McDONALD INSTITUTE MONOGRAPHS

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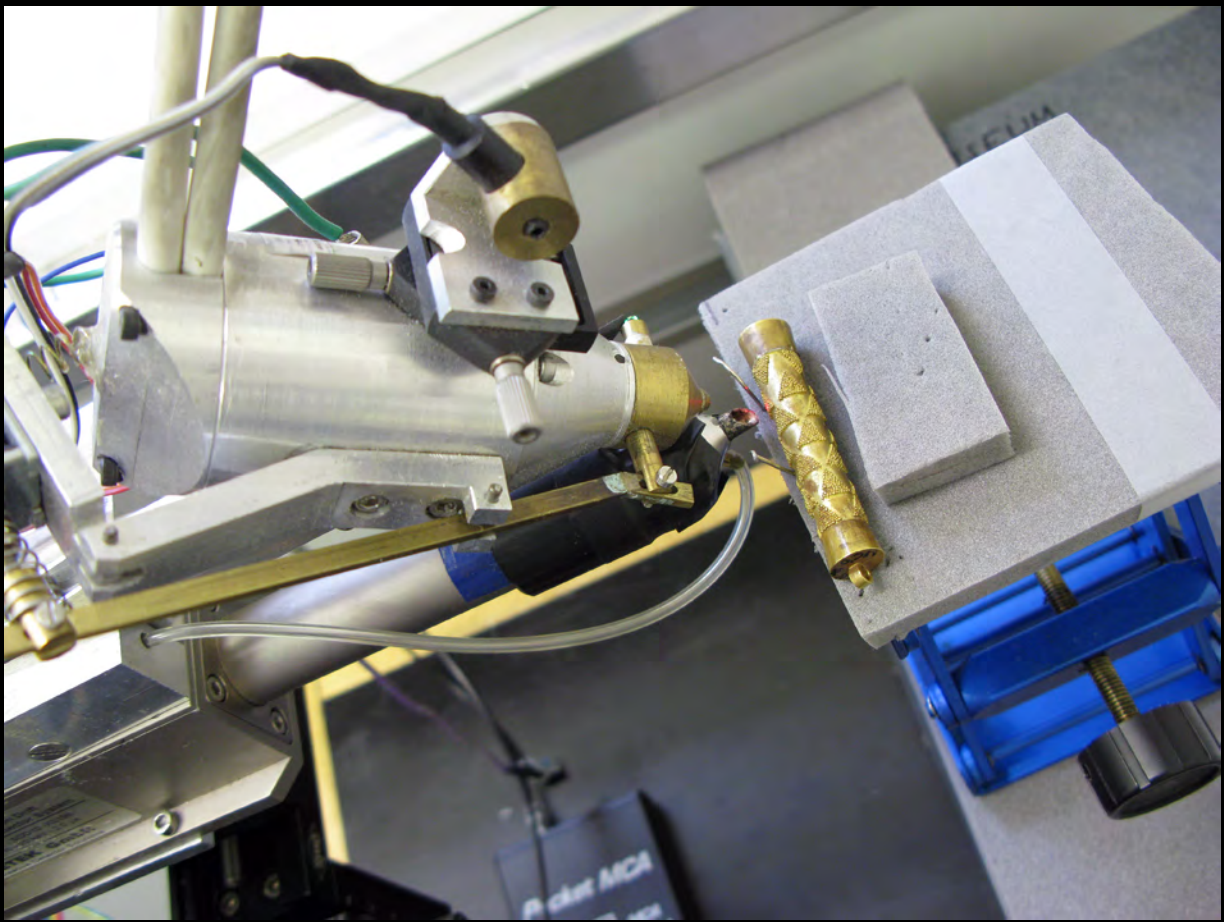
Archaeology and science in jewellery (3500–1000 BC)

Edited by Maria F. Guerra, Marcos Martinón-Torres & Stephen Quirke



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with contributions from
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On the front cover: *Analysis of the gold cylindrical amulet from Haraga at The Petrie Museum of Egyptian Archaeology (UC6482) using a portable XRF spectrometer*.
On the back cover: *Details under the SEM of the triangular designs of granulation on the tube of the cylindrical amulet from Haraga*.

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Second Intermediate Period jewellery

Maria F. Guerra, Marei Hacke, Susan La Niece, Marcos Martinón-Torres, Gianluca Miniaci, Sandrine Pagès-Camagna†, Stephen Quirke, James Tate & Lore Troalen

This chapter presents the technological study of the jewellery excavated at Qurna, together with a few additional examples of gold pieces that are either well contextualized, or that can be attributed to the Second Intermediate Period and early 18th Dynasty based on their inscriptions. These parallels include objects that are in some way related to king Nubkheperra Intef, notably the first heart-scarab recorded for a king, several pieces bearing the name of Ahhotep, the three gold components of an armband found in the burial of king Kamose, and several pieces from excavations at Qau by G. Brunton.

Chapter 9.1

Jewellery in the Second Intermediate Period

Maria F. Guerra

Contrary to the abundant Middle Kingdom jewellery that attained such a 'superb skill and taste' that 'have never been surpassed' (Aldred 1950, 26), the items made during the Second Intermediate Period are scarce and of variable quality (Aldred 1971; Lacovara 1990). Among the few examples of contextualized jewellery from this period are two outstanding groups. One is the impressive assemblage of jewellery and weapons found by Auguste Mariette in queen Ahhotep's burial at Dra Abu al-Naga, today in the collection of the Egyptian Museum Cairo. Wife of king Seqenenra Taa and mother of the founder of the 18th Dynasty, king Ahmose I, she served as regent after the death of Kamose, the last king of the 17th Dynasty. This group of jewellery and weapons is shown in Figure 9.1 as exhibited in the Museum of Egyptian Antiquities opened at Bulaq in 1863 by Auguste Mariette (Mariette 1872, pls. 29–31).

Petrie (1909a) found the main other noteworthy example inside the intact burial of an adult and child discovered in 1909 at Qurna. Petrie (1909b) described the burial as follows: 'This is perhaps the most varied and rich burial ever brought from Egypt, and it will be preserved as an entire group in the Royal Scottish Museum, Edinburgh'. The jewellery is therefore nowadays in the collection of the National Museums Scotland and it was the sole focus of the original research project that culminated in this volume (see Chapter 9.2).

The broader research on the jewellery from the Second Intermediate Period was, indeed, prompted by the results obtained for the construction, use-wear, and type of gold employed for the manufacture of the group from Qurna by using several analytical techniques. Among the quite puzzling results obtained for this group are the simultaneous presence in the burial of quite freshly made and quite heavily worn gold items (Troalen et al. 2014). While one could expect family jewellery worn by certain individuals to be buried with them (this might be the case of the adult's girdle), in the case of the Qurna group one part of the objects appears to reflect extensive use, which may be attributed to workshop practices related to reuse of standard gold components from older items to make new ones. If so, these results would support the continuity of workshop practices in Egypt observed for jewellery from previous periods.

Therefore, and in order to shed more light on the Second Intermediate Period workshop practices, objects in several collections were also selected for analytical study. Some are contextualized and others have inscriptions that allow their attribution to a particular period. Among the jewellery studied are four items in the British Museum, which were analysed in the Department of Scientific Research. One is a heart-scarab, the first object of this type recorded for a king, another is a finger-ring and the other two are space-bars (Miniaci et al. 2013). From the collection of the Louvre Museum were selected seven gold items that were analysed at the C2RMF. One is a gold signet ring and another a blue scarab set in a gold frame bearing the name of queen Ahhotep. The remaining items are two small amulets in the shape of the god Seth standing, also bearing the name of queen Ahhotep, and three gold components of an armband found in the burial of king Kamose, bearing the name of his successor, Ahmose (Lemasson et al. 2015; Guerra & Pagès-Camagna 2019). While the objects in the collection of the British Museum are all in some way related to the 17th Dynasty king Nubkheperre Intef, those in the collection of the Louvre Museum are related to queen Ahhotep and king Ahmose. To complete the study, a few more gold items were selected for analysis from the collection of the Petrie Museum, dated to the end of the Second Intermediate Period. The selected items are one gold amulet in the form of a shell bearing king Seqenenra Taa's cartouche, and a gold oval flat pendant bearing king Kamose's cartouche, to which were added four objects (gold beads, strings of beads and gold spirals) from the excavations at Qau by G. Brunton (1930).

The results obtained are presented in the sections below, where we also reconsider the results obtained in Chapter 8.6 for one string found by J. Garstang inside tomb 492 at Abydos, which contained pottery types typical of the Second Intermediate Period–Early 18th Dynasty.

References

For references see pp.356–7 at the end of this chapter.

Figure 9.1. *Ahhotep's group of jewellery and weapons found at Dra Abu al-Naga, as exhibited in the Museum of Egyptian Antiquities opened in 1863 by Auguste Mariette at Bulaq, Cairo (from Mariette 1872, pls. 29 to 31).*

Chapter 9.2

The Qurna burial

Lore Troalen, James Tate & Maria F. Guerra

The Qurna burial, discovered intact by Sir William Matthews Flinders Petrie in 1908 on the west bank of Thebes (Petrie 1909b), is dated to the 16th century BC on typological grounds as well as by radiocarbon dating (Eremin et al. 2000). The burial was centred on a large anthropoid *rishi*-coffin (Miniaci 2011), painted dark blue and gilded, and containing the mummified remains of a young adult female surrounded by a wide range of grave goods, including ivory, faience and gold jewellery items (Fig. 9.2). The Qurna group includes a significant number of objects that indicate cultural influence from Nubia, including pottery vessels imported from Kerma, as recently described by Maitland et al. (2022). Above the foot of the woman's coffin was a simple chest-shaped coffin containing the remains of a young child also buried with several jewellery items (Petrie 1909b).

The Qurna jewellery forms one of the most important groups of gold jewellery attributed to the Second Intermediate Period; the burial is today part of the National Museums Scotland (NMS) Ancient Egyptian collection. Several aspects of the mummies and coffins have been investigated in recent years with a particular focus on the study of the gold jewellery (Eremin et al. 2000; Manley et al. 2002; Tate et al. 2009; Troalen et al. 2009, 2014).

The Qurna gold jewellery

The adult individual wore a necklace made of 1699 gold rings (4.5 mm external diameter) strung together to form four decorative strands (Petrie 1909b; Tate et al. 2009), which has often been described as the earliest example of *shebiu*-type collar. This is however an erroneous description, as *shebiu*-type necklaces are made of large, thick lentoid-beads, tied around the neck (Roehrig 2007, 19). In addition to the necklace, the adult wore two penannular gold earrings consisting of four penannular hoops soldered together, four gold bangles made from a D-section bar bent into a ring and soldered, an electrum girdle consisting of 26 semi-circular so-called wallet-shaped beads (10 mm diameter) spaced by two threads of 6 barrel-shaped beads (4 mm length), and an electrum button. The child wore three ivory bangles, several strings of faience beads around the waist and both ankles, a necklace made of 215 small gold rings (< 1.5 mm external diameter) strung together, and two asymmetric rings made of three-and-a-half gold rings soldered together, which have been interpreted as earrings from their location in the burial (Petrie 1909b). The form of these asymmetric rings that were deposited next to the ears of the child is reminiscent of earrings or hair rings, but they do not match as a pair. They could however fasten together as a clasp for a necklace which was re-used as earrings for the burial; indeed the registration book at National Museums Scotland reports that they were originally attached to the child's necklace, apparently being mistaken for a clasp, but were removed and registered as separate earrings by Cyril Aldred in 1939.

All the Qurna jewellery items were made with the use of sheets or strips of gold, which were then hammered, embossed, stamped-died or rolled, sometimes chased, with the different parts joined together. The jewellery items showed variable levels of wear, indicating different amount of usage. The gold items belonging to the young adult female can be separated into three groups according to their level of wear: the necklace and the two penannular earrings are virtually un-used, the four bangles are slightly used, while the girdle shows very intensive wear. The wear-marks indicate that the bangles were certainly worn, presumably during the lifetime of the woman, in contrast to the girdle, which seems to be a much older piece. In the case of the girdle, we observed loose decoration, deformation of the edges of the beads, and

Figure 9.2. *The Qurna adult's jewellery set (necklace NMS A.1909.527.19; bracelets NMS A.1909.527.16 + A, B, C; earrings NMS A.1909.527.18 + A; girdle NMS A.1909.527.17).*

deformation of holes in the wallet-shaped beads where they sit against the barrel-shaped beads, suggesting that the present construction is the original one (Fig. 9.3a). Occasionally, some small barrel-shaped beads have been pushed into and are now trapped within the wallet-shaped beads as shown in Figure 9.3c. The two visible holes used for stringing the wallet-shaped bead shown in Figure 9.3a are larger than the ends of the barrel beads next to it which are therefore able to fit inside. The barrel-shaped beads are more worn than the wallet-shaped beads, and it is this which has made it easier for them sometimes to fit through the opening and so get wedged inside.

Interestingly, the work of different goldsmiths is indicated in this item, where two types of chisels and characteristic differences in craftsmanship could be detected in the wallet-shaped beads. The wallet-shaped bead shown in Figure 9.3a was decorated by chasing small parallel lines first on one side and then on the other side of the chased curved line, which was chased before those on the inner side. The radiograph in Figure 9.3c also shows that the wallet beads have variably thickness, notably thinner at the centre where the metal has been deformed to raise the top surface.

The jewellery items belonging to the child also show marks of wear; these are extensive for some of the necklace beads and less so for the two earrings. The necklace is very heterogeneous and clearly shows the reuse of gold beads from different gold items. The small ring beads are of two different sorts, as shown in Figure 9.3b. (Further discussion on such tiny beads is given in Chapter 7). A few specimens show marks of polishing at the ends and others exhibit a scraped surface. It is interesting to note that several of the child's necklace beads exhibit a slight border, suggesting that their form was adjusted slightly to match an adjacent round stone or paste/glass bead, such as a spacer. Petrie's report only records numerous faience beads around the ankles and waist of the child rather than at the neck (Petrie 1909b), but the adjustments might relate to an earlier use of the beads. These findings tend to show reuse of gold components from different items without melting. This could corroborate our hypothesis on the reuse of a clasp to serve as the child's earrings or hair-rings (Troalen et al. 2014).

Gold alloys from Qurna

The elemental composition of all the jewellery items, plotted in Figure 9.4, shows two scenarios for the groups of jewellery accompanying the adult and the child.

The adult's composite objects are extraordinarily homogeneous in composition (Table 9.1): the necklace is made of an alloy containing, on average, 86 wt% Au,

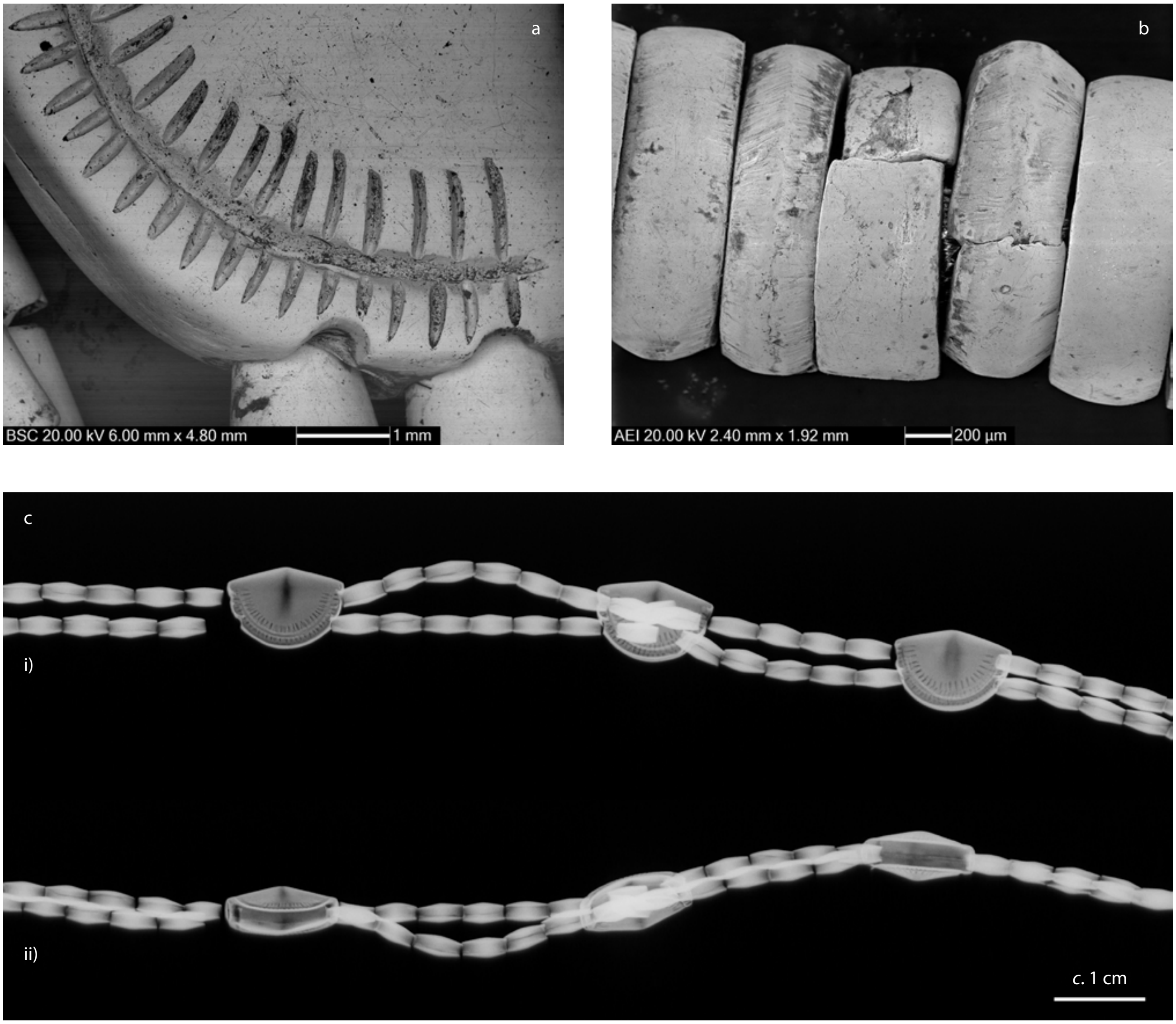


Figure 9.3. *a) SEM-BSE micrograph showing details of one the wallet-beads from the adult's girdle (NMS A.1909.527.17); (b) SEM-AEI micrograph showing details of the typologically heterogeneous beads of the child's necklace (NMS A.1909.527.11); (c) detail of X-Radiographic plate showing the construction of the wallet-beads, it is possible to see the chasing of the wallet-beads and, on the side view of the wallet-beads the line of the joint on their outer edge. Also visible on the radiography are small differences in thicknesses at the centre of each of the wallet-beads and several barrel-beads that have fallen inside due to extensive use-wear (NMS plate 180908-3, 170 kV, 4 mA, 2 min, lead screen, 0.25 mm lead screen intensifiers filtration, Structurix film D 7).*

12 wt% Ag and 2 wt% Cu while the earrings are richer in gold with a composition of 95.4 wt% Au, 4.3 wt% Ag and 0.3 wt% Cu. The four bangles are made with an alloy close to that of the necklace, but with almost no copper: 87.3–88.3 wt% Au, 11.6–12.5 wt% Ag and 0.1 wt% Cu. The adult's girdle is made of electrum alloys, with a gold content inferior to 45 wt%. The wallet-beads were made of a single alloy, with an average of 43.8 wt% Au, 52.5 wt% Ag and 3.7 wt% Cu. The spacer barrel-beads are more heterogeneous in composition, ranging from 42.1 wt% Au, 51–55 wt% Ag and 2.8–7.4 wt% Cu. Interestingly, the small barrel-beads, used as spacers in the girdle, are so heterogeneous that they are surely from different batches.

