

New Sutton Hoo discovery



British Museum scientists hit the headlines in early December 2016 when our paper revealing the discovery of Middle Eastern bitumen among the grave goods of the celebrated 7th-century AD Sutton Hoo ship-burial was published in *PLoS ONE*.

The ship-burial was excavated in 1939 and the spectacular treasure recovered – including gold and garnet jewellery, silverware, coins and ceremonial armour – is the centrepiece of the display in Room 41 (The Sir Paul and Lady Ruddock Gallery of Sutton Hoo and Europe AD 300–1100).

Fragments of black organic material found scattered within the burial had previously been thought to be caulking tar produced by heating wood and associated with waterproofing and maintenance of the ship. The samples were analysed by Dr Pauline Burger, an EU-funded Marie Curie fellow researching the production and preservation of tars associated with ancient boats (cordis.europa.eu/result/rcn/57519). The discovery that these black tarry fragments are actually bitumen came as a huge surprise and we set to work in collaboration with geochemists at the University of Aberdeen to determine source of the bitumen. There are quite a few local sources of bitumen in the UK but our analyses showed that this material comes from the Dead Sea family of bitumens, perhaps sourced in modern-day Syria.

Although we don't know whether the pieces are fragments of small objects or part of a larger composite object combining other materials that did not survive, it is now clear that these are the remains of exotic grave goods which can be counted among the other treasures from the burial. The results are also exciting because archaeological finds of bitumen from ancient Britain are extremely rare and this is the first example to be linked to Middle Eastern sources.

You can read about the research at [dx.doi.org/10.1371/journal.pone.0166276](https://doi.org/10.1371/journal.pone.0166276)

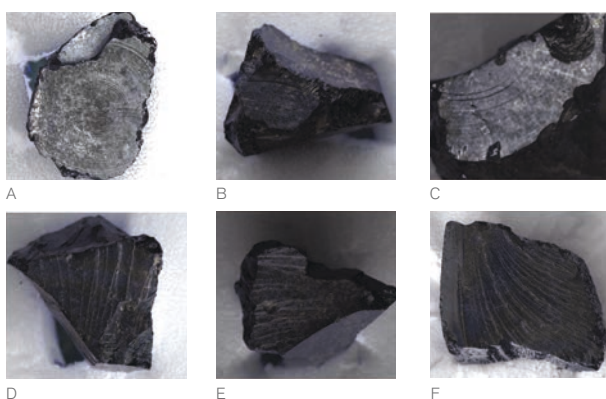
Rebecca Stacey, Scientist

Room 41, The Sir Paul and Lady Ruddock Gallery of Sutton Hoo and Europe, AD 300–1100.

The Sutton Hoo ship excavation in 1939. Anglo-Saxon, early 7th century. Suffolk, England.



RTI images of surface morphology on fragments. Upper images (A, B and C) show concentric rings suggestive of working or worked imprints; lower images show natural fracture surface on the same fragments (D and E) and on a reference specimen of bitumen (F).



Metalwork from 3rd millennium BC Ur



I have recently been working on a study of metalwork from the Early Dynastic III period (2600–2500 BC) of the city of Ur in southern Mesopotamia. This project was set up in collaboration with the team of scientists, based in Germany, who have been analysing the part of the excavated Ur material which is now in The University Museum of Archaeology and Anthropology, Pennsylvania. The aim of the project is to provide data on the materials and technology in use at the period of development of metalworking in the context of early urban centres.

No metal-bearing deposits are found in the vicinity of Ur, raising the question of where the metals came from. Isotope analysis is being carried out in Frankfurt on samples of silver and bronze objects from the British Museum and Penn Museum collections. Our preliminary results suggest a source of the copper in Oman (although ore deposits in Turkey have some similar characteristics). These results have been published (*Metalla 2016*) and trace element analysis is still in progress.

The part of the project based in our Scientific Research Department aims to establish the metalworking techniques which were practised in Ur in the 3rd millennium BC – for example, joining, forming and decorative techniques. The goldworking repertoire for which we have good examples so far ranges from the simplest items made of hammered sheets of unalloyed alluvial gold with mechanical joints, through to alloying with copper and using heat and silver-rich solder to join gold components. Depletion gilding has already been identified on cast, low-purity gold alloy chisels in Queen Puabi's tomb. This method involved the deliberate removal of copper and silver from the surface of these metal tools to produce a more golden surface, giving the illusion of greater opulence.

