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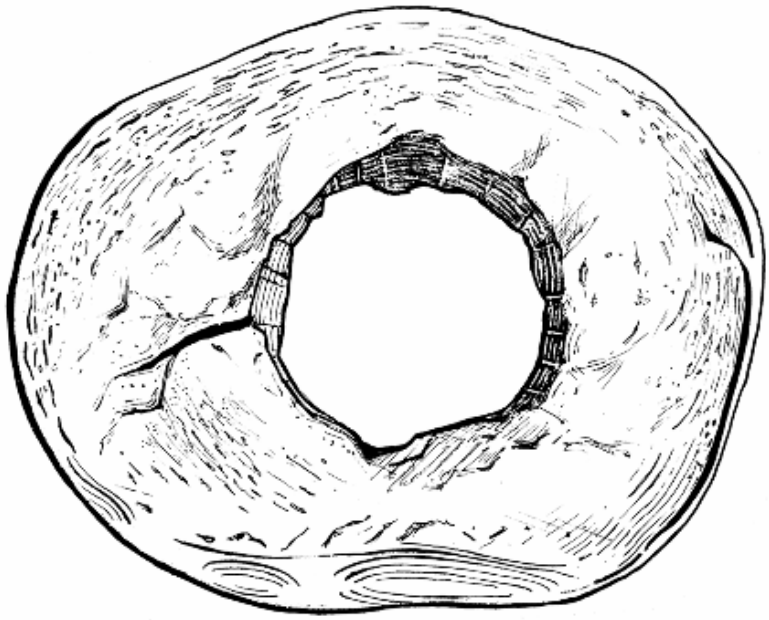
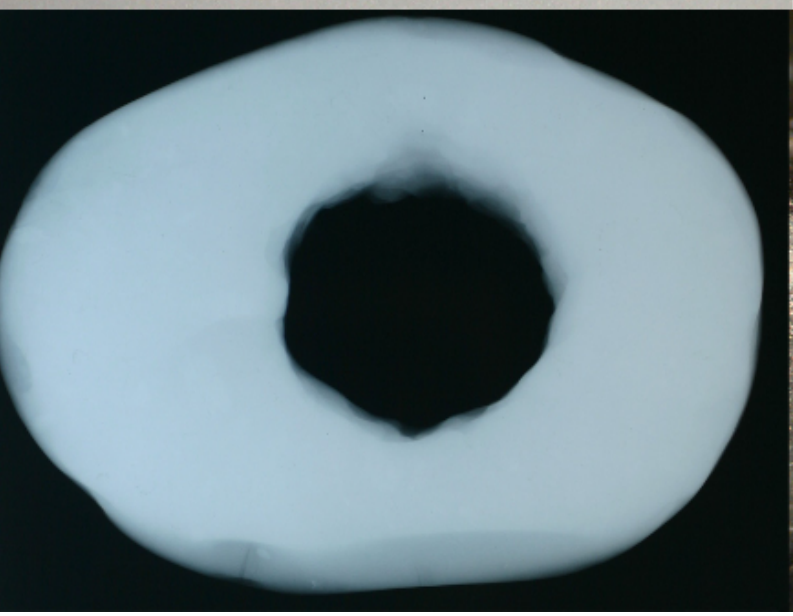
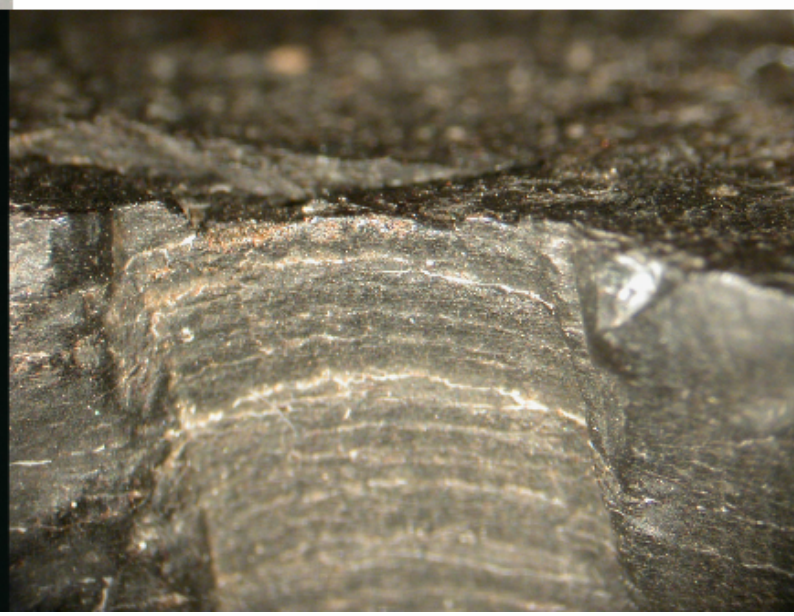
CLATTERFORD ROMAN VILLA, ISLE OF WIGHT
THE INVESTIGATION AND CONSERVATION OF A WATERLOGGED SHALE OBJECT

ARCHAEOLOGICAL CONSERVATION REPORT

Angela Karsten







ARCHAEOLOGICAL SCIENCE

ENGLISH HERITAGE

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CLATTERFORD ROMAN VILLA, ISLE OF WIGHT

The conservation and investigation of a waterlogged shale object

Angela Karsten

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SUMMARY
This report deals with the conservation of a Roman shale object. The use of saturated salt solutions is explored for the controlled drying of the artefact after impregnation with Polyethylene Glycol. A number of investigative techniques were applied to confirm the objects composition to be shale. The report concludes with an investigation of the tool marks.

