



Thames Gateway

Report on the investigative conservation of waterlogged finds

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Number of artefacts

Material	Quantity
Rope	1
Copper alloy	1
Lead	2
Textile/concretion	1
Leather	
Wood	10
Wood/iron	1
Concretion	1

INTRODUCTION

This report describes the analysis phase investigative conservation of waterlogged artefacts from the site of Thames Gateway, as excavated by Wessex Archaeology. The work carried out has been the desalination and stabilisation treatment of the artefacts submitted. Once the artefacts had been treated they would be packed appropriately for return to the client and for archive storage.

DESCRIPTION

The list below describes the objects sent for conservation:

- 66896/5051/0042: rope with knot
- 5019/006: copper alloy ring
- 5019/007: lead alloy sheet/object
- 5019/005: lead bilge pipe
- 66892/5051/66: leather shoe fragments
- 66892/5051/67: leather boot upper
- 66896/5204/0011: leather off-cut
- 5019/003: leather rand
- 5204/040: leather shoe sole
- 66896/5051/0046: wood shovel handle
- 66896/5051/0047: wood shovel handle

5019/001: wood gun stock fragments
5051/0030: wood pulley block
5051/66896/0051: wood bucket staves and base
66896/5051/50: ceramic flagon
5019-008: wood and iron dead-eye
Concretion with wood handle protruding
Structural timbers, frames, wheels, stem post.

METHODOLOGY

Desalination

The objects were desalinated by placing them in baths of tap water, the chloride levels of which were checked at intervals using silver nitrate titration. Once the levels of chloride was found to be stable below 50ppm of chloride the objects were considered desalinated and could go on to further treatment.

Wood

Once desalinated the wooden items were conserved by consolidating with two grades of Polyethylene Glycol (PEG) wax followed by freeze-drying. Individual treatment records for the artefacts are recorded below.

For the larger structural timbers, including the frames and truck wheels, a two stage PEG process was adopted. Initially the timbers were impregnated with 10% v/v PEG 400, a liquid wax at room temperature, which acts primarily as a cryo-protectant during the freeze-drying process (i.e. reduces expansion of water during freezing which can disrupt the wood cell structure). The concentration was increased monthly in 5% increments, and then the timber was allowed to soak for a couple of months before the PEG 4000 was added. This grade of wax is a solid at room temperature and acts as a "scaffold" to support the decayed wood cell structure. Again, the concentration was increased monthly in 5% steps until a final concentration of 25% PEG 4000 was achieved. At this point the timber was left to soak in the solution for a further three months to ensure adequate penetration. Throughout the treatment, the solution was periodically dosed with 0.1% v/v Linkcide KMC™ broad spectrum biocide to retard microbial activity. The timbers were then loaded into the 4m freeze-drying chamber, frozen to -30C and then freeze-dried (run 34, 8/1/15 to 24/2/15). A total of 60 litres of water was removed from the timbers. Once the end point had been reached, the timbers were removed from the drier and allowed to equilibrate with ambient conditions. Excess surface PEG wax was removed using a hot air blower and absorbent paper towels. All wood surfaces had two coats of 25% w/v aqueous PEG 6000 (a solid wax at room temperature) applied as a final protection. Concretion surviving around a wrought iron ring and bracket attached to a stem post section was mechanically removed and then coated with a 10% w/v tannic acid solution (made up in a 1:1 mix of water and Industrial Methylated Spirits).

Leather

Once the leather items had been desalinated they were put through a 5% w/v aqueous solution of ethylene diamine tetraacetic acid, di-sodium salt (EDTA) for approximately a day to remove as much iron staining as possible, followed by rinsing in several baths of tap water. The objects were then placed in Netlon™ bags and pre-treated with 25% v/v aqueous glycerol for 7 days, agitating the solution each day to ensure even distribution of the consolidant within the objects. At this point the objects were placed in the chest freezer to be frozen to approximately -25°C, followed by freeze drying.

Part of SF66 and SF040 was X-rayed (X8145 and X8146) using YAT standard exposure and equipment.

RECOMMENDATIONS

The objects are stable but should be stored in the relevant environmental conditions to remain stable:

Wooden artefacts/structural timbers - ideally 55% RH, stable temperature and light levels not to exceed 150 lux.

