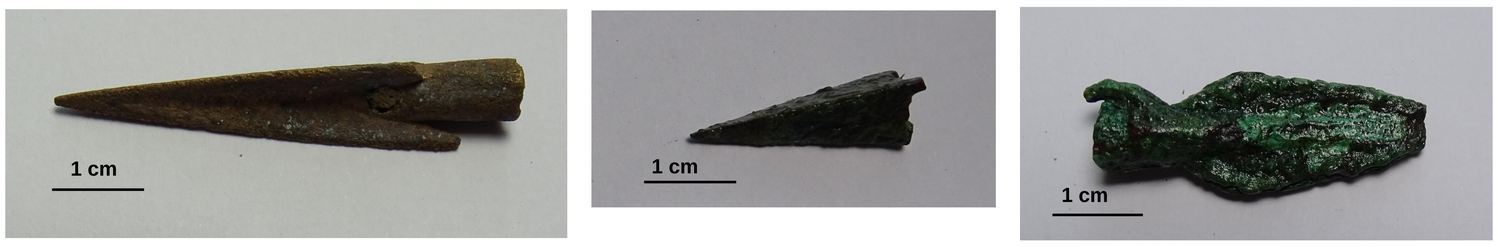
NEW X-RAY FLUORESCENCE ANALYSES ON SCYTHIAN-TYPE ARROWHEADS AND ARROWHEAD-SHAPED TOKENS FROM HISTRIA AND TOMIS (ROMANIA)

Daniela CRISTEA-STAN[1], Alexandra ȚÂRLEA[2]

[1]Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering, PO BOX MG-6, Bucharest –Magurele, Romania
[2]Faculty of History, University of Bucharest, 4-12 Regina Elisabeta Bd., 030018 Bucharest, Romania

The Scythian-type arrowheads modified to be used as tokens and the specially cast tokens in the shape of arrowheads are possibly creations of the Greek colonies from the western coast of the Black Sea during the Archaic period. They are part of the categories of Greek items which had a strong influence on the local communities, in the context of economic and commercial exchanges, being spread in the Istro-Pontic space and on the northwestern coast of the Black Sea. The large number of finds in the local cultural environment of present-day Dobrudja makes them a significant part of the archaeological and numismatic repertoire of this area.

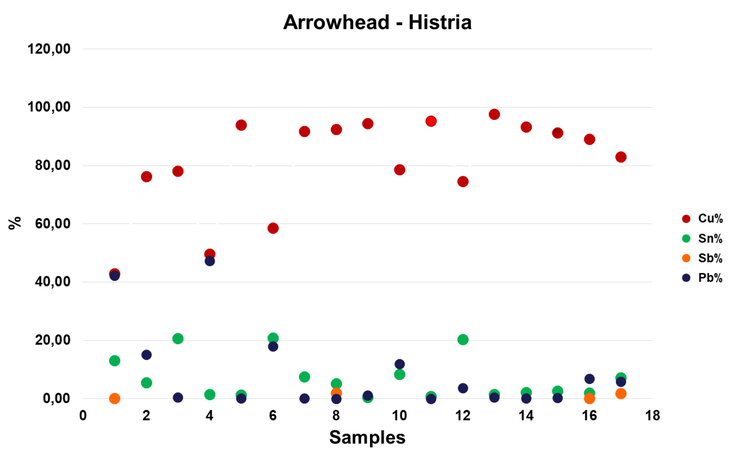
The documented material was subjected to elemental composition analysis in order to identify technological production processes and to obtain some clues regarding the origin of the constituent metal (from the perspective of metal ores and geological deposits).