ACKNOWLEDGEMENTS
I would like to thank all those people that have shared their experience of conserving waterlogged shale with me: Glenn McConnachie, Mary Rose Trust, Paul Simpson, IoW Museum Service, Jennifer Jones, University of Durham, Liz Goodman, Museum of London and Felicity Bolton, Homimann Museum. I am also grateful to Roger Wilkes, English Heritage for his assistance during the analysis, to Claire Tsang for her assistance with the data loggers and Sharon Penton, British Museum for her help and support, and also Chris Evans, for granting permission to use the drawing of the object.

KEYWORDS
Conservation, Roman, Jet/Shale

ARCHIVE LOCATION
Isle of Wight Museum Service

DATE OF Conservation Work
November 2008 — February 2009

CONTACT DETAILS
English Heritage, Fort Cumberland, Fort Cumberland Road, Portsmouth, PO4 9LD
Angela Karsten, 023 9285 6787, angela.karsten©english-heritage.org.uk

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INTRODUCTION

The excavation of the Roman Villa in Clatterford on the Isle of Wight brought a number of artefacts to light (Busby et al 2001), among them a waterlogged shale object of unknown function.

Waterlogged shale is unstable and if allowed to air dry will flake and warp out of shape. Its instability upon excavation is reported widely (Cronyn 1990, 110; Howie 1978, 13; Oddy and Lane 1976, 63); but publications focus more on the scientific analysis and identification of black lithic materials rather than on the conservation of such objects (Davis 1993; Pollard et al. 1981; Hunter et al. 1993; Watts and Pollard 1998; Penton 2008).

This object from Clatterford Roman Villa provided the ideal opportunity to analyse, conserve and investigate a waterlogged shale object. X-radiography, SEM, and FTIR are used to confirm the composition of the object. The use of saturated salt solutions for the slow and controlled drying after impregnation with Polyethylene Glycol 4000 will be investigated. The examination of tool marks and thoughts on the possible function of this unusual object conclude this report.

ANALYSIS

Initial identification on site is often based on visual examination alone. This can be misleading and often objects have been misidentified, which lead to a number of research projects to devise clear identification methods for jet and jet-like materials (see above). To determine what material this object has been made from various investigative techniques were applied and the results are presented below.

Apart from x-radiography all analyses were carried out on a small fragment removed form the broken edge at the bottom of the artefact and subsequently air dried.

X-Radiography

The use of x-radiography provides a non-destructive technique to get an insight into the objects structure. The usefulness of x-radiography for the distinction between jet and shale and other jet-like materials has been demonstrated by various authors (Watts 1992; Penton 2008). In fact, Hunter et al. (1993, 84) recommend to start an identification with x-raying the artefact. X-radiographs show density differences in the material due to different absorption of the x-rays which can be used as a guideline for an initial identification. A piece of shale for example will appear denser then a piece of jet of the same thickness (Watts 1992, 17).

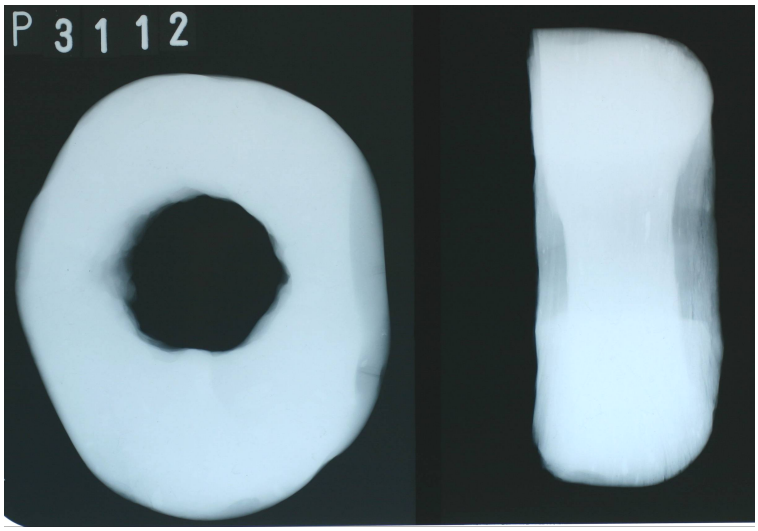

Figure 1: X-radiography image of shale

The x-radiograph[1] (Fig I) shows how opaque, hence dense the object is. This supports the identification as shale. It furthermore allows the visualisation of the layers, which were formed when clay was deposited and eventually turned into shale. Also visible are inclusions.

SEM

The layers and inhomogeneous structure could also be examined under the Scanning Electron Microscope. Two small fragments were embedded into carbon powder, one laying flat down, the other one standing up (Fig 2 and 3). The mount was ground and polished using silicone carbide paper and polishing cloths and subsequently examined under the scanning electron microscope.

