

# Radiographic imaging technique applied on conservation archeological metals: The case of Saruq Al Hadid

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## Introduction to the Site

In southeastern Arabia, the period from 1300-300Bc is conventionally known as the iron age although evidence for the use and production in the region at the time is both small scale and rare. however the recent discovery of the site Sarooq al-hadid in the desert of Dubai (Fig .1.) has revealed abundant iron artifacts made from ferrous, and bimetallic (copper and iron ) that previous discovering must be the more clear clue to understanding the iron age and metallurgy in Arabia and wider near east.

Exceed than 24 thousand different artifacts were discovered in Sarooq al-hadid site which lead the professionals to start the research to understanding the site, give proper explanations, and conducting comparative studies.

Among the >200 kg of iron material excavated at Sarooq al-Hadid, the vast majority are fragmented pieces with two sharp edges. These objects could be broken parts of complete swords and daggers, or possibly the basic form (an ingot, or billet) in which iron was traded across prehistoric Arabia.



Fig. 1. Sarooq al-hadid archaeological site ( taken by archaeology section in Dubai municipality) 2017 taken by jama safi

## X-Ray Radiography

X-radiography's most superpower in archaeological, its ability to specialist to reveal the artifact within. In Sarooq al-hadid artifacts the diversity of objects , conditions and different metallurgical work lead us to use more highly technology , the most common use is seeing through ferrous corrosion on iron artifacts, also help with other metal and non-metal artifacts.

Radiography, for several decades, more recently, is an excellent technique of investigation and is considered essential for the non-invasive analysis of invasive analysis of works of art, such as corroded metals, paintings, ceramic artifacts, for conservation and archaeometry. With metals, for example, radiographic examination provides a corrosion state of the artifact in its entirety, returning important its entirety, returning important information on the history of the object, on the pictorial layers, useful for interpreting the stratigraphic, chronological succession of the original or restored portions. The radiographic image allows to reveal an underlying type of rust, to highlight existing fractures. It will give a first characterization and mapping of the materials employed by the conservator and during previous restorations.

Preliminary results of the survey of selected subjects. At this moment the results of the metallographic survey, of artifacts by radiography are available. In this poster, only the results of the material studies of selected objects from the different periods from Sarooq al-Hadid in Dubai will be presented in the photos in the poster. We can thus observe the gradual development of ancient metallurgy from the use of iron in the eastern Arabian territory. Diagnostic imaging based on the use of X-rays allows, in an increasingly efficient way and with high resolutions, non-invasive analysis of surface structures for metal and internal structure for full corroded objects. With efficient and high resolutions, non-invasive analysis of the internal structures of artifacts. The study of pictorial stratigraphies and identification of underlying drawing on the metal surface and the X-Ray Radiology study of discontinuities or inhomogeneity of the metal object. In cultural heritage, X-ray Radiology has found widespread use because it is very suitable for non-invasive analysis, both structural and compositional, through the different radio-opacity of the materials making up the study of the artifacts, a complementary to other methods. It is used in several archaeometrical issues, such as dating studies, authentication, and studies on executive techniques but, also of conservative problems to understand the aging and deterioration mechanisms, detachments, superimpositions of layers juxtaposed to the original.

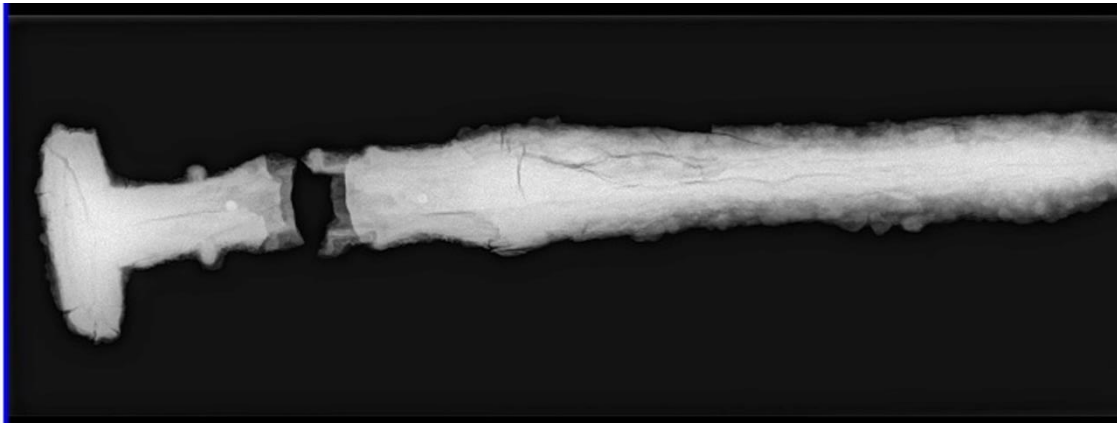
The application of X-ray imaging techniques which is electromagnetic radiation of a short wavelength able to pass through the opaque bodies has experienced a long use in the field of archaeology and conservation of cultural heritage. Although it can be classified as basic techniques, with a great potential for analysis. This non-destructive technique has become the key tool for the development of the conservation and research of the archaeological site of Sarooq Al Hadid in the UAE. (Fig .2.)

