New Standards in the Analysis of Archaeological Metalwork Using LA-ICP-MS: A Case Study from the South Caucasus Archaeometallurgical Project

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Abstract

Researchers have found problems in integrating OES data with collected new techniques (Pollard et al. 2007-2008). This paper explores the effectiveness of Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS) in determining trace elements and minerals in copper and bronze alloys. The results show that LA-ICP-MS can identify new standards for the analysis of ancient metalwork.

Introduction

The South Caucasian region provides a unique opportunity to study the development of metalworking technologies. The region is located in the South Caucasus Mountains, where copper metalwork appeared in the early 4th millennium BC. This early metalworking activity was characterized by the use of copper and bronze artifacts, which were produced using the lost-wax casting technique.

Materials and Methods

Sample Preparation

Portions of 16 copper and bronze artifacts were selected for analysis, including small pieces of metal in very low quantities, and polished to ensure that they were free of rust and could be orientated perpendicular to the laser beam. These samples were embedded in epoxy, then sanded and polished. The LA-ICP-MS analysis was performed on a Thermo X Series 2 Inductively Coupled Plasma Mass Spectrometer (ICP-MS) and a FEI Quanta 200F Scanning Electron Microscope (SEM) equipped with an Oxford EDS detector.

Results and ICP-MS and OES Comparison

The results obtained show a pattern of differentiation that was shaped by processes of both aesthetic and technical preferences based on the materiality of copper and bronze. Arsenic improves the fluidity of brasses and nickel, and plays an essential role in the formation of alloys.

Discussion

The research presented in this paper suggests that LA-ICP-MS can be used as a complementary technique to OES for the analysis of ancient metalwork. However, further research is needed to explore the full potential of LA-ICP-MS in this context.

Acknowledgments

The authors would like to acknowledge Dr. Philip Kohl and Dr. Ruben Badalyan for use of materials from their excavations at Horom.