire during the Iron Age are long and narrow, with flattened and thickened tips (Ilan 2016: 142, Fig. 5). The granulation technique was commonly employed for globular decorations on the body (Golani 2013: 235, Fig. 8; Daguet 2017: 51, Fig. 3.6:c). In the Archaic period, the bodies of these earrings began to take a flat

form (Williams and Ogden 1994: 230, No. 162, 240, No. 175), often featuring a single row of globules made with the granulation technique at the lower end (Becatti 1955: Pl. 75, Nos 293–295; Gitin and Golani 2001: 35, Pl. 2.10; Meriçboyu 2001: 48, No. 1; Castor 2008: Fig. 14; Guerra and Rehren 2009: 152, Fig. 1; Üngör 2015: 167, No. 7). Crescent-shaped earrings continued to be highly favored during the Hellenistic and Roman periods, as well as throughout the Early and Middle Byzantine periods (Šribar and Stare 1974: 463, No. 6; Bollók 2010: 182, Pl. 2, No. 11; Golani 2013: Fig. 8:31). In the Late Roman and Early Byzantine periods, the body became completely flat (Langó 2010: 372, Fig. 2, No. 1d). The earring bodies were often decorated with a central cross motif set within a medallion. The extremities of the crosses, frequently observed in the Early Byzantine period, extend outward and feature peacocks or stylized plant motifs on both sides (Albani 2010: 194, Pl. 3). In Christian symbolism, the peacock represents the immortality of the soul, beauty, virtue, rebirth, and dignity; it also symbolizes Christians partaking of holy water from a sacred stream (Langó 2010: 385, Fig. 6, No. 1). The popularity of



Fig. 4. Crescent-shaped earring from the Burdur Museum (K.65.87.85) (Photos A. Soslu)

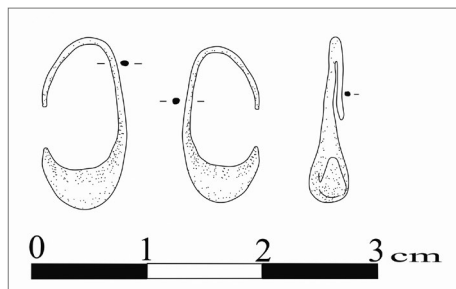


Fig. 5. Drawing of the crescent-shaped earring from the Burdur Museum (K.65.87.85) (Drawing A. Soslu)



Fig. 6. Comparative examples of crescent-shaped earrings from the Burdur Museum (Plate A. Soslu)

the peacock suggests a possible association with the goddess Hera, regarded in Hellenic mythology as the guardian of marriage and women (Köroğlu 2016: 6). During the 6th and 7th centuries AD, these earrings were known as “bridal earrings” (Köroğlu 2016: 6).

Examples comparable to the Burdur Museum earring are represented by finds from outside Anatolia. This earring type is not frequently encountered in archaeological excavations or surface surveys. Similar gold earring forms to that in the Burdur Museum are more commonly found in contextual assemblages abroad [Figs 4–6].

Earrings from the Treasures of Troy (Çanakkale) —assemblages “A” (Sazcı 2007: Fig. S-58), “C” (Sazcı 2002: 73, Fig. 7; 2007: 216, Fig. C-S6; Sazcı and Treister 2006: 210, Fig. 1), and “D” (Schliemann 1881: Nos 830–831; Sazcı and Treister 2006: 215, Fig. 6; Sazcı 2007: 222, Fig. D-S16; Numrich et al. 2023: Fig. 1, No. 4332)— which exhibit forms comparable to those in the Burdur Museum, are dated to the Early Bronze Age in western Anatolia. The Treasures of Troy “C,” “E,” and “K” groups also contain gold, silver, electrum, and bronze ingots. Excavations at Troy yielded significant data concerning metallurgy, demonstrating that the city functioned as a specialized metalworking center in the mid–3rd millennium BC (Sazcı 2007: 365). Similarly, artifacts discovered at Troy were made of gold and resemble the Burdur Museum specimen in their use of wire, sheet, and hammering techniques; the hoop is thin and elongated, extending upward. They differ from the Burdur Museum example in that the hoop end is closed, and

the body is long and slender, with the ends thickened by flattening. One earring features granulated embellishments along the body, while another displays small globules around the body and larger globules at the hoop ends.

Earrings found in Sumnu (Şumen) in the Balkans, now in the Regional History Museum, Bulgaria (Alexandrov 2017: 31, No. 2), at Tell el Ajjul in the Levant (Palestine) (Petrie 1934: Pl. 18, No. 79), and at Asur in Mesopotamia (Tomb 20) (Lilyquist 1993: Fig. 5), are dated to the end of the Middle Bronze Age and the beginning of the Late Bronze Age. These examples, made of gold, are similar to the Burdur Museum earring in their use of wire, metal sheet, and hammering techniques, and in their open semicircular form (not overlapping), which is undecorated. They differ, however, in that the hoop is thin and short, the hook end is bent toward and left along the body, and the body end is flattened with a straight termination.

Earrings dating to the Late Bronze Age have been found in Romania (Smig) (Cristea-Stan and Constantinescu 2016: 29, Fig. 3), Cyprus (Nicolaou 1990: Pl. 25a), Hala Sultan Tekke (Fischer 2019: 200, Fig. 8, No. 1), and in the Levant at Megiddo (Israel) (Golani 2013: Fig. 8, No. 15), Beth-Pelet Necropolis (Israel) (Starkey and Harding 1932: Pl. 18, No. 36), and Tel Ashdod (Israel) (Golani 2013: Fig. 8, No. 4). These examples were produced in electrum (Tel Ashdod) and gold. It has been suggested that such earrings are of eastern Mediterranean origin (Nicolaou 1990: 118). They closely resemble the Burdur Museum specimen in their use of wire, sheet metal, and hammering techniques; they are undecorated, feature

a short drop-shaped crescent body, possess an elongated hoop, and have a hook tip that is slightly bent downward and tapered toward the body.

Earrings found in southern Phoenicia (Eshel et al. 2018: 202, Fig. 3) in the Levant, at Tell el Ajjul (Palestine) (Ilan 2016: 142, Fig. 5), Tell Beit Mirsim (Israel) (Golani 2004: 190, Fig. 4, Nos 1–2), and Assyria in Mesopotamia (Pedde 2018: 185, Fig. 1), date to the end of the Late Bronze Age and the beginning of the

Early Iron Age. They were produced in gold, silver, and copper (Tell Beit Mirsim). These earrings resemble the Burdur Museum specimen in their use of wire, metal sheet, and hammering techniques, open semicircular ends, and absence of decoration. However, they differ in that the semicircular body is thin and short, the hook end bends slightly downward toward the body, the body is elongated and narrow, and the terminal is flattened and thickened.

