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CONSERVATION AND INVESTIGATION OF AN ANCIENT HUMAN BURIAL AT ABYDOS, EGYPT

LUCY SKINNER, CORINA ROGGE, ISLAM SHAHEEN, AND SALIMA IKRAM

Excavations at Abydos during 2012 uncovered several graves in the sand at the base of a giant dune in the North Cemetery, including one well-furnished human burial from the Middle Kingdom (around 1800 BC) requiring urgent conservation intervention. The conservation and investigation of this burial is the focus of this article.

The first phase of the project took place in 2012 and combined field conservation, block-lifting the body within the remains of the coffin, and transfer of the “block” to the on-site magazine at Abydos. Thanks to a grant from the American Research Center in Egypt, a small team returned to Abydos for five weeks in 2015 and three weeks in 2016 to complete the treatment, analysis, and investigation of this and other bio-archaeology remains. Careful planning was essential throughout the project to ensure that we had sufficient materials (both imported and sourced locally in Egypt) and suitable personnel in the field to carry out conservation treatment and investigation of the burial. Analytical equipment, including a Bruker portable x-ray fluorescence spectrometer and an Agilent portable Fourier transform infrared spectrometer, were imported to enable scientific analysis and materials investigation in the field. The project was ambitious in its aims, striving to demonstrate that rigorous and high-quality research is possible in a challenging environment (regarding both logistics and resources) through the application of determination and ingenuity.

KEYWORDS: Archaeology, Egyptology, Field conservation, Block-lift, Human remains, Bio-archaeology

1. INTRODUCTION

Abydos is an ancient Egyptian sacred site containing temples, cemeteries, and settlements, situated about 6 miles from the west bank of the river Nile, at 26° 10’ N, in Upper Egypt (O’Connor 2011). Professor David O’Connor at the Institute of Fine Arts, New York University (NYU-IFA), holds the permit to excavate at a part of Abydos, and for several decades this has allowed research teams from various universities and museums in the United States to carry out excavation and research there. The primary goal of the North Cemetery excavations, directed by Dr. Matthew Adams over the past 15 years, has been the conservation and stabilization of the important mudbrick structure—the Shunet el Zebib. The Shunet el Zebib (fig. 1) is the last of the second dynasty monumental mudbrick funerary enclosures in the Northern Cemetery and was built for King Khasekhemwy (ca. 2611–2584 BC) (O’Connor 2011).

During the 2012 season, excavations were carried out on the northern side of the Shunet in advance of and to facilitate the mudbrick restoration work on the Shunet’s north wall. Conservation has been an integral part of the NYU-IFA project since at least 2000. The primary author has been coming to Abydos since 2009 and has developed a deep understanding of the materials, the technology, and, most importantly, the vulnerability of the artifacts commonly excavated at Abydos.

Since it spanned three excavation seasons, the team involved in the project was large and it varied considerably over the years. The main participants include Lucy Skinner, principal investigator and lead conservator; Corina Rogge, conservation scientist at the Museum of Fine Art, Houston; Salima Ikram, bio-archaeology expert, x-ray operator, and professor at American University, Cairo; and Islam Shaheen, imaging specialist and conservator working at the Grand Egyptian Museum. Others mentioned in this article include Mohamed Ibrahim, who was the conservation assistant during 2015 and 2016, and Deborah Vischak, the archaeologist who excavated the grave.

In preparation for the restoration of the Shunet el Zebib, everything at the foot of the wall had to be cleared away to prevent the destruction of any antiquities that lay buried beneath the desert’s surface. This revealed two coffins, complete with human remains. The focus of this article is on one of the two coffins and its contents that were excavated during the 2012 campaign, and conserved and investigated in the summers of 2015 and 2016. It is an account of a modern conservation treatment and investigation.
with unexpected discoveries and tantalizing results in a challenging archaeological field environment where such conservation intervention and archaeometric investigation is rare.