Rope - similar to PEG treated wood.

Leather - RH of between 50 - 55%, stable temperature and light levels not to exceed 50 lux.

Ferrous metals - RH less than 15%, stable temperature and light levels not to exceed 300 lux.




Non-ferrous metals - RH less than 35%, stable temperature, and light levels not to exceed 300 lux.




In addition, all objects should be handled with care.









Treatment record table:

Photograph Before	After	Identification, Condition and Treatment
		<p>66896/5051/0042 Rope with knot</p> <p>The object arrived wet-packed and was in relatively good condition although slightly fraying at the ends and with sand and silt within the interstices. There was a knot at one end but the other end was open.</p> <p>Treatment: after desalination sand and silt was removed from the interstices of the rope as far as possible using small hand tools and a gentle flow of running water. A small loose section of the rope came away at this point and this was used to test the drying treatment. Tests of one or two strands of the rope showed that air drying would not be possible without collapse and shrinkage of the rope and therefore it was decided to put the rope through an acetone dehydration regime. The rope was placed in a 30% solution of acetone v/v in water for 24 hours, then a 60% solution of acetone and finally in 100% acetone. After this the rope was removed from the acetone which was allowed to evaporate slowly under an aluminium foil cover.</p>
		<p>5019/006 Copper alloy ring</p> <p>The object arrived wet packed and in quite good condition. The surface was found to be covered with a thin but uneven corrosion crust with some areas of more bulky corrosion. There is an incised line in the centre running all the way round and several square protrusions with associated nail holes. Appears modern.</p> <p>Treatment: after desalination the object was dried out in a warm environment and some removal of the surface crust was undertaken to reveal the incised line and square protrusions. A layer of micro-crystalline wax was brushed on to protect the surface from handling.</p>

		
		<p>5019/007 Lead alloy sheet/object</p> <p>The object arrived wet-packed and in good stable condition. The surface retains a brown/grey surface crust with areas of marine concretion. The object is bent up and broken but this is not fresh damage.</p> <p>Treatment: after desalination, the object was dried out in a warm environment. Some surface finishing took place at this point to remove as much of the adhering marine concretion as possible. A layer of micro-crystalline wax was brushed on to protect the surface from handling.</p>


		<p>5019-005 Lead bilge pipe</p> <p>The object arrived wet packed and in relatively good condition. The object is large and robust although some of the edges have bent up and it is worn through on one side at the join between the pipe and 'skirt'.</p> <p>Treatment: after desalination the object was removed from the water bath and air dried. At this point the surface was treated by removing any remaining concretion and any white corrosion products formed during the desalination process, using a brush, small hand tools and a vacuum cleaner. The surface was then consolidated using 5% Paraloid B72 (methyl methacrylate co-polymer) applied with a brush and given a final coat of micro-crystalline wax.</p>
		<p>5204 044 Concretion with textile, X8247</p> <p>A small concretion with large amounts of textile attached. The X-ray shows a long hollow tube at one side and a button within the central area. There were also two pieces of leather at the outer edges of the concretion. The concretion, leather and textile is heavily iron stained and held very solidly together. The concretion appears to represent a number of organic items that have become massed together through contact with an iron object, probably the long hollow tube.</p> <p>Treatment: after desalination, the leather fragments were removed from the outer edges of the concretion and treated separately. First, as much iron as possible was removed using a 3% aqueous solution of ammonium citrate, followed by extensive rinsing. At this point the leather was treated with 25% glycerol v/v in water by immersion for a week followed by freeze drying.</p> <p>The textile was also treated with ammonium citrate to remove iron staining and as much of the concretion was removed as possible using an electric engraving tool. The textile could then be dried and this was done by 'sandwiching' the fragments between layers of Correx™ plastic sheet with paper towelling to absorb the moisture, the paper being changed each day until no more moisture was absorbed. This was done with small amounts of weight on top of the sheets to keep the textile flat.</p> <p>As part of the concretion was a small fragment of heavily mineralised</p>