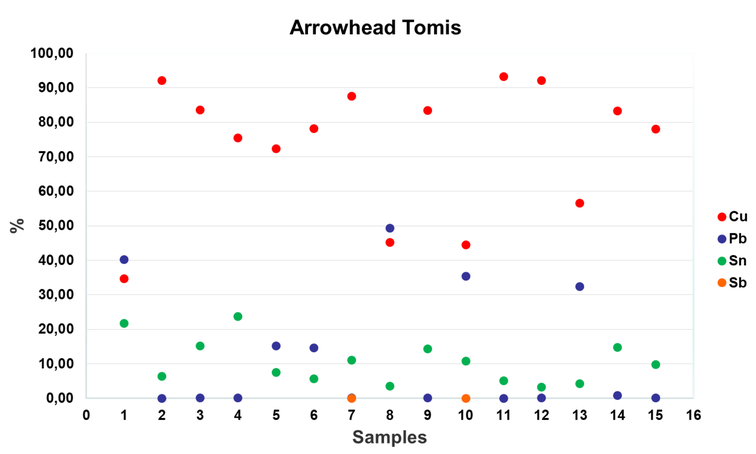


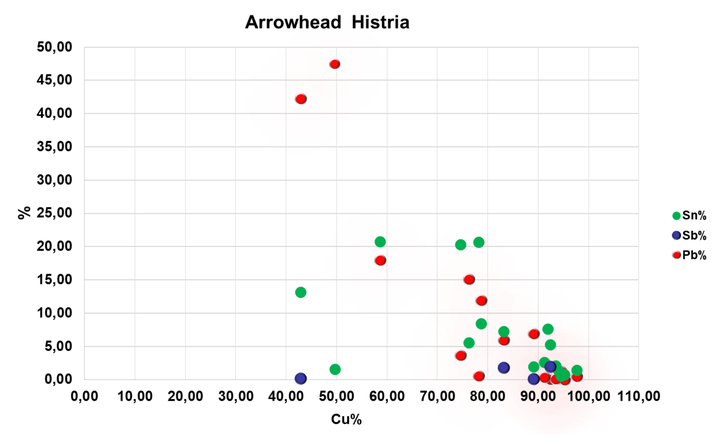
Examples of Scythian-type arrowheads from the Greek colonies Histria and Tomis

Preliminary XRF analysis with a portable spectrometer

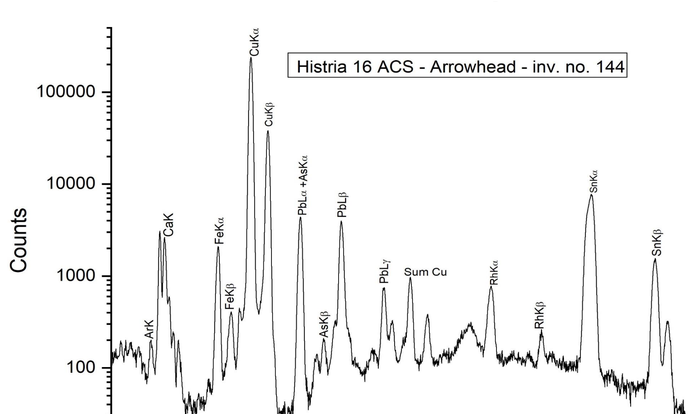
A number of 17 items from Histria and 15 items from Tomis (arrowheads, transformed arrowheads, and arrowhead-shaped tokens) were analyzed using a portable spectrometer with the X-Ray Fluorescence (XRF) method. Two main types of alloy were identified: the "classical" Cu-Sn-(Pb) bronze, which is the most common, presenting variable amounts of Sn (in order to increase hardness) and Pb (to facilitate easier casting), and another with a Cu-Sn-Pb-Sb combination.