The child's earrings are rather variable in composition, with silver contents varying from 13.5 to 15.3 wt% and copper contents from 1.7 to 3.8 wt%. This variety of the alloys could be explained by the low quality

Table 9.1. *Results obtained for the Qurna jewellery by: X-ray fluorescence analysis (XRF, ED 2000 Oxford system), µPIXE (3 MeV proton beam, AGLAE accelerator at C2RMF), SEM-EDS (CamScan MX 2500 with Si(Li) Noran Vantage micro-analytical system), and pXRF (Niton XL3t portable XRF system with a 'GOLDD' detector, set to 'Precious Metals' mode).*

Acc. No.		Au wt%	Ag wt%	Cu wt%
Adult's mummy				
Gold foil A.1909.527.1 (pXRF)		81.6	17	1.5
Bangle 1 A.1909.527.16 (PIXE)		88.2	11.6	0.3
Bangle 2 A.1909.527.16 (XRF)		87.3	12.5	0.2
Bangle 3 A.1909.527.16 (XRF)		87.6	12.2	0.2
Bangle 4 A.1909.527.16 (XRF)		87.4	12.4	0.2
Earring 1 A.1909.527.18 (PIXE)		95.2	4.1	0.2
Earring 2 A.1909.527.18 (XRF)		95.3	4.3	0.3
Necklace A.1909.527.19 (PIXE)	Ring 1	87.6	10.5	1.9
	Ring 2	87.7	10.7	1.5
	Ring 3	88	10	2
Girdle A.1909.527.17 (XRF)	Wallet-bead 1	43.7	52.6	3.7
	Wallet-bead 1	42.8	53.4	3.8
	Wallet-bead 2	43.8	52.4	3.8
	Wallet-bead 3	43.8	52.4	3.8
	Wallet-bead 4	43.9	52.4	3.8
	Wallet-bead 5	43.9	52.3	3.8
	Wallet-bead 6	44.1	52.2	3.7
	Wallet-bead 7	44	52.4	3.6
	Wallet-bead 8	43.7	52.7	3.7
	Wallet-bead 8	43.6	52.6	3.8
	Wallet-bead 9	44.2	52.2	3.6
	Wallet-bead 10	43.6	52.9	3.5
	Wallet-bead 11	43.6	52.7	3.8
	Wallet-bead 12	43.9	52.3	3.8
	Wallet-bead 13	43.9	52.4	3.6
	Wallet-bead 14	43.7	52.6	3.7
	Wallet-bead 15	44.2	52.6	3.3
	Wallet-bead 16	44.3	52.2	3.5
	Wallet-bead 17	44	52.3	3.7
	Wallet-bead 18	43.9	52.4	3.7
	Wallet-bead 19	43.8	52.7	3.5
	Wallet-bead 19 (a)	43.9	52.6	3.5
	Wallet-bead 19 (b)	43.6	52.7	3.6
	Wallet-bead 20	43	53.2	3.8
	Wallet-bead 21	44.2	52	3.9
	Wallet-bead 22	43.7	52.5	3.8
	Wallet-bead 23	43.8	52.5	3.7
	Wallet-bead 24	43.4	53	3.6
	Wallet-bead 25	44	52.3	3.7
	Wallet-bead 26	43.9	52.3	3.8
	Barrel-bead 1	40.8	53	6.2
	Barrel-bead 2	39.6	54.3	6.1
	Barrel-bead 3	44.2	52.4	3.5
	Barrel-bead 4	39.1	55.4	5.5
	Barrel-bead 5	46.4	50.8	2.8
	Barrel-bead 6	43.5	52.7	3.8
	Barrel-bead 7	41.7	53	5.2
	Barrel-bead 8	37.8	54.8	7.4
	Barrel-bead 9	43.5	52.9	3.6
	Barrel-bead 10	44.3	52	3.6
Child's mummy				
Earring A.1909.527.43 A (PIXE)		82.5	14.6	2.9
Earring A.1909.527.43 B (PIXE)		83.7	14.2	2.1
Necklace A.1909.527.11 (PIXE)	Ring A	71.3	26.8	2
	Ring B	65.9	32.1	2
Necklace A.1909.527.11 (EDS)	Ring 1	72.9	25.5	1.6
	Ring 2	70.7	27.3	2
	Ring 3	70.3	28.1	1.6
	Ring 4	70.3	28	1.7
	Ring 5	72.4	25.1	2.5
	Ring 6	70.6	27.8	1.6
	Ring 7	70	28.3	1.7
	Ring 8	69.5	29.7	0.8
	Ring 9	72.1	26.5	1.3

Table 9.1 *(cont.)*.

Acc. No.		Au wt%	Ag wt%	Cu wt%
	Ring 10	71.3	26.7	2
	Ring 11	70.2	28.1	1.7
	Ring 12	70.1	29.3	0.6
	Ring 13	70.7	28.1	1.2
	Ring 14	69.8	29.2	1
	Ring 15	68.5	30.3	1.3
	Ring 16	66.8	31.6	1.6
	Ring 17	62.3	36.4	1.3
	Ring 18	72	26.4	1.6
	Ring 19	71.8	26.6	1.6
	Ring 20	71.2	27.2	1.6
	Ring 21	72.8	25.2	2
	Ring 22	69.2	29.3	1.5
	Ring 23	68.4	30.5	1.1
	Ring 24	75.2	23.7	1.1
	Ring 25	71.8	27.4	0.8
	Ring 26	71.5	27.6	0.9
	Ring 27	72.5	25.8	1.7
	Ring 28	72.1	26.5	1.4
	Ring 29	70.1	27.9	2.1
	Ring 30	70.9	27.7	1.4
	Ring 31	70.7	26.9	2.3
	Ring 32	73.3	24.8	2
	Ring 33	75	22.9	2.1
	Ring 34	69.8	28.9	1.3
	Ring 35	67.1	31.1	1.8
	Ring 36	69.7	27.9	2.4
	Ring 37	68.2	30	1.9
	Ring 38	72.8	26.2	1
	Ring 39	74.8	23.2	1.9
	Ring 40	71.8	26.9	1.3
	Ring 41	69.8	29.6	0.6

soldering of the rings giving rise to large melted regions, although it must also be noted that visual inspection shows that these pieces had their surface covered with some organic residues that would not be removed before the analysis. The child's necklace contains beads visually heterogeneous in shape and in colour. The copper content of these rings varies between 0.6 and 2.6 wt% while their silver content varies between 16.6 wt% and 32.1 wt%. This string is thus made from beads in gold and electrum and from different batches like the barrel-beads in the adult's girdle.

Finally, the analysis of the gold foil on the ancient parts of the coffin surface showed an average composition of 81.5 wt% Au, 17 wt% Ag and 1.5 wt% Cu.

The copper content observed in most of the items, below 2 wt%, is consistent with what would be expected for alluvial gold (Ogden 2000, 162; Klemm & Klemm 2013, 42–3). The electrum alloys are the notable exception, with the wallet-beads from the girdle containing up to 3.7 wt% Cu, and the barrel-beads with a copper content ranging from 2.8 to 7.4 wt%. Such addition of copper has been reported to occur in gold objects from

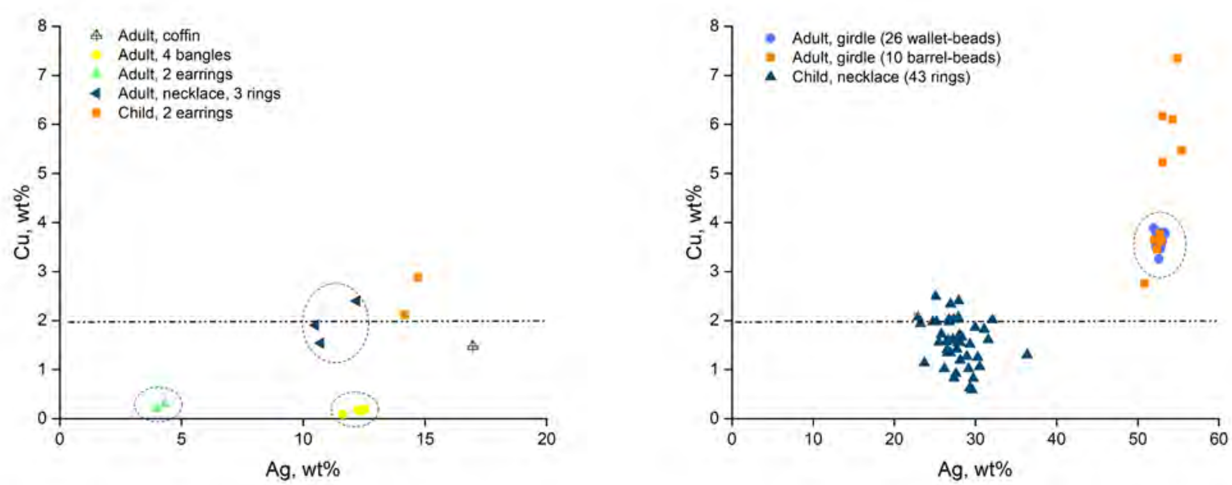


Figure 9.4. *Silver versus copper contents obtained for the jewellery from the Qurna burial. The circles indicate single alloy batches. The line at 2 wt% copper is the level limit for natural Egyptian gold (Ogden 2000, 162; Klemm & Klemm 2013, 42–3).*

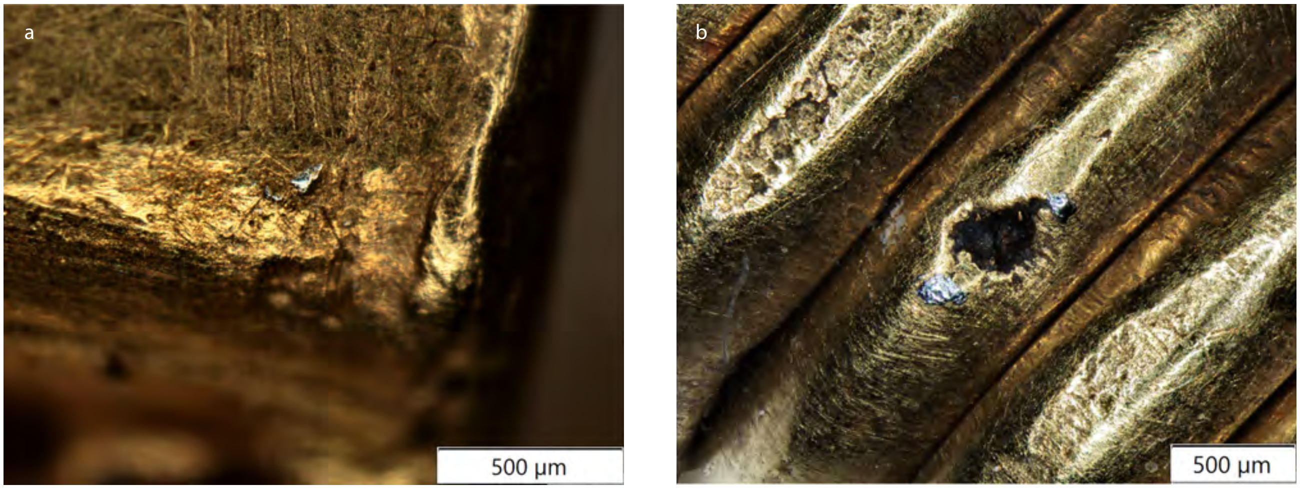


Figure 9.5. *Stereomicroscopic observation of (a) a PGE inclusion in one of the adult earrings and (b) two PGE inclusions in one of the rings constituting the adult's necklace.*

the Ashmolean Museum containing high silver contents, ranging from 0.2 up to 26 wt% (Gale & Stos-Gale 1981).

Platinum-group element (PGE) inclusions were observed in all the jewellery from Qurna, including the adult's earrings made of high purity gold, as shown in Figure 9.5, which also shows inclusions on one of the rings that constitute the adult's necklace. Their presence is characteristic of the use of alluvial gold. Thirteen PGE inclusions were analysed in the adult's and child's jewellery by EDS analysis (Table 9.2). From these results, all the inclusions were found to be rutheniridosmine (Harris & Cabri 1991) with an average composition of 22 wt% Ru, 35 wt% Ir and 43 wt% Os, although several inclusions from the adult's necklace exhibit up to 55 wt% Ru and in another case 69 wt% Os (Troalen et al. 2014).

Table 9.2. *Results obtained by SEM-EDS for PGE inclusions in the Qurna jewellery (CamScan MX 2500 with Si(Li) Noran Vantage micro-analytical system).*

Acc. No.		Ru wt%	Os wt%	Ir wt%
Adult's mummy				
Necklace A.1909.527.19	PGE -1	30.4	41.1	28.5
	PGE -2	54.2	28.3	17.6
	PGE -3 (attach)	16.8	44	39.2
	PGE -4 (attach)	4.1	69	26.9
Earring A.1909.527.18	PGE -1a	21.6	41.8	36.6
	PGE -1b	21.6	42.4	36
	PGE -2	16.6	44	39.4
Child's mummy				
Earring A.1909.527.43 A	PGE -1a	13.5	46.9	39.6
	PGE -1b	19.6	44.1	36.4
	PGE -2	23.9	40.7	35.4
Necklace A.1909.527.11	PGE -1	25	37.6	37.4
	PGE -2	19.1	41	39.9
	PGE -3	20.4	42	37.6

The presence of PGE inclusions in the adult's earrings, which have the highest gold contents in the group of jewellery, confirms the exploitation of gold-rich alluvial deposits. High purity gold alloys can be obtained by parting, but there is no recorded evidence of this process at that time in Egypt (Ramage & Craddock 2000).

Joining technique

The predominant use of hard soldering instead of mechanical joints in gold jewellery was reported by Ogden (2000) in his review of Ancient Egyptian metalworking techniques, although it was also suggested that colloidal soldering or diffusion bonding might have been used for more delicate soldering work, but without specifying from which period. The use of gold-based solder alloys in Ancient Egypt is also supported through archaeological evidence and it is reported that some form of bellows were used in Egypt by about 2500 BC (Wolters 1975). However, the use of hard solder made by the addition of copper and silver to a base gold alloy seems to be a regular practice in Egypt. It was so far only considered in a few artefacts,

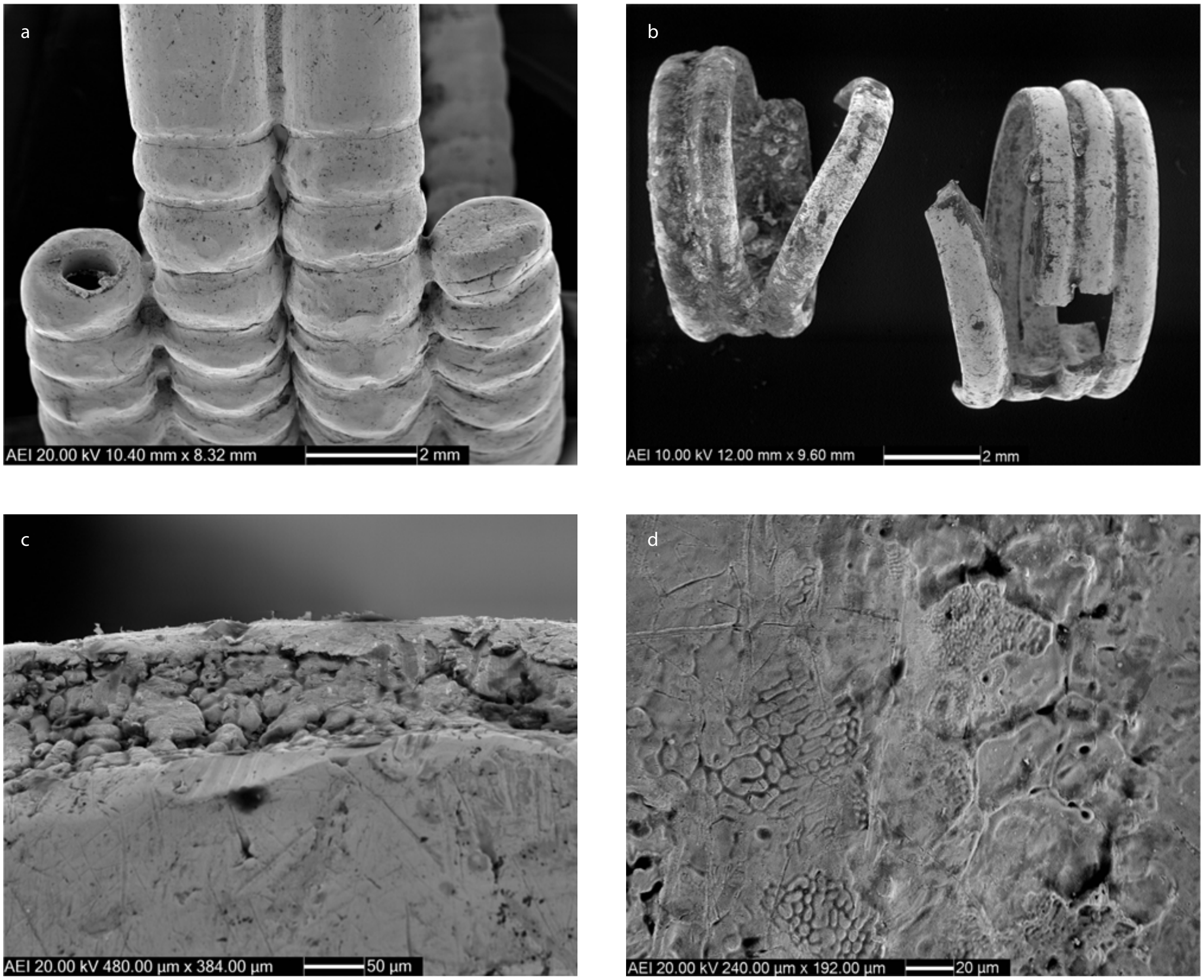


Figure 9.6. *SEM-AEI micrographs of: (a) the adult's earring (NMS A.1909.527.18) showing the four penannular hollow beaded hoops soldered together, one cap soldered over the end of one of the hoops and one missing cap. Interpretation of the trace of gold foil within the open tube is unclear, possible traces from the soldering which had attached the cap?; (b) the child's earrings (NMS A.1909.527.43 + A); (c) a detail of the thick but perfectly controlled joining area of terminal plate of one of the adult earrings; and (d) a detail showing the metal adjacent to the joint of the child's earrings, where the parts to be joined show signs of melting due to poor temperature control.*

including a granulated gold cylinder-pendant from tomb 211 at Haraga (Ogden 1992, 51–2; discussion on granulation in Egypt and analytical data obtained for this pendant is given by Meeks & Guerra in Chapter 8.5 of this volume), and demonstrated, for example in the case of Middle Kingdom objects studied in this volume, as well as for gold and silver beads from the burial of Wah at Thebes (Schorsch 1995) and gold jewellery from tomb 124 at Riqqa (Troalen et al. 2019 and Troalen & Guerra in Chapter 10.2 of this volume).