		<p>textile with remains of stitching and a loop of lacing, possibly to fasten round a button. The surface was revealed as far as possible using the air abrasive set to air only.</p>
		<p>66892/5051/66 Leather shoe fragments (X8146)</p> <p>This small find number contained 20 pieces of leather shoe fragments including rands, sole fragments, heels and heel fragments and a few scraps and off-cuts.</p> <p>The leather was in fair to good condition, many torn and worn with a fairly high degree of iron staining.</p> <p>The three heel pieces were X-rayed to determine if iron nails had been used to fasten them to the main heel. The image shows that nails may have been used in the largest heel fragment but that wooden fastenings were probably used for the other two.</p> <p>Treatment: the objects were treated as described in the report above. The objects were freeze-dried in the 7.5 litre Birchover unit (run number 6), the run lasting a week.</p>

		
		<p>66892/5051/67 Leather boot upper</p> <p>This lace-up boot upper was found to be in good condition, the leather being somewhat stiff but intact except for some damage to the sewn edge. There was a large iron stain on one side.</p> <p>Treatment: the object was treated as described in the report above. The object was freeze-dried in the 7.5 litre Birchover unit (run number 6), the run lasting a week.</p>

		<p>66896/5204/0011 Leather off-cut</p> <p>This off-cut was in poor condition, with the tendency for delamination and heavily iron stained. There was also a large crack in the central area.</p> <p>Treatment: the object was treated as described in the report above. The object was freeze-dried in the 7.5 litre Birchover unit (run number 6), the run lasting a week.</p>
		<p>5019/003</p> <p>Leather rand in quite good condition, though with patches of iron staining.</p> <p>Treatment: the object was treated as described in the report above. The object was freeze-dried in the 7.5 litre Birchover unit (run number 6), the run lasting a week.</p>
		<p>5204/040 Leather shoe sole (X8145)</p> <p>This almost complete shoe sole was found to be in good condition, with some use-wear and iron staining. The X-ray shows that there is no metal within the 'nail holes' showing that the fastenings used have completely mineralised. Wooden pegs seem to have been used at the heel.</p> <p>Treatment: the object was treated as described in the report above. The object was freeze-dried in the 7.5 litre Birchover unit (run number 6), the run lasting a week.</p>

		
 		<p>66896/5051/0045 Wood shovel handle</p> <p>Wood shovel handle of <i>Fraxinus Excelsior</i> L. (ash) with the letters 'W G' stamped onto the surface on one side.</p> <p>The object arrived wet packed and in good condition, although the wood itself was found to be quite soft. There was heavy iron staining around the grip and within the interstices of the lettering.</p> <p>Treatment: As much iron staining as possible was removed by immersing the object in a 3% Ammonium citrate solution w/v in tap water for roughly 7 hours. After rinsing, the object was put through a PEG treatment regime of 10% PEG400 v/v and 25% PEG 4000 w/v in water with the addition of 0.2% v/v of Linkcide KMC biocide.</p> <p>At this point the object was freeze-dried in the 7.5 litre Birchover unit (run number 7), the run lasting one month.</p> <p>After freeze-drying, the surfaces were cleaned of excess PEG using small amounts of hot water, dried off with paper towelling and further dried with a hot air blower. The surface was then coated with 25% PEG 6000.</p>