Susan La Niece, Scientist

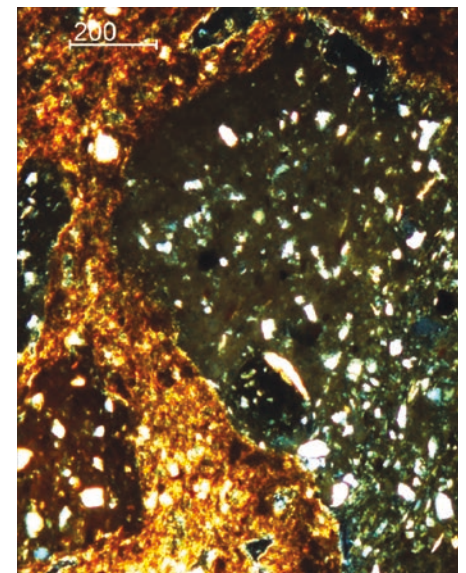
Facetted bead of sheet gold around a core (length 41mm). X-radiograph shows it had been threaded via an internal metal tube, identified by XRF as silver.

Photomicrograph of a thin section of a pot which was tempered with recycled pottery (grog): this technique was used at one Late Neolithic site in Serbia to make two different pottery styles/cultures'.

Ancient ceramics workshop in Lithuania

In September 2016 I co-organised a session at the 22nd Annual Meeting of the European Association of Archaeologists (EAA) at Vilnius, Lithuania. I was the main organiser of the one-day workshop *Blurred borders? Making pottery and cultural interaction in Neolithic and Eneolithic Europe*, in collaboration with Dr R Hofmann (Christian-Albrechts-Universität zu Kiel, Institute of Pre- & Protohistory Kiel, Germany) and Assistant Professor J Vuković (Faculty of Philosophy, Department of Archaeology University of Belgrade, Serbia). Speakers discussed culturally mixed Neolithic and Eneolithic assemblages from throughout Europe, to map their occurrence and debate their interpretation. Issues covered included trade, imitation, migration, conflict, and also national research traditions.

Michela Spataro, Scientist



Scythian gold under the microscope



I have had the great opportunity to study the manufacturing and decorating techniques and the alloy composition of nine gold objects from the Oxus Treasure. These objects are associated with the Scythian-style art of Western Siberia and will feature in a special exhibition on the Scythians from September 2017 at the Museum.

I investigated various objects including gold armlets, ring, hair-ornament and fittings, mostly using optical and scanning electron microscopy. The latter technique allows the capture of black-and-white images at low and high magnifications to identify and record tool marks. It also provides analyses of alloy compositions at a precise spot on the object. I have identified a variety of skilful goldsmithing techniques and gold alloys (gold with silver and copper). The findings from this scientific study will be incorporated in the exhibition catalogue and will be presented at a conference in September 2017.

Aude Mongiatti, Scientist

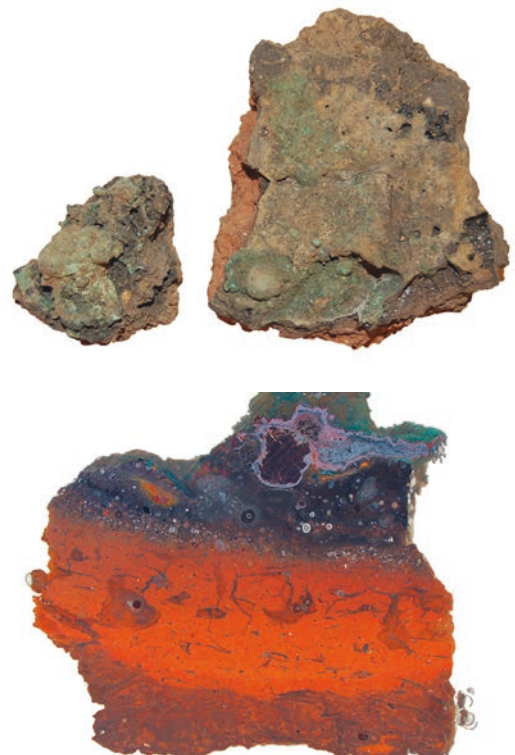
Kushite metal-working assemblage from Sudan