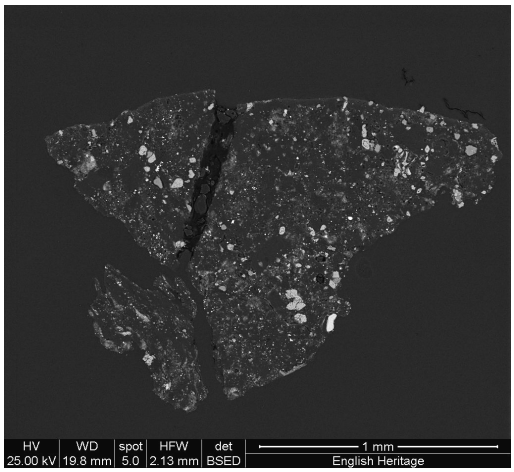

Figure 2: SEM image of sample, plan view

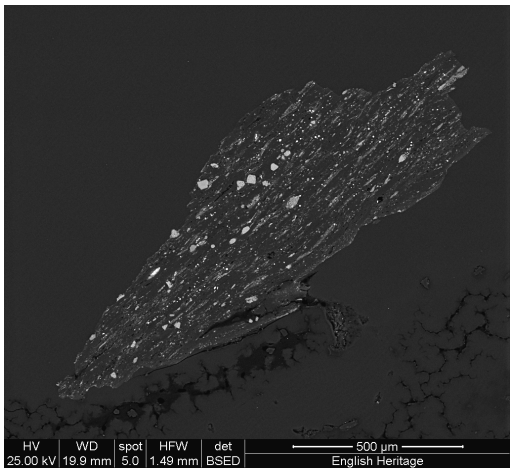

Figure 3: SEM image of sample, cross section

[1]The x-ray parameters are as follows: Film: Kodak MX 125; Film Focus Distance 80cm; Lead Screens: half; KV: 50; mA: 3; Exposure Time: I 8seconds.

FTIR

The use of FTIR spectra for the identification of jet and jet-like material has been demonstrated by various studies (Hunter et al, 1993; Watts and Pollard, 1998). Characteristic peaks in the FTIR spectra can be used to identify black lithic materials.

The spectra collected from the Clatterford Roman Villa object (Fig 4) shows all the characteristic shale peaks identified by Watts and Pollard (1998, 41).

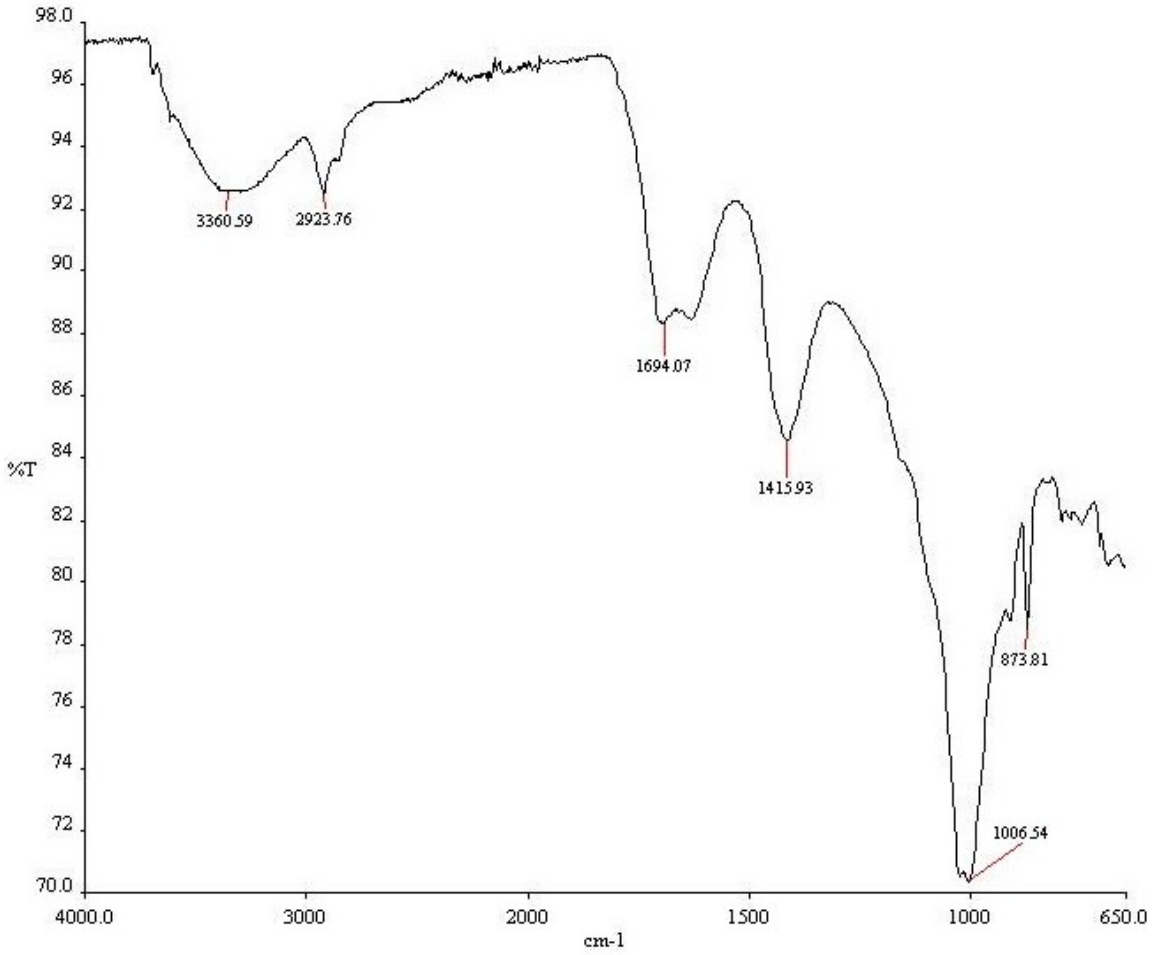

Figure 4: FTIR spectra of shale from Clatterford with characteristic peaks marked