2. DISCOVERY AND EXCAVATION

2.1 DISCOVERY

It is common in excavations around the Shunet to find isolated burials dating from the Middle Kingdom or younger. In the second week of excavations, it quickly became apparent in one of the excavation squares that three rectangular wooden panels lying on the ground next to each other formed the composite lid of a coffin—possibly originally sourced from wooden boxes or reused from other coffins (Cooney 2008). Once the decayed wood was drawn and carefully removed, it was possible to see the rim of a rectangular box coffin underneath.

This small, crooked box (190 x 45 cm) was patched together in three sections, in a similar fashion as the lid. It could originally have been a smaller coffin that was cut in two and lengthened with a central panel to fit a larger body. It was oriented east-west along the line of the Shunet’s external wall. At first, the distorted shape of the coffin led us to believe that the grave had been robbed in antiquity, but we came to believe it is more likely that the shifting sand of the dune above and around the coffin caused this deformation (it is possible to see the distortion in figure 11).

As Dr. Debbie Vischak, the archaeologist, proceeded to excavate to the right side of the coffin, the top of a small basket was exposed. Termites had long since devoured almost all of the vegetable fibers from the coil-formed basket (termites are a particularly common form of deterioration to organic artifacts at Abydos). This left behind a fragile shell over frass, interspersed with a few grass fibers in the shape of the basket. Once conserved, the contents of the basket were revealed (fig. 2). Inside and spilling over the side was a string of blue faience beads held together with the original thread. Some unidentified dried vegetal material, a faience cylinder bead, and a faience scarab bead were also discovered inside.
The scarab has a small piece of original cordage sticking out of it. The hieroglyphs on the scarab have been studied by the epigrapher Bryan Kramer, revealing the name of a known Middle Kingdom official, Senebsumay, who was the royal seal-bearer of [undeciphered]. Based on this official’s name, the grave was dated to around the end of the 12th to the beginning of 13th dynasty (1800–1700 BC) (Martin 1971).

To the north of the coffin, we found two clappers made of hippopotamus tusk (see fig. 2). To form a clapper of this type, the entire tusk would be sawn down the length, creating slivers of about 0.5 cm thick. A hand shape with fingernails and a bracelet design would be carved into the pointed end, and finally the carving would be polished (the sheen has survived burial). This type of ivory object (although often decorated in a different way) has been found in other graves from the late Old Kingdom through to the New Kingdom, including several at Abydos. Clappers have frequently been found together with wood or ivory female figurines and copper alloy mirrors (although not in this case), and may have been utilized in mortuary temples by Hathoric priestesses who danced for the dead king in his semblance of Re (Morris 2017).

Several of the fingertips on the clappers are broken and smoothed off, indicating that the initial damage occurred in antiquity and continued use in religious ceremonies wore the break edges down. They are not size matched and may have come from tusks of different animals, which is curious, because often a matching pair of clappers were cut from one hippo tusk (Krzyszkowska and Morkot 2000), although size can vary depending on from where on the tusk it is sliced. Pressure exerted in the grave had caused one of the clappers to be snapped in half. After rejoining the two halves using Paraloid B72, the clappers were packed carefully and have been registered and taken to the government store near Sohag.

A second basket was also found, originally placed near the foot on the northeastern side, on the exterior of the coffin. This one was difficult to recognize as a basket because it looked like a lump of termite frass attached to the coffin side. The basket must have tipped over in the grave, as the contents were found spilling out underneath it. These included three miniature vessels carved from Egyptian
alabaster (calcite) (see fig. 2, top middle). One had a chipped calcite lid, held in position on top with a textile strip, inside of which was the powdery remains of black kohl eye makeup. A sample of the powder from inside was collected for analysis. The other two (one of which was a double-bodied vessel) contained the remnants of some sort of paste or dried liquid. These items were also registered and taken to the government storeroom. Ideally, the human remains will be reunited with these artifacts in the future to allow future researchers the possibility of examining the entire assemblage while acknowledging the “deep interconnectedness of these different elements in the grave” (Balachandran 2009, 202).

