

SUOMEN KESKIAJAN ARKEOLOGIAN SEURA –SÄLLSKAPET FÖR MEDELTIDSARKEOLOGI I FINLAND RY.

Suomen keskiajan arkeologian seura – Sällskapet för medeltidsarkeologi i Finland ry. on toiminut keskiajan ja uuden ajan arkeologian tutkimuksen edistämiseksi vuodesta 1990 ja on Tieteellisten seurain valtuuskunnan jäsen.

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<http://org.utu.fi/muut/skas>.

Puheenjohtaja:

Dos. Janne Harjula

puh. 050-5233837

janne.harjula@utu.fi

Varapuheenjohtaja:

Ulrika Rosendahl

ulrika.rosendahl@helsinki.fi

Sihteerit:

Maija Helamaa

Puh. 0400-262 162

maija.helamaa@utu.fi

Rahastonhoitaja:

Janna Jokela

Puh. 050-342 0753

janna.jokela@utu.fi

Sähköpostia hallitukselle voi lähettää osoitteeseen skas-hallitus@lists.utu.fi

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ENVIRONMENTAL MONITORING AND *IN SITU* PRESERVATION OF URBAN ARCHAEOLOGICAL DEPOSITS

– An information resource and a preservation challenge

ABSTRACT

This paper presents some of the challenges of *in situ* preservation of medieval urban archaeological deposits in Norway. Environmental monitoring is presented as a method to study preservation factors, and the paper discusses the consequences of choosing to preserve *in situ*, including the risks of loss of contextual information.

INTRODUCTION

During the last two decades the aim of heritage management has changed from rescuing cultural heritage from destruction through documentation and excavation to preservation *in situ*. This applies both to standing structures and archaeological deposits. This change of policy has been formulated in two international charters and subsequently incorporated into the national legislation of the countries that have ratified these. The Convention Concerning the Protection of World Cultural and Natural Heritage was adopted by the General Assembly of UNESCO in 1972 (<http://whc.unesco.org>). The European Convention on the Protection of the Archaeo-

logical Heritage (www.conventions.coe.int), also known as the Malta or Valletta Convention was agreed on in 1992. Far from being a passive approach of leaving the archaeological sites alone and letting their natural deterioration proceed, the new policy calls for active monitoring of structures and deposits in order to prevent or minimize damages caused by natural or cultural factors (Williams & Corefield 2003; Willems 2008).

The Malta convention was designated to protect the archaeological heritage as a source of the European collective memory and as an instrument for historical and scientific study. As a result, the strategy for preservation of the national heritage is already now and will in future be undertaken by seeking to preserve archaeological sites, urban and rural, primarily *in situ*. The concept of *in situ* preservation implies that the cultural heritage should remain unchanged 'forever' as opposed to the earlier strategy of rescuing through archaeological investigation.

However, archaeological sites and deposits or cultural layers are specific geosystems affected by environmental processes (Smit *et al.* 2006; Martens 2008). To ensure that *in situ* preservation may even be considered a possibility and ensuring that the archaeological record is not simply left

to vanish without attempting to document it, knowledge about the current state of conservation and the physical and chemical conditions for future preservation is necessary. This accumulated knowledge, and a search for mitigation strategies and remedial actions if or when critical levels are reached, is called 'environmental monitoring'.

Archaeological remains are threatened by a number of factors such as wear through use, agriculture, maintenance of infrastructure, construction work, and natural forces. The focus in this paper is the preservation the invisible and vulnerable heritage type 'urban archaeological deposits'. Special to the wet or waterlogged archaeological deposits is the preserved organic matter. The deposits are an immense source of information about past activities, at least for as long as archaeologists are able to interpret the contextual meaning. Degradation of archaeological deposits is caused first and foremost by oxidation of organic or inorganic material, leading to decomposition and loss of organic matter and thus compression of the deposits (Matthiesen *et al.* 2006). The management, preservation, and conservation of archaeological sites *in situ* are complex tasks requiring a basis of multi-disciplinary knowledge. It is a relatively new tool to be used in the management of cultural heritage (Smit *et al.* 2006, Reed & Martens 2008).

