Gerhard Eggert and Britta Schmutzler (Eds.)

Archaeological Iron Conservation Colloquium 2010

Extended Abstracts

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AIAE

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DBU
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Poster Session

IDENTIFICATION OF ORGANIC REMAINS ON IRON FINDS USING VARIABLE PRESSURE SCANNING ELECTRON MICROSCOPY (VP - SEM)

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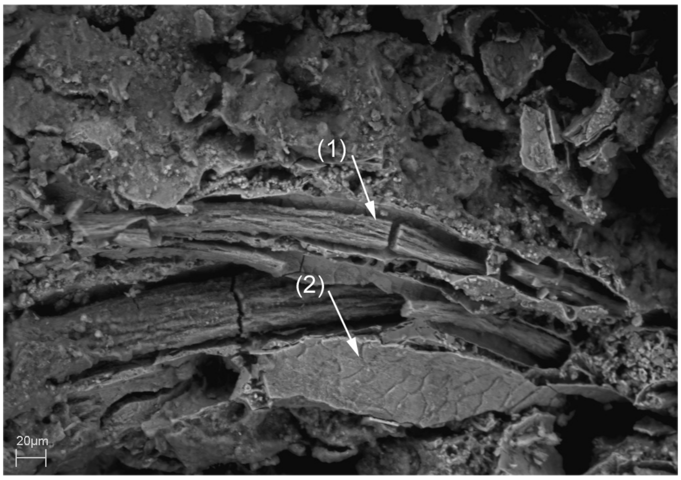
The remains of organic material, which have been preserved in the corrosion products, can be observed on many iron finds. Recent systematic and methodical approaches have increased the understanding of the original function and use of textiles, leather and other organic materials. Identification of these materials depends on their condition and state of preservation and has greatly improved because of the introduction of the SEM in the 1980s.

Using a Zeiss EVO 60, investigations at the State Academy of Art and Design in Stuttgart have revealed the potential of VP- SEM to study organic remains. Alternative applications of the microscope were tested on iron finds lifted in a block.

The microscope facilitates the analysis of samples without prior preparation and the sample chamber can accommodate small archaeological finds such as fibulae, fittings or knifes. It is possible to study surface details of fragile and brittle materials which had not been recognized before. The non-destructive observations provides a more thorough insight into organic remains, showing the state of preservation of disintegrated substances and preserved morphological characteristics, thereby enabling identification of the material.



(1)highly degraded fibre, the cuticle is lost
(2) negative cast of fibre   Image: A. Fischer, SABK

It must be recorded that the capacity of the cooling stage is limited as far as both weight and size are concerned. Furthermore, using the VP - SEM accelerates the drying process and therefore the exposure time for in situ examinations of waterlogged organic remains is limited. To some extent, damp samples can be examined, because water vapour can be introduced into the chamber and the temperature of a Peltier cooling stage can be controlled. Organic remains from hydrated soil blocks were lifted in small sections and placed on the cooling stage for examination. Excellent results have been achieved, distinguishing highly degraded textile and leather remains used perhaps as belts, bags or wrappings.

THE LABORATORY PROCESSING OF BLOCK – LIFTED FINDS FROM GRAVES

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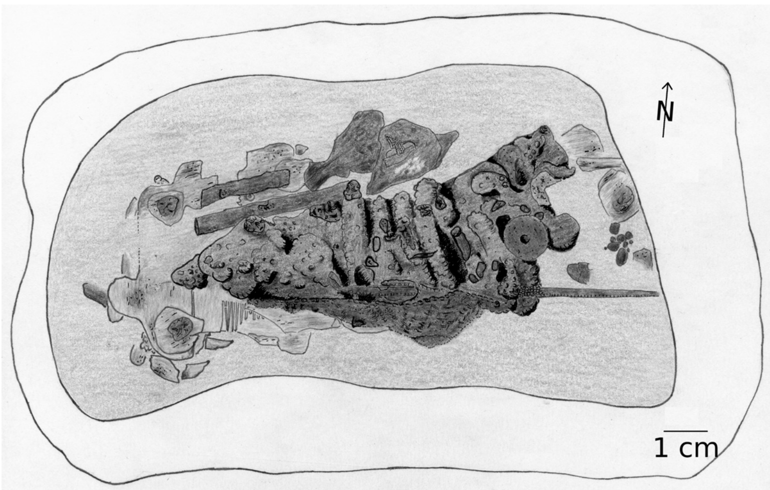
To reconstruct and gain knowledge about early medieval clothing, archaeological research relies on the examination of the organic remains preserved in close proximity to metal burial finds. Lifting the finds at archaeological sites as a block enables the recognition and identification of all preserved information, ensuring safe excavation and careful investigative cleaning in the conservation laboratory. This „excavation en miniature" is a particular challenge to conservators and is well suited to the didactical imparting of the basic principles and skills of archaeological conservation. For this reason, practical studies in processing block-lifted finds are of significant value in the curriculum of the Objects Conservation Course at the State Academy of Art and Design Stuttgart.