Radiographic techniques have been able to better understand the behavior of the corrosion products and rescue the available archaeometry information. In addition to being an easily accessible and visually comprehensible technique for all disciplines.

The benefits of X-radiography may be summarized as follows:

**The state of conservation and Structural cohesion**

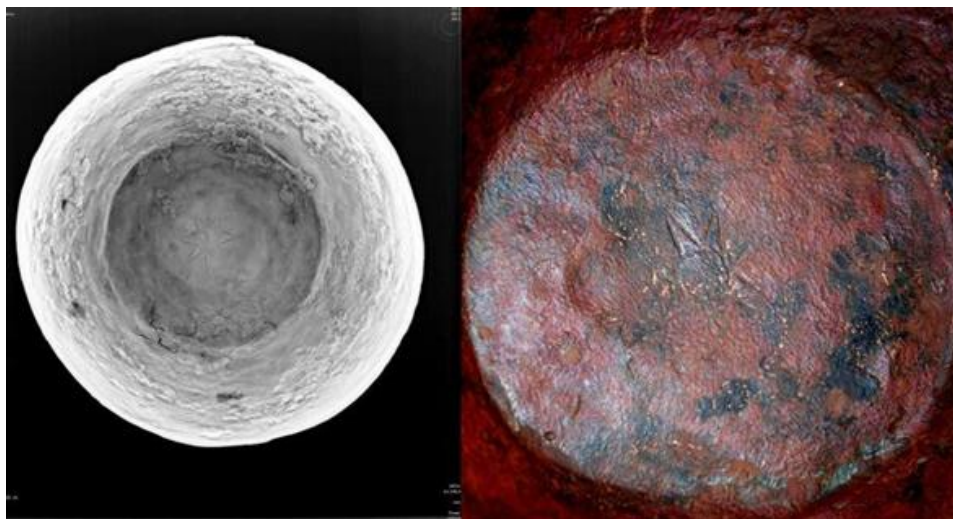
This technique has been highly effective to determine the inner state of conservation of archaeological metals. Areas less dense (black) are usually the ones with more corrosion products. Areas denser (white) are with metal core and absorbed more radiation. X-Ray images have been especially needed in objects with difficult shapes where the access to their interior corrosion is more problematic



*Fig .2. : object discovered in Sarooq al-Hadid archaeological site, the right shown an object before the conservation, in the middle, an X-ray pic (good condition object ), in the left the picture shown the abject after conservation. (archaeology section, Dubai municipality 2017. taken by jama safi*

**Hidden decorations**

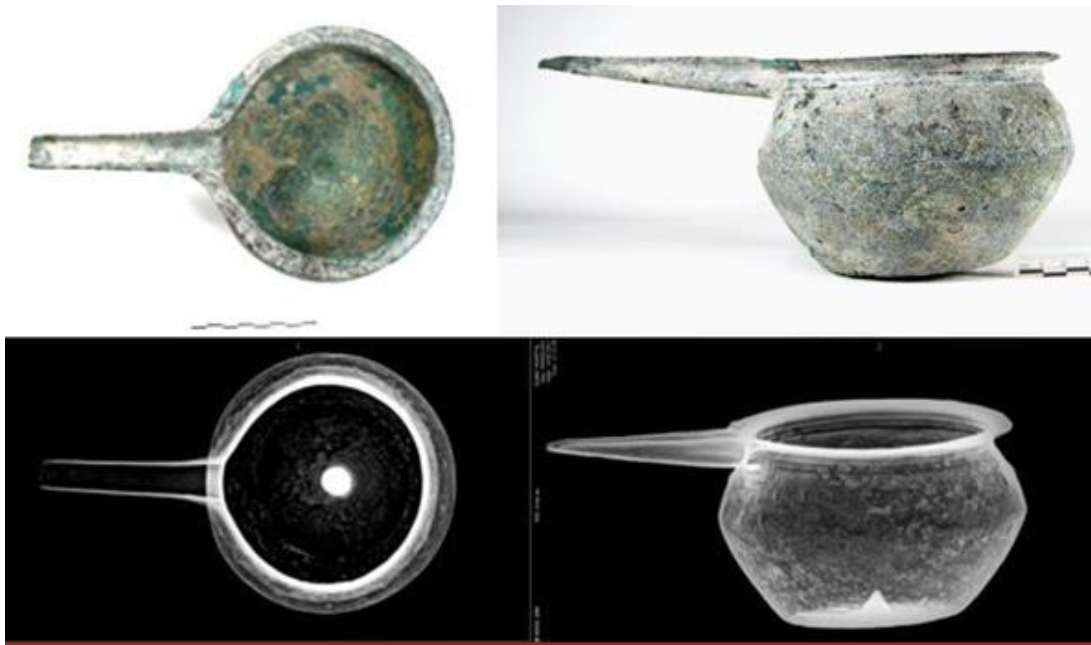
The use of X-Ray images has recovered hidden detailed decorations. Thanks to this technique, the areas with decoration have been delimited for restoration and showed fragile ornate elements. They are based on very thin incised lines which have been recuperated only with the help of this technique (Fig.3).