		<p>66896/5051/0046 Wood shovel handle</p> <p>Wood shovel handle. The object arrived wet packed and in quite good condition, although quite soft in places. The handle was in two joining fragments. Wood species identified as ash (<i>Fraxinus Excelsior</i> L.)</p> <p>Treatment: The condition assessment suggested the handle should be put through a PEG treatment regime of 10% PEG400 v/v and 25% PEG 4000 w/v in water. The PEG additions were carried out in 5% increments beginning with the PEG 400 until the desired concentration was achieved. Further additions of PEG 4000, in 5% increments were then made until a total concentration of 35% wax was reached. The solution was periodically dosed with 0.2% v/v of Linkcide KMC biocide to control microbial activity.</p> <p>Once impregnation was complete, the wood was frozen and then freeze-dried in the small 7.5litre Birchover drier, with the run lasting 4 weeks. After drying excess PEG wax was removed from the surfaces using a hot air blower and absorbent towelling. The surfaces were then coated with 25% w/v aqueous solution of PEG 6000. After freeze-drying the two pieces of the object were adhered together using HMG Cellulose nitrate adhesive.</p>
		<p>66896/5051/0047 Wood tool handle</p> <p>Wood tool handle with five incised horizontal grooves near the handle. Wood species identified as ash (<i>Fraxinus Excelsior</i> L).</p> <p>Treatment: The condition assessment suggested the handle should be put through a PEG treatment regime of 10% PEG400 v/v and 25% PEG 4000 w/v in water. The PEG additions were carried out in 5% increments beginning with the PEG 400 until the desired concentration was achieved. Further additions of PEG 4000, in 5% increments were then made until a total concentration of 35% wax was reached. The solution was periodically dosed with 0.2% v/v of Linkcide KMC biocide to control microbial activity.</p> <p>Once impregnation was complete, the wood was frozen and then freeze-dried in the small 7.5litre Birchover drier, with the run lasting 4 weeks. After drying excess PEG wax was removed from the surfaces</p>

		<p>using a hot air blower and absorbent towelling. The surfaces were then coated with 25% w/v aqueous solution of PEG 6000.</p>
		<p>5019/001 Wood gun stock fragments</p> <p>Fragments of gun-stock of <i>Fagus Silvatica</i> L. (beech). The three fragments fit together but the joins are not good due to erosion of the edges and some shipworm damage. The wood itself is in good condition, a little soft and with some marks to the surface, but otherwise stable.</p> <p>Treatment:</p> <p>As much iron staining as possible was removed by immersing the object in a 3% Ammonium citrate solution w/v in tap water for roughly 7 hours. After rinsing, the object was put through a PEG treatment regime of 10% PEG400 v/v and 25% PEG 4000 w/v in water with the addition of 0.2% v/v of Linkcide KMC biocide.</p> <p>At this point the object was freeze-dried in the 2m Birchover unit, the run lasting one month.</p> <p>After freeze-drying, the surfaces were cleaned of excess PEG using small amounts of hot water, dried off with paper towelling and further dried with a hot air blower. The surface was then coated with 25% PEG 6000.</p>



5051/0030 Wood pulley block

Complete wood pulley-block. The outer casing is of *Ulmus* Sp. (Elm) but the inner block was not possible to identify as it was not possible to gain access to all faces of the wood. The pulley was heavily mineralised and iron-stained and one end had suffered substantial cracking.

Treatment:

As much iron staining as possible was removed by immersing the object in a 3% Ammonium citrate solution w/v in tap water for roughly 7 hours. After rinsing, the object was put through a PEG treatment regime of 10% PEG400 v/v and 25% PEG 4000 w/v in water with the addition of 0.2% v/v of Linkcide KMC biocide. At this point the object was freeze-dried in the 7.5 litre Birchover unit (run number 7), the run lasting one month. After freeze-drying, the surfaces were cleaned of excess PEG using small amounts of hot water, dried off with paper towelling and further dried with a hot air blower. The surface was then coated with 25% PEG 6000.

		
		<p>5051/66896/0051 Wood bucket elements</p> <p>Bucket, waterlogged and in a fair condition, with both soft and hard zones present, indicating heterogeneous decay. Wood species identified as oak, <i>Quercus spp.</i></p> <p>Treatment</p> <p>The condition assessment suggested the bucket staves should be put through a PEG treatment regime of 10% PEG400 v/v and 25% PEG 4000 w/v in water. The PEG additions were carried out in 5% increments beginning with the PEG 400 until the desired concentration was achieved. Further additions of PEG 4000, in 5% increments were then made until a total concentration of 35% wax was reached. The solution was periodically dosed with 0.2% v/v of Linkcide KMC biocide to control microbial activity.</p> <p>The bucket was frozen and then freeze-dried in the 7.5 litre Birchover unit (run number 7), the run lasting one month.</p> <p>After freeze-drying, the surfaces were cleaned of excess PEG wax using small amounts of hot water, dried off with paper towelling and further dried with a hot air blower. The surfaces were then coated with 25% w/v aqueous solution of PEG 6000.</p>



66896/5051/50 Ceramic flagon

A complete ceramic flagon, with the opening almost entirely covered with marine concretion. This suggests that the contents may still be intact.