Among the other items formerly inside the second basket were a large number of what appeared to be berries and seeds (food for the deceased); two tiny, fish-shaped beads (see fig. 2); a small, rectangular, gray stone object with many parallel striations along and around its edges (a model palette, maybe for grinding makeup); a tiny, smoothed, black stone with a flat face (possibly a model grinder to go with the palette); and last, a smooth, rounded, light-brown lump of an unidentified material (see fig. 2).

2.2 EXCAVATION AND CONSERVATION OF SMALL FINDS

The basket and objects discovered in the vicinity of the grave were stabilized in the field before being carefully excavated and taken to the dig house for further treatment.

The small basket was consolidated in the field using Paraloid B72, 3% in (75:25) acetone:ethanol. Once stable, it was undercut with a stiff plastic board (created by cutting down a flexible plastic chopping board) to support it from underneath and prevent collapse. In the dig house, sand was excavated from in and around the basket to reveal the degraded remains of the fibers. A solid, dark organic fragment on one side may have been the basket lid.

Once cleaned in the conservation lab, all items were photographed. Analysis of the artifacts remaining at the dig house took place in 2016.

While continuing to clean within the grave, Dr. Vischak was surprised when a beaded headband emerged from the sand. A visual assessment quickly revealed that the beads remained wrapped around the head of a well-preserved skull. We proceeded to clean the burial, removing sand from inside the coffin (fig. 3). The body was revealed, wrapped in the remnants of textile with pieces of skin in position and perfectly preserved braided hair still attached to the head.

2.3 IN SITU CONSERVATION AND BLOCK-LIFTING THE BURIAL

Although extremely fragile, the exceptional state of preservation of the burial and the information that could be retained by removing it from the ground as a unit warranted a departure from conventional dissociative archaeological methods.

Leaving the burial in the ground and preserving it in situ was not an option due to the potential risk of looters and because of the proximity of the burial to the Shunet wall where there was high risk of damage from the overlying mudbrick conservation campaign. Therefore, it was necessary to block-lift it in its entirety. This was done by building a box around the burial, filling the empty space around and above the coffin and human remains with expanding foam to create a firm structure, and undercutting the entire block for transport back to the dig house. The following is a description of this process:

- The fragile, fragmentary, and wobbly state of the coffin and the absence of decoration on its surface helped us decide, after documentation, to reduce the height of the coffin walls using a craft knife and spatula to facilitate excavation of the skeletal remains.
- Cyclododecane (CDD) was melted in a double boiler over a butane stove and brushed over cotton gauze strips applied to the coffin and the body to consolidate their surfaces (fig. 4). This is a well-practiced method developed on archaeological sites in Egypt (Balachandran 2010; Skinner and Kariya 2017). The benefit of using CDD is that although it does function in a strengthening capacity, it also has the ability to sublime at room temperature. This means that
once the burial had been block-lifted and transported, we could be reassured that the consolidant would gradually disappear, leaving no residue.

- Once the edges of the burial were protected as described, we dug away and leveled the surrounding sand so that the burial sat up on a pedestal.
- All surfaces of the burial were covered with aluminum foil to provide a barrier layer.
- A box design was drawn and constructed by a local carpenter, comprising a four-sided frame screwed together at the corners to ensure that it could be easily taken apart during the following stages. The inner surfaces of the box were lined with aluminum foil to prevent the expanding foam from sticking to them. The box was heavier than hoped for, but fit snugly when lowered over the prepared burial.
- Any undercuts around the body were filled with cotton wool. Wedges made of aluminum foil were placed down between the coffin and the wooden box to fill space around the coffin and economize on the amount of foam needed to cover the burial, and a two-part expanding urethane foam was mixed and poured on and around the coffin to support, stabilize, and fix everything
together as one (fig. 5). The foam was poured first, thinly, in a single layer into the cavity around
the side of the coffin and then over the surface of the body. This gave the foam room to expand
upward, rather than sideways, preventing pressure being exerted on the burial itself. Once it had
fully expanded and cured, additional foam was added where necessary on top until the burial was
covered. There was not enough foam to fill the box, but at this stage it was not necessary.