With the exception of the child's necklace and possibly the barrel-beads from the adult's girdle (where because of the geometry definitive analysis was not possible), all the pieces from the Qurna jewellery set were hard soldered. The soldering seams are more or less visible in each element either because of the level of wear, or because of the craft worker's skill (or both), the latter being of such variability that it suggests production by different goldsmiths. The most visible joints were found in the earrings from both bodies (Fig. 9.6). In the adult's earrings, the joints are thick but perfectly crafted, as can be seen in Figure 9.6a in the evenness of the joint attaching the four hoops together, and the neatness of the small

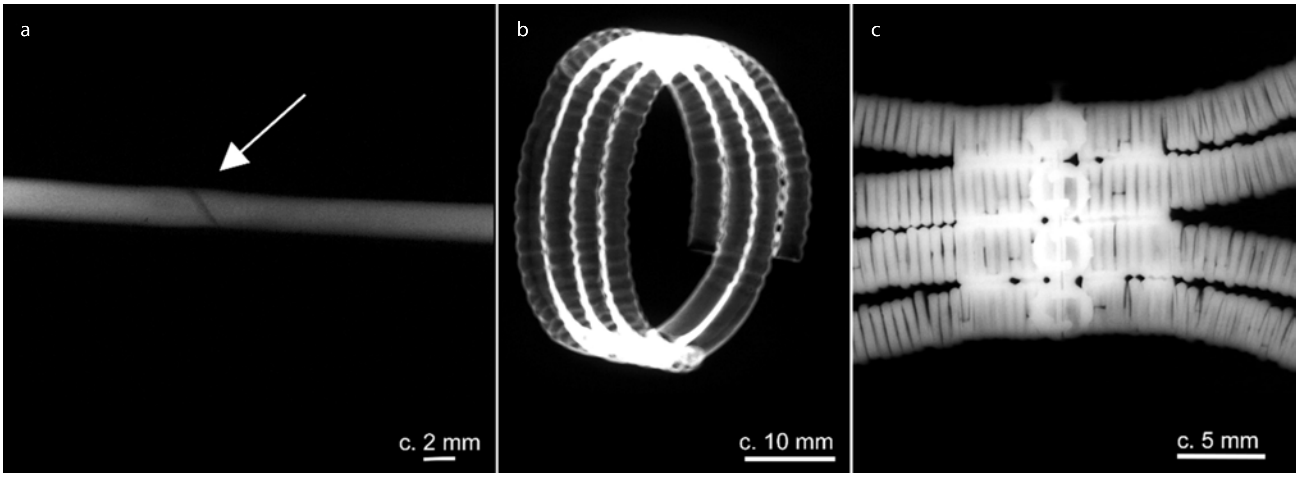


Figure 9.7. *(a) Detail of X-radiograph taken at 400kV to reveal the joint cut at an angle and soldered (the image is rather fuzzy because of the difficulty of imaging a circular section object and the amount of unavoidable scatter); (b) X-radiograph of one of the adult earrings (NMS A.1909.527.18) showing the thin beaded hollow tubes with even soldering (C2RMF plate RA2284, 6 min at 1 m, 400 kV, 4 mA, 2 mm lead filter, Kodak type M Contactpack); (c) X-radiographic detail showing the soldering of the clasp of the adult's necklace where the solder has bonded the rings but with no deformation (It is also just possible to see small dark lines across a small number of the rings which are the joints in those rings). (NMS X-ray plate 190908-6, 4 mA, 200 kV, 3 min, lead screen, 1 mm Cu filter, Structurix Film D7).*

cap soldered over the end of one of the hoops (the cap is missing from the other hoop showing very clearly that it is hollow, and in fact it is hard to interpret the thin edge of gold sheet visible within the hollow, is this part of the missing cap, or an artefact of the soldering process?) In contrast, for the child's earrings the joints indicate a lack of temperature control as the parts that were joined show signs of melting of the gold ring (see Fig. 9.6d). Petrie (1909b, 10) noted in his report that the child's earrings 'had been over-heated while on a mandril in the furnace for soldering; the solder had stuck them together, and they parted and

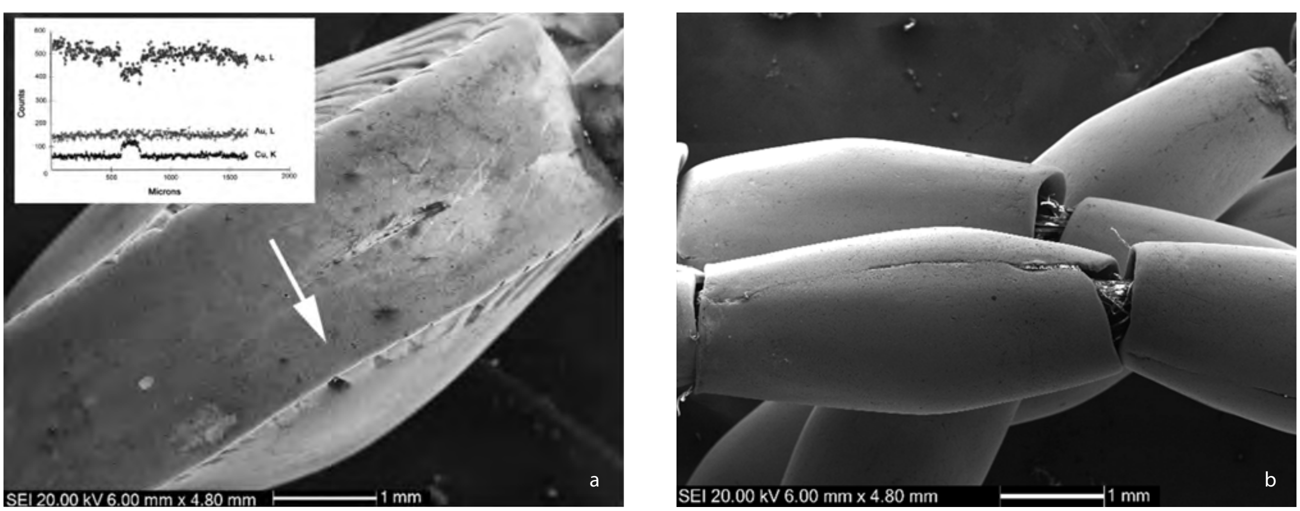


Figure 9.8. *SEM-SEI micrographs of the adult's girdle (NMS A.1909.527.17): (a) a wallet-bead from the adult's girdle, showing the very wear-used edge together with elemental scan across the joint where the two halves of the 'shell' have been brought together, the solder is revealed by the increase in the copper concentration across the line of the joint (Troalen et al. 2014) and (b) a barrel-bead with a visible seam where the two edges of the gold sheet which has been rolled join together, but the presence or absence of solder could not be analytically confirmed.*

began to drop away, being half melted'. In contrast to this the joints in the bangles are very thin and (near) invisible to the naked eye, but could be found by X-radiography at 400 kV, showing that they had been formed from a solid tube, the joints cut at an angle and soldered (Fig. 9.7a).

The least visible joints occur in the adult's necklace and girdle but for different reasons. The very high level of abrasion of the girdle due to wear use has effectively wiped out almost all of the joint seams of the wallet-beads so that hard soldering could only be detected by elemental mapping in the SEM (Fig. 9.8a). Although looking even more wear used than the wallet beads, the barrel beads in the girdle still have visible

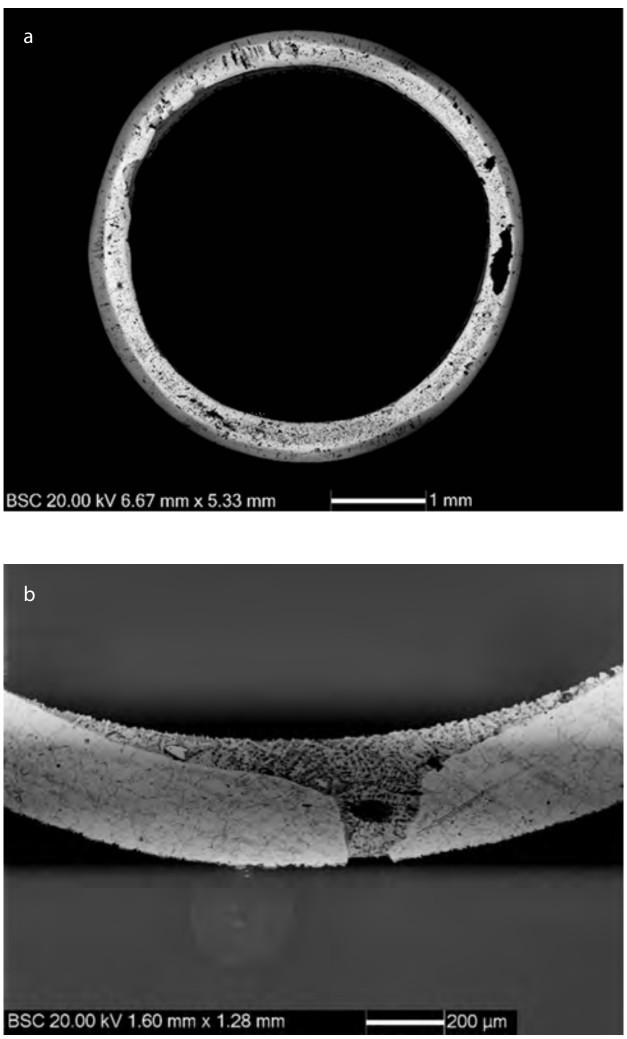


Figure 9.9. *SEM-BSC micrographs of (a) a ring from the adult's necklace (NMS A.1909.527.19) and (b) the morphology characteristic of the use of hard-soldering after etching in aqua regia (the shape and working of the ring is described further in Tate et al. 2009).*

Table 9.3. *Results obtained for the joining areas in the Qurna jewellery obtained by: X-ray fluorescence analysis (XRF, ED 2000 Oxford system), µPIXE (3 MeV proton beam, AGLAE accelerator at C2RMF) and SEM-EDS (CamScan MX 2500 with Si(Li) Noran Vantage micro-analytical system).*

Acc. No.		Au wt%	Ag wt%	Cu wt%
Adult's mummy				
Bangle 1 A199.527.16 (PIXE)		84	10	6
Bangle 1 A.1909.527.16 (XRF)		81	11	8
Bangle 2 A.1909.527.16 (XRF)		82	11	7
Bangle 3 A.1909.527.16 (XRF)		83	11	6
Bangle 4 A.1909.527.16 (XRF)		82	11	7
Earring A.1909.527.18		93	5	2
Necklace A.1909.527.19				
	Ring 1 (PIXE)	87	9	4
	Ring 3 (EDS)	80	12	8
	Terminal Part (XRF)	80	15	5
Girdle A.1909.527.17				
	Wallet-bead 15 (XRF)	43	53	4
	Wallet-bead 15 (EDS)	50	42	8
	Wallet-bead 19 (XRF)	44	52	5
	Wallet-bead 19 (EDS)	54	39	7
Child's mummy				
Earring A.1909.527.43 A (PIXE)		81	12	7
Earring A.1909.527.43 B (PIXE)		84	9	7

joint seams where the two edges of the rolled gold sheet join together or slightly overlap. However it was not possible to determine whether this joint had been hard soldered, or whether the gold is just rolled (it is worth considering that the latter would have made it easier for the beads to deform and so enter the wallet beads). For the adult's necklace, which showed no particular signs of wear, only the clasp clearly shows signs of hard soldering (Fig. 9.7c). However, a clear joint made with an alloy of higher copper content could be seen when one of the small rings, removed during an earlier conservation treatment, was polished and etched in aqua regia (Tate et al. 2009; Troalen et al. 2014), as shown in Figure 9.9.

The hard soldered joints in the Qurna jewellery stand out due to their copper contents. The solder alloys were obtained by addition of copper to the base alloy in order to lower the melting point and allow the parts to be joined (Maryon 1949). For all the Qurna objects, the solders and the parts to be soldered contain very similar Ag/Au ratios (Troalen et al. 2014), which suggests that a similar soldering technique was used for all the objects, with the use of the basic gold/electrum alloys mixed with additional copper (Table 9.3).

Conclusions

The study of the gold jewellery from Qurna revealed the use of different workshop practices for the goods of each individual, who were certainly both of high-rank. All the jewellery items were made by casting, hammering, stamp-dying or rolling, sometimes decorated by chasing, with the different parts joined together using hard soldering processes. The solder was produced by adding copper to the base alloy, a technological unity which contrasts with the very different skill levels observed for the objects manufacture.

Although for the Qurna burial each object exhibits a single colour (with the exception of the variability shown in the child's necklace) without the use of surface treatment, it seems that at the end of the Second Intermediate Period a range of coloured gold alloys was used in the jewellery. The variety of alloys found in Qurna range from very pure gold to silver-rich electrum. Despite the possible use of primary gold, the compositions of the alloys and the presence of PGE inclusions indicate the systematic use of alluvial gold.

The marks of use-wear and the heterogeneity of the alloys employed in the fabrication of certain beads, reveal that 'new' and 'old' items were deposited together in the burial of the young woman, while for the child only objects made by putting together 'old' components were deposited. Interestingly, the child's jewellery seems to demonstrate reuse of ancient components, at least in the use of common string components in gold, such as spacer beads and in the components of the earrings or clasp.

References

For references see pp.356–7 at the end of this chapter.

Chapter 9.3

Second Intermediate Period jewellery in the collection of the British Museum

Susan La Niece, Gianluca Miniaci, Marei Hacke & Maria F. Guerra

Among the few gold objects dated to the Second Intermediate Period in the collection of the British Museum, the most renowned is a green jasper scarab set in a gold plinth (EA7876) bought in 1835 from Henry Salt's third collection. This scarab belongs to the type 'heart-scarab' – intended to restrain the heart of the owner from witnessing against them during judgement in the afterlife – and represents the first recorded for a royal figure (Malaise 1978; Miniaci et al. 2018).

There is some mystery surrounding the circumstances of the scarab's discovery, allegedly found inside the coffin of king Nubkheperra Intef at Dra Abu al-Naga (d'Athanasi 1836, xi–xiii), in the northernmost part of the Theban necropolis (Miniaci 2009), but in the base of the scarab is inscribed the name of another sovereign: 'Made for the Osiris king Sobekemsaf, justified' (Hall 1913). Knowing that heart-scarabs were not transferable from one person to another, there is no reason to attribute this one to king Nubkheperra Intef. Unfortunately, the name of the king is written along the sides of the heart-scarab plinth without prenomen so that it is currently uncertain to which king Sobekemsaf it might have belonged, Sekhemra Shedtawy Sobekemsaf or Sekhemra Wadjkhau Sobekemsaf, both from the Second Intermediate Period. It seems however unlikely that the owner was king Sekhemra Shedtawy Sobekemsaf, whose tomb at Thebes was sacked, according to the accounts stated in the Abbott papyrus, if its findspot in the description can be considered reliable (for a summary of the scarab historical and archaeological context, see Miniaci 2011, 70–2; Miniaci et al. 2013).

In the collection of the British Museum are other objects dated to the Second Intermediate Period, all donated by Dyson Perrins (1864–1958). One is a lapis lazuli scarab inscribed with the name Intef, set in a shallow gold tray, which acts as a ring bezel (EA57698); the others are two gold bracelet spacers decorated with cats (EA57699 and EA57700). The spelling of the name Intef on the ring could point to king Nubkheperra Intef of the 17th Dynasty (the same king linked with the heart scarab above); the spacers were inscribed with the name of a queen called Sobekemsaf and king Nubkheperra Intef. The objects are unprovenanced, but some evidence led scholars to suppose that these spacers and the ring could actually come from Edfu, where the tomb of a queen Sobekemsaf could be (Miniaci et al. 2013).

The objects were examined and analysed in the Department of Scientific Research at the British Museum for their construction and the gold alloys employed in their fabrication. Optical microscopy, X-radiography, X-ray fluorescence spectrometry (XRF) and scanning electron microscopy with energy dispersive X-ray spectrometry (SEM-EDS) were used. The stones were identified *in situ* by Raman spectroscopy and the nature of the fill of the hollow heart-scarab was identified by Fourier transform infrared spectroscopy (FT-IR) and gas chromatography-mass spectrometry (GC-MS).

Technical description

The heart-scarab EA7876 (Fig. 9.10) consists of a human-headed green scarab set into a cloison on top of a sheet gold box or plinth that was confirmed to be hollow by X-radiography (Fig. 9.11). The stone of the scarab was identified as green jasper by Raman spectroscopy.

The base, sides and top of the box forming the hollow plinth are made of three sheets of gold, soldered together and apparently filled with a translucent brown material. The cloison surrounding the scarab has a double wall enclosing a corrugated strip of gold that imitates a beaded wire border, Figure 9.12a. The beetle's legs were individually cut from sheet gold, and

Figure 9.10. *Heart-scarab EA7876 (weight 17.1 g, length 3.8 cm and width 2.5 cm), in the collection of the British Museum. On the left the green jasper set in a gold mount and on the right the inscription on the base of the mount.*

Figure 9.11. *X-radiographic image of heart-scarab EA7876 produced using a Siefert DS1 X-ray tube operating at 100 kV with an exposure of 5 mA for four minutes.*

sharply incised to represent hairs, Figure 9.12b. They were soldered to the top sheet of the plinth before its sides were added. Hieroglyphs around the plinth (Fig. 9.13a) and in five horizontal rows across its underside, were chased with a blunt tool, causing indentation of the sheet gold around each symbol (Fig. 9.13b). Some marks may have been punched using a tool with a wedge shaped tip. Straight lines dividing the inscription appear to have been scraped with several sweeps of a sharp pointed tool, as shown in Figure 9.13c.