RING EXHIBITED IN BURDUR MUSEUM (K.58.28.95)

Rings have been esteemed by women, men, and children for millennia, serving both as important adornments and signet rings that signify power. These rings were used for ornamental purposes as well as for symbolic meaning. A diverse assortment of rings made from metals (gold, silver, iron, bronze, lead), faience, bone, and natural stones has been found (Facsády and Verebes 2009: 994, Fig. 1, No. 1a–IIa. B¹ Rings generally comprise three components: the hoop that encircles the bottom section of the finger, the bezel that occupies the upper portion, and the shoulder. The cross-section of the ring is rhombic, square, circular, semicircular (D-shaped), or a thin band (A. Soslu 2023: 86). The forms of rings and their bezels vary according to the period. In the 3rd millennium BC, rings made of gold, silver, electrum, copper, bronze, and lead were common (Boardman 1967: 5; Golani 2013: 248–258). Simple hoop-shaped rings with overlapping ends and open-ended hoops were especially prevalent (Golani 2013: 249). Hoop-shaped rings with overlapping ends are created by bending wire

into a hoop form. These rings may be either hollow or solid and are produced by turning thin sheets of metal through the hammering technique and subsequently bending them upon themselves using the wire technique (Golani 2013: Nos 2–3, 9, 11). Open-ended hoop rings, on the other hand, were made of solid wire using the hammering technique (Golani 2013: 253, Fig. 18, No. 2, 255, Fig. 19, Nos 2, 5). Blue faience seal rings and rotating bezel rings, manufactured in molds during the 3rd to 2nd millennium BC, are notably prevalent (Tite, Freestone, and Bimson 1983: 17; Sparavigna 2009: 10; Lansing 2012: 2; Matin and Matin 2012: 763; Tajeddin 2014: 50). The discovery of many seal rings from the 2nd millennium BC demonstrates the active use of seals (Marshall 1907: 15–16). The production of gold rings increased, and the crown section of the rings, often set with stones such as obsidian and lapis-lazuli, was decorated with line engravings (Zimmermann 2016a: 318, 320, Fig. 19). At the beginning of the 1st millennium BC, metal ring hoops were decorated with roughly processed ring stones

(Spier 1992: 17, No. 13). Between the 7th and 5th centuries BC, rings became thinner and more round-sectioned, with the crown section taking a thin, leaf-shaped form (Williams and Ogden 1994: 50). In the 5th century BC, human and animal figures were widely used in ring designs (Higgins 1961: Pl. 24, Nos c, d, e; Dági 2013: 88, Fig. 3). During the 4th century BC, ring sizes expanded, and the use of precious or semi-precious stones in their production increased (A. Soslu 2023: 89). The hoops of these rings were round in cross-section, and the crown section was affixed to the ring. Human and botanical figures were typically favored for these representations (Williams and Ogden 1994: 95, No. 48, 105, Nos 58–59, 205, No. 136, 211, No. 143, 253). By the mid-3rd century BC, the ring assumed a “D” sectional form, and the crown sockets became broad and oval-shaped. Depictions of gods and goddesses were commonly used (Williams and Ogden 1994: 198, No. 133). In the early 2nd century BC, the perimeter of the oval and protruding crown socket converged with a circular ring. The shoulders of these rings, featuring a circular hoop, extended vertically, with a convex profile stone situated within the elevated oval crown socket. In some instances, the shoulder ascended with a concave profile (Higgins 1961: Pl. 53, Nos d, e, f). In the 1st century BC, the crown height decreased, and the

shoulders were rounded (Higgins 1961: 61, No. d). During the Roman period, rings with wide ring forms and oval crowns were produced, and “D” sectioned rings remained common (Marshall 1907: 231; Lightfoot and Arslan 1992: 234; Whitehouse 2003: 64). In the 2nd century AD, the ring hoop thickened upward, and the ring gap and crown surface began to take a rounded shape. Ring stones were positioned half-embedded within the crown socket (Ogden 1982: 154, No. 29; Facsády and Verebes 2009: 994, Fig. 1, No. 1a–IIa; S. Soslu and A. Soslu 2024: 42, Cat. No. 8). By the 3rd century AD, rings with raised shoulders and thin hoops were made, with the crown socket designed to be flat. Pair-hoop and snakehead rings were also produced (Higgins 1961: Pl. 62, Nos a, b, c). In the Late Roman period, rings with conical bezels, polygonal hoops on the outside and round hoops on the inside, thin hoops, and hoops with quadrangular bezels placed on solid hoops were also produced (Higgins 1961: Pl. 63, Nos h–i; S. Soslu and A. Soslu 2024: 42, Nos 9–10).



Fig. 7. Simple hoop-shaped ring from the Burdur Museum (K.58.28.95) (Photos A. Soslu)

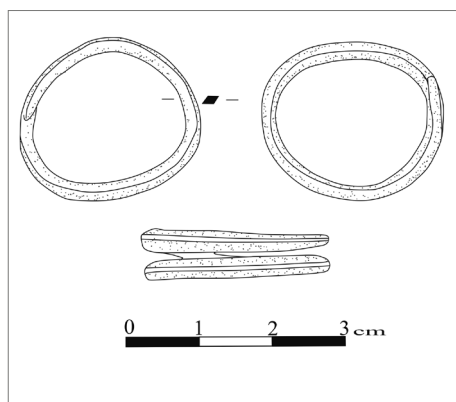


Fig. 8. Drawing of the simple hoop-shaped ring from the Burdur Museum (K.58.28.95) (Drawing A. Soslu)