Once the foam had fully set, we were ready to perform the block-lift, the first part of which was
“the undercut.” Iron guidance rods were first hammered through at intervals underneath the box until the
point of the rod was visible on the other side (fig. 6).
The local blacksmith prepared three thick, sheet-steel plates, each with two metal loops welded to one edge. These plates were lined up on top of the iron guidance rods and hammered underneath the wooden box until they stuck out the other side. A scaffolding pole was slotted through the loops, creating a useful handle (fig. 7). Fortunately, we only had to insert the metal plates through sand, but it still was not easy to get them all the way underneath and out the other side. Once undercut, the box, with the metal plates now forming the base, was slid across to a wooden board and transferred to a large wooden lifting cradle.

One of the most rewarding elements of being at Abydos is working alongside the local Egyptian archaeologists and workmen with their endless enthusiasm and enormous strength. The team bonded while taking turns to carry the extremely heavy burial box on the cradle over 500 m to the storage magazine (fig. 8), while others followed issuing encouragements and forming the entourage.

Back at the dig house, a lid was constructed for the box to protect the burial until the time of our return.

3. CONSERVATION AND INVESTIGATION IN THE FIELD-LAB

A grant received from the American Research Center in Egypt enabled work to continue on this burial as part of the Abydos Bio-archaeology Conservation project. The aim was to stabilize the burial both from below and above, investigate the coffin construction, and conserve the human remains, preserving them for the future. It may sound extreme, but it was decided that the burial needed to be turned over to conserve the coffin and construct a secure mount from underneath. The author’s previous experience working in Egypt has shown that no matter how well the top surface of an Egyptian coffin panel is conserved, if the underside is not stabilized and mounted on a secure base, it is unlikely that the object will survive long-term storage due to compression damage and subsequent slumping and movement of material.

The second stage of the project was supposed to take place during 2014 but was delayed for a year as a result of security issues in Egypt, and finally happened during the summer of 2015. A plan was set in motion, and most materials required were purchased in Egypt and transported to Abydos overland.
3.1 INVERSION AND STABILIZATION OF THE COFFIN BASE

The first and most nerve-racking part of this stage involved inverting the burial box. But first, to secure the burial firmly inside the burial box without adding to its weight, expanding foam (cans of commercially available wall cavity-filling foam, obtained in Cairo) was squirited into the box, along with chunks of Ethafoam and mattress foam put in to decrease the volume needing to be filled. The box was
filled almost to the top with foam, leaving space for the foam’s expansion, and the lid was secured back in position.

Ratchet tapes were strapped around the box and the wooden lifting cradle and ratcheted tight to hold everything together. Padding in the form of a heavy fiber mattress was added to the side of the box to cushion the turn, and with the help of Egyptian workmen, the burial and its cradle was rolled upside down. The inversion went smoothly, although there was a little further loss of sand from the base. After unfastening the ratchet tapes, the cradle was lifted off, followed by the three metal plates.

We began the process of removing loose sand, some of it dark and semisolidified—impregnated with body fluids—to reveal the underside of the coffin. The sides of the coffin were held in position by the expanding foam that had been applied from the top and had extended around the edges (fig. 9).

Clearly, the coffin was made of three sections, similar to the sides and lid, and painted red and black, just as the sides had been. Although now displaced, four cross braces would have originally lifted the base of the box coffin off the ground—a common design feature for Middle Kingdom coffins (Taylor 1989). The middle section of the coffin had slipped to the right side, and the central portion of the body, wrapped in textile, was lying on the ground, directly on the sand. A long unpainted plank of wood running along the length of the right side of the coffin base is what had kept the three sections of coffin together while it was carried to the burial site. Traces of linen textile found on the outside of the central section suggest that cloth strips may have been wrapped around the coffin to hold the three sections in place. Such strips are also used to secure coffins and to help move them (Ikram, pers. comm.).

