Early copper metallurgy in ancient Egypt and Nubia

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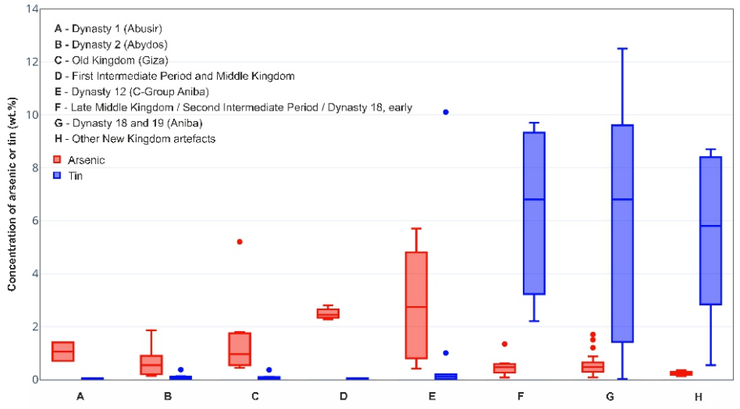
Introduction

The aim of this work is to conduct a comprehensive study focused on metallurgical material associated with copper production from Predynastic to New Kingdom period (app. 3000 to 1100 BC) excavated at Egyptian and Nubian sites.
Ancient Egypt is an example of a civilisation with all copper ore sources situated outside its core territory. Every metal object found in the Nile Valley had to be made of imported ore. For ancient Egyptians, all of these sources were situated "abroad", including the Eastern Desert and Sinai, which are administrative parts of Egypt's territory at present. The potential that is hidden in this fact is clear: it would be hypothetically possible to examine and identify all the sources entering the system in Egypt and describe the circulation of copper within the system.



Key Questions

Several main research questions is proposed for this project, and the answers will be sought within three individual case studies.

- Provenance of early Egyptian and Nubian copper
- Early Egyptian and Nubian copper alloys
- Production technologies and mechanical properties of Egyptian and Nubian copper alloys

A comparative approach has been adopted to address these questions, drawing on the rich dataset presented within the case studies and integrating existing literature.

Where did the copper used by ancient Egyptian and Nubian metallurgists come from?

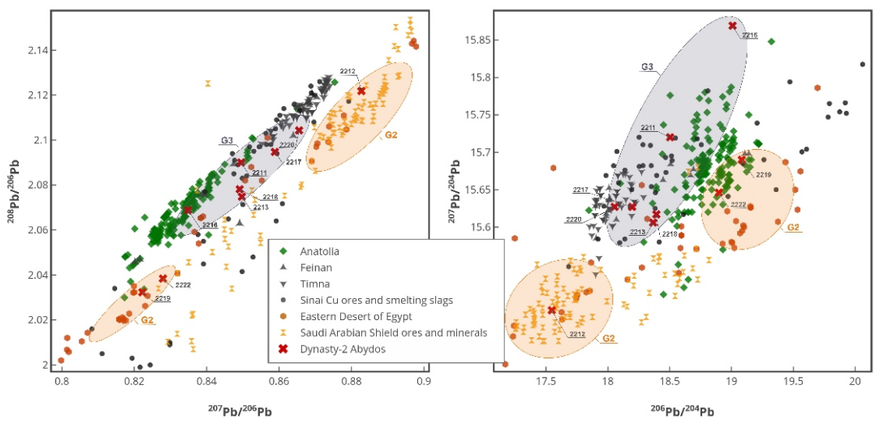
Which method was used to produce alloy of arsenical copper in Old Kingdom Egypt?

How fast and homogeneous was the diffusion of arsenical copper and tin bronze alloys within Egyptian and Nubian societies?

Is it possible to find any differences in the quality and composition of full-size and model tools and between artefacts excavated from royal tombs, non-royal tombs and from settlement contexts?

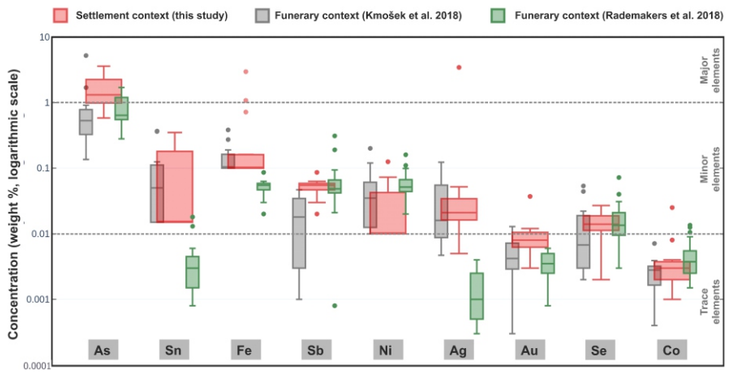
Methods

Copper alloy artefacts, metallurgical remains and copper minerals from Predynastic to New Kingdom Egyptian and Nubian sites, deposited in the European museum collections and resulting from currently ongoing excavations in Egypt are analysed within this interdisciplinary project. Method of **micro X-Ray diffraction analysis** (μXRD) is applied to identify microstructural phases of sample cross sections. The combination of the methods of **optical microscopy** (OM), **scanning electron microscopy with energy dispersive spectrometry** (SEM/EDS) and **Vickers microhardness tests** (HV) is used to obtain relevant metallurgical information from the samples cross sections. Methods such as **energy dispersive X-ray fluorescence analysis** (ED-XRF), **instrumental neutron activation analysis** (INAA), **Inductively Coupled Plasma-Optical Emission Spectroscopy** (ICP-OES) and **lead isotope analysis** (MC-ICP-MS) is used to discuss the provenance of the artefacts. The obtained analytical data are compared with available analytical results and evaluated by a combination of various statistical methods including the **Principal Component Analysis** (PCA), **Cluster Analysis** (CA), etc. All obtained results are continuously discussed and interpreted in direct cooperation with archaeologists and Egyptologists specialized in ancient Egyptian and Nubian metallurgy.



Preliminary results

An assemblage of ancient Egyptian metalwork currently in the Egyptian Museum of Leipzig University (Germany), has been studied using a wide range of available archaeometallurgical methods (OM, HV, SEM/EDS, ICP-MS, NAA, etc.). By their application, more secure arguments were provided for our conclusions concerning the circulation of copper in Early Dynastic and Old Kingdom Egypt. These results, the first solid ore provenance data for the Early Dynastic period Abydos and Old Kingdom Giza, are slightly different from what would be expected from the study of the current literature. A First Dynasty bowl from Abusir was proved to be made of similar ore as CuAsNi artefacts from Early Bronze Age Anatolia. This is the first piece of evidence of a possible (in)direct connection of Early Bronze Age Anatolia with Early Dynastic Egypt. A heterogeneity of the assemblage for King Khasekhemwy has been proved on the basis of lead isotopes, whereas the assemblage from several Old Kingdom West Field tombs at Giza was made only of ore from the Eastern Desert, possibly from several sites. A dataset related to 60 already sampled and analysed artefacts from C-Group and New Kingdom Nubian site Aniba show relative homogeneity of minor and trace element composition and lead isotope ratios that indicates the probable use of copper from a specific unknown source rather than intensive recycling of older copper artefacts. Based on the current state of knowledge and the limited amount of comparable analytical data from Nubian artefacts and copper ores, the question of the provenance of the used copper must be left open.



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