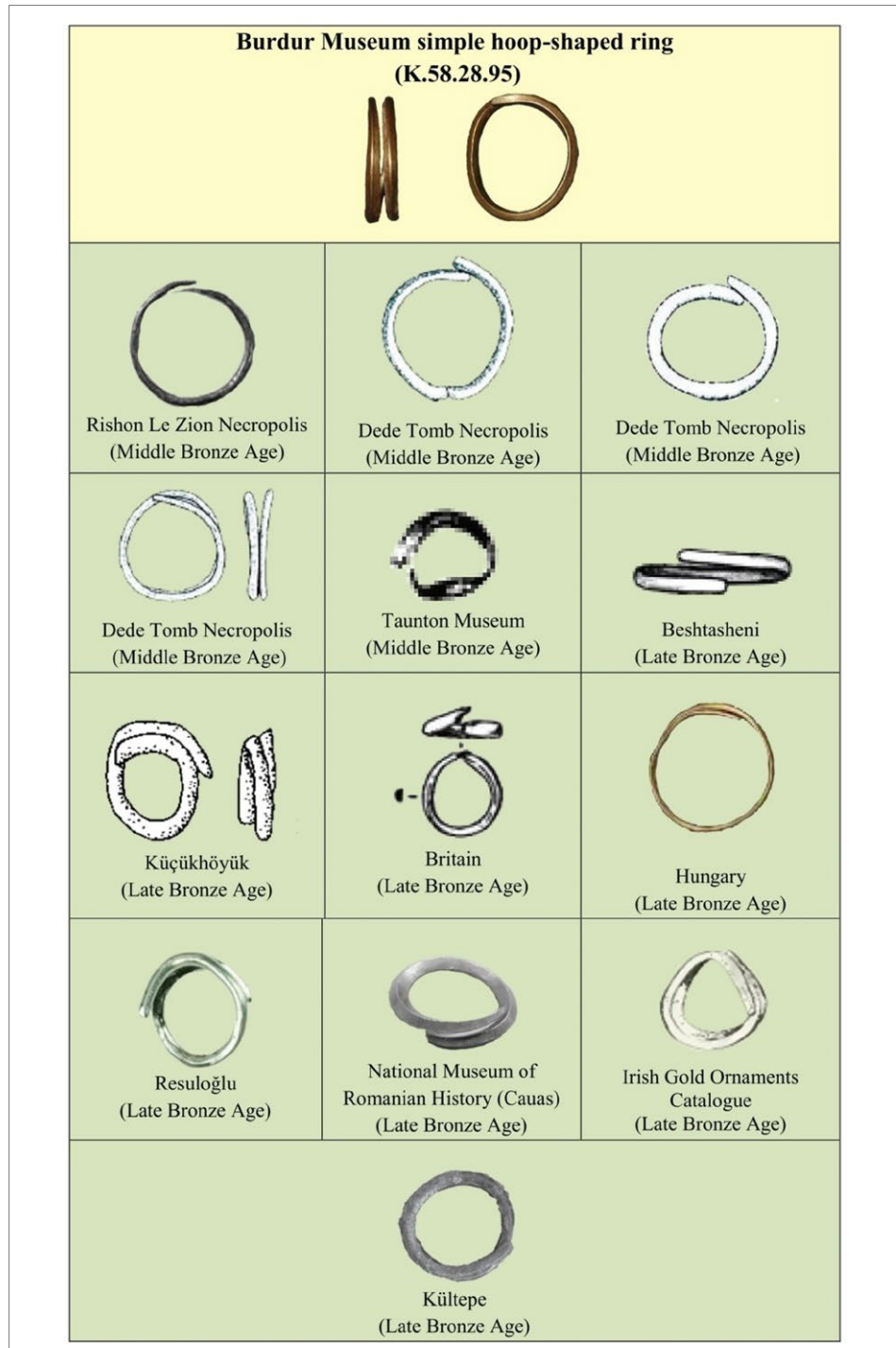


Fig. 9. Comparative examples of hoop-shaped rings from the Burdur Museum (Plate A. Soslu)

The artifact was acquired by the Burdur Museum on 1 May 1995 through purchase. It is held in the same museum's collection under inventory number K.58.28.95. The ring is made of gold, the most favored material in jewelry production. Constructed from solid wire using hammering techniques, it is in good condition. It was created by bending gold, previously shaped into a thin sheet through hammering, around its own axis using wire-bending techniques. It has a simple hoop shape and a rhombic cross-section. The thin wire converges and narrows at the extremities, which terminate near the center of the body. After production, the ring was polished to remove rough edges and surface scratches. It is undecorated. The height measures 2.3 cm, and the thickness is 0.3 cm [Figs 7–8].

Comparable examples to the Burdur Museum ring are found both within and beyond Anatolia. Similar forms are most frequently encountered among contextual finds in Anatolia [Fig. 9].

Artifacts classified as rings, hair hoops, and necklace pendants are often difficult to distinguish because of their close resemblance. Although some examples can be categorized based on unique characteristics, typological differentiation remains challenging due to numerous shared features (Zimmermann 2016a: 316, Fig. 10). Information about function can be obtained for artifacts found *in situ* in tombs, whereas objects not recovered *in situ* are harder to identify. In the Early Bronze Age, alongside simple hoop-shaped rings made of precious metals, examples in copper, lead, and bronze are also known (Gürkan and

Seeher 1991: 87, Fig. 23, Nos 7–21, 89, Fig. 24, Nos 1–4). Natural gold is an alloy that invariably contains small amounts of copper and silver. Intentionally produced gold alloys emerged toward the end of the Bronze Age, used to combine different metals. In the Late Bronze Age, metallic gold solders with lower melting points than the base metals were used to join separate pieces through heating. In the Early Iron Age, gold jewelry reappeared predominantly in elite burials (Armbruster 2013: 465).

Artifacts comparable in form to the Burdur Museum example include rings from Harmanören, Isparta (Özsait 1995: Fig. 10; 1998: Fig. 22, K-1; Efe and Fidan 2006: Pl. 8, Nos 12–13), and from Iasos, Muğla (Pecorella 1984: Fig. 14, Nos 3, 5–8) in southwestern Anatolia; Küçükhöyük, Afyon (Gürkan and Seeher 1991: Fig. 23, Nos 11–12, 21; Efe and Fidan 2006: Pl. 8, Nos 9–11) and Çeşme-Boyalık, İzmir (Şahoğlu 2024: 6, Fig. 5, No. d) in western Anatolia; the Museum of Anatolian Civilizations in Ankara (Ateşoğulları 2008: Lev. 50, Nos 2–5); Demircihöyük-Sarıket, Bilecik (Seeher 2000: Figs 39, G. 323a–b, 46, G. 440b, 51, G. 515b; Efe and Fidan 2006: Pl. 8, Nos 5–8) in northwestern Anatolia; Devret Höyük, Amasya (Türker et al. 2018: 128, Fig. 10) in northern Anatolia; Leukas (Tomb R4), Greece (Vasileva 2017: 4, Fig. 2:a) in southeastern Europe; and the southern Levant (Golani 2013: 249, Fig. 15, Type II, I, No. 9). Gold rings from Early Bronze Age tombs VIII–IX and the female tomb X in Allative are also comparable. Copper (southern Levant, Çeşme-Boyalık) and gold were used in their production. They resemble

the Burdur Museum specimen in being hoop-shaped with overlapping ends, made from thick solid wire bent into a small hoop, and undecorated. They differ, however, in having a circular cross-section, slightly tapering ends, and extremities terminating on the upper part of the body.

