Metallurgy of middle bronze age axes: first results of the study on a hoard in Bény-sur-mer

Session 1.1 Poster 4

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Abstract

This work presents analyses of a Middle Bronze Age (1600-1350 B.C.) hoard containing a total of 182 axes between intact objects and fragments.

Our research is focused on evaluating 19 axes chemically, metallographically to try to better define manufacturing techniques, the composition of the materials and the quality of the axes themselves.

All the objects were sampled and mounted in cold epoxy resin and polished for microstructural analyses with LOM, the chemical analyses were performed using SEM-EDXS and each sample was etched for metallographic examination with ferric chloride. In addition, typological studies have already been carried out.

The samples that were analyzed show Cu and Sn composition with a variable percentage of Sn ranging from 12 to 15 wt% falling within the specifications of Middle Bronze Age alloys.

Introduction

Figure 1) *a unmachined axe; b machined axe.*

The aim of this work is to understand the manufacturing techniques of these axes by metallographic and chemical analyses, with whom it's possible to understand the techniques used to obtain the finished object.

The investigation of the non-metallic inclusions in the samples provide us the possibility to figure out the thermomechanical processes adopted in the manufacture of the artifacts.
Similarly, the different percentages of Sn present is significant in order to understand the different qualities of the axes.

The study of the artifact's thermomechanical history provides us the knowledge of the shaping steps.

Results

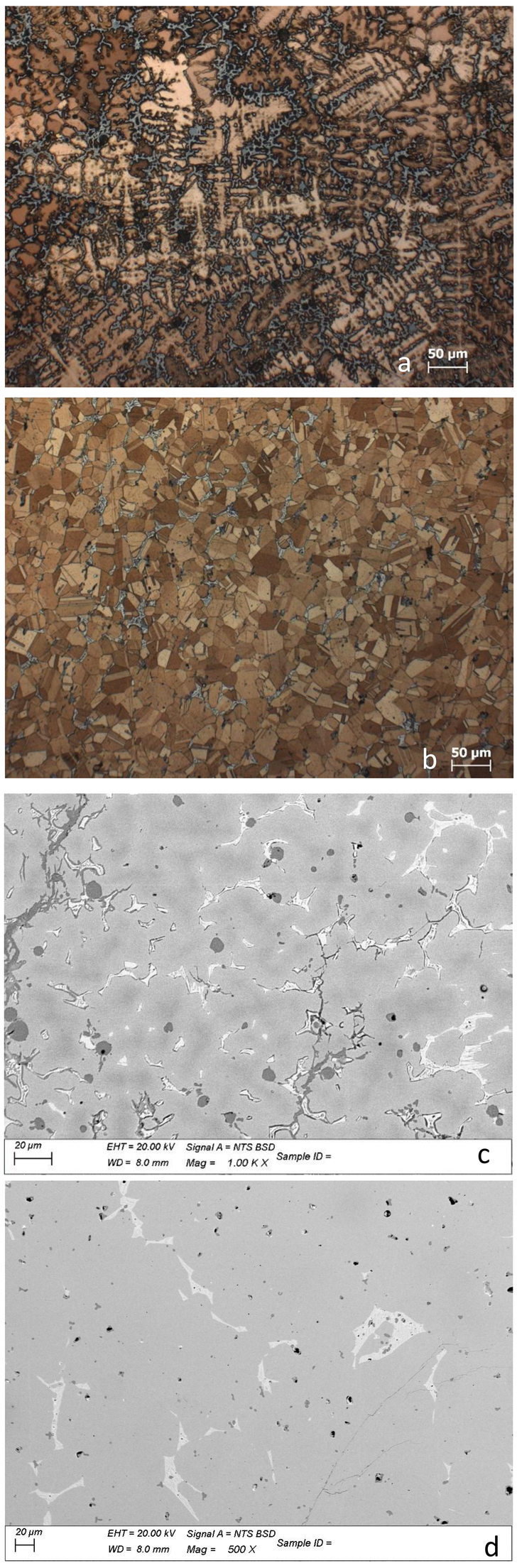

Figure 2) *a LOM image for a dendritic structure, b LOM image for a polygonal structure , c SEM-BSD image solidification blank, d SEM-BSD image machined axe*

Future development

We will provide the Pb isotopes analysis with the ICP-MS technique.

Discussion and conclusions

- A univocal production of axes can be confirmed since common characteristics are found on the different pieces of the corpus. Of the 19 axes selected 10 were worked axes and 9 were solidification blanks.

- Considering unworked axes, they do not show any mechanical processing. From the microstructural point of view, dendritic grains have been observed that testify the absence of heat treatments.

- On the other hand, the machined axes show evident signs of mechanical processing. Following the microstructural analysis of the samples it can be deduced that these axes have generally undergone a heat treatment that provided enlarged dendrites

- 13 out of 19 axes have an established content of Sn between 12-15 wt% falling within the compositional parameters typical of the Middle Bronze Age. Such a narrow range confirms that the artisans had found optimal percentages for this manufacturing activity. This hypothesis would be confirmed by the presence of 6 samples with a much higher percentage of tin, which could be evidence of both experimental activity and the presence of ingots that were intended to produce a pre-alloy for future uses.

- Within the archaeological corpus we found three broken axes: two of them used and then deliberately broken, with a concentration of tin by weight between 14-15%. The third, with an average tin concentration of 25% by weight, differs from the first two in that the break is due to the fragility of the alloy, probably as a result of an attempt at processing.

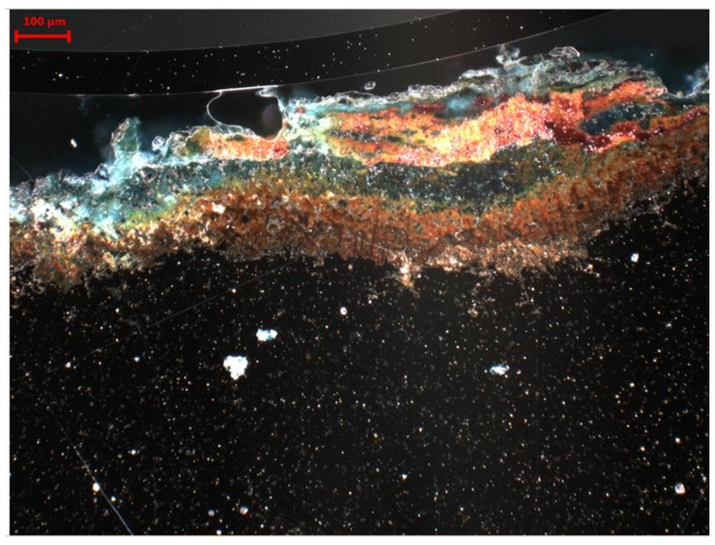

Figure 3) *corrosion layer (oxides and carbonates)*

- The presence of oxides and carbonates is consistent. The latter presents alterations due the humidity and acidity of the environment. The presence of stratified corrosion patinas is compatible with an area frequented by an anthropic activity.

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