After fully documenting the coffin base, it was selectively consolidated where needed. Mowital B60-H, a polyvinyl butyral available in the UK as an alternative to Butvar B98 (Butvar has a proven track record for the consolidation of dry wood [Spirydowicz et al. 2001]), and Paraloid B72 and were tested to gauge their effectiveness for strengthening the deteriorated wood. Alternative consolidants considered include methyl cellulose and a commercially available alkoxysilane (Conservare OH100) tested on decayed wood at Abydos in 2014 (Davis and Chemello 2014). Although these might be practical alternatives for smaller artifacts or when the darkening of paint surfaces is a concern, neither imparted a significant increase in strength to the large, heavy, and crumbly remains of the coffin base. Both Paraloid B72 and Butvar B98 were found to darken the wood (but this was not of great concern since the coffin base would be concealed), but only Paraloid B72 imparted sufficient strength and so was used at 10% in (50:50) ethanol:alcohol.

### 3.2 BUILDING A MOUNTING SYSTEM

Once the solvents had evaporated, we were ready to construct a mount for the coffin. In the spirit of minimal intervention, the aim was to create a solid base and rigid support while not permanently physically attaching (gluing) the mount to the coffin. This was carried out as discussed next.
CDD was melted using a method developed at Abydos by treating an electric kettle like a double boiler and setting a heatproof glass jar inside containing CDD crystals (Skinner and Kariya 2017). CDD was employed in this case for its hydrophobic properties—it was melted and painted over the coffin base in a solid layer, forming a temporary barrier layer that prevented the water-based adhesive Lascaux 498HV from soaking into the wood, and also protected the coffin from small amounts of hot water used during application of the X-LITE sheet in the subsequent step.

Next, a 1:1 solution of Lascaux:water was used to adhere a lining layer of spider tissue (machine-made mulberry fiber tissue) over the entire surface, over the CDD. We found that overlapping small rectangles of tissue, about 8 x 5 cm, ensured that the tissue conformed well to the surface.

To make sure that the tissue layer was thick enough to cover the base of the coffin without developing holes, a second layer of tissue was applied using local wood glue. In this way, the adhesive was made to go further, and even after the CDD has sublimed, any PVAC adhesive (not conservation grade) has been kept out of direct contact with the coffin and body.

Over the smooth and soft tissue layer, we directly applied an X-LITE sheet to give structure and support to the base. X-LITE is a rigid bandage material used in orthopedics. It takes the form of a mesh coated in a thermoplastic material, and when heated it becomes plastic and moldable. A molded support for the coffin was applied by dipping strips of the X-LITE in boiling water, shaking off the excess water, and pressing the X-LITE onto the coffin to conform to its shape.

Finally, we built up the level on the back of the coffin to create a flat support (fig. 10) using blocks, cushions, and columns of Ethafoam and blue (Egyptian-sourced) Styrofoam, held in position with bamboo skewers and the weight of the coffin. The box was sealed by placing a wooden board over the foam mount. Once the block was rotated upright again, this board became the base of the mount.

3.3 REMOVAL OF BLOCK-LIFTING MATERIALS

After the coffin box had been reverted upright, we removed the lid and began to unscrew the sides of the box. With one long side of the box removed, we were able to commence cutting away the expanded foam from over and around the body using craft knives. It came away easily thanks to the aluminum foil barrier layer put in place before the foam was poured, and because all undercuts had been padded out and filled. The remaining sides of the box were removed and the body slowly revealed, bit-by-bit, and cleaned with brushes and puffers (fig. 11). The aims of the 2015 season achieved, we readied the burial for a further year of storage in the bio-archaeology magazine.

The wooden box used for the block-lift was redesigned and put back together, this time with a drop-down door, creating a side opening. This made it relatively easy to slide the mounted burial and
pack the body away at the end of the 2015 season, ready to be taken out again in 2016 for the next stage—the investigative part of the project.

3.4 CONSERVATION OF THE BODY, SANDY ENCASEMENT, AND COFFIN

Even though most sand had already been removed from the burial while it was still in the ground, there was still sand remaining that was removed using teaspoons whose handles had been bent to create scoops. Consolidation was kept to a minimum but was necessary for stabilizing the sandy shroud layer where it had cracked. As before, Paraloid B72 was used for this purpose.