Summary of Analyses

All the analyses point to this object being made from shale. The visual examination of its inhomogeneous and laminar structure, which was more pronounced when looking at the x-ray or SEM images, coupled with the FTIR analysis confirm the identification as shale.

CONSERVATION

As mentioned above the conservation literature on waterlogged shale is rather scarce: One material that has been mentioned time and again is Polyethylene glycol (PEG) (Oddy and Lane 1976; Cronyn, 1990, 115; Watts 1992, 130). As there was no material for conservation trials available it was decided to use a method that has been tried and tested in the past.

Condition

The object was stored in a zip-lock bag filled with water in the cold room at a temperature of approximately 4-5°C since its discovery. The object has an irregular, oval shape, with a rounded surface at the top and a flat, broken off edge at the bottom (Fig 5 and Fig 6-9). The hole in the middle is not quite central and tapers towards the bottom. The object was still wet, clean and of a black colour all over, the broken side did however appear as a dark grey.

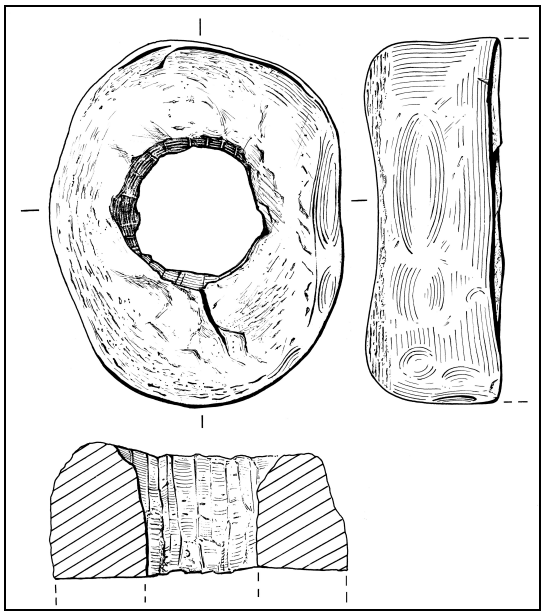

Figure 5: Drawing of the shale object from Clatterford (Busby et al, 2001, 109)

Impregnation

The shale object was submerged in a 10% (w/v) solution of PEG 4000. This solution was increased every 14 days by 10%. The shale remained in the final solution of 30% for two weeks.

Drying

The use of saturated salt solutions for the conditioning of showcases is widely reported (Aastrup 1987; Aastrup and Hovin Stub 1990; Crehan 1991a; Crehan 1991b; Piechota 1992). Their use enables the accurate conditioning of environments which can be used for the slow drying of sensitive materials.

Figure 6: Shale object before conservation, top

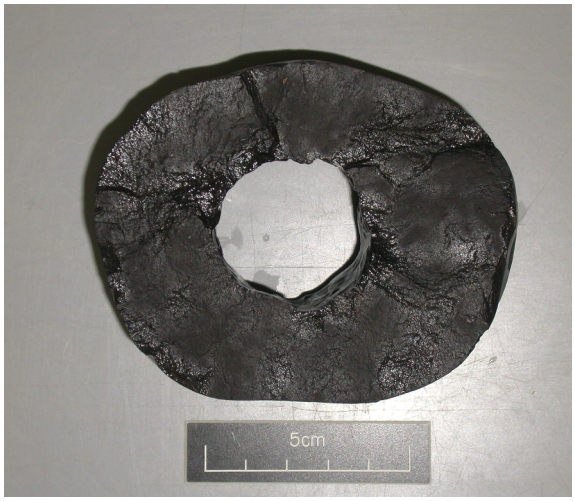

Figure 7: Shale object before conservation, bottom

Figure 8: Shale object before conservation, side view

Figure 9: Shale object before conservation, side view

A sealed acrylic case was used as a drying chamber for this object. The lid of a *Stewart Box* was modified so that a large hole in the lid was covered with a semi permeable membrane held in place by double sided tape (see: Crehan 1991, 18). This prevents the creeping of salts but still allows the free passage of water vapour. This box was placed at the bottom of the chamber and a metal grill placed above it (Fig 10). The shale sat on a glass plate. A *Tini Tag* data logger was placed in the chamber to record temperature and humidity.