Recent excavations of the temple precinct in Dangeil, Sudan, by Julie Anderson and her team in the Department of Ancient Egypt and Sudan have uncovered various pits, one of which yielded a relatively large quantity of metallurgical remains clearly related to the melting and working of copper alloys. They include fragments of crucibles, moulds, furnace walls and tuyères, some of which have most likely been heated. The context in which the pit is located has been dated to around the 1st century BC to the 1st century AD.

I am studying the microstructure of polished cross-sections of metallurgical remains to identify the type of metal worked in Dangeil, the metallurgical processes involved and their purpose – for example, for alloying, refining, casting or hand-working. The processes undertaken have implications for the type of raw material needed by the coppersmith and imported to the temple to be worked there and therefore on the type of metallurgical trade between the temple community and other regions of the kingdom of Kush and outside. This study will inform about the choice (or not) of raw materials for the technical ceramics to the estimation of temperatures and durations of processes in which they were involved. At the same time, copper-alloy bowls and other copper-alloy objects from the cemetery are analysed non-destructively to give a direct comparison between finished products and tools/processes and see whether both match. This will also allow a comparison between techniques and alloys used in imported and locally produced metalwork.

This assemblage gives the first real opportunity to investigate the production of copper-alloy objects through the study of technical ceramics. The characterisation of the material per se is important as no other comparable collection has ever been investigated scientifically from Upper Nubia during the kingdom of Kush.

Aude Mongiatti, Scientist



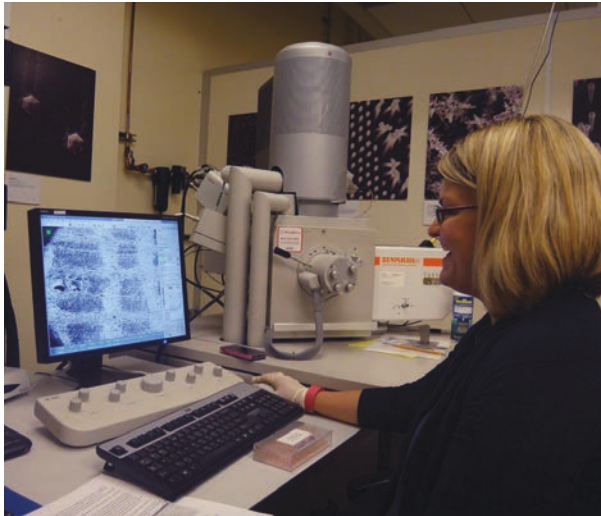
Backscattered electron image of an animal head on finger ring.

Backscattered electron image of an inlay cell and decoration on armlet.

Crucible fragments with corroded metallurgical remains on the inner surface.

Crucible cross-section X8.

Ancient Egyptian funerary wood and food



At the invitation of Kathlyn (Kara) Cooney, Professor of Egyptian Art and Architecture at the University of California, Los Angeles (UCLA), I participated recently in the project *Reuse of ancient Egyptian coffin wood in the 19th and 21st Dynasties*. Kara's focus is the socioeconomic and political turmoil of those times, which affected funerary and burial practices. My focus is the choice of timbers selected, the nature and types of reuse of coffin woods, and an evaluation of the apparently diminishing sources of timber raw materials.

I participated in numerous project meetings and discussions, and gave a workshop at the Cotsen Institute of Archaeology, UCLA, on techniques for identifying ancient Egyptian coffin wood. I directed scanning electron microscope identifications of ancient Egyptian coffin wood samples of the 21st Dynasty, using a FEI NOVA NanoSEM 230 in the Department of Materials Science and Engineering at UCLA. I also gave a lecture at the Cotsen Institute titled *Food for the dead: organic material from ancient Egyptian funerary contexts*. I was invited to speak on this particular topic because of recent media coverage (such as in *New Scientist*) highlighting my scanning electron microscope identification of biscuit beetles in fragments of ancient Egyptian bread in the British Museum's collection.