*Fig. 3. Object discovered on sarooq al-hadid site with star decoration in the bottom of objects, on the right (object after conservation treatment), archaeology section /Dubai municipality taken by: Jamal Safi . 2017*

### Previous undocumented interventions

Different densities of the products with the original metal are observed with the X-Ray images and lead to know their exact location, their state of conservation, and their interaction with the original material. Once detected, has been evaluated their efficiency, their help to keep the object stable, and their positive effect on the archaeological object (Fig. 4)

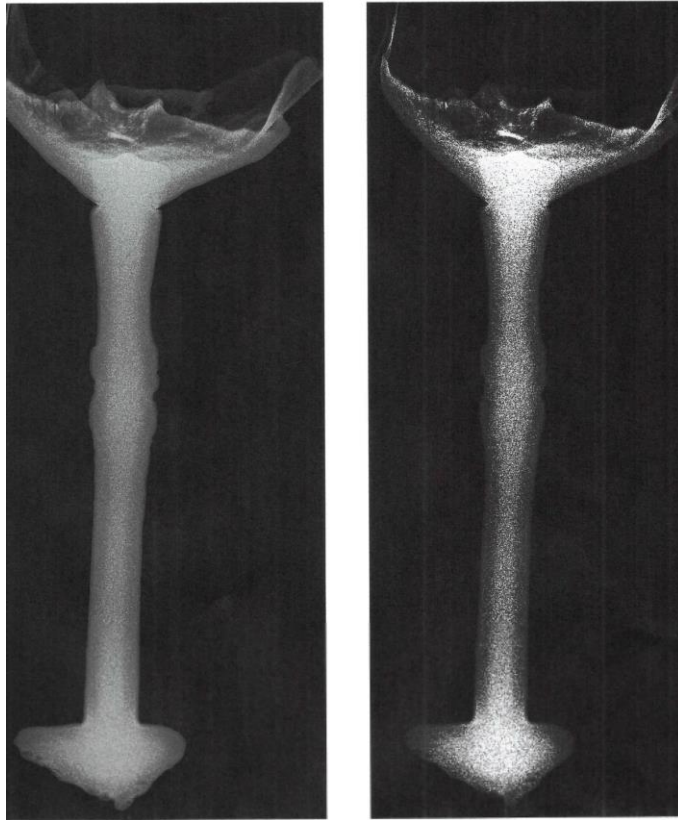


*Fig. 4. Object discovered from Sarooq al-hadid archaeology site , with previous conservation work , archaeological section /Dubai municipality (2017 ) taken by :Jamal Safi*

### Interpretation and identification

Object identification Accretions can be so dense that the original shape of the object is obscured. This happens particularly with ferrousartefacts, which are more susceptible to this extensive form of deterioration.<sup>1</sup> It helps the professionals to identify the object and help in interbetation of object from archaeology side (Fig. 5).

<sup>1</sup> Guidelines on the X-radiography ofarchaeological metalwork(.page 5)2006



*Fig. 5. Object discovered on sarooq al-hadid site, the x-ray technique help to interpretation of the object manufacturing. By x-ray photo we discovered that they made a hole in the bottom and welded it with the stand and left the upper part of the stand knob the middle of the plate of the censers. 2018*

## Affiliation

The research done by the Architectural Heritage and Antiquities Department, Dubai Municipality / archaeological section /conservation team 2017.

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