Finger-ring EA57698, shown in Figure 9.14, is set with a blue scarab with details of the insect's head outlined. Raman spectroscopy identified lazurite, the marker mineral for lapis lazuli, in the blue stone. The back of the gold setting is inscribed with the name Intef, with no surrounding cartouche. The hieroglyphs are chased into the gold with marks that indicate the use of a blunt tool, producing feathered lines around

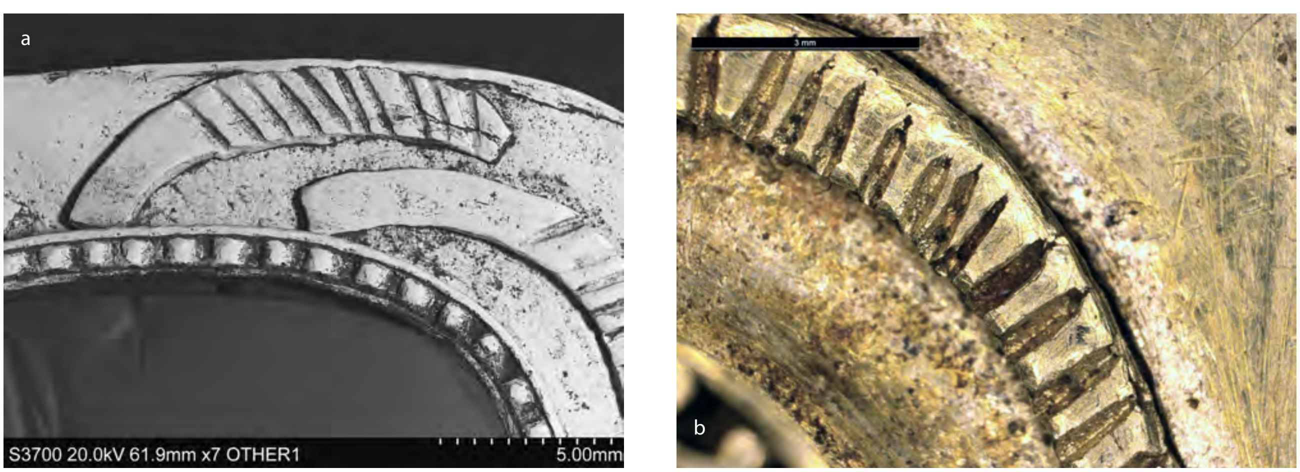
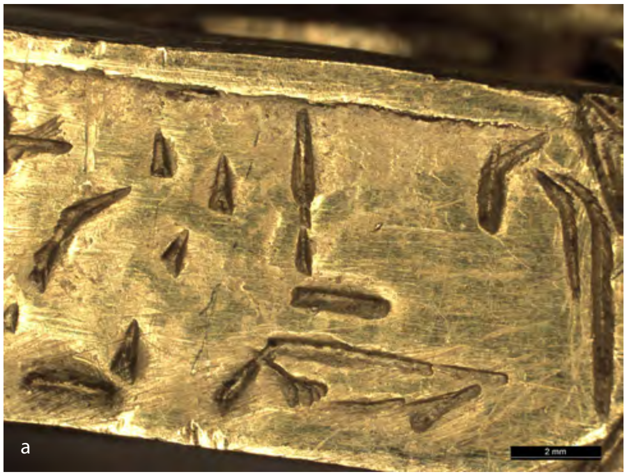
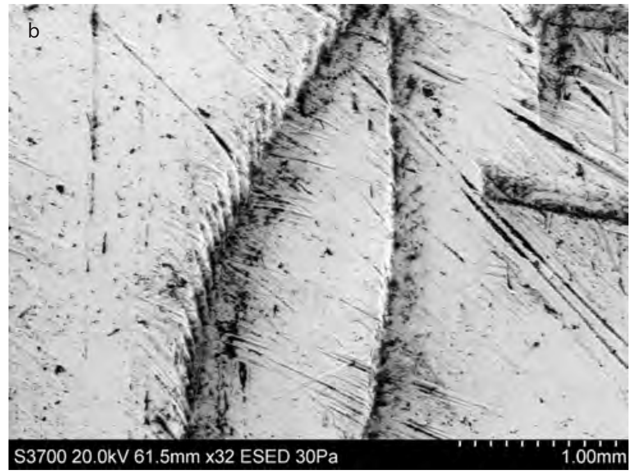


Figure 9.12. *Details of heart-scarab EA7876: (a) SEM detail of the corrugated gold strip in imitation of beaded wire around the stone and (b) detail of the incised hairs on the beetle's legs.*





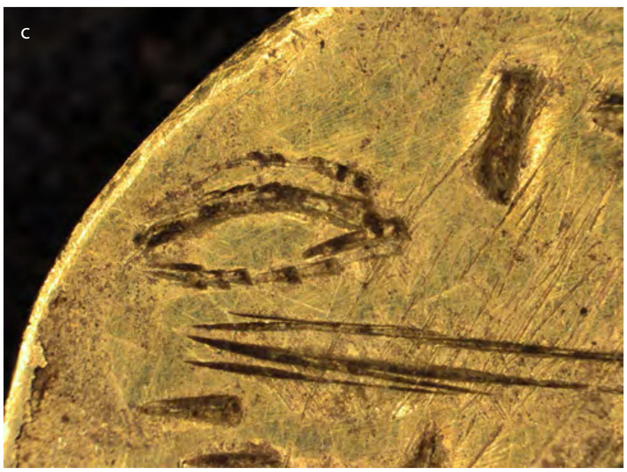


Figure 9.13. *Details of hieroglyphs on heart-scarab EA7876: (a) around the plinth, and (b,c) on the underside.*

the curves (Fig. 9.15). Sharp scratching overlies these toolmarks, which is likely to relate to later cleaning out of the inscription.

Three holes are drilled at each side of the scarab (Fig. 9.15) and another runs through its body from end to end. The legs of the scarab are made of six gold strips joined by hard soldering to the inside rim of the gold setting. Two legs show traces of inscribed markings, indicating hairs, but these have largely been overlaid by hard solder. The tops of the legs slotted into the holes

Figure 9.14. *Finger-ring EA57698 with lapis lazuli scarab (diameter 2.6 cm, thickness 1.2 cm and weight 7.2 g). On the right the inscription on the underside.*

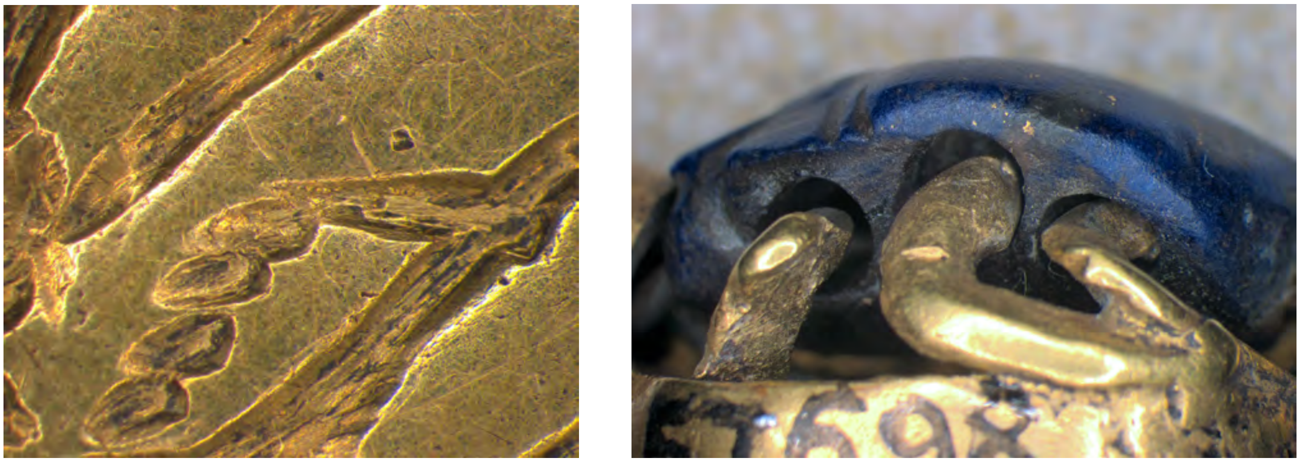


Figure 9.15. *Details of finger-ring EA57698: (left) inscribed hieroglyphs in the gold and (right) holes drilled in the stone for the gold legs.*

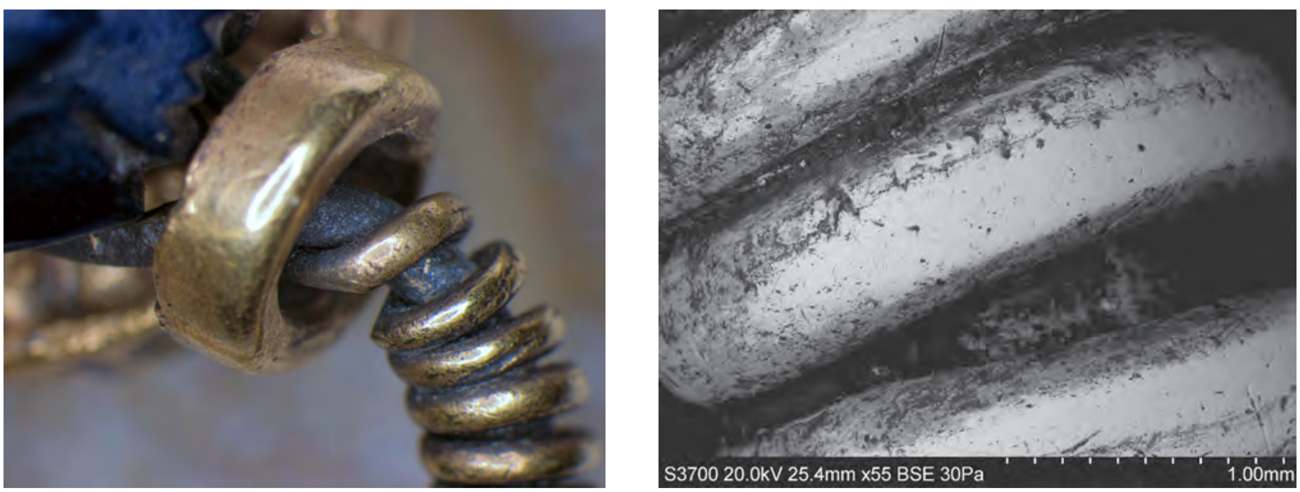


Figure 9.16. *Details of the wire of the shank of finger-ring EA57698 showing features indicative of rolling. Left, under the stereomicroscope. Right, under SEM.*

Figure 9.17. *Spacer-bars EA57699 and EA57700 (3 cm long, 1.8 cm wide, 1.2 cm high, and weight 19.2 g and 19.1 g, respectively).*

Figure 9.18. *Detail under the stereomicroscope of the hieroglyphs incised on underside of spacer-bar EA57699.*

in the side of the scarab holding it in the manner of a claw setting. At either end of the setting is soldered an undecorated gold collar through which the ring shank – a gold rod of hammered wire – is threaded.

The wire of the shank runs through the perforation of the body and is coiled around the other side of the shank to form a decorative mechanical join shown in Figure 9.16. The wire of the shank at the tail end of the scarab is threaded across the setting, under the scarab body, and is coiled to matching effect around the shank at the head end. The marks on the wire could be indicative of a form of strip-drawing.

The pair of gold spacer-bars EA57699 and EA57700 in Figure 9.17, consists each of an open-sided shallow box formed around 12 gold tubes through which strings for the bracelet were threaded. The tubes are each formed of a single sheet of gold crudely rolled into a cylinder with a longitudinal seam. The box is formed of a top plate on which three cats lie, an inscribed base plate, deeply chased (Fig. 9.18), and two separate sheets along the shortest sides. The three cats that are soldered onto the top of each box are each made up of seven solid rod/wire components, worked to shape and hard soldered together. The body and head are one piece, but the ears were made separately and soldered onto the heads. The four legs and tail were formed of wire and details of the front paws and striped tail were cut into the metal.

Gold alloys and joining technique

The elemental analysis of the objects was carried out on the surface of the metal by a Bruker Artax XRF with a 0.65 mm collimator operated at 50kV and 800 μA and small components were analysed using EDS in a Hitachi S-3700N SEM set to an accelerating voltage of 20kV and a chamber pressure of 30Pa. It should be remembered that the surface composition of the gold alloy quoted here is likely to be depleted in the baser metals silver and copper compared to the original alloy due to a combination of losses during manufacture and burial. These semi-quantitative results of the surface analyses were calculated using British Museum in-house gold alloy standards.

The different parts of the heart-scarab showed the use of gold alloys that contain 11 to 13 wt% Ag with a copper content that ranges from about 1 to 2 wt% (Table 9.4). The visible soldered joins in the box construction may account for some elevation of the copper levels near the joins.

A sample of the adhesive filler, extracted from the side of the setting after removing the surface layers to minimize the risk of contamination from the mummy, was identified by FTIR spectroscopy and GC-MS as a mixture of Pistacia resin and a coniferous resin from the Pinaceae family (Hacke 2013). Although these tree resins have previously been identified in many ancient Egyptian contexts, ranging from uses in mummification to incense and varnish, analytical evidence for their use as a filler in goldwork has hitherto been scarce (Lucas & Harris 1962, 7–8, 35–6).

The elemental analysis by XRF of the different parts of the finger-ring showed the use of different

Table 9.4. *Results obtained by XRF and SEM-EDS for heart-scarab EA7876.*

Region of analysis	Method	Au wt%	Ag wt%	Cu wt%
top plate of plinth	XRF	86.2	12.6	1.2
corrugated strip around scarab	XRF	86.1	12.6	1.3
side wall of plinth	EDS	86.5	11.5	2
base plate of plinth	XRF	86.8	12.3	0.9
leg – front left	XRF	86.1	12.6	1.3
leg – back right	EDS	85.4	13.1	1.5
leg – back left	EDS	87.5	11.3	1.2

Table 9.5. *Results obtained by XRF and SEM-EDS for finger-ring EA57698.*

Region of analysis	Method	Au wt%	Ag wt%	Cu wt%
hoop	XRF	85	14	1
bezel plate	XRF	83	16	1
coiled wire	XRF	84	15	1
leg left	EDS	91.3	7.6	1.1
leg right (including hard solder)	EDS	85.2	10	4.8
collar	EDS	87	11.3	1.7

Table 9.6. *Results obtained by XRF for spacer-bars EA57699 and EA57700.*

Region of analysis	Au wt%	Ag wt%	Cu wt%
EA57699			
base plate	81.7	17	1.3
end plate	81.1	16.8	2.1
top plate	80.5	17	2.5
cat body 1	88	11	1
cat body 2	88.7	10.3	1
cat body 3	88.9	10.1	1
cat tail	82.4	16.3	1.3
cat front leg	85.6	13.3	1.1
EA57700			
base plate	81.1	17.4	1.5
end plate	81.3	17	1.7
top plate	79.1	17.5	3.4
cat body 1	87.8	11	1.2
cat body 2	87.5	11.2	1.3
cat body 3	86.6	11.8	1.6
cat tail	84.4	13.4	2.2
cat front leg	85.6	12.7	1.7

alloys (Table 9.5). The hoop and the bezel plate are made from a gold alloy that contains an average 15 wt% Ag and 1 wt% Cu, while the alloy employed to fabricate the collar contains about 11 wt% Ag and almost 2 wt% Cu. The scarab legs are also made from a different alloy, containing about 1wt% Cu and lower silver contents, and hard soldered to the base plate. The spatial resolution of the XRF equipment used to carry out the analysis is not appropriate to separate the different regions of the join, but it is clear that the hard solder, visible under magnification, contains a higher copper content.

The elemental analysis by XRF of the different parts of the two spacer-bars showed the use of different alloys (Table 9.6). Both the boxes are made from alloys containing about 17 wt% Ag and copper contents ranging from 1.3 to 3.4 wt%, and it is suggested that the sheets were cut from the same piece with some elevation of the copper levels near the joins where the soldered joins are clearly visible. The different parts of the cats are made from alloys containing lower silver contents with a wider variation suggesting they were cut from different pieces of wire or rod.

The alloys employed contain amounts of silver expected for unrefined alluvial gold. Its use is confirmed by the presence of several platinum-group element inclusions in all the pieces, one is shown in Figure 9.19. Although white metal inclusions were

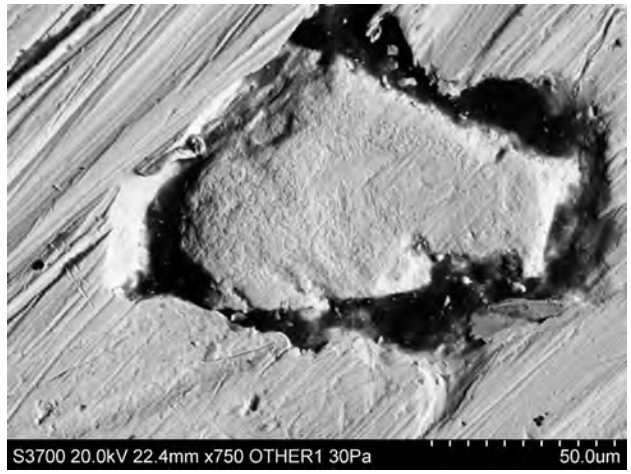


Figure 9.19. *SEM image of platinum group element inclusion at the surface of the gold component of heart-scarab EA7876.*

seen on the bracelet spacers, these were not accessible for analysis due to the geometry of the instrument, but normalized EDS analysis could be carried out on inclusions present at the surface of the heart-scarab and the finger-ring, summarized in Table 9.7.

Conclusions

A similar repertoire of manufacturing techniques was employed in the fabrication of all these items: sheet and wire components, sharp chisel cuts to mark details on the cats and scarabs, and chasing, with perhaps some punching, for inscriptions. A comparison of details of the toolmarks on all the pieces demonstrates however that they were made by different hands and there is no evidence of a workshop link. The use-wear marks found on the jewellery surface do not indicate intensive use.

Some variation was observed for the alloys employed in the fabrication of the jewellery, with a gold content that ranges between 80 and 87 wt%. These alloys are very similar to those employed in the fabrication of part of the jewellery group from Qurna (see Chapter 9.2). With the exception of the girdle, the adult's jewellery is made from alloys similar to those employed in the manufacture of the jewellery in the British Museum.

Table 9.7. *Results obtained by SEM-EDS for platinum-group element inclusions.*

Acc. No.	Ru wt%	Os wt%	Ir wt%
Ring 57698	37	32	31
Heart-scarab 7876	12	48	40

The amounts of silver in the alloys are those expected for unrefined alluvial gold, which is confirmed by the presence of platinum-group element inclusions in all the pieces. The copper contents in the alloys are sometimes higher than those expected for unrefined alluvial gold, and would have been added to lower the melting temperature in particular when the construction includes hard soldering of components.

References

For references see pp.356–7 at the end of this chapter.

Chapter 9.4

Jewellery bearing the names of Ahhotep and Ahmose

Maria F. Guerra & Sandrine Pagès-Camagna†

Enriched with Napoleon's conquests in the beginning of the 1800s, the collection of the *musée central des Arts*, inaugurated in 1793 in the *Grande galerie* of the Louvre, included Egyptian statues from the old royal collections. The acquisition during the Restoration of several known collections and the new 'progressive conception of history' introduced under the Revolution (Chaudonneret 1991, 491) resulted in the opening in 1827 at the Louvre of the *musée Charles X*. After the acquisition of the Durand collection in 1824, of the Salt collection of *Egyptian monuments* in 1826, and of the Drovetti collection in 1827 (Tanré-Szewczyk 2017), some 9000 Egyptian objects were available for display in the museum.

Appointed in 1826 as curator of a new section dedicated to Egyptian Antiquities at the *musée Charles X*, Jean-François Champollion rapidly enlarged the Egyptian collection (Champollion 1827). His successors continued this expansion with items offered or bought from notable collectors such as Clot, Tyszkiewicz and Delaporte, and, more acutely, with finds from Auguste Mariette's excavations in Egypt, in particular at Saqqara.[1] Among the items sent by Auguste Mariette, were three gold components of an armband (E7168) bearing the name of the first king of the 18th Dynasty, Ahmose I, found in 1857 at Dra Abu al-Naga inside the *rishi* coffin of his brother, king Kamose.