Rings found in the Aegean Bukhara Tomb Necropolis, Afyon (Üyümez et al. 2007: Fig. 19); in the Afyon Museum (excavated from Tomb 9 in Yanarlar) (Emre 2020: 120, Pl. XLI, No. 1b); in the Rishon le-Zion Necropolis, Israel (Kan-Cipor, Shalev, and Shalev 2018: 503, Fig. 7.8, No. 5); in the Levant; and in the Taunton Museum, England (Fox 1964: 239, No. 50) in Europe, are dated to the Middle Bronze Age. Gold was used in their manufacture. They resemble the Burdur Museum specimen in that they employ wire and hammering techniques; the thin solid wire tapers slightly toward the overlapping ends, which terminate near the midpoint of the body, and they are undecorated. They differ from the Burdur Museum example in being made of bronze and having a circular cross-section.

Artifacts in the Romanian National Museum of History in the Balkans (Cristea-Stan and Constantinescu 2016: 29, Fig. 3) and in the *Catalogue of Irish Gold Ornaments* from northwestern Europe (Armstrong 1920: Pl. XIV, No. 240) date to the Late Bronze Age. Made of gold, they resemble the Burdur Museum example in their use of wire and hammering techniques, hoop shape, rhombic cross-section, open ends, gradually tapering wire terminating close to the middle of the body, undecorated sur-

face, and post-production polishing to remove roughness and surface scratches.

The artifact reportedly originating from Cauas and now in the Romanian National History Museum differs from the Burdur Museum example in being a bracelet (6.69 cm in diameter). Rhombic-sectioned, open-ended, and undecorated bracelets and rings began to be produced in gold and bronze during the Middle Bronze Age and became widespread in the Late Bronze Age (Târlea et al. 2016: 78, Fig. 8, No 1–2). It is thought that bronze bracelets and rings were produced by casting in two-piece molds, while gold examples were made by hammering (Târlea et al. 2016: 70).

Many gold rings from the Late Bronze Age have been found in Küçüh-öyük, Afyon (Gürkan and Secher 1991: Fig. 23, No. 20) in western Anatolia; Kültepe, Kayseri (Lehner et al. 2015: 198, Fig. 2, Nos 91–96); and Resuloğlu, Çorum (Zimmermann 2016a: 319, Fig. 18) in Anatolia; Beshtasheni, Georgia (Hamburg and Pawłowska 2017: 609, Fig. 5, Nos f–1) in the Balkans; Bronze Age treasure finds in Hungary (Szabó 2019: Fig. 43); and Britain in northwestern Europe (Roberts 2007: 3, Fig. 2, No. 13). Bronze, copper, lead, silver, and gold were used in their production. They closely resemble the Burdur Museum specimen in their use of wire and hammering techniques, hoop form, and thin solid wire that gradually tapers toward the overlapping open ends, with the ends terminating near the midpoint of the body. They remain undecorated. They differ from the Burdur Museum example in having a circular cross-section.

Rings from the Early Iron Age have

been found as burial goods in the Hüsam-
lar Necropolis (Tomb 351) (Özer 2019: 143,
Fig. 10) in Ege; the Karagündüz Necropo-
lis in Van (Sevin and Kavaklı 1996: No. 19;
Ayaz 2016: 287, Fig. 3, No. k2); Evditepe in
eastern Anatolia (Sevin 2004: Fig. 3); the
southern Levant (Golani 2013: 249, Fig. 15,
Tip II, I, Nos 10–11); the Jordan Valley
in the Middle East (Green 2013: 423, No.
2); and Qinghai in northwestern China
(Mei 2003: 6, Fig. 3, No. 2). Some rings
discovered in the Karagündüz Necropolis
were found *in situ* alongside phalanges
and other skeletal remains. The fact that
several of the rings were found stuck

together suggests that multiple rings
could be worn side by side on the fin-
gers (Sevin and Kavaklı 1996: 32). Bronze,
copper, iron, and silver were used in their
production. The rings are similar to the
Burdur Museum example in that they
were made using wire and hammering
techniques, with thin solid wire bent into
small, undecorated hoop forms featuring
overlapping ends. They differ from the
Burdur Museum sample in having cir-
cular, flat, or rectangular cross-sections,
with solid wire that thickens toward the
overlapping ends, which terminate near
the central portion of the body.

MATERIALS AND METHODS

All artifacts examined in this study are
made of gold. Three analytical methods
were applied: Portable Energy-Dispersive
X-ray Fluorescence Spectrometry (P-
EDXRF), X-ray radiography, and Pro-
ton-Induced X-ray Emission (μ -PIXE).
Microanalytical techniques are widely
used in ore characterization research. It
is noteworthy that the P-EDXRF method
is widely employed by archaeologists be-
cause it provides instant analytical data
without any physical contact with the
artifact. However, it should be noted
that this commonly used method does
not provide highly precise data; there-
fore, erroneous or misleading readings are
possible, and negative effects may occur
(Pearce 2018: 83–84).

The P-EDXRF technique was select-
ed for its sensitivity at the parts-per-
million (ppm) level in non-destructive
artifact analysis, its ability to measure
directly from the surface, and its capac-
ity to determine chemical components.

This method produces instantaneous
analytical results without removing
any material from the artifact (Araújo,
Alves, and Cabrai 1993; Liritzis and
Zacharias 2011: 112). The alloys of the
artifacts, along with their structural
visualization, were analyzed by X-ray
radiography. Due to the varying absorp-
tion of X-ray radiation, visualization of
the material distribution was possible
based on the different alloys used. This
technique enables the determination of
material composition within small areas
using analytical imaging methods (Tro-
alen et al. 2009). The μ -PIXE method
was employed to identify minor and
trace elements within the artifacts. The
quantitative and visual data obtained
during this analysis represent the mi-
croanalytical results of the study. This
method achieves lower detection lim-
its by utilizing protons, which possess
greater mass than electrons (Halden,
Campbell, and Teesdale 1995: 295–300).