The cleaning of metal finds with associated organic remains is an irreversible process, determining whether information is preserved or irrecoverably lost. Only a systematic examination and treatment, including a stratigraphical excavation of all structures and layers, comprehensive documentation and the identification of the nature of organic remains, can provide optimal basic data for research.



Documentation of iron finds with mineral preserved textile remains Image: K. Bott, SABK

The careful documentation is of scientific importance, because most of the organic remains will be destroyed after the objects are taken out of the block.

The process of drawing several plana trains one to recognise delicate and sophisticated details. Drawing details is learning to see - and learning to see is learning to understand!

THE IRON COLLECTION OF ANCIENT MESSENE: A METHODOLOGICAL CONSERVATION APPROACH

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In Greece, but also in other Mediterranean countries, in museums that house archaeological collections next to sites and/or excavation areas, iron finds of every day use may be stored for many years after excavation without proper conservation or maintenance programs. To compound this problem, wide temperature and RH fluctuations during the year create further damages to metal artifacts. Thus, the nature of these collections in terms of typology, technology and condition is unknown and it is difficult to design an effective conservation plan to preserve the collection. Furthermore, the current legislation does not easily permit the transportation of artifacts to a scientific laboratory or sampling for further diagnostic examination. Consequently, a "re-excavation" and a damage assessment of the collection should be carried out in-*situ.*
Under the auspices of the 6th Framework funded project, PROMET, the T.E.I. of Athens has developed a systematic methodology approach based on statistics for surveying quickly the technology and condition of large metals collections prior to treatment and possibly many years from excavation, so as to identify treatment priorities. Such an approach requires also the application of diagnostic techniques in-*situ*, in order to identify the value and condition of each artefact and determine their treatment priority.
A technology survey was performed using the variables that describe the type, such as morphological characteristics. Burt frequency tables and classification trees were produced according to the defined variables presenting the characteristic technological types of the collection. A condition survey was carried out to determine treatment priority levels using the

prediction-answer of the question: *Which objects are in urgent need of treatment, would benefit from treatment, do not require treatment*? Variables affecting the condition (such as burial environment, environment and time after excavation, technological characteristics, type of corrosion products) and the 'value' were used. With the assistance of a statistical package SPSS12.0 (SPSS 2004), frequency tables were produced showing how all the probable values of a variable(s) are correlated in the sample. From here, Multinomial Logistic Regression was chosen to predict the answer to the question.

X-ray Radiography was applied in the entire sample of 549 wrought iron objects, as it is an essential non-destructive technique for revealing hidden clues as to the methods of manufacturing, decorative detail, as well as the overall condition of the artifacts (amount of remaining metal core, presence of cracks, extent of corrosion layers).

The process of the results helped to design an effective conservation program for the preservation and the protection of the collection, including management after excavation, storage and treatment and was applied experimentally on a sample of 16 wrought iron artifacts that retained the original metal core but exhibited clear signs of 'active' corrosion (akaganeite formation, spalling), so as to evaluate the efficiency of the application.

This poster presents the overall results from the application of a systematic methodology approach for surveying the technology and the condition and from the design and application of an efficient conservation program for the iron artifacts collection of Ancient Messene.

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FREEZING CORROSION – A VIABLE STORAGE OPTION?

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Introduction

Several authors assume a good corrosion stability of archaeological iron stored at deep-freeze temperatures, but systematic studies about the efficiency of this conservation method are missing. The corrosion of iron in Antarctica (e. g. Buchwald and Clarke 1989), following the same mechanisms as post excavation corrosion, raises doubts about the stability of iron artefacts under such conditions.