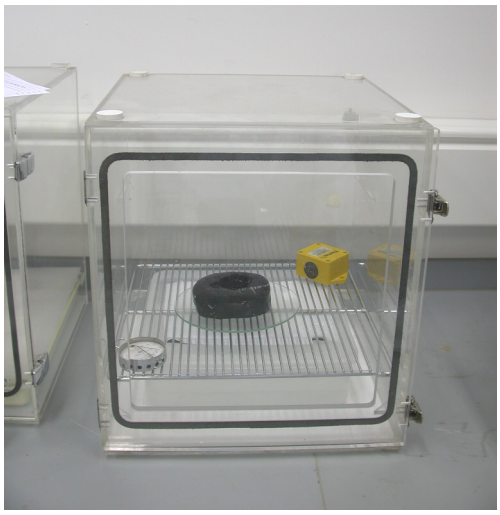

Figure 10: Shale inside the chamber during the drying process

A simple hair hygrometer allowed for an immediate reading of the relative humidity present in the chamber. Throughout the drying process the weight of the shale was recorded (Table I and Fig 11):

Table I: Weight recording of shale during treatment

Date	Weight in g	Salt Solution
09.09.08	202.41 (waterlogged)	
11.11.08	201.43 (after impregnation)	Barium chloride 90%
25.11.08	199.38	Potassium iodide 70%
09.12.08	197.69	
06.01.09	196.65	
08.01.09	196.54	
09.01.09	196.46	Magnesium nitrate 54%
13.01.09	196.28	
14.01.09	196.23	
20.01.09	195.92	
22.01.09	195.80	
23.01.09	195.71	
27.01.09	195.66	

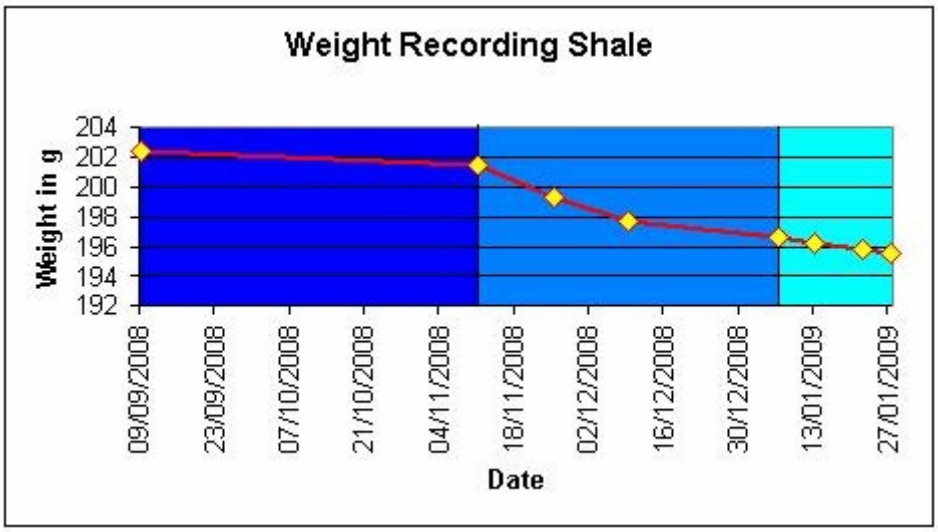

Figure 11: Drying curve of shale object

Barium chloride 90% RH

Potassium iodide 70% RH

Magnesium nitrate 55% RH

Drying of the shale started with a saturated solution of Barium chloride establishing a relative humidity (RH) of 90%. The salt solutions were exchanged every two weeks to first Potassium iodide (RH 70%) and then Magnesium nitrate (RH 54%) (Greenspan 1977).

Barium chloride and Potassium iodide worked well. However it proved extremely difficult to make a saturated solution of Magnesium nitrate. Furthermore the solution did not seem to establish the required RH of 54% but seemed to settle at about RH 70%. After several attempts and adjustments without any success it was decided to keep the RH at the required level by adding silica gel to the chamber. This does however require slightly more maintenance than the salt solution alone, as the silica gel had to be exchanged when it became exhausted and the RH rose above 60%. By doing this the shale object could finally be dried slowly (Fig 12-15).

Storage and Handling Recommendations

The susceptibility of shale to changing relative humidity is a well known problem especially in geological specimen, it is therefore important to store shale objects at a stable and low humidity, of below 50% (Howie 1987, 19). The shale artefact is currently stored in a Stewart box containing silica gel at below 30% RH.

The object should be handled with care, as its soft surface makes it prone to mechanical damage.

Figure 12: Shale object after conservation top

Figure 13: Shale object after conservation bottom

Figure 14: Shale object after conservation, side view

Figure 15: Shale object after conservation, side view

Summary of Conservation Measures

The dry shale object is stable and can be handled safely (see above). Only minor cracks appeared in the surface of the object, which are not visible to the naked eye. The colour is now more typical of shale, a dark grey.

The use of saturated salt solutions generally can be recommended. The use of Magnesium nitrate however proved to be difficult and in the future another salt such as Calcium nitrate could be used instead to establish a RH of 54%.

INVESTIGATION OF TOOL MARKS AND OTHER FEATURES

After the artefact was treated and dried it could be handled safely and examined thoroughly. Tool marks inside the hole could already be seen when the object was still wet. Three more tool marks and a fossil impression were found on the broken edge.

Tool Marks

The tool marks inside the hole on this object are somewhat crude and look very much like chisel marks in wood work. Closer examination did however reveal that the tool used to create the hole did not have a straight but a curved blade (Fig 16 and 17). Gouges were used in wood and masonry work. Roman examples can be found in Manning (1985, plate II, B45-50). Typical gouges and cross sections of the blades can be seen in Salaman 1975.