4. ANALYSIS AND INTERPRETATION

The analysis and investigation phase mostly took place over two weeks in April and May 2016. Corina Rogge carried out analyses in the field using a Bruker Tracer III-V pXRF and portable Agilent Exoscan...
Islam Shaheen, imaging and documentation specialist from the Grand Egyptian Museum, was responsible for multispectral imaging, reflectance transformation imaging (RTI), and visible light photography. Salima Ikram joined us to assist in the bio-archaeological interpretation, both visually and through x-ray radiography, using a portable x-ray unit belonging to the Institute of Bioarchaeology. Mohamed Ibrahim and Lucy Skinner were present throughout to document and study the body and complete the conservation process.

4.1 TEXTILE SHROUD AND SKIN DOCUMENTATION

The body was faced toward the left side of the coffin and was originally covered in textile, about four layers thick. The way the textile drapes between the limbs and the shape of the textile folds discernible through the sandy shroud layer indicate that each limb was wrapped individually in wide strips of linen. The torso and head were similarly bound. A shroud was folded around the body and tied in place using rolled (folded?) linen straps, visible at the ankles, around the thighs (where it holds the arms in position at the side of the body), and probably in the neck area, although the textile and sandy shroud are not well preserved in this section (fig. 11). There is not much skin remaining, but that on the soles of the feet is so well preserved that it is possible to discern “toe prints.”

4.2 BIO-ARCHAEOLOGICAL ANALYSIS (SKELETAL REMAINS AND ORGANIC MATERIALS)

Most muscle and flesh had decayed and disappeared, but there are muscle fibers in the thigh area that have a dark and almost woody appearance. We are almost certain that the body belonged to a female for several reasons:

1. The burial goods (including the ivory clappers) that, as mentioned previously, are typically found in female graves
2. The long, braided hair with a beaded headband/fillet that was worn only by women (see section 3.5)
3. The fine features of the body and skeleton, and notably the absence of a pronounced brow ridge, the shape of the chin, and the small mastoid processes.

However, the only sure way to discern the sex of an individual when skin is not well preserved is to examine the skeleton. Unfortunately, the most diagnostic part of a skeleton for determining sex—the pelvis (White and Folkens 2005)—was not visible in this case because it is wrapped in textile. In addition, we cannot be totally sure of the age of the individual because only a few of the bone epiphyses (the parts of long bones used to determine age by assessing the degree to which the epiphyses have fused) are visible. However, the femur and radius bones, as well as the iliac crest, are exposed, enabling Salima Ikram, upon examination of the skeleton and burial, to make an estimation of its age—tentatively suggesting 17 or 18 years old.

To permit further examination of the skeleton, and possibly discern details of the grave such as the location of beads concealed beneath textiles and bone in the hip region, we carried out x-ray radiographic imaging. This was facilitated through the transport to Abydos of a portable x-ray unit (Karmex Diagnostic X-ray Unit PX-20N [AC 115V 50/60HZ, 50–130 KVp 2-20mA]), belonging to the Institute of Bioarchaeology, and operated by Salima Ikram, with the films being developed in the darkroom of the dig house. The procedure involved placing the mounted coffin/body onto the floor of the bio-archaeology lab. Conventional AGFA Structurix x-ray film sheets, which are presealed within lightfast foil and lead wrapping were used. Each sheet of film was inserted successively underneath the body between the wooden base and the foam mount. The x-ray tube, mounted onto an A-frame, was positioned over the top of the body, and each sheet of film was exposed at 70Kv for 40 seconds. In thicker areas, the exposure time was lengthened to 55 seconds at 70Kv.
Unfortunately, x-ray radiography of the burial was not helpful for discerning shape and features of the skeleton. The thick, radio-opaque layers of coffin and sand underneath the body almost completely obscured the bones in the x-ray images in almost all areas (fig. 13), and no great insights were offered.

Brown staining on the sides of the coffin is particularly concentrated in the central portion, the area corresponding with the abdomen, indicating that there were fluids emanating from the body as it decomposed, which soaked into the plaster and up the coffin sides. This, as well as the lack of large quantities of wrapping, suggest that the body was not eviscerated, desiccated, nor wrapped as one would expect had it been properly mummified. This is not unusual for the period (Ikram and Dodson 1998).