ANALYSIS RESULTS

All analyzed artifacts served as jewelry. The objects were categorized according to their shapes. The P-EDXRF technique was employed to determine the alloys and chemical constituents. The elements Au (gold), Ag (silver), and Cu (copper) were identified in

the artifacts [Table 1]. The primary element is gold, while silver and copper are present as minor and trace elements [Fig. 10]. The average gold content of all artifacts is 97.3%, the average silver content is 1.06%, and the average copper content is 2.2%.

Table 1. P-EDXRF analysis data

No.	Inv. No.	Au %	Ag %	Cu %
1	K.87.35.89 (earring)	96.1	1.1	2.8
2	K.65.87.85 (earring)	97.3	1	1.6
3	K.58.28.95 (ring)	98.6	1	—

K.65.87.85 is an earring dating to the Early Bronze Age. The gold concentration is 97.3%, the silver concentration is 1.0%, and the copper concentration is 1.6%.

K.87.35.89, also an earring, belongs to the Late Bronze Age. The gold concentration is 96.1%, silver 1.1%, and copper 2.8%.

K.58.28.95 is a ring from the Late Bronze Age. The gold concentration is 98.6% and silver 1.0%.

The chemical compositions of the artifacts include gold+silver and gold+silver+copper alloys. The analyses

reveal a high concentration of gold in all items examined. It is therefore suggested that these artifacts were produced from natural gold ore.

Further analyses were conducted using X-ray radiography and μ -PIXE techniques [Figs 11, 12]. The artifacts were manufactured using wire and hammering techniques. It was observed that four thick wire rods were soldered together to form the earring identified as shell-shaped. The analyses indicated that copper was used in the soldering process. If

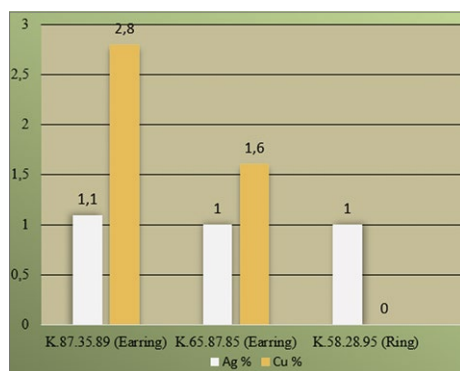


Fig. 10. Elements detected in the artifacts by the P-EDXRF method (A. Soslu)

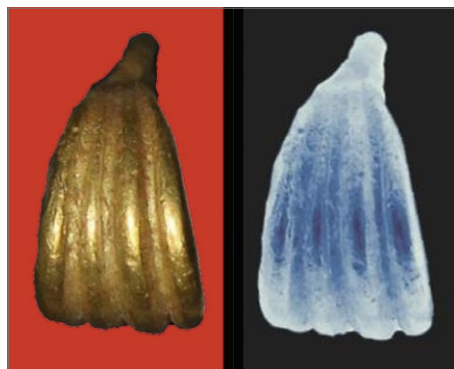


Fig. 11. μ -PIXE analysis and X-ray radiography of the earring (K.87.35.89) (A. Soslu)

filigree and granulation techniques had been employed, higher concentrations of copper and silver alloys would have been detected, as these metals are typically used in soldering. However, the levels of copper and silver alloys in this artifact

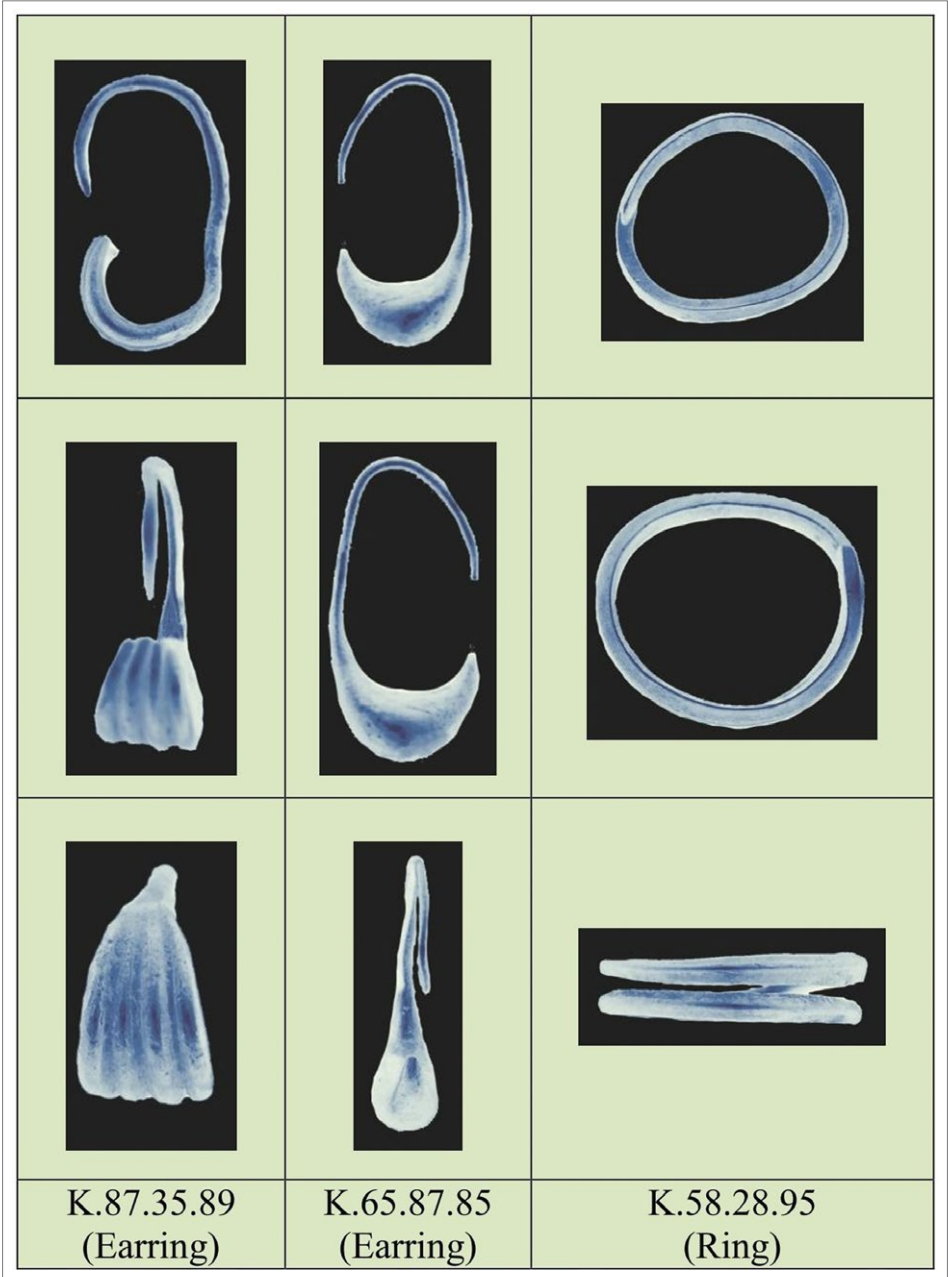


Fig. 12. X-ray radiographic appearance of the artifacts (A. Soslu)

are below the expected standard — both elements occur only as minor or trace components.