With time, many other objects entered what is now the Department of Egyptian Antiquities of the Louvre Museum. Among these are several items bearing the name of Ahhotep, borne by at least two queens of the early 18th Dynasty (Roth 1999): one gold signet ring, one blue lapis lazuli scarab set in a gold frame, and two cast amulets representing the standing figure of god Seth (Barbotin 2008). The objects can be seen in Figure 9.20a. The gold signet ring (E7725) and one gold amulet (E7659) were bought in 1883 from the antiquities dealer E. Allemant (Monnot 2015). The other gold amulet (E7715) was bought in 1884 from antiquities dealer H. Pennelli (Monnot 2015; Hill et al. 2010). The blue scarab set in a gold mount (E3297) was among the one hundred and seventy one objects acquired in 1860 (Monnot 2015) from art collector L. Fould (Fould 1860).

Concerning the three gold components of an armband (E7168), shown in Figure 9.20b and already mentioned, they consist of two hollow lying lions and one cartouche in which is inscribed the name of king Ahmose I (Biston-Moulin 2012). They were purchased in 1881 from numismatist and art collector F. Feuardent, together with one gold lion-headed aegis bearing the name of king Osorkon IV of the Third Intermediate Period (Monnot 2015). As mentioned, the armband components were found by Auguste Mariette inside the *rishi* coffin of king Kamose, on the king's breast, together with one bronze mirror (Winlock 1924) also in the collection of the Louvre Museum, and one dagger made from gold and silver[2] nowadays in the collection of the Royal Library in Brussels (Aruz et al. 2008), legacy of baron Lucien de Hirsch (Ben-Amar 2012). No established support band for the cartouche and lions attesting its function as armband was found inside the coffin of king Kamose. However, among the jewellery and weapons found in 1859 by Auguste Mariette in queen Ahhotep's burial at Dra Abu al-Naga (as exhibited in the Museum of Egyptian Antiquities, Fig. 9.1), today in the collection of the Egyptian Museum in Cairo, can be found one gold armband also inscribed with the name of king Ahmose. Identified by E. Vernier (1907–27, no. 52642) as a 'hair ornament' in the form of a bracelet, it consists of three components in gold – two sphinxes and one cartouche with the name of king Ahmose – mounted on a gold band in the form of a braid. This armband can be seen in Figure 9.1, on the bottom plate also showing the gold flies. According to Vernier (1907–27) richly decorated with cloisonné work alternately filled with lapis lazuli, amazonite and carnelian, it is undoubtedly of the same inspiration as the three

Figure 9.20. *Gold jewellery in the collection of the Louvre Museum. (a) Objects bearing the name of Ahhotep. From left to right: gold signet ring (E7725), blue scarab set in a gold tray (E3297), and the two cast amulets representing the standing figure of god Seth (E7659 on the left and E7715 on the right). (b) Two of the three elements of an armband bearing the name of Ahmose (E7168), found at Dra Abu al-Naga in 1857 by Auguste Mariette inside the coffin of Kamose.*

components belonging to king Kamose. In addition, though less rich, the dagger found on king Kamose's breast is quite similar to the dagger made from gold, silver and bronze found in queen Ahhotep's burial (Vernier 1907–27, no. 52660), showing that the jewellery in the Louvre Museum collection corresponds to the aesthetic values of the Second Intermediate Period.

The objects in the collection of the Louvre Museum could have been manufactured in different periods. While the inscription on one of the gold amulets representing the standing god Seth cannot be read, it is worth noting that the crescents in the hieroglyph 'iah' used to write Ahhotep's name are not represented in the same direction for all items. Considering that the orientation of this hieroglyph changed from upward to downward crescent during the reign of Ahmose I (Biston-Moulin 2012, 2015), this suggests that the blue scarab E3297 might have been made before the other objects bearing the queen's name, which could indicate that the signet ring and the amulets are funerary items or that they belong to a later queen of this name. The crescents in the hieroglyph 'iah' inscribed in the cartouche E7168 suggest that the armband might be from the same period as the blue scarab.

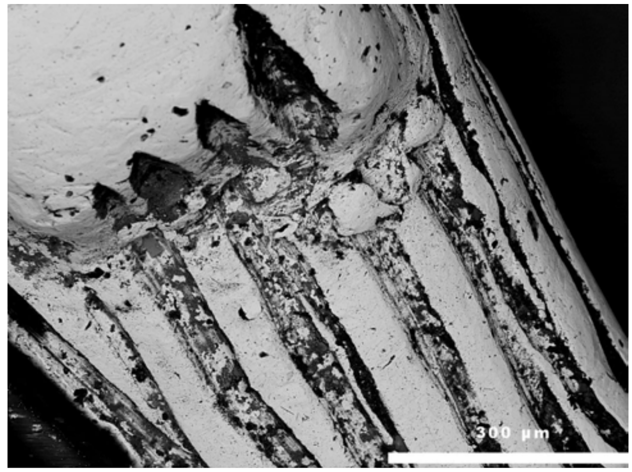


Figure 9.21. *Details of one of the amulets representing the standing figure of god Seth (E7715): (left) defects on the right leg due to improper casting (shrinkage and gas cavities); (right) chased motif with tool marks corresponding to engraving perhaps from a modern restoration.*

The jewellery construction

The massive oval gold signet ring E7725 bearing the name of Ahhotep was cast in one piece, as were the gold amulets E7659 and E7715 representing the standing god Seth. Although with equivalent dimensions and postures, these massive amulets (bought separately from two antiquities dealers) have different morphological and decorative details showing that they were not made with the same mould or intended to form a 'pair'. In addition, amulet E7715 has casting defects quite visible on the legs (Fig. 9.21 left) indicating a less skilled casting.

After casting, the signet ring and the amulets were finished by polishing, except the inner side of the ring (Fig. 9.22). The deeply incised hieroglyphs in the ring bezel and the amulets details were cut in the wax and finished after casting. One of the amulets (E7715) shows however a few tool marks that could correspond to the use of engraving (Fig. 9.21 right), perhaps from a recent restoration process. Furthermore, while the suspension ring on the back of amulet E7659 was made in the mould, the suspension ring of amulet E7715 is nowadays soldered to the reverse of the figurine, reflecting a modern restoration. Curiously, the name of Ahhotep that is visible on amulet E7659 plinth almost disappeared on amulet E7715, but in both amulets the inscriptions were chased as expected.

The signet ring shows marks of use-wear on the hoop and on the bezel, but under high magnification and grazing light some deeper scratches on the bezel seem to correspond to a polished metal finishing that could result from the use of an abrasive cleaner. Contrary to the ring, the amulets show no marks of use-wear.

The blue lapis lazuli scarab E3297 inscribed 'king's wife and mother Ahhotep' (Desti 2004) is encircled with a rather massive gold band forming an oval shaped gold frame. An undecorated gold collar is soldered at either end of the frame. This piece is certainly the bezel of an incomplete swivel ring, a type of ring particularly common in Egypt from the mid-12th Dynasty onwards (Newberry 1906). The hoop of a swivel ring usually consists of a gold shank that runs through the bezel. In this case, the hoop should

Figure 9.22. *The as-cast finishing of the inner side of the signet ring bearing the name of Ahhotep (E7725).*

originally run through both collars and the scarab, as shown by the use-wear deformation of the collar holes. Like the surface of the blue scarab, where the incised morphological details faded by use-wear, the gold frame and collars have so many marks of use-wear that the joins, made by hard soldering, are today almost imperceptible.

In contrast to the mentioned pieces, the two lying lions and the cartouche bearing the name of king Ahmose (E7168), showing many marks of use-wear, are a skilled work of gold sheet mounting and decoration. The cartouche is a box, made by joining several gold sheets: one bottom sheet, one wall sheet, and one cover sheet. The bottom sheet also covers the oval loop, made from a bent gold strip joined to the top of the box. Two gold rings joined to the box bottom should originally attach the cartouche to the original support band. Two pairs of gold tubes made from rolled sheets, applied inside the box and on the cover, fit together to close the box (Fig. 9.23). No signs of a filler (resin or any other material) could be found.

The cover sheet is richly decorated. Two round section wires, perhaps made by strip-twisting, twisted into a braid, encircle the name of the king.

Figure 9.23. *Details of the closing system of the cartouche bearing the name of Ahmose (E7168), which is mounted as a box.*

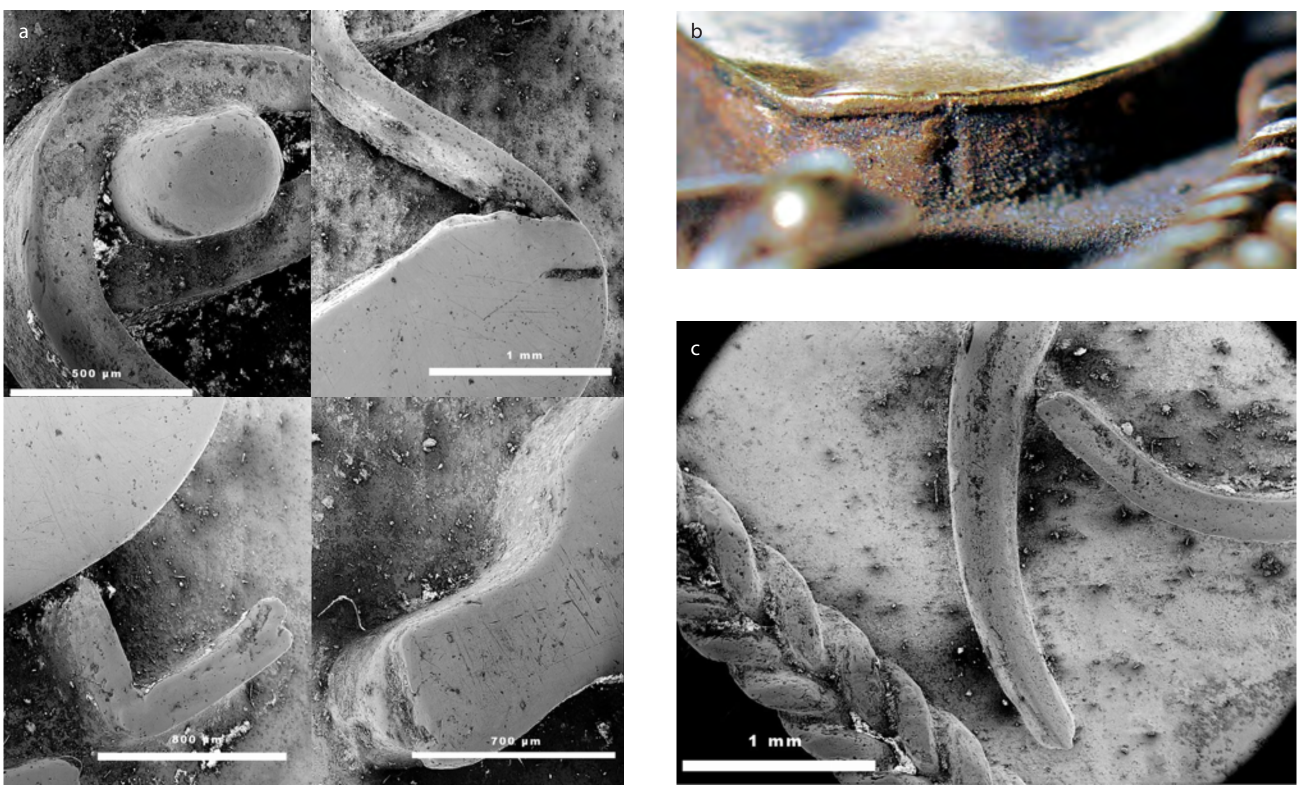


Figure 9.24. *Details of the cartouche bearing the name of Ahmose (E7168). (a) The duck used to write 'the sun' is mounted with rectangular wires, while one granule represents the eye. (b) The body is a gold sheet supported supposedly by a gold band or a rectangular wire. (c) Two wires are used to write the name of Ahmose.*

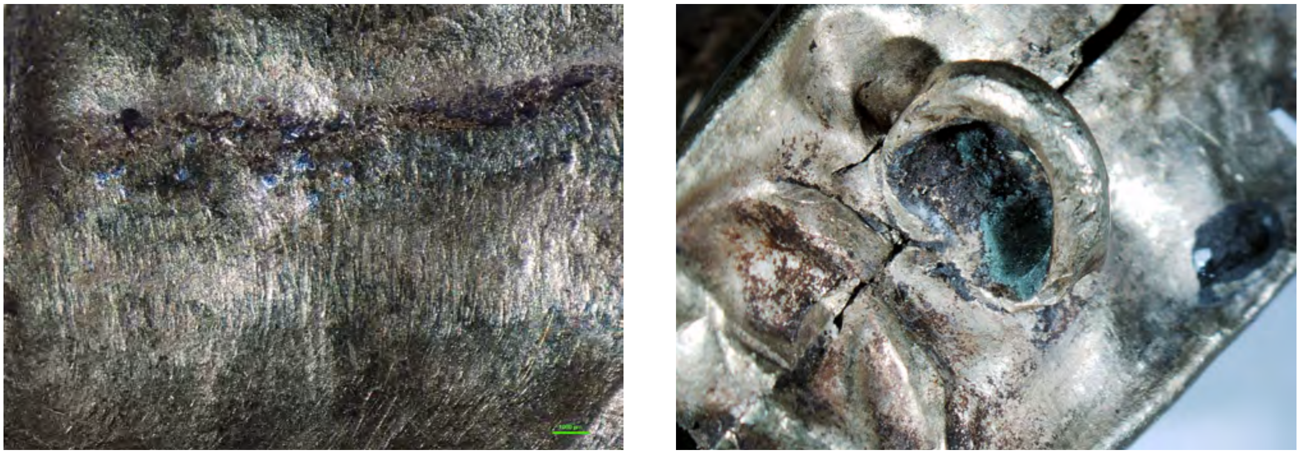


Figure 9.25. *Details of one of the lions from the armband (E7168), showing the many PGE inclusions along the joining of the two halves that constitute the animal's body and the corrosion products of copper visible in one of the gold rings soldered to the lions' bases, over the joining.*

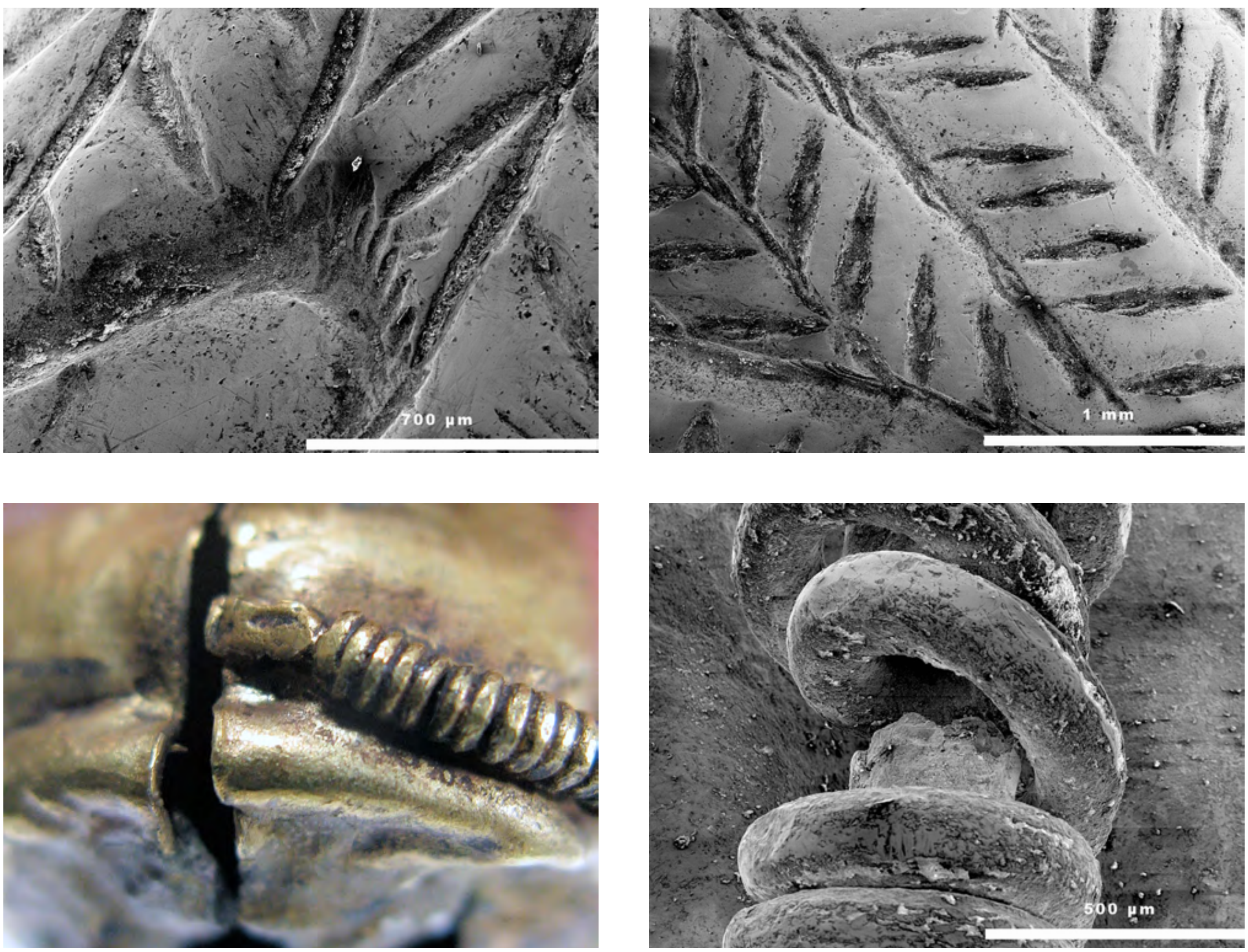


Figure 9.26. *Details of one of the lions from the armband (E7168) showing (top) the chased decoration of the animal's body and (bottom) the tail made by coiling a gold round wire around a gold rod (today broken) soldered to the animal's body.*

The hieroglyphs consist of skilful mountings of gold sheets and wires. 'Ahmose' is written with rectangular section wires, one of them rounded at the ends (see Fig. 9.24a), the first made by hammering and the second probably also made by hammering. The duck in the hieroglyphs 'the sun of Ra' is written with rectangular wires, one gold sheet, and one granule (Fig. 9.24b).

The hollow lying lions are made by joining two halves, which could have been obtained by embossing. Along the joining, many PGE inclusions are visible, as shown in Figure 9.25. The gold sheets are folded on the underside. Two gold rings soldered to the lions' bases should originally attach them to the support band. The corrosion products of copper visible in one of them, as shown in Figure 9.25, result perhaps from the decayed missing support. The morphological details are obtained by chasing (Fig. 9.26 top), except the tail that consists of a rod soldered to the body with a coiled-around wire that looks hollow (Fig. 9.26 bottom).