4.3 THE COFFIN

Neither the inside nor outside of the coffin was decorated with texts or figurative designs—or at least none have survived. However, the inside was coated in white plaster. XRF spectroscopy of the plaster indicates that it is calcium carbonate based, suggesting a predominantly lime- rather than gypsum-based plaster. The entire outside surface of the coffin was painted with a thick coating of red paint. Over the red paint was a liberally but patchily applied black coating. The red paint is rich in iron, suggesting that it is red ochre. Red is associated with solar deities and thus with rebirth and resurrection, which was the destiny that the deceased hoped to achieve.

Further confirmation is needed, but photomicrographs have been produced of the cross section of a tiny piece of wood found within a crumbing wall section of the coffin. This gives a preliminary identification of the wood as Ficus sycomorus (fig. 14), which is a typical wood used in ancient Egypt for coffin construction and could have been harvested locally.

4.4 BEADS

Found on either side of the body near the waist and the wrists were two strings of beads. One of these appears to pass underneath the body, maybe forming a girdle. Unfortunately, x-ray radiography...
neither confirms nor denies the possibility, as it was not possible to discern whether this formed a continual string. The possible girdle string consists of small black beads interspersed with large red and white beads (fig. 15). Some of the beads have been individually analyzed with XRF, the results of which suggest the following:

1. The black beads are made of faience, which is rich in iron, indicating that the colorant is iron oxide.
2. The large white beads are calcium rich but low in silicon, indicating that they are shell and not faience.
3. The red beads have not been analyzed, as none were found loose individually, but have the appearance of carnelian.

The other string appears to consist of black seeds strung on a thick vegetable fiber thread. XRF confirms this because there is no significant calcium or silicon in them, whereas analysis using diffuse reflectance FTIR indicates the presence of carbohydrates. At this time, the plant source of the seeds has not been identified.
4.5 BEADED HEADBAND

From close examination and photomicrographs, it is possible to see that the headband was constructed using a brick-stitch (also known as peyote-stitch) technique. This involves threading beads onto a thread and weaving them freehand using a fine needle-like tool. The pattern created is of colored beads in nested green, turquoise, and white diamond shapes, and in the middle is a blue cross-shape cutting through the center of a brown diamond. Rows of black, white, and green beads square up the pattern on the sides. RTI illuminates a slight variation in size of the different colored beads (white and light turquoise seem bigger than dark turquoise and brown), but generally they are about 1.5 mm in diameter (fig. 16). RTI also shows how the beads remain firmly stuck to the head. The headband does not form a complete loop around the head but ends on either side behind the ears, tapering to triangular points. Originally, the band must have been stitched to a textile or leather strap, tied at the back of the head, but no trace of this remains.

XRF analysis of detached individual beads from the headband detected silicon, potassium, and calcium, indicating that all colors are made from faience. This includes the white beads, which sets them in contrast to the white beads of the girdle, which are made of shell. As expected for faience objects, copper is the colorant present in blue and blue-green beads (fig. 17), while the black beads contain both copper and manganese. The white beads obtain their color from the faience itself.

4.6 HAIR

Almost as spectacular as the headband is the hairdo that it adorns. The deceased has fine dark black hair, which is plaited into small braids (approximately 0.5 cm in width), swept back from the face,
down the back and around the side of the head. Looking closely, it is possible to see that the hair closest to the skull, her natural hair, is lighter brown in color than the rest of the hair and that the dark braids are hair extensions. The extensions appear to be made from human hair. The tops of the hair extension strands are tightly bound together by a few hairs to prevent them from unraveling. The extensions are
held onto the head by incorporating her natural hair into the braids and wrapping unbraided strands over the top of bunches of the dark hair extension braids, holding them in position (fig. 18).

The hair extensions are beautifully preserved. They are incorporated close to the skull and extend around the side of the head, scoop over the shoulder, and come to an end, in a knot, against the chest (fig. 19). Clearly, someone carefully positioned the hair of the deceased before she was tied in linen and sealed inside the coffin.