Silver and copper alloys were employed as additives in the artifacts. The average silver content is 1.06%, while the average copper content is 2.2%. Since the artifacts are made of gold and have concave-convex geometries, it would be difficult to maintain their shape without the inclusion of alloying elements, as gold is a highly malleable and easily deformed

material. It is well established that silver and copper harden and strengthen the alloys to which they are added (Araújo, Alves, and Cabrai 1993). A higher silver content in the base alloy typically results in greenish discoloration, while a higher copper content produces reddish tones. Nevertheless, given the relatively small quantities of silver and copper detected in these artifacts, it is concluded that they did not significantly affect the color of the finished objects.

EVALUATION OF ANALYSIS RESULTS

The first analyses of metal artifacts in Anatolia were conducted on the Alacahöyük findings (Koşay 1938), focusing on metal production in the region (Przeworski 1939) and the identification of spectrographic data pertaining to these objects (Esin 1969; Zimmermann 2016b). The examination of metalworking and usage in Anatolia, together with Bronze Age metal artifacts, has provided valuable information regarding craftsmanship and chemical alloys. The study of metal utilization from the Bronze Age —along with technical and sociological assessments (Yener 2000) and issues related to metal consumption and alloying— remains a significant area of research (Kuruçayırılı and Özbal 2005). Spectroscopic analyses of metal artifacts found in the Kalinkaya-Toptaştepe Bronze Age cemetery revealed copper-arsenic alloy components as well as traditional copper-tin mixtures (Geniş and Zimmermann 2014). These studies, which have largely focused on western Anatolia, have analyzed metallurgical artifacts in terms of their chemical composition, craftsmanship, and production

processes. It is evident that western Anatolian mining in the Early Bronze Age possessed a distinctive character, and that locally extracted metals —particularly gold and silver— were used intensively in artifact production. The intensive use of silver for jewelry at Baklatepe is associated with the chemical composition and analysis of silver artifacts from the Cyclades Islands, indicating overseas trade between the two regions (Keskin 2011b: 147). The analysis of metallic artifacts from the Cyclades further demonstrated that one-third of the lead and silver artifacts originated from Anatolia (Gale and Stos-Gale 2008: 387). Evidence of metallurgical activities —such as molds, blowpipes, ore preparation tools, and slag— was identified at Limantepe (Keskin 2004: 143). Only a small amount of copper flux was detected in the slag analyses (Kaptan 1998). Analyses of artifacts from Çukuriçi Höyük revealed the use of arsenic copper in many items (Horejs, Mehofer, and Pernicka 2010: 22). At Altıntepe, analyses determined the use of high-quality copper alloys (Kaptan 1999). Studies of arti-

facts from the Seyitömer Höyük excavations showed the frequent use of bronze and arsenical copper alloys (Keskin and Fidan 2022). Analyses of artifacts from the excavations in Resuloğlu revealed the presence of silver, gold, and copper alloys (Dardeniz and Yıldırım 2018).

The scarcity of analytical studies on gold is particularly noteworthy, considering the major role of Anatolian metal resources (gold, silver, and copper) in the complex trade networks that extended from the Balkans through Anatolia to Mesopotamia, beginning in the Early Bronze Age and continuing into the Late Bronze Age. Gold deposits are found in the Pactolus River and Mount Tmolos in the Lydian region of Anatolia, near Lampsakos in the Troad, and at Astyra and Cremastre southeast of Abydos (Strab. XIII.1.23; Sevin 2001: 71). These deposits were exploited and processed throughout the Bronze Age (Waldbaum 1983: 4). Gold artifacts have been discovered at numerous sites across Anatolia. Notable examples include finds from İkiztepe (Bilgi 1984: 70, Fig. 18); Alacahöyük (Koşay 1951: 157, Pl. CXXIX, Fig. 2, 168, Pl. CXCV, L. 1); Kalinkaya-Toptaştepe (Yakar 1985: 430, Fig. XXVIII, No. 11); Eskiypar (Bingöl 1999: 56, Nos 18–19); Sardis (Waldbaum 1983: Pl. 58, Nos 997–999); and Beşiktepe (Korfmann 1987: 264). Other examples include gold jewelry and vessels from Troy (Sazcı and Treister 2006: 209–216; Sazcı 2007: 137–353); a gold band discovered on the floor of a residence in Limantepe (Erkanal, Artzy, and Kouka 2003: 425; Keskin 2004: 144, Fig. 8:a–b); gold and jewelry from Baklatepe (Keskin 2004: 147, Fig. 7; 2008; Erkanal 2008); a collection of 89 gold

artifacts—including necklaces, rings, and earplugs—from Gavurtepe (Meriç 1993: 356–366, Fig. 4); gold bracelets from Küçükhöyük (Gürkan and Seeher 1991: 85–93, Figs 22–26); various gold items such as bracelets, bands, jewelry, and earplugs from the Demircihöyük-Sarıket cemetery (Seeher 2000: 230); gold artifacts from Karataş-Semahöyük (Warner 1994; Efe and Fidan 2006: 15); and gold jewelry from Bademağacı (Duru and Umurtak 2010: 24–25, Fig. 8).