Experimental and Results

To study the process of post excavation corrosion at deep-freeze temperatures, powder samples consisting of iron and iron(II)-chloride-tetrahydrate (Watkinson and Lewis 2004) in similar weight proportions were stored at maximum -20 °C and under common working room climate as a reference. To observe the transformation of the initial powder samples, FTIR spectroscopic measurements were carried out at regular intervals. The intensity of the band at 852 cm^{-1}, which is specific for akaganéite, can be referred to for a quantitative evaluation of the akaganéite content in each measured sample. Therefore, a calibration line was created by measuring pellets with known amounts of akaganéite (Thickett 2003).

Experimental results show, that significant amounts of akaganéite can form within days under uncontrolled environmental conditions. Concerning samples stored at deep-freeze temperatures slight changes in colour as well as minimal changes in the IR spectra also indicate ongoing chemical reactions after just few days. However, corrosion reactions are significantly delayed. The deep-freeze storage of archaeological iron finds thus seems to be maintainable for short periods to minimize active corrosion, but can not be recommended as a long-term storage solution.

References

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METAL 2010: ICOM-CC WG 'METALS' INTERIM MEETING IN CHARLESTON, SOUTH CAROLINA FROM OCT. 11-15, 2010

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ARCHAEOLOGICAL IRON AFTER EXCAVATION (AIAE): A SUB-WORKING GROUP WITHIN THE ICOM-CC METALS WORKING GROUP

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Archaeological Iron After Excavation (AIAE) is an international forum for scientists, conservators, archaeologists and other researchers interested in the investigation and conservation of iron artifacts after they have been recovered from archaeological contexts.
The objectives of AIAE are:

1. To identify research groups working on any aspects of post excavation changes and storage conditions of archaeological iron excavated from land or marine sites
2. To compile and maintain an exhaustive and accessible bibliography of these topics
3. To identify research areas that need to be further developed
4. To promote research and disseminate relevant information

AIAE was initiated in 2003 as a sub-working group of the International Council of Museums Committee for Conservation Metal Working Group (ICOM-CC Metal WG), and encourages participation by ICOM-CC Members. AIAE is a partner with the State Academy of Art and Design, Stuttgart, Germany in the 2010 Iron Conservation Colloquium in Stuttgart. For more information please contact Eric Nordgren, AIAE Sub working group co-ordinator.

CORROSION PROTECTION WITHOUT RED LEAD: A CONTRADICTION IN TERMS?

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When restoring historic iron and cast-iron objects, the selection of a suitable anti-corrosive protective coating is often a key concern. A drawback of most modern anti-corrosion systems is that they have been developed for use in industrial applications. As a consequence, these systems have a monochrome appearance, and short drying times often do not allow for the artistic embellishment of the object's surface. Another challenge posed by the conservation of historic objects is that the surface to be treated typically displays a residual level of rust (according to ISO surface preparation standard St 2). The corrosion protectant frequently used in the past, red lead, is an environmental and health hazard.

A two-year research project, titled *Korrosionsschutz in der Denkmalpflege* ("Corrosion protection in the preservation of historic monuments"), funded by the German Federation of Industrial Research Associations (AiF), aims to contribute to the investigation, evaluation and modification of modern anti-corrosion systems for historic iron and cast-iron objects. Together with the metal conservation workshop Haber & Brander, BAM will evaluate the performance of modern anti-corrosion systems in comparison with red lead. A key aim is to adapt commercial anti-corrosion systems to the requirements associated with the conservation of historic objects.

At the start of the project, a comparative study of red lead and modern anti-corrosion systems will be performed. Numerous sample materials will be tested: new and artificially corroded low-alloy steel; historic cast and wrought iron; as well as materials already treated with red lead or featuring other residual coatings. After applying various commercially available anti-corrosion systems, the samples will be subjected to an accelerated aging process in a controlled-humidity atmosphere, under exposure to UV light and, as the case may be, corrosive gasses. Using a range of optical and physical methods, the researchers hope to evaluate the performance of the various anti-corrosion systems. The adaptation of the anti-corrosion substances as well as the preparation of advisory guidelines for conservation practice are two additional goals of the project.