Treatment

The marine concretion was removed mechanically using an electric engraving tool. The contents were sampled and sent for analysis at the University of York (see separate report).








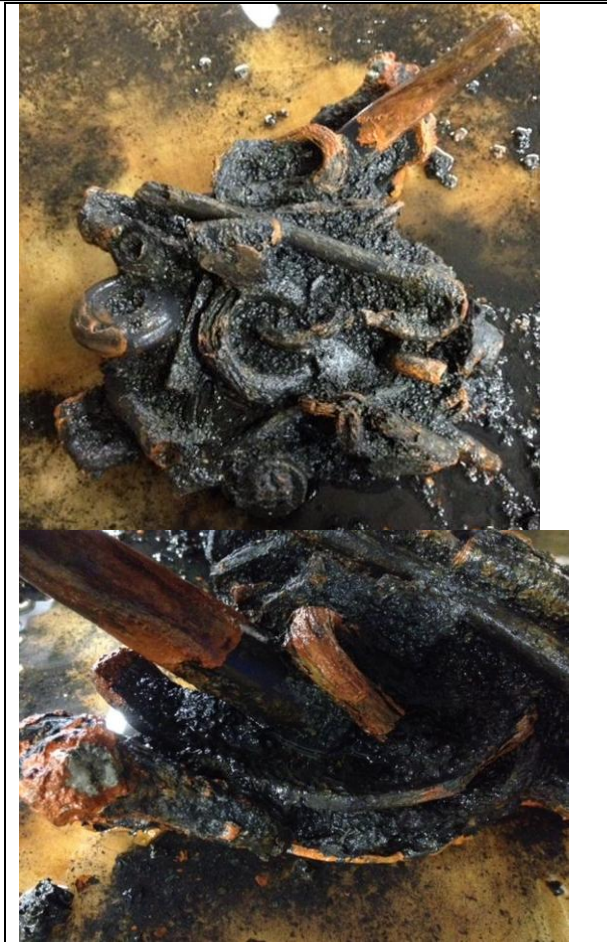


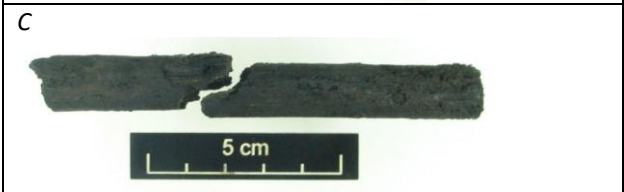

5019-008 Wood and iron dead-eye

Complete dead-eye, consisting of a round wood central core with three perforations surrounded by an iron band and with a section of iron at the top encased in concretion. The top of the concretion has modern rope attached.