Gold artifacts (earrings, necklaces, bracelets, needles, pendants, and lock rings) from the Early Bronze Age site of Troy in western Anatolia were analyzed for the first time using archaeometric methods (Sazcı 2007: 137–353). This study examined artifacts discovered in Poliochni, Lemnos, in the Aegean, and sought to elucidate the relationship between the two settlements (Numrich et al. 2023: 1–13). Regarding our topic, it was concluded that the shell-shaped earrings obtained in the towns of Troy (Sazcı 2007: 221, Fig. D-2, 262, Fig. J-S2, 263, Fig. J-S16; Numrich et al. 2023: 2, Fig. 1, Nos 4332–4333) and Poliochni (Numrich et al. 2023: 4, Fig. 2, Nos 7161–7163, 7165–7168, Fig. 3) exhibit typological similarities to the specimen from the Burdur Museum (K.65.87.85). The typological parallels and archaeometric analyses of the items from these two settlements indicate the potential for determining the origin of the artifact under study. In this context, we will first assess the artifacts from the Troy and Poliochni settlements relevant to our subject, followed by a comparison with the data from the Burdur Museum artifacts. In these analyses, laser ablation (pLA) and ICP-MS methodologies were

employed; these techniques operate on a microscopic scale and do not produce visible alterations to the artifact (Numrich et al. 2023: 2). The gold concentrations of the objects from Troy are higher than those of the objects from Poliochni. The silver content in the Poliochni artifacts is markedly greater than that in the Troy artifacts. The artifacts display relatively low copper concentrations (0.08–2.0%). Nonetheless, as with most prehistoric gold artifacts, the copper content in the majority of objects from Troy and Poliochni exceeds that of native gold, which typically contains less than 0.1% copper (Pernicka 2014). This raises the question of deliberate alloying with copper, for example, to alter the color of the gold. Observable variations in the hue of the alloy can indeed be detected. However, the slightly higher copper content in two objects from Troy in particular is likely due to the use of reaction solder during granulation, and thus it cannot be confirmed that native gold was intentionally alloyed with copper (Numrich et al. 2023: Fig. 1, No. Sch. 6007/1–15). The average gold concentration of the Burdur Museum artifacts is 97.3%, which aligns closely with the average gold content of the Troy artifacts. The average silver concentration is 1.06%, comparable to Troy but significantly lower than Poliochni. The average copper concentration is 2.2%, consistent with natural gold and paralleling the data from both settlements. Given the copper concentration of the shell-shaped earring and its craftsmanship, it is plausible that copper was used in the soldering process, resulting in a potential color alteration. However, it was determined that no such change occurred

and that the copper served to strengthen the concave-convex form of the artifact. The same phenomenon is observed in the aforementioned Troy artifacts.

These analyses aimed to obtain information regarding the individuals who used the gold artifacts, the provenance of the objects, and the chemical composition of the alloys (Numrich et al. 2023: 5–7). The identity of the producers and wearers of these artifacts is currently a subject of debate. However, since their workmanship is of high quality, they must have been prestige objects whose use paralleled the emergence of social elites. There is no known example of such an accumulation of prestige objects in an earlier period in western Anatolia. This phenomenon appears to coincide with the establishment of hierarchical systems and the emergence of proto-urban centers such as Troy II and Limantepe V during the Early Bronze Age. The unexpected typological similarities of gold objects (earrings, pendants, and hoop rings) discovered at the Poliochni settlement on Lemnos, in proximity to Troy, may be cited as a contributing factor to this development (Numrich et al. 2023: 9–11). We must also consider settlements such as Baklatepe, Limantepe, Ege Gübre, Beşiktepe, Sardis, and Çukuriçi Höyük, where proto-urban cultures emerged during the Early Bronze Age and where gold artifacts have been discovered. For example, “hoop idols” found at Ege Gübre, which are radiocarbon dated to the first half of the 4th millennium BC, represent the earliest precious metal finds in western Anatolia (Sağlamtimur 2007; Keskin 2011a: 199–200). These artifacts are of the same

type as the Balkan idols and are quite common in that region. This relationship is significant, as it demonstrates the existence of commercial connections between the Balkans and western Anatolia. Researchers have asserted that the examinations of the gold artifacts from Troy, Dubene in Bulgaria, and Po-

liochni in the Athens Museum are highly effective in elucidating the relationship between these regions. The analytical results of the Burdur Museum artifacts and their typological similarities indicate that they were used by an exclusive group and were integral to these broader cultural developments.

CONCLUSION

In this study, three gold artifacts from the storage collection of the Burdur Museum were examined. The artifacts were classified into two groups based on their forms: Group 1 consisted of earrings, and Group 2 included rings.

The first earring, which differs in form, is shell shaped. Comparable examples to the Burdur Museum artifact have been discovered in Çorum (Eskiyapar) and Çanakkale (Troy A and D Treasures) in Anatolia; outside Anatolia, parallels occur in Greece (Poliochni), Israel (Beth-Pelet, Tel Dan, Wadi el-Makkuk, Tell el-Far'ah, and Yama), Palestine (Tell el Ajjul), France (Lanrivoare), and southern Britain. A few examples of this earring type are also present in Irish museum collections. Early Bronze Age specimens are known from Anatolia and the Aegean. While represented by a single example in Anatolia (Eskiyapar) and the Aegean (Poliochni), a substantial number were found at Troy in western Anatolia. It appears that the production and use of seashell-shaped earrings during the Middle Bronze Age were not widespread outside the Levant and Europe. In the Late Bronze Age, such earrings were found extensively in the Levant, particularly in Israel. When comparative examples are

considered, it is noteworthy that no similar examples from the Middle Bronze Age or Late Bronze Age have been found in Anatolia. The closest parallels to the Burdur Museum earring, in terms of form, are those from Eskiyapar (Çorum) in Anatolia and from the Treasures of Troy ("A," "D," and "J,") in western Anatolia, as well as examples from Poliochni in the Aegean region. Considering the concentration of comparative examples dating to the Early Bronze Age, it is plausible that the earring originated from Troy, one of the major settlements of Anatolia. In the mid-3rd millennium BC, Troy functioned as a specialized metalworking center, as evidenced by semi-finished products in some treasures ("A," "F," and "R") and by the recovery of raw materials and other metallurgical remains during excavations. Bronze and gold wire were used in the production of earrings. Beginning in this period, earrings were manufactured using wire-drawing and hammering techniques. They were formed by soldering together four to six thick, solid wires, shaping one end into a hook. The thick wire hook attached to one end of the body was hammered into a hoop shape, with one end of the wire extended downward from the earlobe.