The gold alloys and the joining technique

The different parts that make up the objects were analysed by μPIXE, XRF and EDS. Table 9.8 summarizes the results obtained for each of them and shows that the alloys are of quite variable quality and thus of variable colours and shades.

The amulets are made from very pure alloys containing 97–99 wt% Au. The signet ring is made from an alloy containing 86 wt% Au, and the frame and collars of the blue scarab bezel are made with alloys containing 92–94 wt% Au. Conversely, the components of an armband are in electrum containing amounts of silver that reach more than 30 wt%. The lion and the cartouche are made from distinct alloys, which could indicate that they were made separately, but the soldering process of the many cartouche components may justify the observed difference. The copper contents in the alloys used to elaborate the cartouche (2–3 wt%) and the signet ring (4 wt%) indicate that this element was intentionally added. The presence of 1–3 wt% Cu in the electrum alloys is expected based on data obtained for other Egyptian jewellery items (Gale & Stos-Gale 1981; Troalen et al. 2014; Lemasson et al. 2015).

The blue scarab bezel and the three components of an armband are mounted by using the hard soldering process. The composition of the base alloys and of the quite visible joins that were analysed using EDS and μPIXE are summarized in Table 9.9 and represented in the diagram of Figure 9.27, showing the expected addition of copper to the base alloys to obtain the solders. The use of hard soldering was observed for other Egyptian items (Roberts 1973; Wolters 1975; Schorsch 1995; Ogden 2000) including those included in this volume.

Table 9.8. *Results obtained by μPIXE and XRF for the jewellery bearing the names of Ahhotep and Ahmose.*

Acc. No.	Region of analysis	Technique	Ag wt%	Au wt%	Cu wt%
Signet ring E7725		XRF	10.0	86.1	3.8
		XRF	9.9	86.3	3.8
		PIXE	9.9	86.3	3.8
Scarab E3297	collar 1	XRF	6.8	92.5	0.7
	collar 1	PIXE	6.9	92.4	0.7
	collar 2	XRF	6.7	92.8	0.6
	collar 2	PIXE	6.5	92.9	0.6
	tray	PIXE	5.9	93.8	0.3
		PIXE	5.9	93.9	0.2
Amulet E7659	body	XRF	1.1	97.2	1.7
		XRF	1.1	97.3	1.6
		PIXE	0.8	97.5	1.7
Amulet E7715	body	XRF	0.5	99.2	0.4
		PIXE	0.4	99.2	0.4
		PIXE	0.4	99.2	0.4
Cartouche E7168	Bottom sheet	XRF	31.0	65.8	3.2
		PIXE	30.6	66.2	3.2
	Wall sheet	XRF	29.2	68.2	2.5
		PIXE	30.2	67.7	2.1
	Loop	XRF	29.2	68.2	2.5
		PIXE	29.3	68.1	2.7
	Duck body	PIXE	31.5	65.5	3.1
	Duck eye	PIXE	30.4	66.5	3.1
	Sun	PIXE	24.6	74.0	1.4
	Wire braid	PIXE	30.9	65.9	3.2
	Ring	PIXE	28.8	69.9	1.2
Lion E7168	Body right	XRF	25.8	72.7	1.5
		XRF	25.2	73.4	1.4
		PIXE	25.6	73.2	1.2
	Body left	XRF	25.7	72.9	1.4
		XRF	25.4	73.2	1.4
		PIXE	26.4	72.2	1.4
	Wire	PIXE	26.0	72.4	1.5
	Ring	PIXE	27.7	71.0	1.3

Table 9.9. *Results obtained by µPIXE and SEM-EDS for the joins and base alloys of armband E7168 and scarab E3297.*

Acc. No.	Region of analysis	Au wt%	Ag wt%	Cu wt%
Lion E7168	Body	72.7	25.8	1.5
	Solder	66.7	26.2	7.1
	Wire	72.4	26.	1.5
	Solder	63.4	25.4	11.2
Cartouche E7168	Wall sheet	68.2	29.2	2.5
	Solder	65.2	27.4	7.4
	Duck body	65.5	31.5	3.1
	Solder	60.4	31.0	8.6
	Duck eye	66.5	30.4	3.1
	Solder	53.9	33.7	12.4
	Sun	74	24.6	1.4
	Solder	61.1	29.4	9.5
Scarab E3297	Collar	92.5	6.8	0.7
	Solder	88.3	6.6	5.1
	Tray	93.8	5.9	0.3
	Solder	86.9	7.0	6.1

The objects contain amounts of silver in the range expected for unrefined alluvial gold in Egypt. The amulets are made from very pure gold, but high purity alloys were observed for several gold foils, such as those from the gilded wooden stick (Adrabou et al. 2019) and from the coffin (Rifai & Hadidi 2010) of king Tutankhamun. Also made of quite pure gold alloys were king Tutankhamun's mask (Uda et al. 2014), one Heh amulet from First Intermediate Period grave 1981 at Hammamiya (Gale & Stos-Gale 1981), the Qurna adult's earrings discussed in Chapter 9.3, and the small gold ring beads in the diadem found in undisturbed grave 1730 at Abydos, dated to Naqada II and discussed in Chapter 7.3.

The use of alluvial alloys to make the Second Intermediate Period jewellery is confirmed by the presence of PGE inclusions revealed for all the studied items except the amulets. Table 9.10 summarizes the data obtained by SEM-EDS and µPIXE for the analysed inclusions. Further information on the analytical details is provided in Chapter 6.5. Interestingly, these PGE inclusions belong to different systems (defined by Harris & Cabri 1991). Those in signet ring E7725 belong to the Os-Ir-Ru system, as commonly observed in Egyptian jewellery. Those in blue scarab bezel E3297 and in the three components of an armband E7168 belong however to both the Os-Ir-Ru and the Ir-Os-Pt systems. Only three gold penannular earrings in the collection of the Louvre Museum (Grandet 2002), made from alloys containing 20 wt% Ag and 1–5 wt% Cu, contain so far identified inclusions belonging to the Ir-Os-Pt system. These earrings were found during excavations of tombs containing female burials dated to the 18th Dynasty at the Deir el-Medina East Cemetery by B. Bruyère

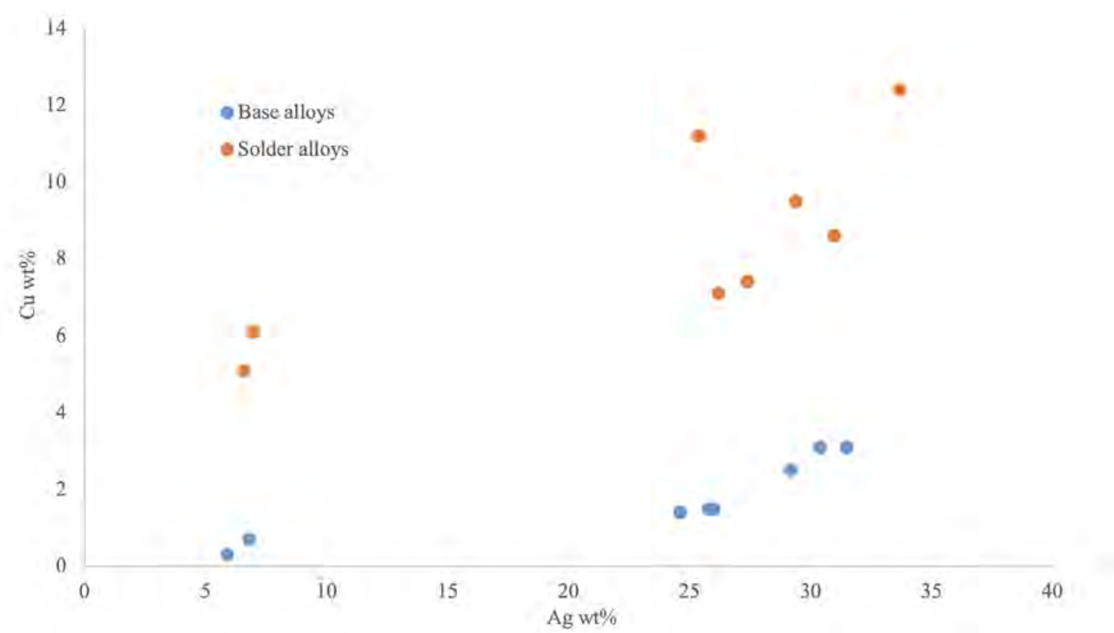


Figure 9.27. *Silver versus copper contents obtained by SEM-EDS and µPIXE for the gold base-alloys and hard-solder alloys, used in the production of the jewellery bearing the names of Ahhotep and Ahmose.*

Table 9.10. *Results obtained by μPIXE and SEM-EDS for PGE inclusions in the jewellery bearing the names of Ahhotep and Ahmose.*

Acc. No.	Technique	Ru wt%	Os wt%	Ir wt%	Pd wt%	Pt wt%	Rh wt%	Fe wt%
Scarab E3297	EDS	18	40	43				
		13		79		8		
		25	35	40				
		32.7	33.8	30.9		1.1	0.4	0.9
		23.4	33.4	38.3		2.8	1.0	0.8
		1.8	82.6	9.2		4.6		1.5
		93.8		6.2				
		15.0	42.3	38.7		3.3	0.4	0.3
Ring E7725	EDS	29	36	34			2	
		29	35	35			2	
		29	35	33			2	
Cartouche E7168	μPIXE	5.2	51.7	39.6	0.3	1.4	0.3	1.4
		20.4	38.2	36.0		3.8	0.9	0.4
		21.9	37.4	34.8		3.5	1.2	1.0
		9.6	45.0	42.1		2.0	0.5	0.6
		16.2	41.6	38.5	0.7		1.5	1.2
		10.5	49.3	32.0		5.0	1.9	1.1
		19.8	40.5	34.8		2.7	1.2	0.9
		20.4	38.2	36.7		3.4	0.8	0.4
		1.1	17.1	66.9	0.1	9.4	0.4	4.6
		7.5	50.0	39.8		1.9	0.4	0.4
		8.3	50.3	41.4				
Lion E7168	μPIXE	15.6	41.0	39.2		3.0	0.7	0.4
		0.9	33.7	58.1	0.2	6.2	0.5	0.2
		29.8	36.6	28.3		5.3		

(1937) and are discussed in Chapter 10.3. It is therefore easy to imagine that the presence in Egyptian jewellery of PGE inclusions belonging to a different system might indicate the use of gold from different 'sources', including recycling. In fact, PGE inclusions from that system were analysed, for example, in two gold objects from the Aigina treasure (Fitton et al. 2009), a group that contains items with Egyptian-Levantine parallels (Schiestl 2009).

It should still be pointed out that PGE inclusions are absent from the cast amulets, are very rare in the signet ring, rare in the blue scarab bezel and very numerous in the components of the armband. The blue scarab bezel and the components of the armband, with the highest number of PGE inclusions and inscribed with the moon sign in its older written form, show the most important marks of use-wear. While the blue scarab bezel is made from a quite 'common' Egyptian yellow gold alloy, the components of the armband are made from the also quite 'common' electrum alloys. This situation is comparable to that in the jewellery from Qurna, discussed in Chapter 9.2. The items made from silver-rich electrum alloys are the adult's girdle and some beads from the child's necklace, showing marks of intense use-wear and suggesting a long use for the girdle and a reuse (from ancient strings) for the ring beads.

In Figure 9.28 the composition of the objects bearing the names of Ahhotep and Ahmose and the heavily worn items from Qurna are compared. It can be observed that the blue scarab bezel matches well the adult's jewellery from Qurna and that the components of the armband match the adult's girdle and many of the beads from the child's necklace. Pale yellow gold alloys seems to be quite commonly employed during the 12th Dynasty. For this reason, the composition of the jewellery from tomb 72 at Haraga discussed in Chapter 8.2, was added to the diagram of Figure 9.28. The polychrome fish amulets from Haraga are quite dispersed in the diagram, but the majority of the beads match the components of king Kamose's armband and the girdle from Qurna. The whitish tail of one of

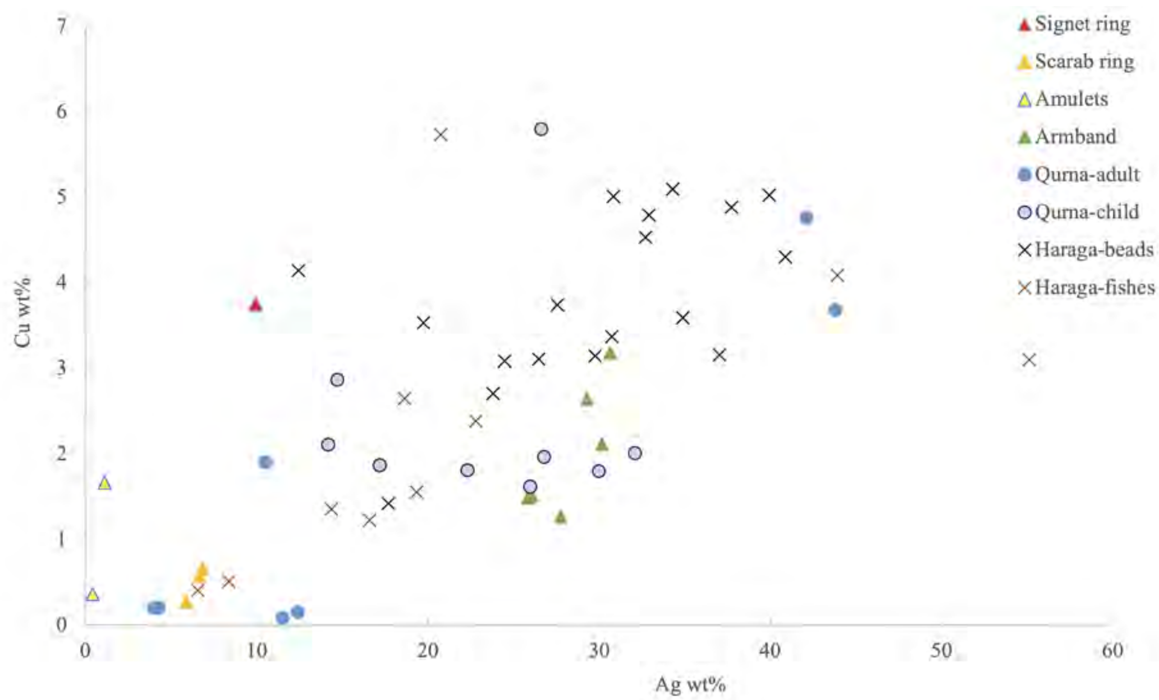


Figure 9.28. *Silver versus copper contents obtained by XRF and μPIXE for the Second Intermediate Period jewellery bearing the names of Ahhotep and Ahmose, compared to the groups from the Qurna burial (Chapter 9.2) and from tomb 72 excavated at Haraga (Chapter 8.2).*

the fish amulets, containing 56 wt% Ag, matches the composition of the barrel bead in string E.2380 from tomb 492 at Abydos (see Table 8.13 in Chapter 8.6), also showing signs of use-wear. Although the compositions of the pale yellow items seem to match, it is difficult to provide further discussion on this.

Conclusions

The study of the gold jewellery in the collection of the Louvre Museum bearing the names of Ahhotep and Ahmose confirms the use of different colours of gold during the 17th to the beginning of the 18th Dynasties.

The objects were produced either by casting or by hard soldering different parts. Solders were obtained by adding copper to the base alloy. Decoration was made by chasing and, in the case of the armband cartouche, by adding gold wires, sheets and granules.

With the exception of the two cast amulets, all the objects contain PGE inclusions, confirming the use of alluvial gold. The amulets, which are not a pair, are in fact made from very pure alloys that were observed so far for a few gold foils and objects (Quibell 1908; Gale & Stos-Gale 1981; Bosse-Griffiths 1986; Hatchfield & Newman 1991; Uda et al. 2014; Tissot et al. 2015; Abdrabou et al. 2019) and the small gold ring beads in the Naqada II diadem found at Abydos (discussed in Chapter 7.2). One of the amulets, quite heavily restored and with casting defects, has an unreadable inscription and could have been manufactured in a different period.

Despite not consisting of a set of contextualized jewellery, similarly to what was observed for the group from Qurna, some pieces in the collection of the Louvre Museum are quite new whilst others present marks of intense use-wear. Those with many marks of use-wear are the three components of an armband and the blue scarab bezel, which means those where the moon sign written form of hieroglyph 'iah' suggests that they were made before the other analysed objects. Concerning the alloys, the composition of the blue scarab bezel matches well the Qurna adult's jewellery, including the high quality penannular earrings. The composition of the components of an armband is however close to the alloys employed in the fabrication of both the highly used items from Qurna and the Middle Kingdom beads from tomb 72 at Haraga. This could indicate either the presence in burials of objects worn for a much longer time than expected, or the constant reuse of components of old objects, or the recycling of a 'Middle Kingdom pale gold', perhaps 'in fashion' or corresponding to a certain colour code during that period, by melting ancient objects without addition of gold or (objects made from?) other alloys.

The PGE inclusions in Egyptian jewellery commonly belong to the Os-Ir-Ru system (Meeks & Tite 1980; Troalen et al. 2014, and many objects in this volume). However, the three components of an armband and the blue scarab bezel contain inclusions that belong to that system and to the Ir-Os-Pt system. Inclusions from this latter system were identified so far only in three penannular earrings from New Kingdom tombs excavated at Deir el-Medina (discussed in Chapter 10.3). This could indicate the use or recycling of gold from other sources, including objects recovered during battles against the Hyksos or another supply during a precise period. Inclusions belonging to this same system were identified in objects belonging to the Aigina treasure (Fitton et al. 2009).

Notes

1. After the discovery of the Serapeum of Saqqara, Mariette sent to the Louvre about 6,000 objects.
2. One scarab and several amulets found after removal of the last bandages of the mummy, disappeared (Winlock 1924, 261).

References

For references see pp.356–7 at the end of this chapter.

Chapter 9.5

Second Intermediate Period jewellery in the collection of the Petrie Museum

Maria F. Guerra, Marcos Martinón-Torres & Stephen Quirke

Among the nearly 80,000 objects in the collection of the Petrie Museum of Egyptian Archaeology, some of the few gold items dated to the Second Intermediate Period were selected for analytical study. They have diverse origins, but the majority are contextualized.

One gold bead (UC26052), four coiled gold wires (UC26019) and one string of gold beads (UC26018) found during the excavations by Guy Brunton of different graves at Qau and Badari were analysed in this work to investigate their composition and manufacturing techniques. We also considered the two scraps of gold foils (UC42860) found during the excavations of cemetery C at Abydos by Thomas Eric Peet. Finally, also included in the study were two unprovenanced gold objects bearing the names of kings of the 17th Dynasty. One is a shell-shaped pendant with the cartouche of king Seqenenra Taa (UC11847) and the other is a flat oval pendant with the cartouche of king Kamose (UC11850).

The objects were analysed using the XRF and the SEM-EDS facilities of the UCL Institute of Archaeology.