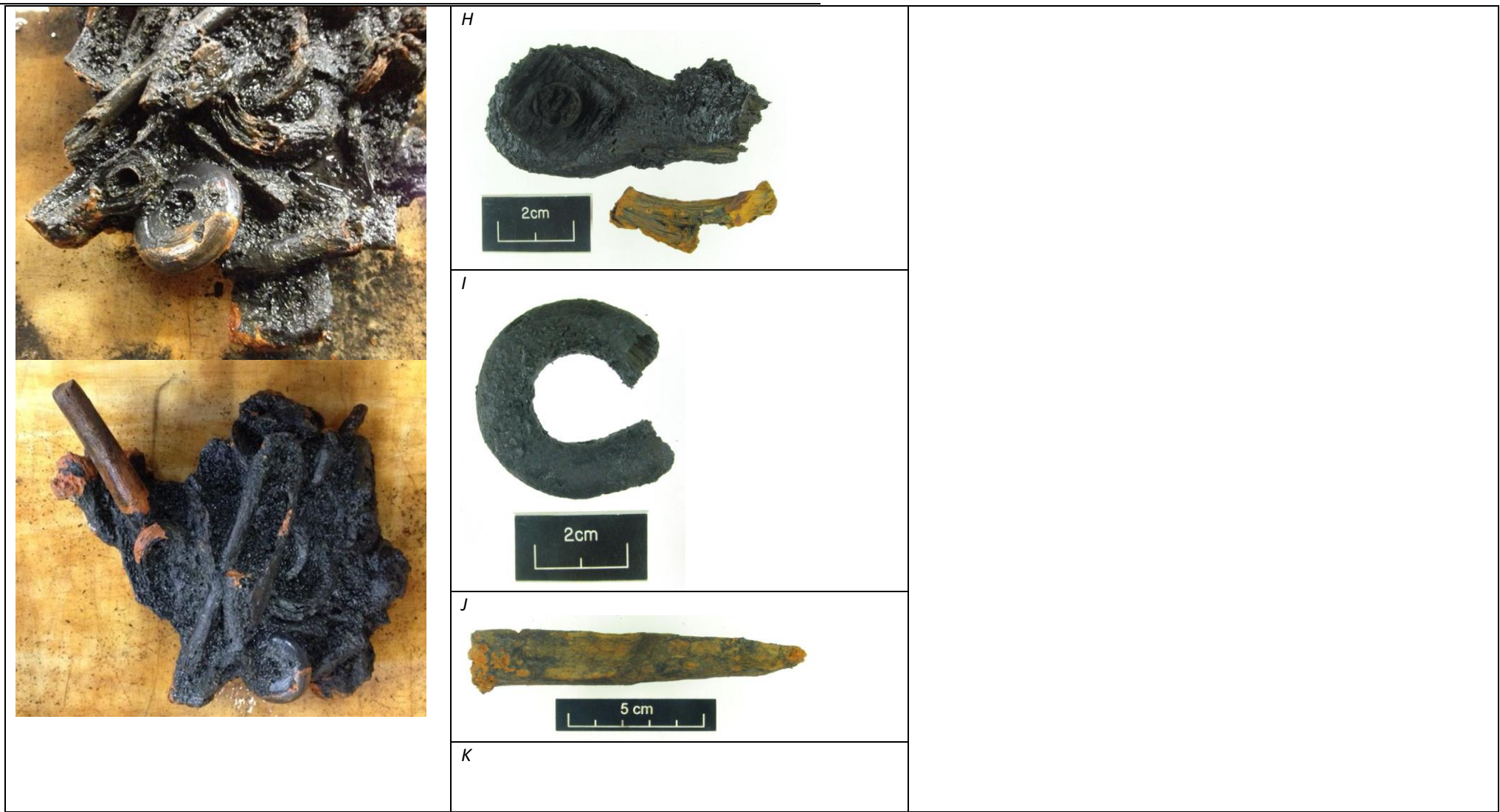
The object is in fair condition, the wood is solid and heavily mineralised due to the contact with the iron and the surface of the iron is somewhat corroded.

Treatment: Concretion was removed from the iron using a hammer and chisel and an electric engraving tool at which point the object was desalinated. Once the chloride levels were measured stable below

		<p>50ppm the pre-treatment of the wood could commence. The object was put through a PEG treatment regime of 10% PEG400 v/v and 30% PEG 4000 w/v in water with the addition of 0.2% v/v of Linkcide KMC biocide and 0.2% Hostakor IT™ corrosion inhibitor. At this point the object was freeze-dried in the 7.5 litre Birchover unit (run number 18), the run lasting one month. After freeze-drying, the surfaces of the wood were cleaned of excess PEG using small amounts of hot water, dried off with paper towelling and further dried with a hot air blower. The surface was then coated with 25% PEG 6000. The iron surface was treated by removing any active corrosion with a stiff brush and treating with 10% tannic acid w/v in 50:50 Industrial Methylated Spirits and water applied with a brush, followed by a layer of microcrystalline wax.</p>
		<p>Concretion with wood handle protruding</p> <p>This concretion appeared to be a conglomeration of a large collection of iron and wood objects. The most noticeable item is a wooden handle protruding from one side. The concretion was X-rayed and was also found to contain a lead object.</p> <p>Treatment:</p> <p>The concretion was investigated by removing corrosion and concreted material initially from the surface and around the protruding wooding handle. This revealed a plethora of other objects of wood and iron including rings, rods, bars, a shackle, a complete padlock and several other handles. Each object was gradually removed from the conglomeration by continuing to remove the concretion from around each object. The iron objects revealed were found to be completely mineralised and were very fragile and with surfaces that often retained impressions of the concreted material. Each object was labelled with a letter for ease of reference.</p> <p>Once all the objects had been separated out from the concretion they were placed in water baths to check the chloride levels. All the objects were found to be within acceptable limits for chlorides.</p>
	 <p>A</p>	

