Development of Storage and Assessment methods suited for organic Archaeological artefacts (StAr) - JPI-CH project

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Abstract. StAr project - Development of Storage and assessment methods suited for organic archaeological artefacts – started in 2020 within the framework of Joint Programming Initiative on Cultural Heritage and Global Change (JPI-CH) Conservation, Protection and Use. The project arises from the need for chemical-physical stabilization strategies of archaeological finds (mainly wood and leather), for long time (up to several months) in the waterlogged state, i.e., under pre-treatment conditions, without compromising the archaeological and scientific evidences they contain. Several methods of controlling storage conditions will be tested on archaeological wooden and leather objects. The experimentations will entail a systematic chemical analysis and monitoring of the organic materials before, during and after storage in different conditions, both in laboratory and on-field at the Biskupin archaeological excavation site in Poland.

1. Introduction

Archaeological organic artefacts are often found in a waterlogged state, which should be maintained until treatment as they cannot support air drying. The StAr project - Development of Storage and assessment methods suited for organic Archaeological artefacts (JPI-CH, http://jpi-ch.eu/) – aims at developing strategies that permit the storage of delicate organic archaeological finds for long durations (several months) in the waterlogged state, i.e. under pre-treatment conditions, without compromising the archaeological, heritage and scientific evidences associated to them. The project, coordinated by ARC-Nucléart (Grenoble, France), involves four partners from four different countries (Figure 1).

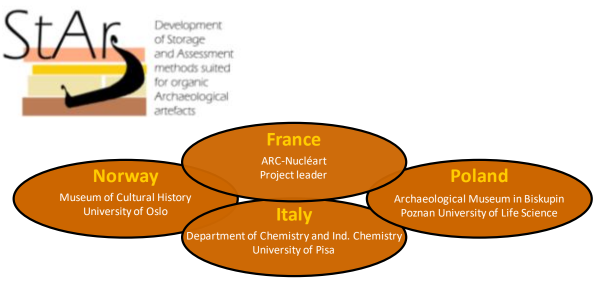

Figura 1 Research partners involved in the StAr project

Several methods of controlling storage conditions will be tested on archaeological wood and leather samples, and specific chemical-physical monitoring protocols will be optimased or newly developed. The experimentations will entail the chemical-physical characterization of organic materials before and after their storage in different conditions. Storage experiments will be carried out in controlled laboratory conditions and also in a true archaeological excavation context, the Biskupin site in Poland [1].

StAr also aims at setting up effective and sustainable methods to assess the short/long-term stability of archaeological organic artefacts, after the conservation treatments. Knowledge of the impact of environmental conditions and of conservation treatments will allow us to identify potential degradation, which in turn offers better protection of the objects and more cost-effective mitigation measures [2]. The objective is to establish an assessment protocol on treated and untreated materials. These assessments well suited for museums and storage centers, will be validated by advanced analytical techniques to detect the real state of degradation.

Archaeological finds represent both an important part of the resources used by historians to study the past and a unique testimony of ancient heritage, shared with a wide public through museum exhibitions.

An Archaeological Organic Artefact (AOA) involves several different successive states of material history. These different states can be coarsely summarized in the following Figure 2, where each step corresponds to a modification, often nonreversible (chemical, shape and visual appearance).

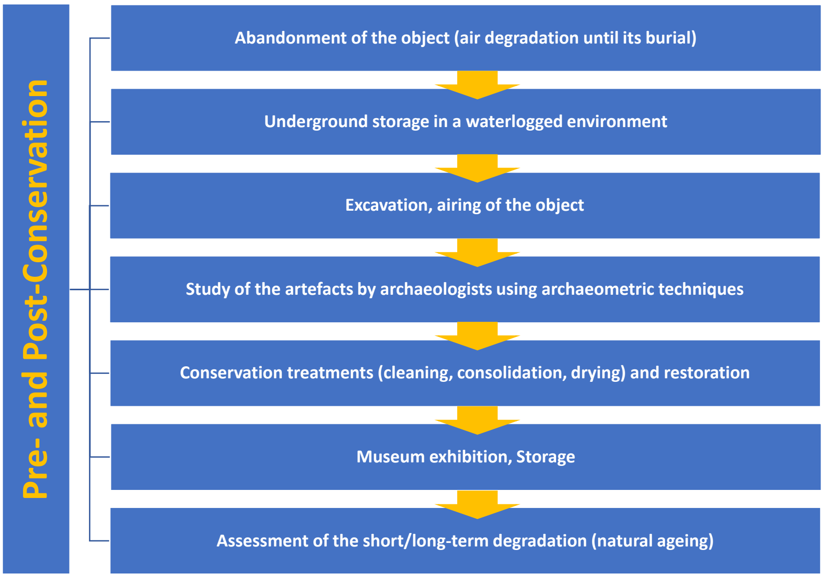

Figure 2 The different successive states of archaeological object containing organic materials.

The evaluation of two main critical phases, namely pre-treatment and post-treatment, related to the conservation of AOAs will be addressed by StAr.