The second earring is crescent shaped. Earrings similar in form to the Burdur Museum example have been discovered at Çanakkale in Anatolia (Troy “A,” “C,” and “D” Treasures); outside Anatolia, comparable finds come from Cyprus (Hala Sultan Tekke), Israel (Beth-Pelet, Tell Beit Mirsim, Tel Miqne-Ekron, Tel Ashdod, Megiddo), Palestine (Tell el Ajjul), southern Phoenicia, Lebanon (Kamed el-Laouz), Mesopotamia (Assur), Bulgaria (Sumnu (Šumen), Regional History Museum), Romania (Smig), and Austria. A few examples of this earring type are also present in museum collections in England. Early Bronze Age parallels to the Burdur Museum artifact are found in western Anatolia. Earrings dating to the end of the Middle Bronze Age and the beginning of the Late Bronze Age are known from the Levant, Mesopotamia, and the Balkans. The production and use of crescent-shaped earrings appear to have increased during the Late Bronze Age, with examples from Cyprus, the Levant, and the Balkan region. Specimens dating from the Late Bronze Age to the Early Iron Age likewise originate from the Levant and Mesopotamia. The earrings most closely resembling the Late Bronze Age example in the Burdur Museum are those from Hala Sultan Tekke in Cyprus, Megiddo, the Beth-Pelet Necropolis, Tel Ashdod in Israel, and Smig in Romania, located in the Balkans. It is believed that crescent-shaped earrings of the Late Bronze Age were products of eastern Mediterranean origin, likely centered in Israel, given the regional concentration of similar examples. These earrings were made of electrum and gold, employing wire, sheet metal, and hammering techniques. They are crescent-shaped and

undecorated. The body was formed by soldering two convex halves of thin gold sheet together. The thin wire hook was attached to one end of the body and hammered into a hoop; one end of the wire was elongated and hung below the earlobe. The growing variety of forms and production techniques in the Late Bronze Age is noteworthy. Triangular earrings with open ends made of thin circular-section wire, repoussé forms, and spiral-twisted earrings were among the most common types. Thin wire was widely used, with bodies typically semicircular or C-shaped. Granulation was frequently employed for decoration, and spherical ornaments of various sizes were also common. Earrings were among the most favored items of personal adornment, yet certain forms were likely produced to serve symbolic or apotropaic purposes. Crescent-shaped earrings belong to this latter group. Representing the eye, they were believed to serve as protection against epidemics, witchcraft, the evil eye, and both physical and mental afflictions. It has been suggested that the crescent/half-moon/boat-shaped earrings that emerged in Sumerian culture in Mesopotamia during the first half of the 3rd millennium BC were associated with rituals devoted to the Moon god Sin. Sin was venerated for his perceived control over fate through the movements and positions of celestial bodies. In Anatolia, Sin acquired a religious significance in Lydia and Ionia, where he was associated with the three phases of the moon within the holy trinity of the goddess Artemis. In Pisidia, the god Men was linked to the Moon god Sin. Sacred areas and small finds dedicated to Men have been uncovered throughout the region.

In the second group, a simple hoop-shaped ring was examined. Analogous examples of the Burdur Museum gold artifact, in terms of form, have been discovered in Isparta (Harmanören), Afyon (Yanarlar, Küçükhöyük, Dede Necropolis), Ankara (Anatolian Civilizations Museum), Muğla (Iasos, Hüsamlar Necropolis), İzmir (Çeşme-Boyalık), Bilecik (Demircihöyük-Sarıket), Çorum (Resuloğlu), Kayseri (Kultepe), Amasya (Devret Höyükand), and Van (Karagündüz Necropolis, Evditepe) in Anatolia; and outside Anatolia in Israel (Rishon le-Zion Necropolis), the southern Levant, Greece (Leukas Tomb R4), Georgia (Beshtasheni), Romania (Cauas), Jordan, Hungary (Bronze Age treasures), Ireland, England (Taunton Museum), Great Britain, and China (Qinghai). Examples from the Early Bronze Age comparable to the Burdur Museum ring are encountered intensively in Anatolia, particularly in the western and northern regions, with a smaller number occurring in the Levant and southern Europe. During the Middle Bronze Age, similar rings appear more densely in Anatolia, while they occur less frequently in the Levant and Europe. In the Late Bronze Age, the number of such examples increased significantly both within and beyond Anatolia. They have been identified most frequently in Küçükhöyük in western Anatolia, Kultepe, and Resuloğlu in central Anatolia; and, outside Anatolia, in Beshtasheni in the Balkans, in Hungary (among the Bronze Age treasures), and in smaller numbers in northwestern Europe. Early Iron Age examples are denser in Anatolia (particularly in the Aegean and

eastern regions), but also occur sporadically in the Levant, the Middle East, and China. Similar rings are common among Bronze Age contextual finds in Anatolia, while smaller quantities have been documented in the Levant, the Balkans, and Europe. Considering the concentration of comparative examples from the Late Bronze Age, it is thought that the main production centers for this type of ring were Anatolia, Europe, and the Balkans, respectively. The fact that rings of this type were found in Bronze Age Anatolia suggests that the Burdur Museum ring was also produced locally. It is likewise noteworthy that no comparable examples have been recorded in the Levant from the same period. Bronze, copper, lead, silver, and gold were used in the production of rings from this era. They were manufactured using solid wire and hammering techniques. The rings have a simple hoop shape, with their ends overlapping each other. They were created by bending gold—previously hammered into a thin sheet—around its own axis using wire-bending techniques.

As a result, two distinct forms of gold jewelry from the Bronze Age in Pisidia have been identified. The shell-shaped earring dates to the Early Bronze Age, while the crescent-shaped earring and the simple hoop-shaped ring date to the Late Bronze Age. Silver and gold were widely used in the production of Early Bronze Age earrings, whereas electrum and gold were more common during the Late Bronze Age. In the Late Bronze Age, the variety of materials employed in ring production expanded, with bronze,

copper, lead, silver, and gold all in use. When comparative examples of the Burdur Museum artifacts are considered, it is suggested that the shell-shaped earring from the Early Bronze Age is likely of Anatolian origin. Its high gold content and low silver and copper content —indicating an alloy close to pure gold— and its similarity to the Troy artifacts support this conclusion. Moreover, comparative examples indicate that it was probably a prestige object used by elite or noble groups. The crescent-shaped earring, dated to the Late Bronze Age, appears to be

an eastern Mediterranean production, likely centered in Israel, given the regional concentration of parallels. Comparative analysis further suggests that certain groups of gold jewelry originating from the eastern Mediterranean circulated in Anatolia through trade. Rings similar to the Late Bronze Age ring are known from Anatolia, Europe, and the Balkans. The continuous production of such rings in Anatolia throughout the Bronze Age supports the conclusion that the Burdur Museum ring was most likely produced in Anatolia.

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