

STUDIES ON EARLY MIDDLE AGES METAL ARTEFACTS FROM DOBRUJA USING X-RAY FLUORESCENCE

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Modern archaeometry offers a wide range of physico-chemical analytical methods for analyzing the elemental composition of archaeological metallic artifacts. We investigated 122 pieces of adornment and clothing which represent important landmarks for dating the archaeological researched complexes on the territory of Dobruja (Hârșova, Adamclisi, Tufani, Oltina, Dinogetia-Garvăn, Cochirleni, Valu lui Traian). The metal from which such pieces were made represent an important aspect regarding the chronological value of ornaments and garments. The garments with a strictly utilitarian role were generally made of bronze and iron.

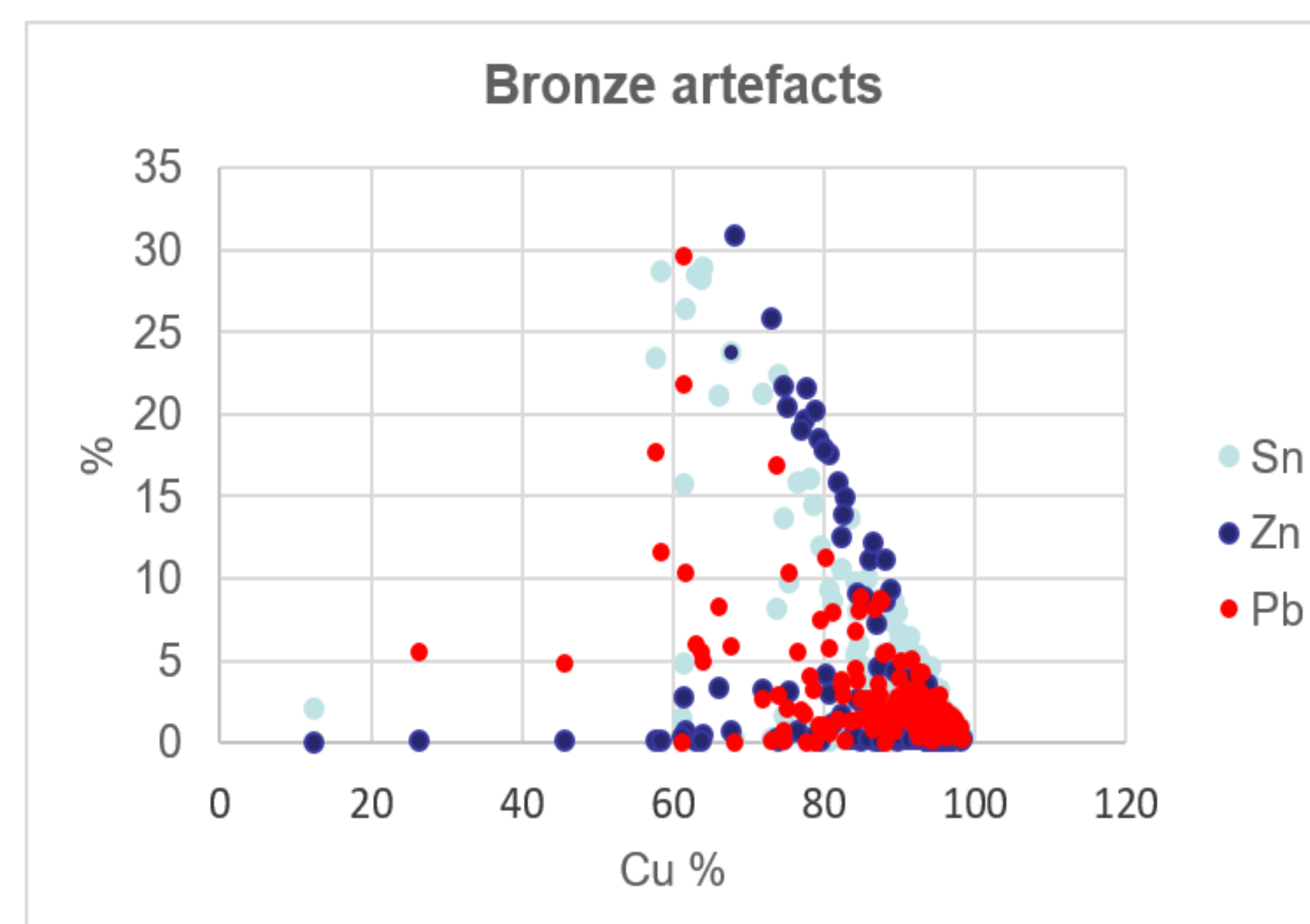
The artefacts analysis was done using a portable spectrometer Tracer 5i from Bruker Instruments, whose principle of operation is based on X-Ray Fluorescence (XRF) and uses as excitation source an X-ray tube with Rhodium (Rh) anode. The detection system is a PIN silicon diode detector with Peltier cooling. The analyses gives the general elemental composition (approx. 30 mm² investigated area), is an excellent tool to investigate the alloys structure. The elemental chemical composition is calculated for elements starting with magnesium (Mg) to uranium (U).