		<p>The iron objects were dried at this point and could be further treated to remove the last fragments of concretion from the surfaces. This was done using the air abrasive with 29 micron aluminium oxide powder followed by surface treatment using 10% tannic acid w/v in 50:50 Industrial Methylated Spirits and water.</p> <p>The wood objects were pre-treated with 3% ammonium citrate w/v in water by immersion for 2 days then rinsed and put through a PEG treatment regime of 10% PEG400 v/v and 30% PEG 4000 w/v in water with the addition of 0.2% v/v of Linkcide KMC biocide.</p> <p>At this point the object was freeze-dried in the 7.5 litre Birchover unit (run number 9), the run lasting one month.</p> <p>After freeze-drying, the surfaces were cleaned of excess PEG using small amounts of hot water, dried off with paper towelling and further dried with a hot air blower. The surfaces was then coated with 25% PEG 6000.</p> <p>Corrosion and concretion was removed from the surfaces of the lead object (object AA) mechanically using small hand-tools. Some mineralised wood impressions on the surface were left in situ.</p> <p>Cylindrical wood object (found with concretion but separate) Conglomeration of several unknown Fe items</p> <p>A: Fe rod in three fragments one of which has cordage impressions B: Fe nail shank fragment C: Fe rod D: Small Fe eyed bar E: Fe ring fragment F: Fe shackle G: Wood discoidal fitting with perforations H: Fe eyed bar with screw and small wood fragment I: Fe 'U'-shaped loop J: Wood wedge K: Fe ring fragments L: Fe/graphitized nut/washer M: Fe fitting fragments N: Fe and Cu alloy round fitting/nut and small bar fragment O: Fe sheet fragment P: Fe ring fragment</p>
	<p><i>B</i></p> 	
	<p><i>C</i></p> 	
	<p><i>D</i></p> 	

	<p>E</p> 	<p>Q: Fe large eyed bar R: Fe eyed loop with ring and curved object S: Fe nail T: Fe nail U: Wood object made from three flat long pieces formed into a triangle V: Fe possible padlock fragment W: Wooden handle X: Fe and Cu alloy padlock Y: Wooden handle Z: Wood and Fe chain links</p>
	<p>F</p> 	<p>AA: Pb flat object/possible lid, with mineral preserved organic fragments on the obverse. AB: Wooden handle AC: Leather shoe sole toe fragment AD: Fe eyed hook AE: Fe curved plate AF: Fe ring attached to a stone AG: Fe eyed bard with loop AH: Fe rod fragments</p>
	<p>G</p> 	