Jewellery from Qau

The objects from the excavation of Qau and Badari were found in three graves dated to the Second Intermediate Period. The gold crescent bead and the two scarabs UC26052 were found inside a sealed pot in tomb Qau 7352 that contained the undisturbed burial of a female (Fig. 9.29). This pot was contained in a rush box found outside the coffin, behind the female's head, where several other objects could be found (Brunton 1930, 9). The four gold coiled wires UC26018 and the string of gold ring and barrel beads UC26019 (Fig. 9.29) were found in tomb Badari 3757 (Brunton 1930, 12–13, pl. 5). Finally, two strings of beads, UC26275 and UC26277, are from intact burial Qau 7323 that contained the bodies of one female and two children, and included a scarab-shaped seal amulet inscribed 'eldest king's son Isheq'. The scarab's back and the title and name combination indicate a Second Intermediate Period date. The strings contain carnelian, garnet, blue faience, bone, steatite, gold, and copper beads together with hollow gold barrel beads and a few gold ring beads. The copper rings on the restrung set of beads UC26277 seem to be the items recorded as being found in the mouth of the child named body B, even though the rest of the beads from that individual were strung as UC26275 with the items found with the body of the other child, named body D (Brunton 1930, 9).

The crescent bead UC26052 was obtained by hard soldering gold sheets. Two details of the mounting are shown in Figure 9.30. One half disk was joined to a tube made by rolling a gold sheet. A bent strip of gold was soldered at either end of the tube. Signs of use-wear are visible on the bead's surface.

The four coiled gold wires UC26019 with different diameters could be intended as earrings or hair rings. A coiled wire of small diameter is mounted inside a coiled wire of larger diameter. There are no distinct signs of wear. The observation of the wires under the steromicroscope reveals the presence of overlapping creases and longiditunal seams, shown in Figure 9.31, which can be associated to hammering and rolling. The wire ends, where the hole corresponding to the hollow body can be seen (Fig. 9.31), are thinner.

String of gold beads UC26019 contains barrel and ring beads and one double tubular bead (Fig. 9.32). At either end of the string can be seen a half hollow spherical bead. If originally soldered, they would have formed one hollow spherical bead. If the string was a necklace closed without a clasp, the double tubular bead – two gold tubes made by rolling a gold sheet and joined by hard soldering – should appear under the chin. However, the diameter of the necklace in such an arrangement would then have been too small

Figure 9.29. *Gold jewellery from two tombs excavated in the Qau region, in the collection of the Petrie Museum. On the top (left) the string of ring and barrel beads joined by a double tubular bead (UC26019) and (right) the two composite coiled spiral rings (UC26018) from tomb 3757 at Badari. On the bottom one crescent bead between one serpentine scarab and one steatite scarab (UC26052) from tomb 7352 at Qau.*

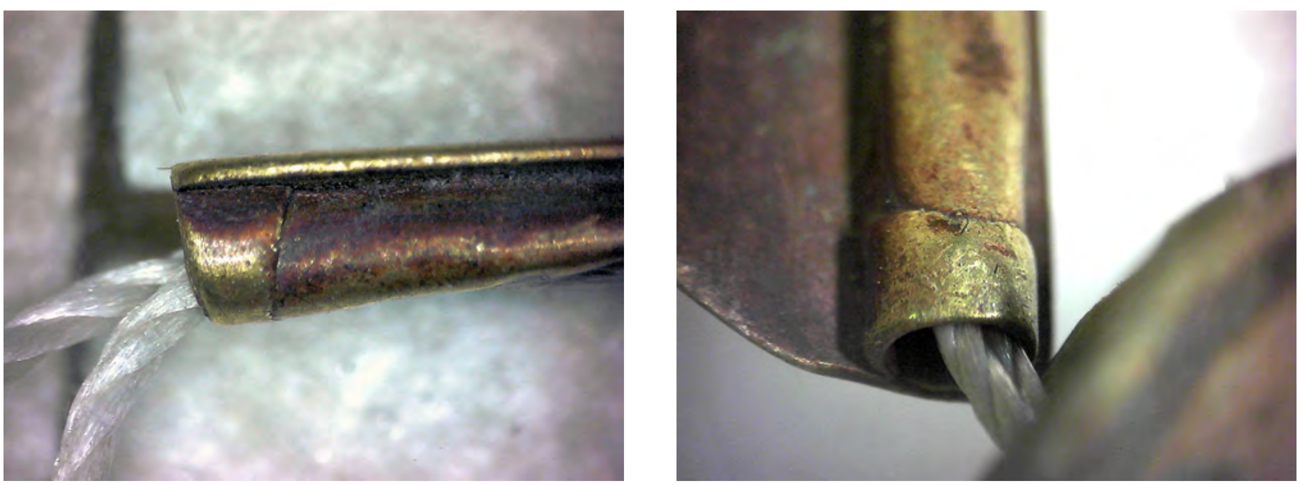


Figure 9.30. *Details of the mounting of crescent bead from tomb 7352 at Qau (UC26052).*

for the individual's head. As such, the most probable explanation is that the very heterogeneous beads were originally strung in different strings.

The variation of the barrel bead shapes and dimensions can be seen in Figure 9.33. The different marks and levels of wear at the surface of these beads – also shown in Figure 9.34 – seem to favour the suggestion that they were originally included in different strings, next to beads made from different materials and with holes of different diameters. Some specimens have particularly enlarged and deformed holes, typically caused by compression against adjacent beads when worn. Most of them show curved scratches from rotating against each other, and a few some dents and cuts that also result from friction. The barrel beads are made by bending sheet gold. No signs of solder could

Figure 9.31. *Details of the coiled wires from tomb 3757 at Badari (UC26018).*

Figure 9.32. *The double tubular bead made by soldering two gold tubes and some of the barrel beads with visible marks of use wear in the string from tomb 3757 at Badari (UC26019).*

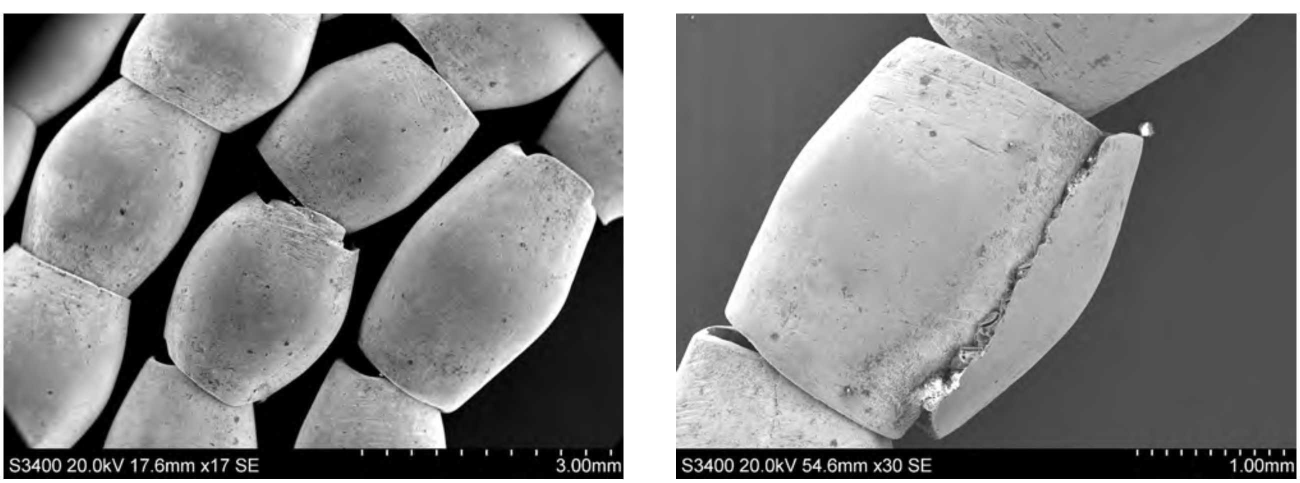


Figure 9.33. *The different forms of the barrel beads in the string from tomb 3757 at Badari (UC26019) and the joining of the bent gold sheet. Wear marks are visible.*

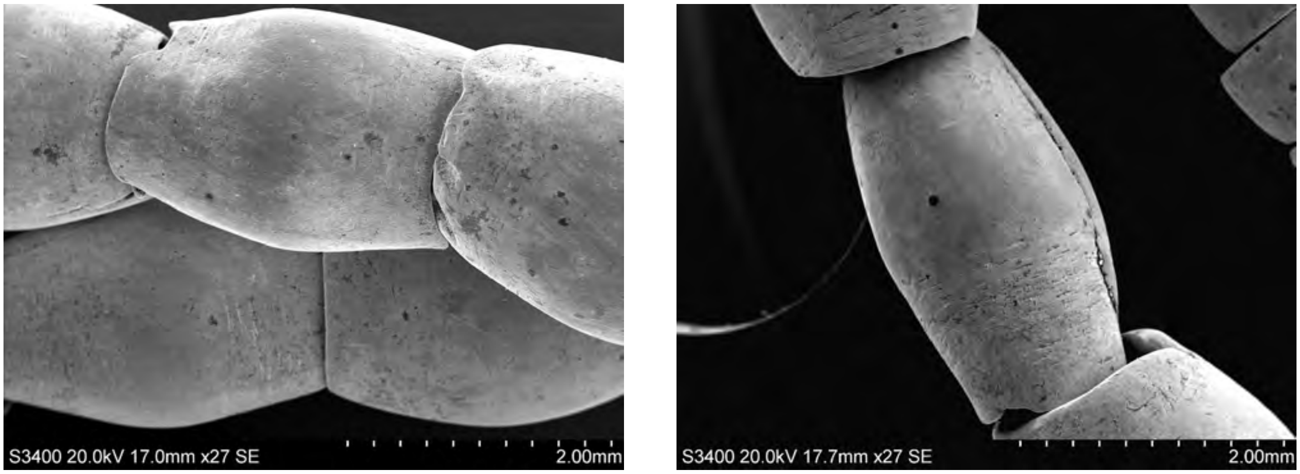


Figure 9.34. *Some of the barrel beads in the string from tomb 3757 at Badari (UC26019), showing marks of wear from use.*

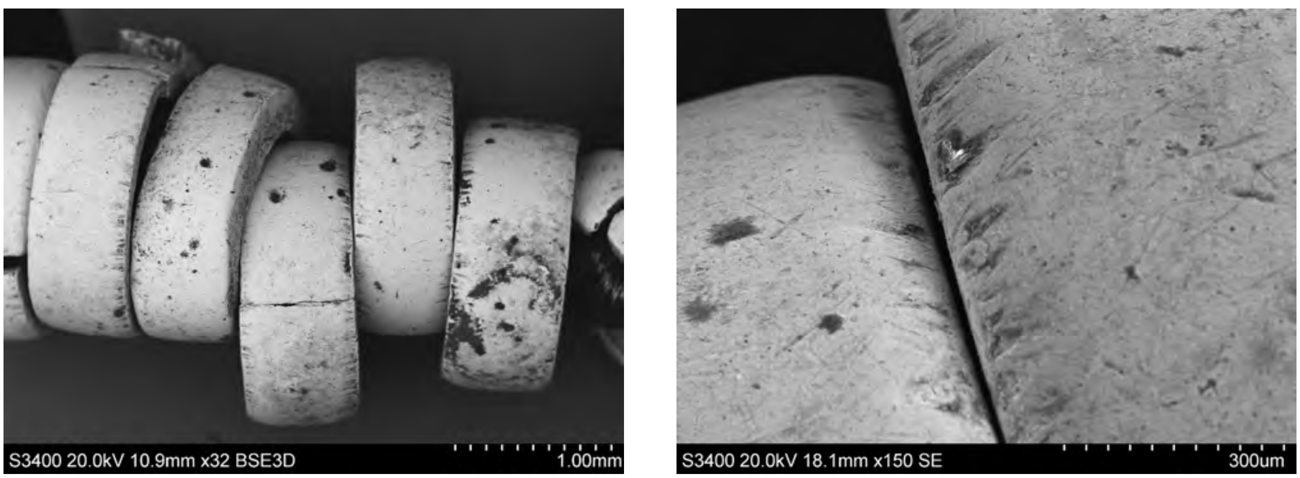


Figure 9.35. *Some of the quite regular small gold beads in the string from tomb 3757 at Badari (UC26019) showing tool marks at the ends.*

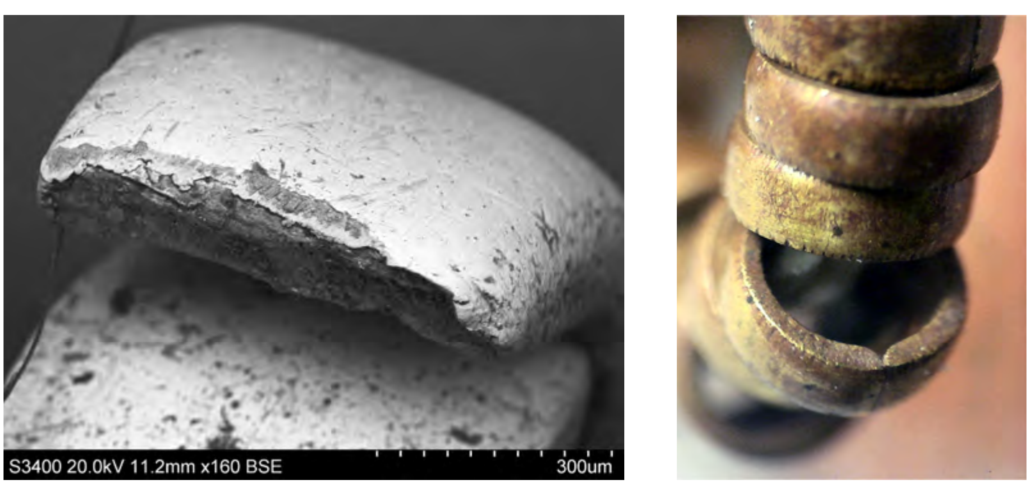


Figure 9.36. *On the left, one of the tiny beads containing probably the tool mark from the cutting process in string UC26019. On the right, the 'V' shaped edge and the deep marks visible at both ends of the small ring bead edges.*

Figure 9.37. *Ring and barrel beads in string UC26275. Some of the barrel beads contain visible PGE inclusions and marks of significant use wear.*

be found at the edges, although the presence of dirt made examination difficult.

Contrary to the barrel beads, the small ring beads are quite regular, showing sometimes small marks at both ends (Fig. 9.35). These marks can be associated to cutting, perhaps with a blunt tool, the strips of gold wrapped around a former to release the individual beads (see Fig. 7.4) , as suggested by Reisner (Reisner 1923, 283) for the manufacture of this type of beads. Further discussion on possible methods of bead manufacture is provided in Chapter 7. Marks of abrasion at each end are also visible. A closer look at these beads, as shown in Figure 9.36, reveals that they have a 'V' shaped edge. No signs of solder could be found at the joining seam.

The two strings of beads UC26275 and UC26277, from burial 7323, also contain barrel beads and ring beads in gold. Some examples are shown in Figure 9.37. Several PGE inclusions are visible at the surface of the beads and many barrel beads have signs of significant use wear. The few ring beads are of different sizes and of the two expected typologies. Similarly to the barrel beads from tomb 72 excavated at Haraga (see Chapter 8.2), the majority of those contained in these strings are made by rolling a rectangular gold sheet. The barrel beads in one string found in the excavations of Mari, and dated to the early 3rd millennium BC are also made using this technique (Nicolini 2010, 223–4, pl. 316), demonstrating its early use. The barrel beads of necklace UC26275 have marks of wear. The surface marks that can be seen at both ends of the beads suggest, similarly to the barrel beads in string UC26019 shown in Figure 9.34, that originally many of them were placed between other beads, certainly made from materials of higher hardness than gold and with smaller diameter holes.

Jewellery bearing the names of Kamose and Seqenenra Taa

One gold shell pectoral bearing the name of king Seqenenra Taa and one oval flat gold pendant bearing the name of king Kamose were also considered in this study. The presence of the cartouches allows us to assign these objects to the 17th Dynasty.

The oval flat pendant bearing the name of Kamose (UC11850), shown in Figure 9.38, consists of a mounting of sheet gold. One gold sheet where the king's name was inscribed is soldered to a back gold sheet cut at the top and bent, also to serve as suspension ring. As

Figure 9.38. *Oval gold pendant bearing the name of Kamose in the collection of the Petrie Museum, UC11850.*

Figure 9.39. *Details of pendant UC11850 showing the suspension ring made by rolling the gold strip.*

shown in Figure 9.39, the suspension ring has a different colour as well as the area that surrounds it, which shows signs of overheating. The high temperature obtained during the joining process of addition of a back sheet, perhaps carried out more recently to transform the cartouche into a pendant, resulted in a change in colour of a large area around the suspension ring.

The cartouche of Kamose seems to be inscribed in repoussé on the today highly altered surface of the gold sheet. The pendant form resembles the bezel of a cartouche-shaped finger-ring, but in the period concerned oval signet rings were frequently cast and chased. The gold sheet bearing the name of the king could have been cut from an originally larger sheet employed in another type of ornament.

The gold shell-shaped pendant UC11847, shown in Figure 9.40, inscribed with 'Son of Ra Seqenenra Taa given life' is unique for the 17th Dynasty until the time

Figure 9.40. *Gold shell pendant with the cartouche of Seqenenra Taa in the collection of the Petrie Museum (UC11847). The suspension ring is made by soldering a bent strip of gold to the top of the shell.*

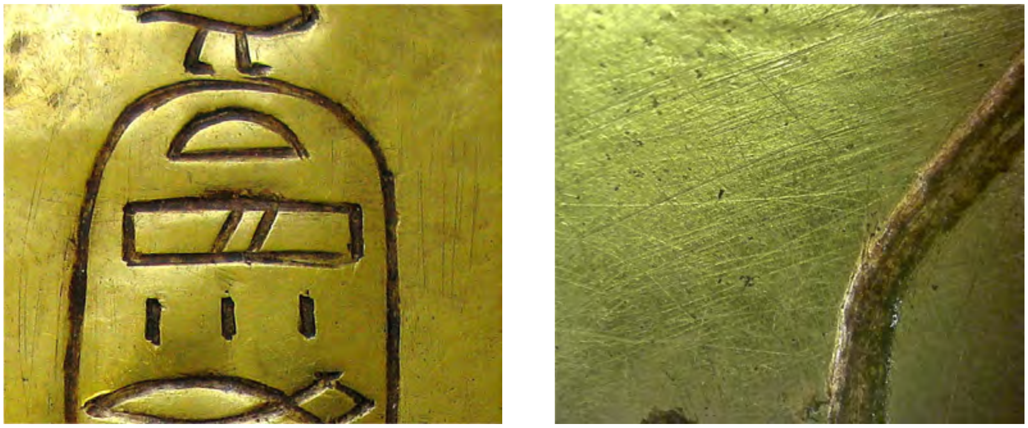


Figure 9.41. *Details of the inscribed motif of gold shell pendant UC11847 showing marks related to the use of an abrasive cleaner.*

of queen Ahhotep (Petrie 1917, 25, pl. 23). As shown in Figure 9.40, the pendant consists of a gold sheet to which a bent strip of gold was added by hard soldering to serve as suspension ring. This suspension ring is quite irregular and the join is very thick.