MATERIAL

An example of the impacts of the Malta convention concerns the archaeology of the medieval towns of Norway¹. The Norwegian medieval towns are the country's largest statutory protected cultural heritage sites. They are important sources of knowledge about

life and activities of both prehistoric and medieval Norway, and they are important physical archives for the present and future experiences of that part of the country's history. They are also a very limited archaeological resource, as remains of medieval occupation are preserved in only eight present-day towns. In addition, seven smaller population centres and market places had an urban character during the Middle Ages, but all of these had lost their importance by the end of that period, and are now either sparsely populated or farm land (Helle *et al.* 2006). Thus these archaeological remains are indeed a very limited resource. To protect them, the stated aim of the Norwegian Ministry of Environment and the Norwegian Directorate of Cultural Heritage is to preserve the underground archives and at the same time establish conditions for continued use of the pertinent areas (Parliamentary Report no. 16 [2004-2005]:29) and limit the allowed disturbance and loss of deposits to maximum 0.5 % a year (Parliamentary Report no. 16 [2004-2005]:16). It is also adhering to the guidelines in the new standard from 2009 (NS 9451:2009) about 'Cultural property. Requirements on environmental monitoring and investigation of cultural deposits'. Consequently the national strategy for dealing with urban archaeological sites is now primarily one of preservation *in situ* wherever possible. In addition, very few infrastructure projects that need excavation are allowed; instead there has been a focus on drilling and extracting archaeological and geochemical information from these drilled samples about the present state of conservation and the conditions for future preservation. This policy requires a basis for assessment and management, and it is a huge change in the performance and focus of archaeology. The question is, however,

¹ In Norway the post-medieval remains are not protected by law as required through the Malta convention.

whether we are able to ensure that additional material is not lost? Furthermore, since medieval town deposits are so limited a resource in Norway even a 0.5% loss per year will inevitably lead to a point when everything is lost. In opposition to most other types of archaeological remains this record will not constantly be renewed by discoveries of hitherto unknown sites. Many studies dealing with the feasibility of *in situ* preservation have done this without debating to which extent this is the desired solution (Membrey 2008; Martens 2010).

A great deterioration factor is urbanization, specifically the effects of development projects on the natural and cultural values in the landscape both in the towns and on the fringes of towns. The continued development and maintenance of the infrastructure of the city; roads, subways, pipelines, and sewage systems are all destructive factors. Not only do these structures in themselves represent threats to the cultural heritage but they also influence and change the surrounding environment leading to known or unpredicted effects on the conditions for preservation of archaeological deposits, which were not directly involved in the building projects. Thus there is a strong need for knowledge about the deterioration processes and their effects on different scales in time and space. That knowledge forms the basis of strategic development and a sustainable management of cultural heritage and the semi-natural ecosystems of the archaeological deposits.

The focus on the Middle Ages is a consequence of the Norwegian Cultural Heritage Act, which only gives automatic protection to archaeological deposits until 1537, the time of the Reformation. This time limit is highly debatable, since it concerns a change in official religion, from Catholic to Lutheran Protestantism, and not a change in material culture, at least not immediately. While

archaeological deposits only are protected if they are older than 1537, standing buildings are protected until 1650. Paradoxically this protection gap of more than 100 years between the listed deposits and the listed buildings on top of them means that it is legal to remove the early post-medieval deposits that these protected buildings are resting on, without archaeological documentation.

Since the 1980s, attempts have been made to reduce the impact of new development on the finite and non-renewable resources of the urban archaeological deposits (e.g. Lunde 1985:129; summarized by Gardelin 2002). Most historical towns are situated in the exact same spot as the modern town centre. As a consequence, they are exposed to more threats than any other single listed monument in Norway. Building activities, land development, and the continued development and maintenance of the infrastructure of the towns; roads, subways, pipelines, and sewage systems, have a profound impact on the limited, buried information resources. Disturbances may occur either through the removal of archaeological deposits, or through their *in situ* modification, both of which lead to a loss of contextual information, and reduction in the potential for archaeological investigation and interpretation. In cases where heavy loads are imposed, deposit deformation may be accompanied by damage to fragile artefacts and ecofacts (Williams & Corefield 2003). Biological and geochemical processes impact upon the preservation of archaeological deposits when oxygen is added, water is drained and organic and inorganic remains are degraded. The same situation exists for the Viking Age and Early Medieval urban settlements in the present rural landscape, though the threats to these consist mostly of changes in land use in addition to drainage and perforation of the deposits.

Preservation *in situ* is not only important for the protection of the historic archive but also for modern urban and landscape development, as many existing buildings are founded on archaeological deposits, and degradation of the deposits results in settlement damages.

Research on *in situ* preservation of archaeological deposits has so far concentrated mainly on the deposits in the saturated zone below the water table (Matthiesen *et al.* 2006). Research projects conducted at Bryggen in Bergen in Norway, and at a number of sites in the UK, the Netherlands, and other European countries (Christensson 2004; Keevill *et al.* 2004, Matthiesen 2004; NIKU & RA 2008) have shown that archaeological deposits are usually very well preserved under strongly anoxic conditions (lacking oxygen) that are predominantly observed in waterlogged environments (Caple 1998; Huisman 2009).