Read the whole article at newsscientist.com/mg23130870

Caroline Cartwright, Scientist

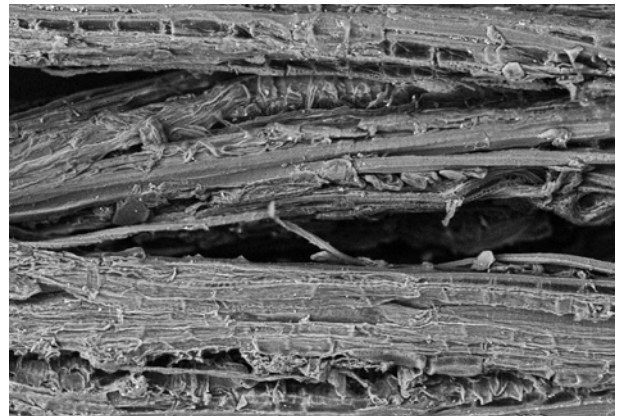
Extraordinary Bronze Age organic survival

In 2011 the excavation of a Bronze Age prehistoric cremation cist burial on Whitehorse Hill, northern Dartmoor (by the Dartmoor National Park Authority) revealed extraordinary survival of organic material and objects. I was called in at an early stage of the post-excavation phase when the cist contents were being painstakingly micro-excavated in the Wiltshire Conservation Service laboratory in Chippenham, so that I could provide specialist advice and undertake sampling.

Subsequently, a large team from many different institutions was involved in the analysis of all categories of artefacts and material, and, after five years of intensive research, this was published by Oxbow Books in autumn 2016 in a volume edited by Andy Jones – *Preserved in the Peat: an Extraordinary Bronze Age Burial on Whitehorse Hill, Dartmoor, and its Wider Context*. My specialist contributions focused on scanning electron microscope identifications of many of the organics, including the lime bast fibre basketry container (Fig. 1a and b), the composite braided hair armband or bracelet, and the wooden studs.

The Museum's variable pressure scanning electron microscope (VP SEM) proved perfect for my analyses, as it has the ideal combination of operating conditions to permit specific identifications of this challenging, damp material, and the details visible in the resultant VP SEM images greatly assisted the collaborative team of specialists studying this remarkable funerary assemblage.

Caroline Cartwright, Scientist



A UCLA graduate student being instructed in the scanning electron microscopy of ancient Egyptian wood. Photo: C R Cartwright.

SEM image showing the lime bast fibres used to make the basketry container.

The basketry container.
© Dartmoor National Park Authority.

Ancient Egyptian leather

I have just started a PhD at the British Museum, working jointly between the Departments of Scientific Research and Ancient Egypt and Sudan to study ancient Egyptian and Nubian leather processing during the pharaonic era. My award from the Arts and Humanities Research Council has a university partner too – the University of Northampton. Northampton is an ideal partner for my research as it is the only university in Europe with a department dedicated to leather science. The Institute of Creative Leather Technologies has a working leather tannery and this will come in useful during the second stage of the PhD, which will use experimental leather tanning techniques to recreate ancient Egyptian and Nubian-style leather.

My PhD will involve the use of scientific analysis and imaging techniques to determine the species of leather and to define the materials and processes used to turn the raw skin into leather. It will be the first time that ancient Egyptian and Nubian skin preparation techniques are compared in such detail, and have been subjected to such detailed scrutiny. Since starting my PhD I have begun to record leather objects in the stores of the Department of Ancient Egypt and Sudan and to discover objects, some for the first time, that include pieces of leather in their composition.