As examination was difficult a silicone rubber cast of the hole was made to assist with the study of the tool marks. Primarily the cast was used to examine, record and measure tool marks. As several side features[2] (see Appendix I) could be observed the width of the blade can be reconstructed as approximately 4.7mm. The longest tool mark measured is 103mm. The curve is rather flat.

After the object was dried and thoroughly examined under the microscope two more tool marks were discovered on the broken edge (Fig 18) and one on the side (Fig 19).

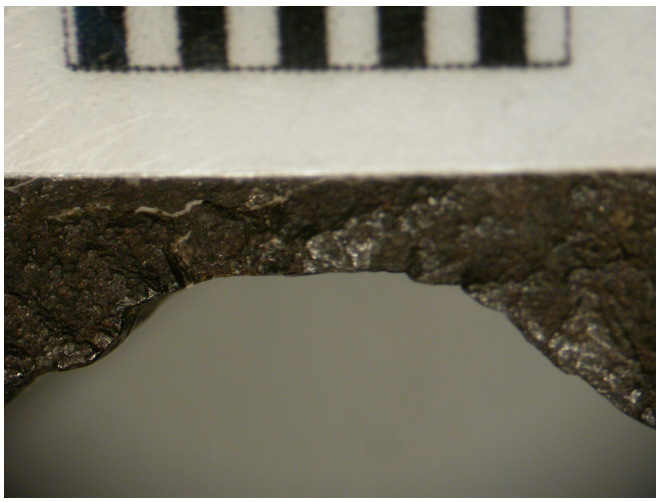

Figure 16: Tool mark inside the hole, looking at it from the top

Figure 17: as Figure 16, looking down on the same tool mark

[2] Terminology is based on: Sands, R: 1997 *Prehistoric Woodworking. The analysis and interpretation of Bronze Age and Iron Age toolmarks:* London: Archetype Publications

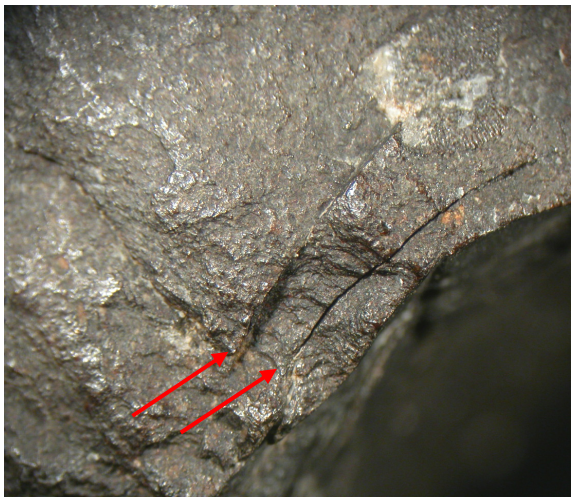

Figure 18: Two jam curves on the broken edge

Figure 19: Jam curve on the side

The two tool marks on the broken edge, sit right next to each other and resemble the jam curves left behind by the tip of the gouge. This strongly suggests that the shale object was worked from both sides. They measure slightly longer at 5.8mm to 6.4mm. The blade is however of the same curvature.

The tool mark on the side also resembles the jam curve. As no tool signature can be seen it is likely that the shale was struck with a gouge at a right angle from the side.

Summary

In the hole the shale was worked with a gouge in a way that left clear tool marks right next to broken off areas. This suggests that the gouge was driven down, as indicated by tool signatures and a step-like structure and then used as a leaver to break larger parts of shale off. The gouge was quite likely driven down with a hammer, as the stop marks are very pronounced and do not feather out (Fig 20 and 21). The presence of tool marks around the hole but also at the broken edge and on the side strongly suggests that the object was carved from all sides. It is possible that the shale object was deliberately broken in half as indicated by the tool mark on the side. But it is just as likely that the object broke in half at a natural crack[3] (lamella) during the carving work.

[3]See Figure 1 (x-radiograph) on how lamellas run through the whole object

Figure 20: Silicone cast (carbon coated) illustrating pronounced stop marks

Figure 21: Step-like cross section received from gouge driven down with hammer

It can only be speculated what the gouge really looked like. All examples in Manning (1985, plate 11, B45-50) have much wider blades than the tool marks observed in this case. The blade was however straight and did not widen towards the end. As to whether the blade was bevelled can not be determined.

Fossil Impression

The impression of a fossil could be found right next to the tool marks on the broken edge (Fig 22 and 23). Shale is formed in shallow marine environments and the organic material is likely to be derived from planktonic organisms (Watts and Pollard 1998, 41). An identification of the fossil can give an insight into the area and time of the formation of the shale. It is however not the purpose of this report to identify the fossil.