Large volumes of archaeological deposits in most parts of the medieval towns are, however, situated in the unsaturated zone above the water table where the layers may be wet but are not permanently waterlogged. In this zone, oxygen can be transported by percolating rain water to the archaeological deposits or by diffusion of oxygen through unsaturated soil layers. Very little information is available about the environmental conditions determining the preservation conditions of these archaeological deposits. This is mainly due to the lack of adequate methods to measure the physical, chemical, and biological conditions in the unsaturated zone and there is thus a need to combine different scientific disciplines for the characterisation of the state of conservation. These deposits may be rather dry and porous, leaving little chance for preservation of organic artefacts, and giving ecofacts a hard time surviving. The porosity of the layers leads to additional degrada-

tion, enabling oxygen carried through air or water to penetrate deep into the deposits (Peacock 2002; Hartnik *et al.* 2000). This is gradually rendering the deposits less legible, so that even if not all artefacts and ecofacts may be lost, soon their stratigraphical context may be. In addition, the state of preservation and the environmental conditions in the unsaturated zone are expected to deviate more in time and space than those in the saturated zone because the aqueous phase does not govern the conditions to the same extent (Huisman 2009; Martens 2010).

A way to at least secure maximum information on the state of preservation of these deposits when they are investigated by archaeologists is to use standardized documentation sheets when describing and determining the components of the layer and their internal distribution, as well as defining their current state of preservation. This description must include information about the state of the organic materials, defined through smell and breakage strength (Smit *et al.* 2006; Huisman 2009; NIKU & RA 2008; NS 9451:2009). In order to predict the future potential of preservation, the archaeologists use the aid of geochemists, geophysicists, microbiologists, and hydro geologists, measuring soil humidity, soil temperature, porosity, content of organic matter (through loss on ignition), pH (acidity and alkalinity), and redox potential (measuring nitrate, sulphate, chloride, phosphor, 2 and 3 value iron, etc.) (Johansen *et al.* 2010; Martens *et al.* 2008; NIKU & RA 2008; NS 9451:2009; Vorenhout & Smit 2006).

DISCUSSION

Contextual information is crucial for understanding a site and for making the artefacts 'talk' about the past. Without its context most

of the information inherent in an artefact may be lost. If the *in situ* preservation policy is carried too far, it is in risk of jeopardizing the information potential in the hidden and uninvestigated archaeological deposits (see e.g. Huisman 2009:91). The aim of environmental monitoring is to avoid this, but if some annual degradation – even the slightest - is accepted, when will the deposits be so degraded that it is impossible to read the most essential information from them? When is the story lost? Someone must take the responsibility for this. These are crucial issues that we as archaeologists and conservators need to deal with (see also Membery 2008). The Norwegian state has so far accepted a yearly loss of maximum 0.5% of all archaeological heritage, but is a loss which is difficult to estimate and even more difficult to control.

If the archaeological remains cannot be preserved *in situ*, they may be rescued for the future by excavation, documentation and conservation in museums and research institutes. However, both artefacts and ecofacts may be degraded during storage. It is therefore of interest to compare preservation *in situ* with preservation *ex situ* in order to achieve a reliable protection and preservation of the archaeological deposits and their contextual, historical information. It is also true that excavation methods and strategies are changing and so are the methods and capacities for documentation. Accordingly, it is important that some part of the past is left for the future to investigate. It is the aim of archaeology to interpret the remains of cultural history, to be able to tell the stories of what happened, or at least what might have happened. It is necessary to discuss to which extent we can allow archaeological remains to degrade before they lose their stratigraphical and contextual meaning, and become unreadable. Research is needed on how to react if or when it can be measured that threshold lim-

its are reached. Another crucial question is how the rescuing of information through excavations or further *in situ* conservation may be financed. In a 'developer pays' system, it may be increasingly difficult to get acceptance for funding of full archaeological excavations, if some developers are allowed to only pay for minor investigations and a few years of monitoring. Further discussions are needed on what happens if a site designated to *in situ* preservation and monitoring shows signs of accelerating degradation. Who takes responsibility, and who will pay for a rescue excavation, if the original developer was only asked to pay for monitoring? All of the above aspects must be taken into consideration before making decisions on whether to preserve a site *in situ* or investigate archaeologically. ♦

Vibeke Vandrup Martens
vvm@niku.no

Norwegian Institute for Cultural
Heritage Research (NIKU)

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