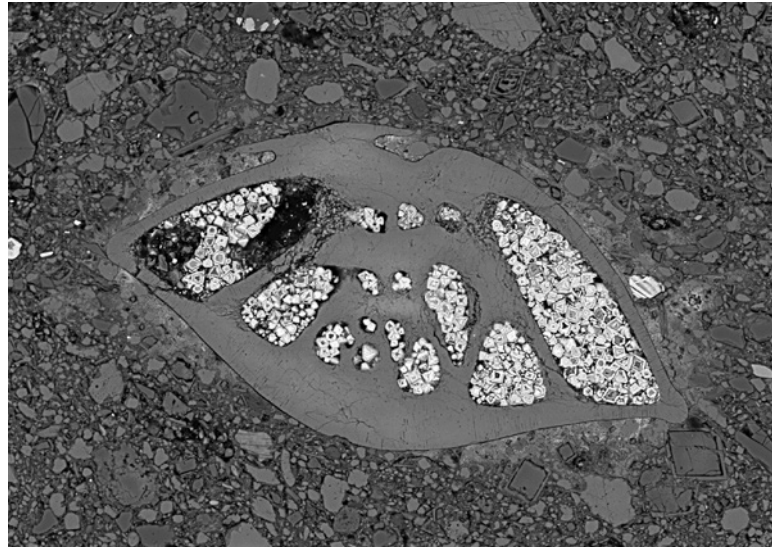
Lucy Skinner,
Collaborative Doctoral Student

Leather tab from a mummy brace dating to the 22nd Dynasty. One of over 200 leather objects in the Museum's collection to be scientifically analysed in the PhD project.

SEM backscattered electron image of sample AW223, which is from an unidentified source (a chemical singleton), with well-preserved foraminifera with micritic and iron particles infilling the chambers.



Pottery provenance and technology in Amara West



One of the Museum's major field projects is the re-excavation of Amara West, a New Kingdom Egyptian town on an island in the Nile, in northern Sudan, directed by Neal Spencer, Keeper of the Department of Ancient Egypt and Sudan. Following a detailed study of local pottery production, and of imports from Egypt and the Levant, published in the journal *Archaeological and Anthropological Sciences*, 7, 399–421, in 2015, I began a second study, together with Anna Garnett (Department of Ancient Egypt and Sudan) and Andrew Shapland (Department of Greece and Rome). This focused on a specific class of imported pottery found at Amara West known as Mycenaean ware. This ware includes spouted vessels thought to have been used to transport olive oil.

Our study investigated the pottery provenance and technology. Trace-element measurements by neutron activation analysis (NAA) at Bonn University indicated probable clay sources in the Peloponnese (Greece) and Cyprus, with two vessels of unidentified origin. My petrographic analysis showed that the Peloponnesian vessels were made to a uniformly high technical standard, whereas the Cypriot and unprovenanced vessels were technologically more variable and less sophisticated. Compositional analysis by SEM-EDX confirmed the NAA groupings, and showed that the unprovenanced samples were not made locally. In addition, it showed that while the Peloponnesian vessels were all painted using very similar pigments, the pigments used to decorate the imitation Mycenaean vessels were chemically quite heterogeneous. We are currently writing a joint publication on the Mycenaean pottery.

Michela Spataro, Scientist

Yurlmun: Mokare Mia Boodja



'Yurlmun: Mokare Mia Boodja' means 'Returning to Mokare's Home Country' and is the name of an extraordinary exhibition at the Albany Museum in Western Australia. The exhibition showcases 14 rare and significant objects from the British Museum that originated from the Menang Noongar people, the traditional inhabitants of the Albany area. The exhibition is important on many levels, not least for the active collaboration between the British Museum with colleagues and communities in Australia for the purposes of engagement and the sharing of cultural knowledge.

13 of the objects, which include spears, spear-throwers, axes, boomerangs and knives, feature wood as a major component. I used the Museum's variable pressure scanning electron microscope to identify the different types of wood of each object and the results proved very interesting, particularly as the southwest region of Australia has a high degree of biodiversity. While historical records indicate evidence of large-scale communal gatherings, trade and exchange, these objects were all made of wood species that can be found within the southwest region.

My research also shows the extent to which different wood properties, such as density, strength, durability and workability, were understood and sought out by the Aboriginal makers of these objects. For example, a spear-thrower (Fig. 1) was made from highly durable and dense jarrah wood from the *Eucalyptus marginata* tree (Fig. 2).

The exhibition booklet is beautifully designed and written, and it incorporates all my wood identifications seamlessly in the text as well as in the image captions, in my concluding section on wood species identification, and also alongside images at museum.wa.gov.au/albany

Caroline Cartwright, Scientist



Spear-thrower
(L 57 cm; W 12.5
cm) made from
jarrah wood.

*Eucalyptus
marginata*, jarrah
tree. Photo:
C R Cartwright.

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