Parallels to similarly well-adorned graves from this period are not known, although there are, of course, tomb paintings and coffins depicting young women with long, braided hair involved in funereal rituals. A fragment of a tomb relief held at the British Museum (EA1150) depicts a girl with long hair and a hair band (British Museum 2016).

4.7 RTI IMAGING

Macrophotography of two tiny beads in the shape of fish showed that they were clearly carved from stone and not faience objects as first suspected. The stone appears to be turquoise, but as this object is now in storage at Sohag, further analysis (using XRF) was not possible.
Images captured from RTI with specular enhancement by Islam Shaheen clearly show tool marks on two small fish beads and the steatite palette (fig. 20). The artifact, which we call a palette, is a curious object. How exactly its owner may have used it, since it is so small, and the striations on the sides do not conform to the palette interpretation.

4.8 FRUITS AND BERRIES

The berries originally inside the second basket have been identified as juniper (see fig. 2, center of image). One species of juniper grows in Egypt (Sinai), *Juniperus phoenicea*, and was probably a component of perfume, a spice, or used medicinally. The other organic material from the basket, which due to decomposition now looks like a flower bud, is actually a tuber from the sedge plant *Cyperus esculentus* and is known as tiger or chufa nut (see fig. 2). Tiger nuts are edible and very nutritious, and
they were ground up to produce a flour used in breads and cakes. They can also be pressed to release oil, which could be used as a base for perfume. Both juniper and tiger nuts have been found in Egyptian burials before, dating from the Predynastic period (Murray 2000).

4.9 RESINOUS MOUND

One of the most intriguing objects found in the burial was the unidentified orange-colored mound/lump from inside the larger basket. Diffuse reflectance FTIR spectroscopy suggests that it is a type of resin. Unfortunately, the spectral peaks are broad, and it has not been possible to determine which kind of resin it may be.

Finally, XRF of the black contents of one of the three calcite pots shows well-defined peaks for iron, lead, silicone, nickel, and zinc. These components indicate that it contains galena and perhaps some hematite, which are typical constituents of kohl used for eye makeup.

5. SUMMARY

This project is now at a stage where the coffin and body are stable and we have carried out every kind of analysis within our capabilities in the field. The investigation was nondestructive and took place in the magazine at Abydos. If able to remove samples and analyze these either in Cairo or abroad, then we would likely be able to make further interesting discoveries. In particular, we are interested in analyzing the resinous material; contents of the calcite vessels found in the grave; and the possible presence of any fats, oils, or waxes in the hair.

The lack of clarity in the images using x-ray radiography due to the thickness of the underlying coffin was quite disappointing. Future developments in technology and the availability of a portable CT scanner in Egypt, which may be brought to the site, would likely give better results and enable the confirmation of age and sex determinations of the body. The burial has been packed carefully, and in the future it may be revisited to prepare the assemblage for display in the as-yet unbuilt Sohag Museum. A lot of new information has been revealed about Middle Kingdom burial practices and destruction has been minimized through careful block-lifting and painstaking conservation treatment.

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REFERENCES


FURTHER READING


SOURCES OF MATERIALS

Conservare OH100
PROSOCO Inc.
3741 Greenway Cir.
Lawrence, KS 66046
800-255-4255
http://www.prosoco.com/products/conservare-oh100-consolidation-treatment

Cyclododecane
Kremer Pigments
247 West 29th St.
New York, NY 10001
212-219-2394

GE STRUCTURIX AGFA industrial x-ray film, developer, and fixer fluid
Private contact through American University in Cairo.

Lascaux 498 HV, Paraloid B72 Methacrylate CO-polymer
Conservation Resources UK
15 Blacklands Way
Abingdon
Oxon OX14 1DY
http://www.conservation-resources.co.uk

Two-part liquid expanding urethane foam (marine foam)
U.S. Composites
6670 White Dr.
Palm Beach, FL 33407
561-588-1001
http://www.uscomposites.com/cinfo.htm

X-LITE
Allard International
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