It is known that storage treatments involving cleaning and drying could lead in some cases to the loss of information. Consequently, valuable archaeometric data are obtained from appropriately stored materials prior to treatment.

Since waterlogged AOAs often cannot support their own drying (resulting in shrinkage, collapse and cracking), it is vital to keep them in a waterlogged state. The main protocol for preserving archaeological collections in a waterlogged state consist of immersion or contact of the objects in water.

Post-treatment phase: another risk to consider is the effect of conservation treatments on the ageing processes of artefacts. This aspect of the StAr project seeks to develop efficient and practical methods of evaluating the post-treatment chemical stability of archaeological wood and leather in the short/long terms. This will be achieved by assessing a range of well-established and more recently developed treatments, with a focus on the relationships between chemical degradation and mechanical properties over time and in response to climate conditions.

The transferable assessment tools and protocols will be highly relevant in cases where assessment of new conservation materials need to be undertaken, which is a growing field of interest in heritage science.

2. Research during the StAr project

2.1. Pre-treatment condition

The research context is very poor for optimization of pre-treatment condition because this issue is not supported by stakeholders and collection authorities, and the pre-mainly concerns the archaeologists that study the artefacts. During the last thirty years, the main focus has been on the conservation treatments (e.g. consolidation, drying, restoration). Nevertheless, the excavation site is a pivotal point for archaeologists, archaeometrists, conservators and museum curators. Moreover, the stability of the organic material during the excavation period is crucial for the quality of the historical data and for the future preservation of the objects. The main issue is the risk of accidental air drying and recurring biological contaminations (Figures 3a, 3b).

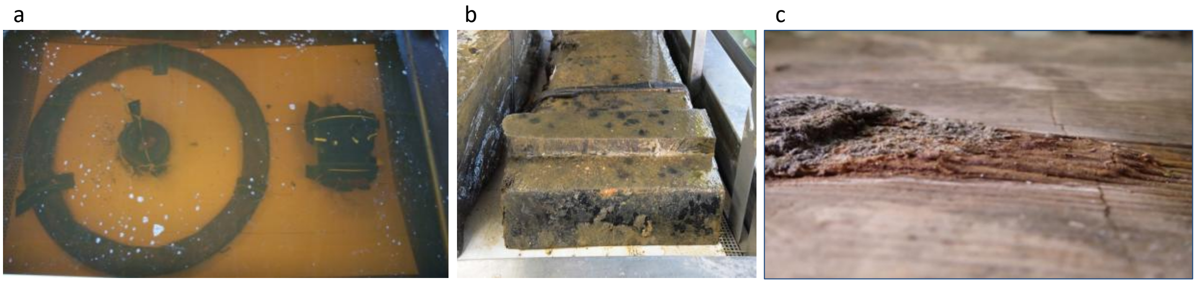

Figure 3 Examples of a) water baths contamination by micro-organisms (fungi white spots, cloudy solution), b) bacterial film on the wooden surface, c) concretions evolution due to pyrite oxidation and acidification on a wooden artefacts due to humid environmental conditions.

2.2. Post-conservation treatment condition

The post-treatment phase is also critical for archaeological collections with degradation induced by environmental conditions. Indeed, AOAs are usually very sensitive materials, especially when they are contaminated by unstable metal salts (Figure 3c) originating either from burial (e.g. iron salts, sulphides) or from the conservation treatment itself (e.g. alum)[3]. Periodic monitoring is necessary to mitigate potentially dangerous degradation processes.

Recent high-profile studies such as the Vasa and Oseberg projects [3, 4] undertaken decades after treatment in response to new serious, visible problems, have highlighted issues related to known and widely-used treatment materials. This project therefore constitutes a rare and valuable opportunity to investigate the stability of several methods of preserving archaeological organic materials and to define protocols for their assessment.

2.3. Monitoring and chemical analysis

StAr addresses two key situations, which have great effect on the enduring stability of archaeological organic materials: study and analysis phase during the excavation, before conservation treatment, and lifetime of the object after the conservation treatment in the museum or in storage facilities.

Several approaches (hydrogen peroxide, ethanol, salts and enzyme as lysozyme) for stabilization during storage will be tested and validated on archaeological wood and leather. Analysis of organic materials will be carried out before and after the stabilization treatments.
For the post-treatment phase, a selection of reference pieces and samples from archaeological materials preserved by chosen treatments (PEG, Kauramin, Nucléart, siloxanes) exposed to natural ageing (short term) and artificially ageing (long term) will be included in the analytical protocols which will be validated and transferrable. The assessment methods will involve pH measurements, water content, microscopy (MO, SEM), molecular characterization of organic and inorganic components by Py-GC/MS, FTIR, XRD, assessment of climate-induced response by dynamic vapour sorption (DVS) and of mechanical properties by Ultrasound Velocity.

3. Conlusions

The expected results will involve field practices both for the stabilization of waterlogged artefacts for excavation/archaeometry situations and for degradation assessments in museums/storage facilities.

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