Figure 22: Fossil impression (red box) next to jam curve broken edge

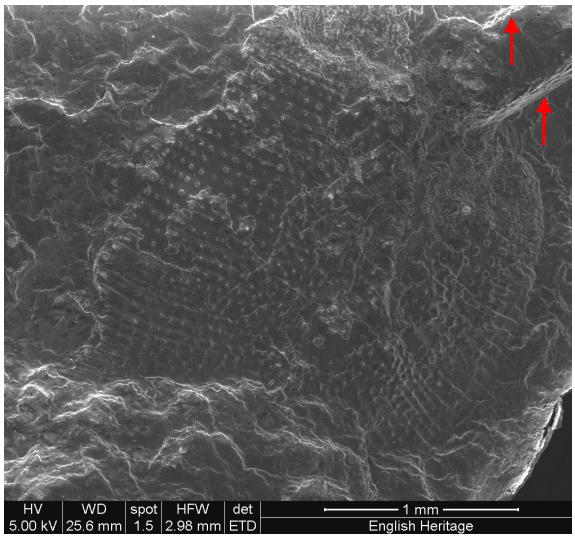

Figure 23: SEM image of silicone cast of fossil impression next to jam curves (red arrows)

CONCLUSION

So far the object has not been identified and is described as a shale object of unknown function (Busby et al. 2001, 111). Two similar objects also from the Isle of Wight are described by Tomalin (1987, 46 ff). These two shale objects are very similar, but more circular in shape and slightly smaller. Both are marked down as tori of unknown use (Tomalin 1987, 46). One is reported to also have chisel marks inside the hole.

The crude round shape of this object with the hole in the middle shows strong similarities to clay or stone loom weights. The use of shale for spindle whorls is well known (Muller 1987, 23; Tomalin 1987, 46; Allason-Jones 1996, 47) but no examples of shale loom weights could be found.

One other possibility is that the shale object from Clatterford Roman Villa is the rough-out for a bracelet that was carved rather than turned. One such example can be seen in Allason-Jones (1996, 50).

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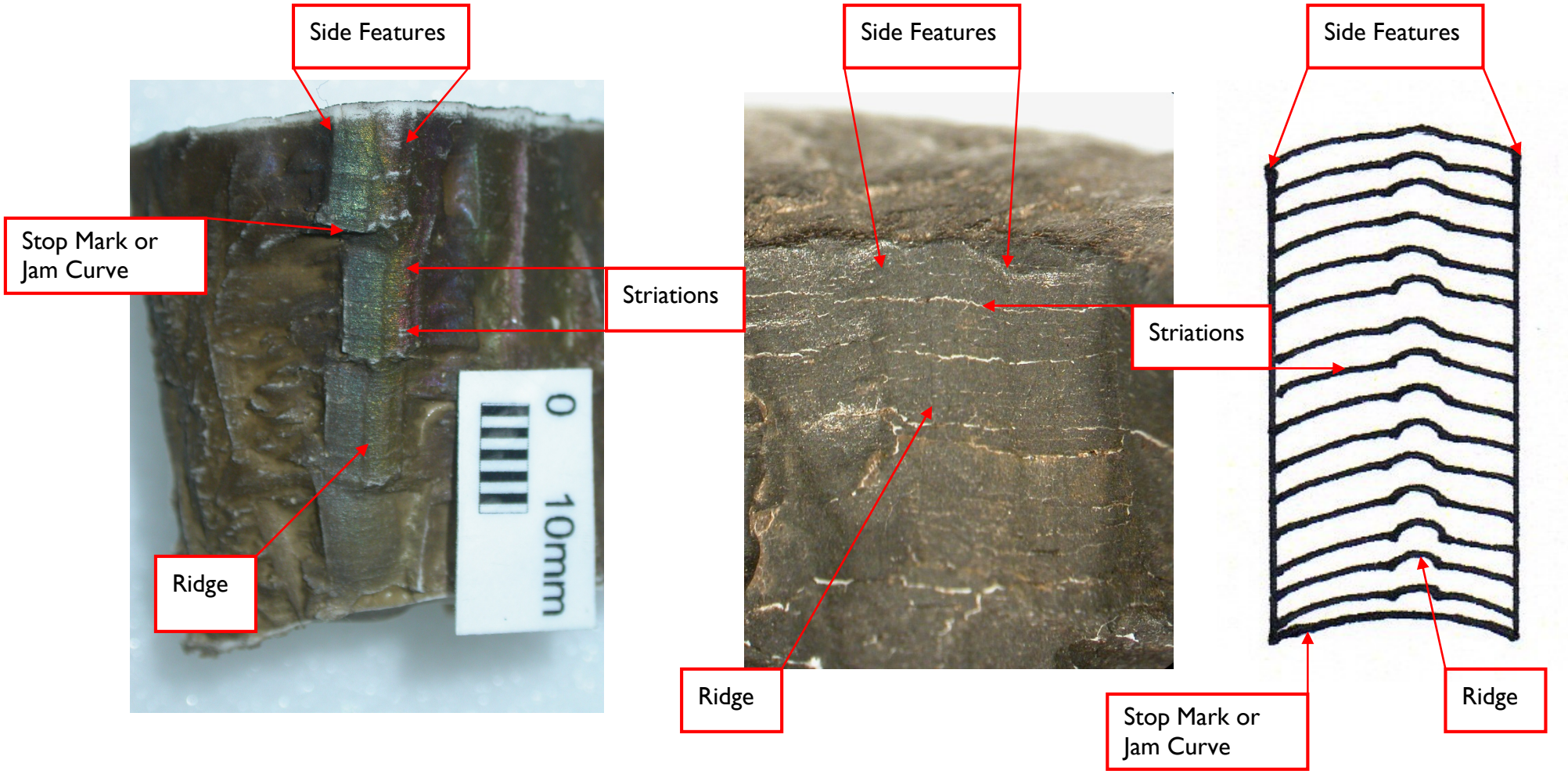
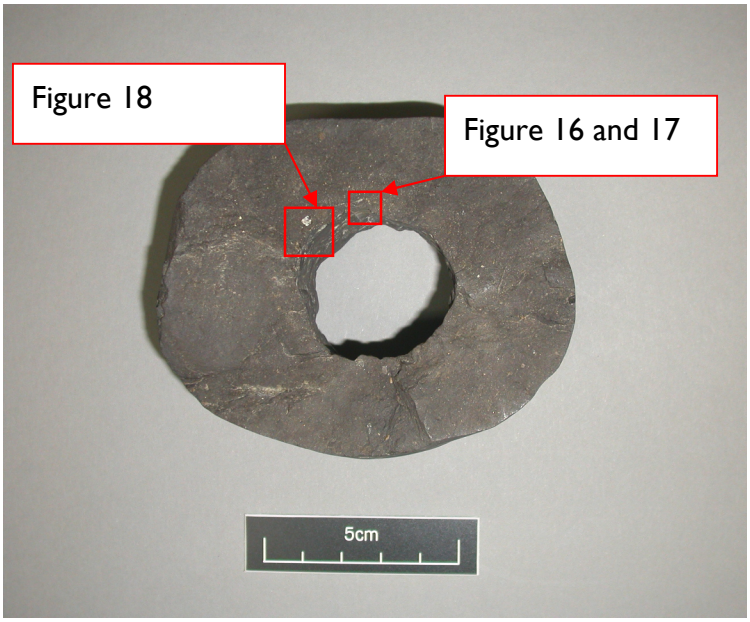
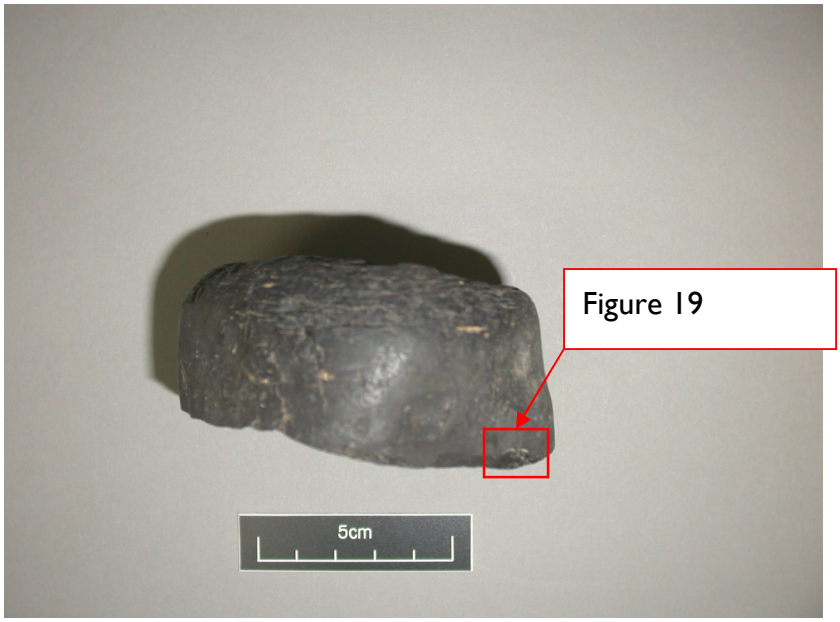
APPENDIX I Terminology of tool marks