The cartouche of king Seqenenra Taa was inscribed on the shell. Around the cartouche can be seen many linear marks related to polishing along the motif, as shown in Figure 9.41, which may reflect the use of an abrasive cleaner. The boundary lines that outline the motif, formerly probably traced by chasing, still seem present in some areas. The tool marks are not very visible, because they are covered with a reddish substance. The XRF analysis of an area where the motif was contained indicates the presence of iron, but further analysis with higher spatial resolution equipment is necessary to confirm the presence of this element.

Indeed, the form of some lines indicates the use of chasing, for example in some of the hieroglyphs and the parallel lines under the cartouche, as shown in Figure 9.42. However, this does not mean that chasing was the only technique that was used to do the motif. Some details, for example the boundary line under the duck (Fig. 9.42), correspond to the use of engraving.

Observation of the reverse of the pendant reveals interesting features. Part of the motif, and in particular the cartouche, is visibly drawn. Figure 9.43 shows that the cartouche contour seems outlined, the gold sheet cracked in some parts (when engraving or chasing the motif?), and the different areas where the hieroglyphs were drawn seem to be predefined using a liner. Those guide marks are commonly used to define in the reverse of the objects the areas to be raised in

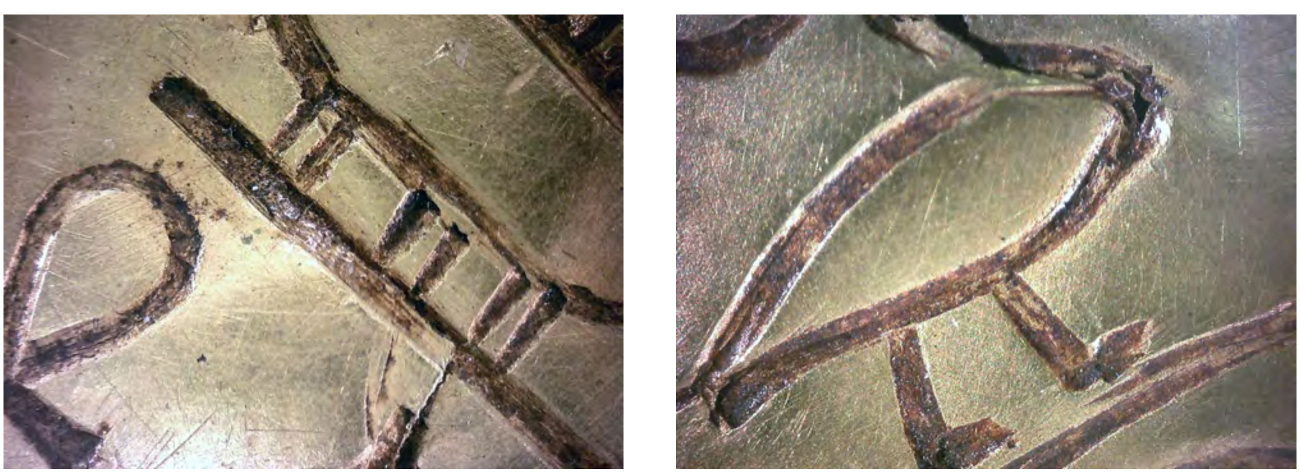


Figure 9.42. *Details of the motif inscribed in gold shell pendant UC11847, showing the tool marks corresponding, on the left, under the cartouche, to the use of chasing and on the right, under the duck's feet, to the use of engraving.*

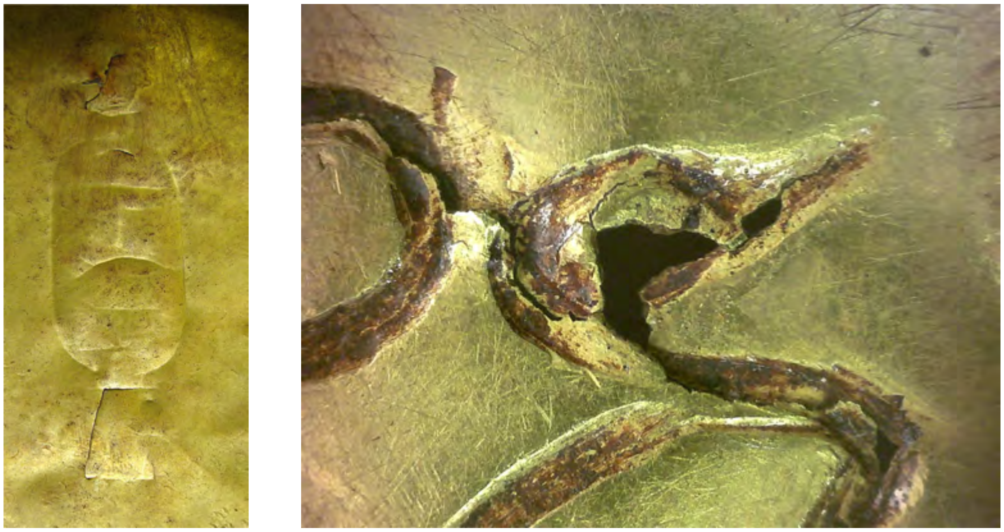


Figure 9.43. *Details of gold shell pendant UC11847, showing the guidelines of the motif and the cracks in the gold sheet.*

repoussé; however, given that this technique does not appear to have been employed here, the presence of these purported lines is harder to explain.

The gold alloys

Data obtained by XRF for the Second Intermediate Period gold items in the collection of the Petrie Museum are summarized in Table 9.11 and plotted in Figure 9.44. These also include the composition of two scraps of gold foils (UC42860) from the excavations of tomb 52 or tomb 62 (findplace not indicated in the published report, Peet 1914, 59) in cemetery C at Abydos, dated to the Second Intermediate Period.

The high copper levels of the oval pendant UC11850 stand out, in particular the front sheet where the cartouche was inscribed; also notable are the high silver contents of this pendant and of crescent bead UC26052. All the other objects contain lower copper contents, under 3 wt%, within the more common range of alloys employed in Egyptian workshops.

Because of their relatively large analytical spot, the mobile XRF systems used in this study for *in situ* analysis are not particularly well-suited for the

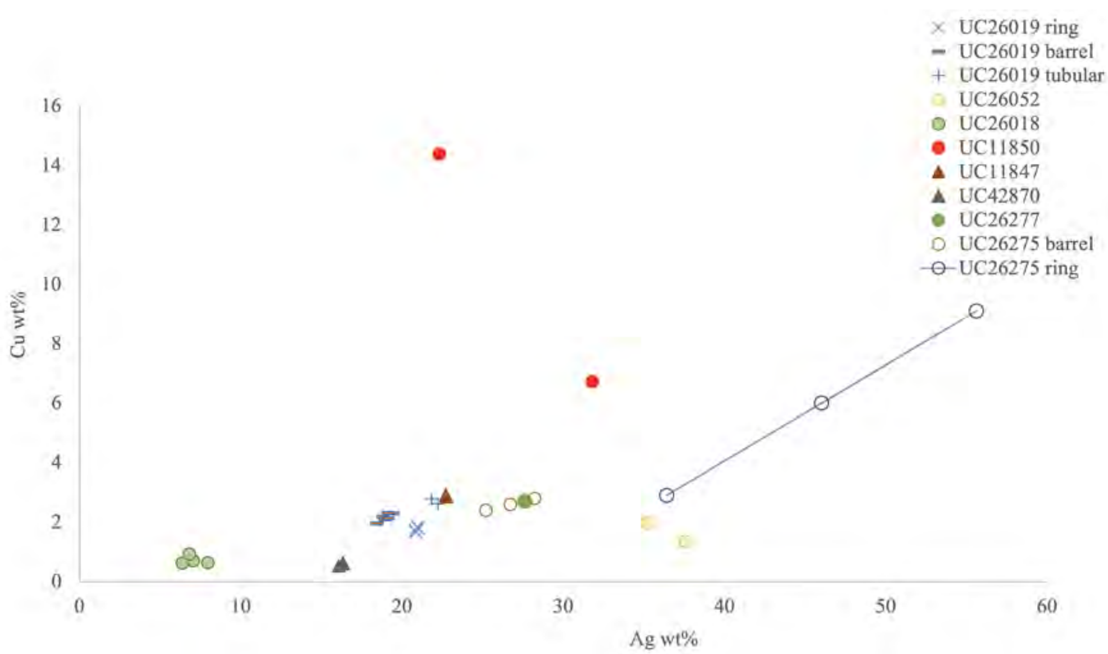


Figure 9.44. *Silver versus copper contents obtained by XRF for the Second Intermediate Period jewellery in the collection of the Petrie Museum. The blue line illustrates the dispersion of the composition of the small beads of string UC26275.*

Table 9.11. *Results obtained by XRF for objects in the collection of the Petrie Museum from excavations at Qau, Badari and Abydos, and for the two items bearing the names of Kamose and Seqenenra Taa.*

Acc. No.	Au wt%	Ag wt%	Cu wt%
UC26052			
sheet	62.8	35.2	2.0
tube	61.1	37.5	1.4
UC26019			
ring beads	77.2	21.0	1.8
	77.5	20.8	1.7
	77.2	21.0	1.8
	77.5	20.8	1.7
	77.2	20.9	1.8
barrel beads	79.0	18.9	2.1
	79.0	18.8	2.2
	78.3	19.4	2.3
	78.5	19.2	2.3
	78.8	19.1	2.1
	79.6	18.4	2.0
double tubular bead	75.2	22.2	2.6
	75.4	21.8	2.8
UC26018			
small spiral A	93.0	6.4	0.6
big spiral A	91.4	7.9	0.6
small spiral B	92.3	7.0	0.7
big spiral B	92.3	6.8	0.9
UC 11850			
front	63.3	22.3	14.4
back	61.5	31.8	6.7
UC11847			
ring	74.4	22.8	2.9
shell	74.4	22.7	2.9
UC42870			
	83.7	16.3	0.6
	83.7	16.3	0.6
	84.0	16.1	0.5
UC26277	70.8	27.6	2.7
UC26275			
barrel beads (average)	71.8	26.7	2.6
σ	1.7	1.5	0.2
ring beads (average)	49.8	46.0	6.0
σ	10.6	9.6	3.1

analysis of thin solder joints. However, the higher copper content obtained for an area of the double tubular bead in string UC26019 containing a join made by hard soldering denotes the use of a solder alloy containing a higher copper content than the gold base alloy.

The alloys of the ring and barrel beads from string UC26019 are quite homogeneous, in spite of their different typologies. They match well the composition of the shell-shaped pendant UC11847 bearing the cartouche of Seqenenra Taa. String UC26019, pendant UC11850 and crescent bead UC26052 contain more than 20 wt% Ag. The two scraps of gold foils UC42860 also contain high silver contents, about 16 wt%. The coiled wires from Badari UC26018 are made from alloys containing higher gold contents.

The barrel beads in strings UC26275 and UC26277 are also quite homogeneous in composition. On the contrary, the few ring beads from necklace UC26275, containing quite high silver contents, are dispersed in the diagram. The three points in the diagram, linked by a blue line, illustrate the spread of the values obtained. The spread is perhaps caused by the presence of specimens of different sizes and shapes, suggesting different batches and a possible reuse of ring beads (see Chapter 7); however, we should note that data obtained by XRF on such small and irregular beads has higher uncertainty.

The copper and silver levels in part of the analysed objects are those expected for unrefined alluvial gold alloys. The use of this type of gold is confirmed by the presence of PGE inclusions at the surface of all the objects, except UC11847 and UC11850. PGE inclusions are particularly numerous in the beads from string UC26019, which also show marks of intense use-wear.

The variation observed for the alloys employed in the production of this jewellery is comparable to that seen in other objects from the Second Intermediate Period presented in the previous sections of this chapter. In Figure 9.45, we plotted the objects in the collection of the Petrie Museum (excluding the ring beads), together with the group from Qurna (Chapter 9.2), the items bearing the names of Ahhotep and Ahmose in the collection of the Louvre Museum (Chapter 9.4), and the string of beads E.2380 from Abydos in the collection of the Garstang Museum (Chapter 8.6). The jewellery in the collection of the British Museum (Chapter 9.3) was also plotted, but it is all included in an area corresponding to about 10–17 wt% Ag. The oval pendant with the cartouche of Kamose was excluded, because one of the gold sheets contained atypically high copper contents.

The plot shows that the majority of the objects dated to the Second Intermediate Period contain less than about 35 wt% Ag, with variable copper contents, ranging between 1 and 6 wt%. The shell-shaped pendant bearing the cartouche of Seqenenra Taa matches quite well the other objects in the diagram.

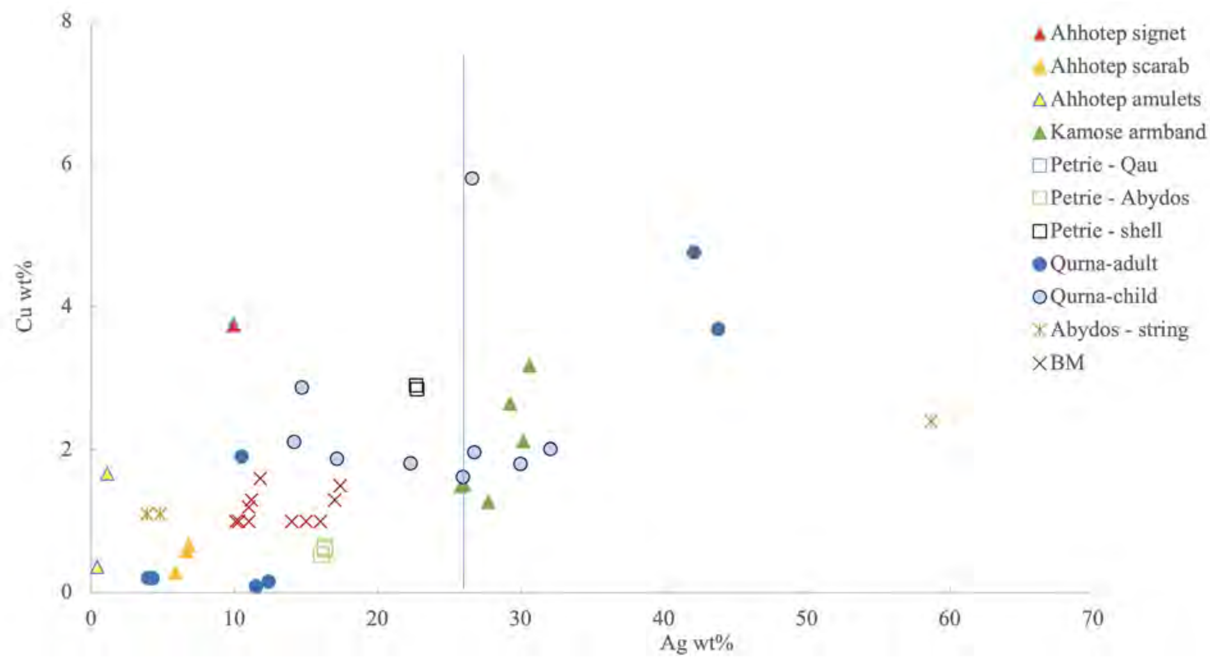


Figure 9.45. *Silver versus copper contents obtained by XRF, μPIXE and SEM-EDS for the objects dated to the Second Intermediate Period. To the data plotted in Figure 9.44 was added the Qurna group (Chapter 9.2) and the jewellery bearing the names of Ahhotep and Ahmose (Chapter 9.4).*

This indicates that the shell-shaped pendant can be considered as made from a 'common Egyptian gold alloy' despite the unexplained technique employed in the cartouche inscription. Even though high amounts of silver were recorded for several contextualized objects, such as the components of an armband from the burial of Kamose at Dra Abu al-Naga and bearing the name of Ahmose, and the crescent bead UC26052 from Qau, the girdle from Qurna still contains the highest silver contents so far observed for objects dated to this period, together with a few ring beads from string UC26275 (found in grave 7323 at Qau) and one barrel bead from string E.2380 (found in tomb 492 at Abydos). It has to be noted for these strings that the beads show many wear marks. Alloys containing high silver amounts are well represented in the jewellery from the 12th Dynasty tomb 72 excavated at Haraga (see Fig. 9.28). This supports the proposition that these heavily worn out items (or components of items) could constitute either a Middle Kingdom production or an early Second Intermediate Period production made with a probably 'traditional' pale yellow gold.

The other items of the adult's jewellery from Qurna are made with alloys similar to those employed in the production of the gold spirals UC26018 from Qau, the foils UC42860 from Abydos, and the blue scarab bezel bearing the name of Ahhotep. The signet ring in the collection of the Louvre Museum bearing the name of this queen and presenting signs of intense use wear falls in the same group, but contains slightly higher copper contents.

Conclusions

The study of the two unprovenanced pendants bearing the names of kings Kamose and Seqenenra Taa revealed unexpected manufacturing details. While the oval pendant UC11850 contains high copper and silver contents, the shell-shaped pendant UC11847 is made from an alloy 'common' in Egypt. The Seqenenra Taa cartouche could be a recent addition to an ancient undecorated gold shell, but the suspension ring could be part of the original mounting, since it is made using the expected technology and the same alloy as the shell.

The ring beads recovered from excavations at Qau are representative of the two different sorts that were identified in jewellery from previous periods. They also contain tool marks already observed in earlier productions. The ring and barrel beads in string UC26019 are heterogeneous in shape, dimensions and type of wear marks, but made from quite homogeneous alloys, such as those from strings UC26275 and UC26277. Containing the most numerous PGE inclusions observed, the beads in string UC26019 also show the most intense signs of use-wear that could be identified in the jewellery in the collection of the

Petrie Museum analysed in this work. The coiled wires found in the same tomb were made by hammering and rolling as already observed for other Egyptian items. Finally, the crescent bead from grave 7352 at Qau, a rather skilled product of hard soldering gold sheets, has some signs of use-wear.

Almost all the contextualized objects contain the expected amounts of silver and copper for unrefined alluvial gold. All of them contain PGE inclusions, confirming the use of alluvial gold. The gold alloys employed in the manufacture of those objects match those employed in the production of other Second Intermediate Period jewellery: some items are made from gold alloys containing low silver contents and others are made from electrum alloys, sometimes containing higher copper contents.

As mentioned, and similarly to what was observed for other jewellery from this period, we could notice for the objects in the collection of the Petrie Museum quite different levels of use-wear. The ring and barrel beads in string UC26019, which have the highest number of PGE inclusions and contain about 19–21 wt% Ag, show the most intense evidence of wear. This situation was observed for the components of an armband found at Dra Abu al-Naga inside the coffin of king Kamose, which contain 25–31 wt% Ag (see Chapter 9.4). In the case of the Qurna burial, the most intense marks of wear are present in the adult's girdle, made from wallet and ring beads containing 52–53 wt% Ag. Therefore, it is possible that along with 'new' yellow gold alloys, the quite pale yellow 'Middle Kingdom alloys' could still be in use at least in the first years of the Second Intermediate Period. It is also possible that these alloys could have been recycled without mixing for direct reuse during the early years of the Second Intermediate Period; subsequently, perhaps progressively and depending on access to gold, they would have been 'diluted' in the mass of gold used in the production of jewellery. We should also consider the possible reuse be restring of common components of old gold strings, such as spacers.

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