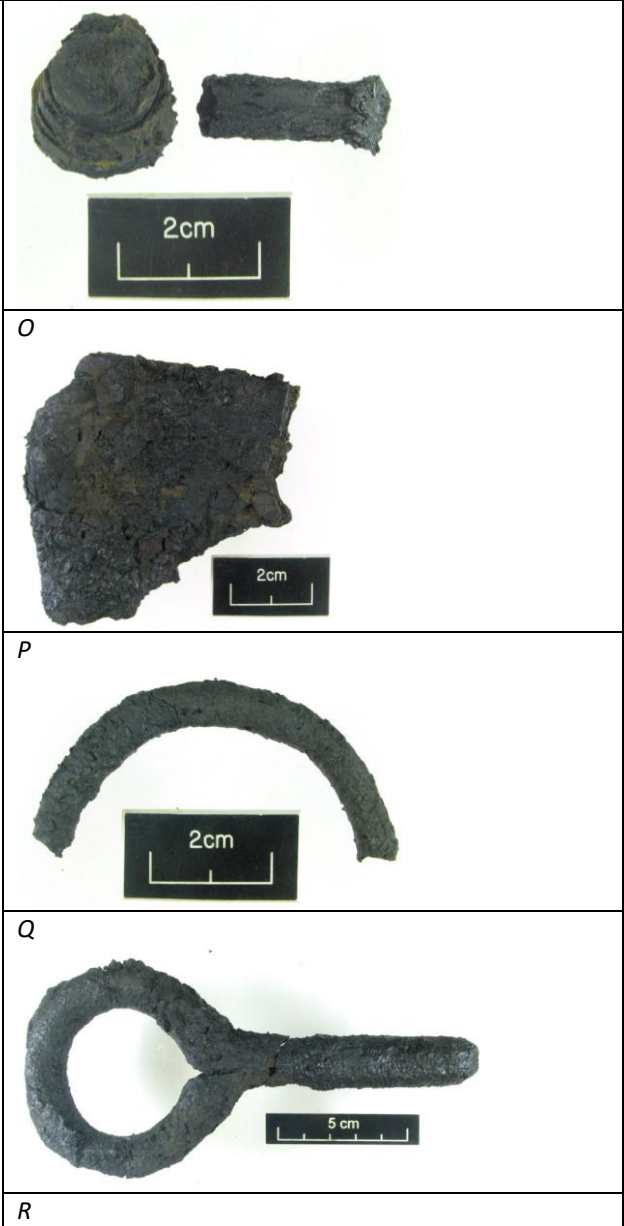
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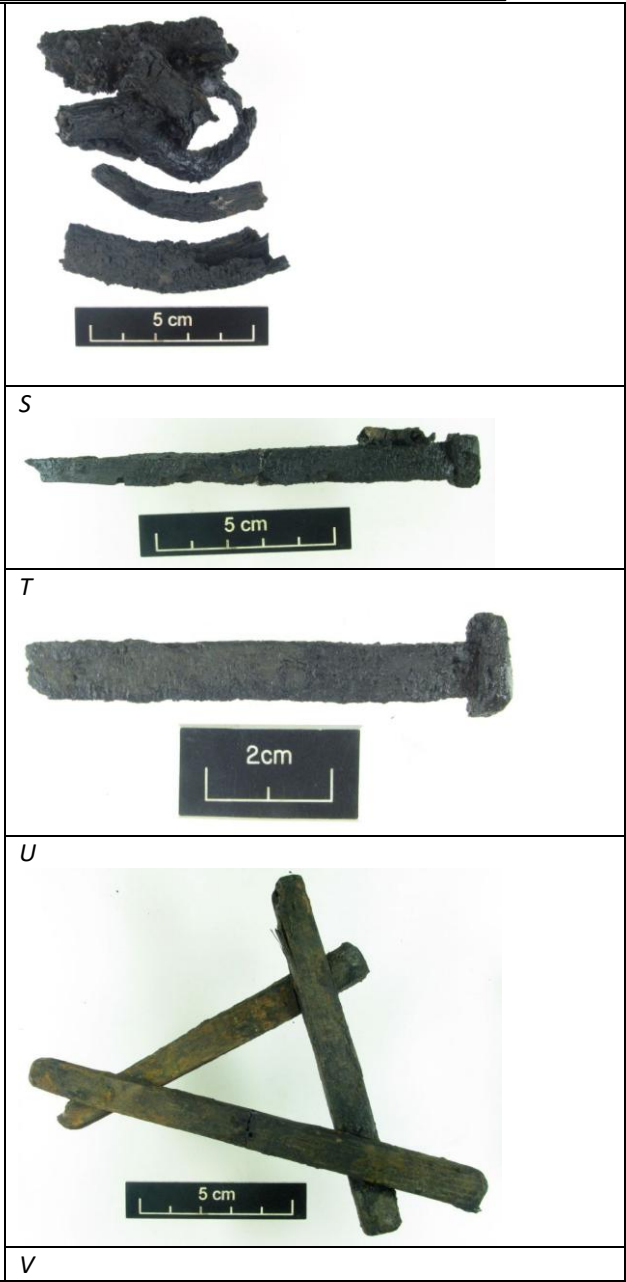


M



N









AA



AB



AC



5 cm

AD



2 cm

AE



5 cm

AF



AG



AH



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