APPENDIX 2 Chart of micro photographs taken

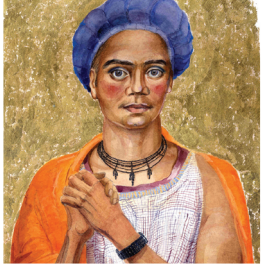




APPENDIX 3 Materials and Equipment

Material	Supplier
Polyethylene Glycol 4000	Fisher Scientific
Potassium iodide	Fisher Scientific
Barium chloride	Fisher Scientific
Magnesium nitrate hexahydrate	Fisher Scientific
Distilled water	In-house production
Silica gel	Baltimore Chemicals Ltd.
Silicone Rubber *Elastosil M45 /4 Catalyst T 51*	Amber Composites Ltd.
Conductive carbon filled powder	Buehler-Met
Stewart Boxes	The Stewart Company
Semi permeable membrane *Sympatex*	Preservation Equipment Ltd.
Double sided tape	Stationary supply
Silicon Carbide Paper (Range 120 - 2500)	Buehler-Met
Micro Cloth (Range 3µ - 1µ)	Buehler-Met
TexMet Polishing Cloth (Range 9µ - 6µ)	Buehler-Met

Equipment	Specification
Hair Hygrometer	Edney Thermo-Hygrometer
SEM	FEI Inspect F FEG SEM
FTIR	Perkin Elmer Spectrometer 100
X-radiography machine	AGO HS Systems
Carbon coater	Polaron Range CC7650
Tini Tag	Gemini Data Logger
Distilled water plant	Aquatron A4S
Molding Press	Buehler Metaserve
Polisher/ Grinder	Buehler Metaserve



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