Diachronic changes of ancient Egyptian and Nubian metallurgy
Case study of material from the Egyptian Museum of Leipzig University

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INTRODUCTION

The Ägyptisches Museum – Georg Steindorff – der Universität Leipzig (ÄMUL, Germany) holds an important collection of ancient Egyptian and Nubian artefacts. The sampled 85 artefacts represent the development of ancient Egyptian metallurgy in more than one and a half millennia, from Dynasty 1 (ca. 3100 – 2950 BC) until almost the end of the New Kingdom (ca. 1350 – 1085 BC).

The most important assemblages are from the Early Dynastic period (Dynasty 1-2) and from the Middle Kingdom (Dynasty 11). The largest sampled assemblage is from the Late Dynastic period (Dynasty 19). The source material is from the Late Dynastic period (Dynasty 19) and from the Early Roman period (Dynasty 18).

The sampled artefacts can be divided into several morphological categories: full-size tools, models, tools, full-size vessels, and other metal objects (e.g. bolts). A diachronic change of the source materials and technology as well as other issues can be studied in detail on the copper (see Methodology and the discussion of the results).

CHRONOLOGICAL COMPOSITION ANALYSIS

The copper alloys used for the production of the analysed artefacts can be divided into groups based on their chemical composition. The most common artefacts were made of a tin bronze alloy, an arsenical copper alloy or copper with small amounts of lead and iron. The other artefacts were made of a tin bronze alloy with small amounts of lead and iron, or of an arsenical copper alloy with small amounts of lead and iron. The least frequent artefacts were made of a copper with small amounts of lead and iron, or of a lead bronze with small amounts of arsenic. The most frequent structures were formed by recrystallized or wrought grains. Only one full-size tool from the late Old Kingdom was made of an alloy of tin and lead and iron. One object was made of a copper with small amounts of lead and iron, and one of the late Old Kingdom was made of an alloy of tin and lead and iron. One object was made of an alloy of tin and lead and iron. The concentration of arsenic in the New Kingdom was much lower than in the Old Kingdom.

METALLURGICAL ANALYSIS

In the most cases, the structures were formed by a single-phase solid solution of copper and arsenic or copper and tin. Only one full-size tool from the late Old Kingdom was made of an alloy of tin and lead and iron. One object was made of an alloy of tin and lead and iron. The concentration of arsenic in the New Kingdom was much lower than in the Old Kingdom. The concentration of arsenic in the New Kingdom was much lower than in the Old Kingdom.

MICROHARDNESS TESTS

The microhardness of the hardest analysed copper alloy structures ranges between 65 and 69 Vickers hardness units. The results clearly indicate that microhardness depended more on mechanical properties of the artefacts than on the content of arsenic and its alloying effect. The hardness of artefacts with work-hardened structures and low concentration of arsenic is much higher than that of recrystallized structures with high portion of arsenic.

CONCLUSIONS AND FURTHER RESEARCH

Ancient copper was found in Egypt already in the Naqada culture. It is present in our corpus from the earliest artefacts of Dynasty 1. Arsenic was used in the most striking elements of the Middle Kingdom, when it was gradually replaced with tin. The hardness of artefacts was intentionally achieved by mechanical hardening rather than using the alloying effect of arsenic.

The production techniques of casting, alloying, annealing, hot or cold hammering and surface finishing were commonly used from the Early Dynastic Period.

The largest part of the analysed artefacts were made from rich copper ores. This is also evident from the presence of arsenic in some non-metallic inclusions.

The project is carried out by neutron activation analysis of all samples used for the identification of trace elements, and by lead isotopes analysis of selected artefacts. The identification of the geographic provenance of the copper ores used for the production of the artefacts is part of this work.

REFERENCES


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