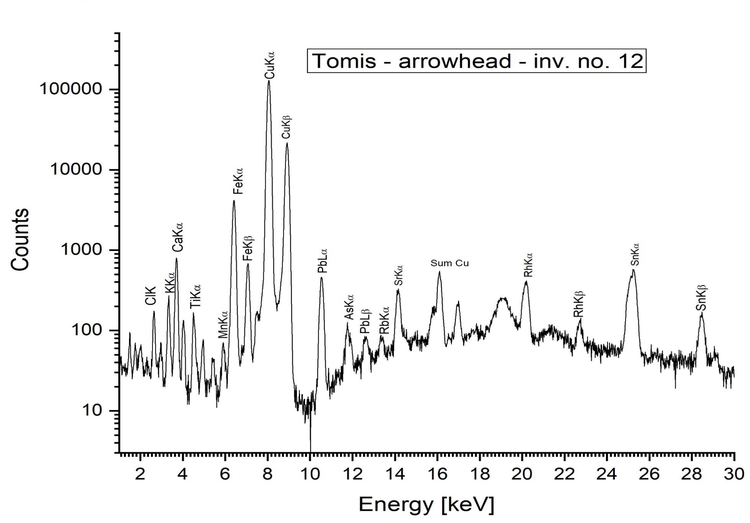


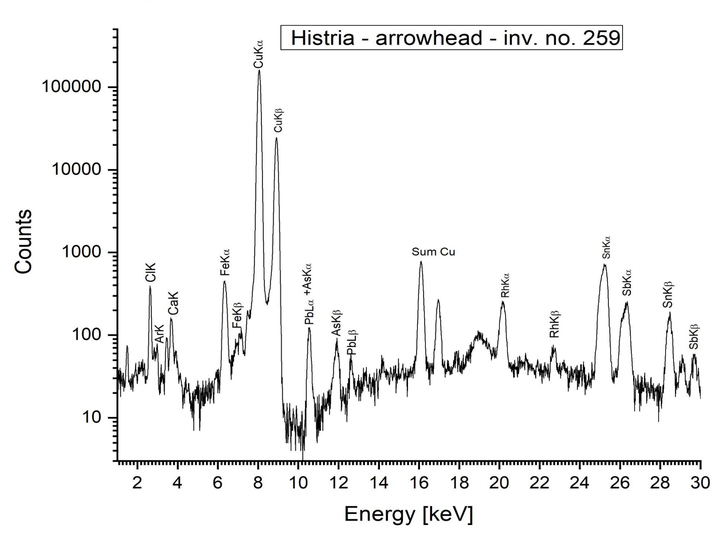




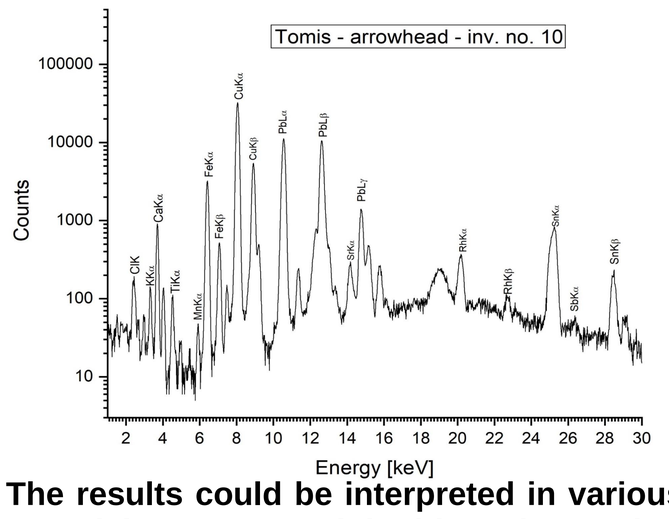
Examples of items made using Cu-Sn-Sb-Pb alloy from Histria, and Cu-Sn-Mn-Pb alloy from Tomis

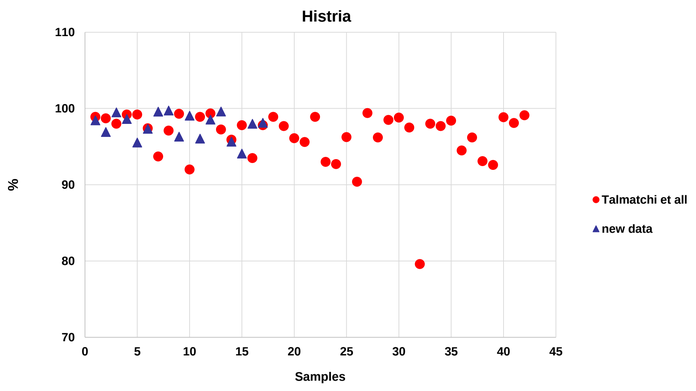


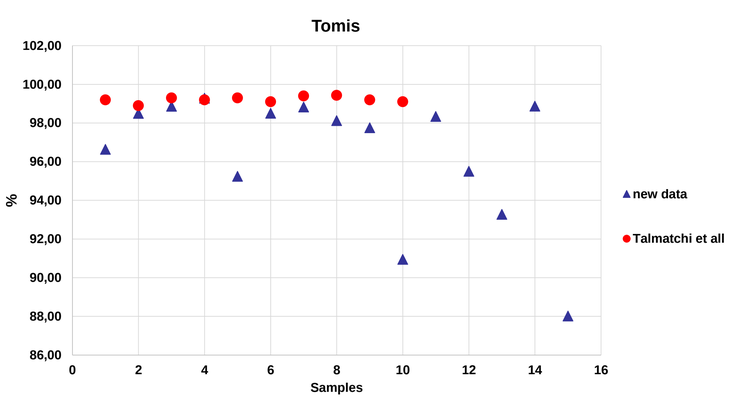




The items analyzed presently were compared from the point of view of the elemental composition of the Cu-Sn-Sb-Pb alloy for a percentage of 100% with the previously analyzed samples, published by Talmatchi & Cristea-Stan 2023 (see reference). It can be noticed that in the case of Histria the composition of the new items matches very well the previous results, while in the case of Tomis there is more variation.







The results could be interpreted in various ways: the existence of either distinct chronological stages of making the respective items; different raw material sources exploited in order to obtain two types of alloy; or their production in two different production centers. One problem to solve is the presence of antimony and manganese in the metal composition. Antimony (present in the case of both sites) is a component of polymetallic geological deposits, its presence being an indicator for the use of enriched secondary sulphide ores (fahlerz ores) in bronze metallurgy, ores including copper, arsenic, antimony, but also, in small quantities - silver, nickel and bismuth. Antimonial bronze is suggested to be present in southern Russia, in association with pyritic copper mines in the South Caucasus. The problem of ancient bronze containing manganese is more complicated. An explanation could be the use of manganese oxides as flux necessary to smelt oxidized ores. Both antimony and manganese presence in Scythian bronze could be explained by the use of primitive metallurgical procedures. These results will be further investigated in order to better clarify the present situation.

Reference: **G. M. Talmaţchi, D. Cristea-Stan, 2023, Studies Regarding the Monetary Signs from the Categories of Modified Scythian-Type Military Arrowheads and Those Specially Cast with Exchange Role Discovered in the Istro-Pontic Space Using XRF and Micro-PIXE Methods, in Aere perennius. More lasting than bronze. Essays in honour of Valentin Dergachev on the occasion of his 80th birthday, STRATUM Library, KISHINEV, pp. 621-642; ISBN 978-9975-3621-1-5; DOI: https://doi.org/10.55086/SL23VAD649;**

Acknowledgements: **Financial support by the Romanian Ministry of Research, Innovation and Digitization through the Project PN 23210201 / F8 is gratefully acknowledged.**