

Non Destructive elemental and mineralogical evaluation of Greco-Roman Bronzes.

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Non-destructive PGAA and ND evaluation measurements were conducted on several coins representative of a 1st century AC Greco Roman copper coin collection along with a number of bronze artifacts from a horse harness found in the course of archaeological excavations at the site of Lithochori-Kavala, North East Greece and currently preserved in Kavalla Museum. The aim of this work was : On the one hand to determine the elemental compositions of Cu-Sn-Zn, and identify traces of secondary elements dissolved in the primary matrix. On the other hand to obtain, through microstructural analysis, bulk information of the metallic phases present in the samples, second to collect data of the structure and compositions of the corrosion products and third to diagnose uncommon additions / growths, observed on the bronzes that may have been deposited during burial.

Spectral analyses of the PGGA patterns showed that the bulk metallurgical distributions with the corresponding weight fractions of the primary elements Cu-Sn - Zn and the Fe may be determined rather accurately. Furthermore traces of secondary elements dissolved in the primary matrix, that have not been discovered in the SEM investigation, can also be identified within the experimental limitations.

Analysis of the diffraction patterns suggests that the main phases are Cu-alloys namely α -CuSn / CuZn with significant additions of Pb. Additionally, significant amounts of cuprite and nantokite confirm the high degree of corrosion observed on the measured objects. Secondary - traceable phases of pyromorphite, chalcopyrite, and Fe-oxides suggest extensive environmental interaction with either phosphorous enriched or anaerobic and humus reach soil .The corresponding tin/zinc content in the Cu-alloy for each item has been estimated from the refined lattice parameters and it is in fair agreement with the value determined by PGGA. The diffraction profiles indicate that there are three distinct categories of coins. The first one is a set of three coins consisting mainly of copper/tin alloy Cu alloy phases with high quantities of Cu₂O , CuCl and Pb . The second group is formed of coins with high Zinc/ copper alloy ratio and the third is a collection of four coins consisting of very high amount of Cu with small tin inclusions. The comparison between the diffraction profiles of the original coins to those of the replicas present distinct variations that may be used to differentiate between authentic and fake pieces. As the results of this preliminary inquiry are encouraging, further analyses will probably help to further the comprehension of Thracian coinage during the first century.

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