Preliminary XRF analysis suggest several different bronze alloys compositions Cu- (Sn-Zn-Pb-Ag). Most belt ornaments are cast from tin-lead bronze (Cu-Sn-Pb) with a high percentage of copper and a variable tin and lead content. Bronzes are alloys of copper with tin, more resistant than copper but with variable compositions. Bronze with a significant tin content was used due to its increased hardness. In many artifacts, the alloy also contains a significant amount of zinc (Zn). Another alloy is the one composed of Cu-Zn with additions of Sn and Pb, and the third alloy encountered is Cu-Pb with additions of Sn and Zn.

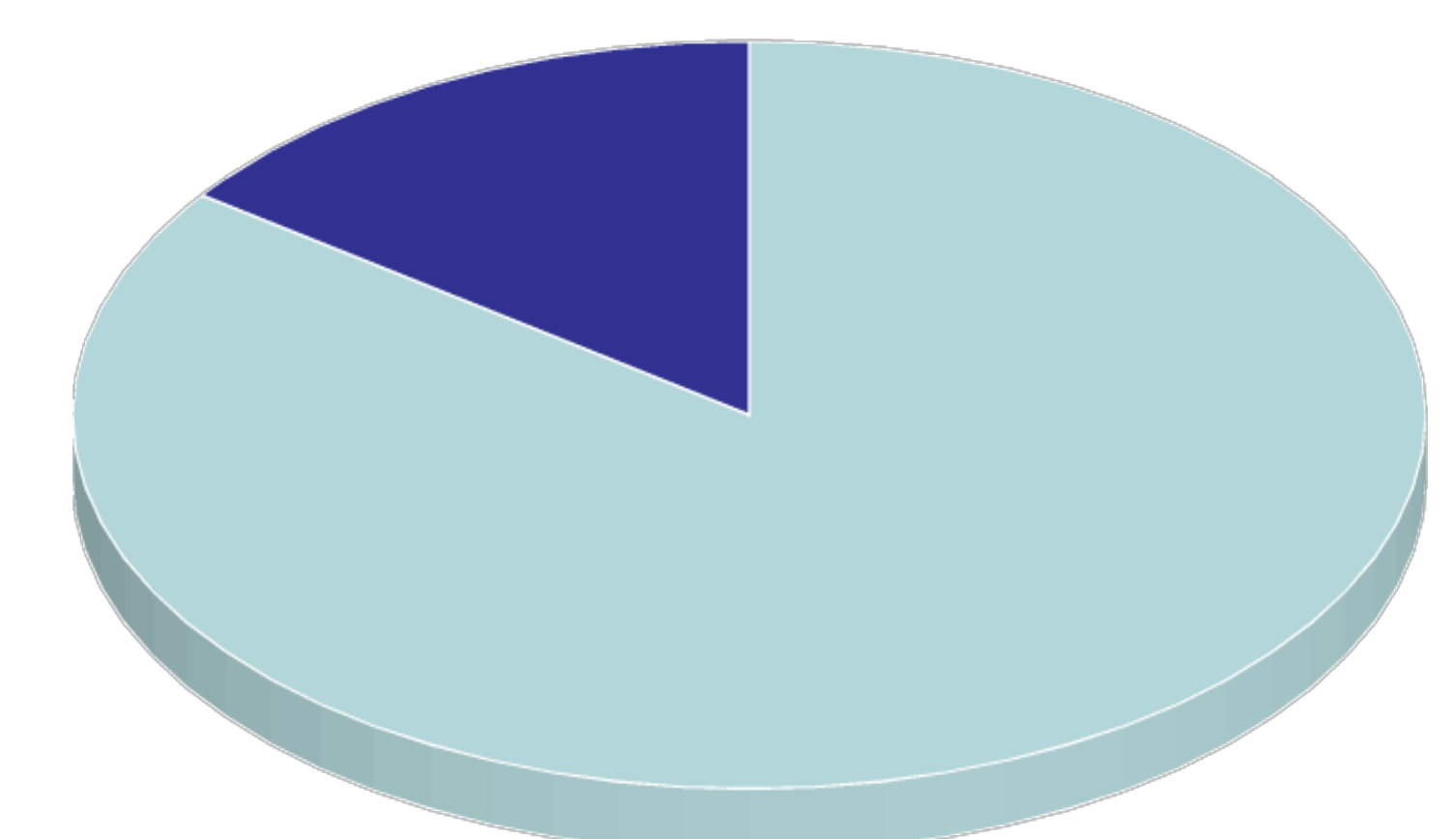
X-Ray Fluorescence spectrometer



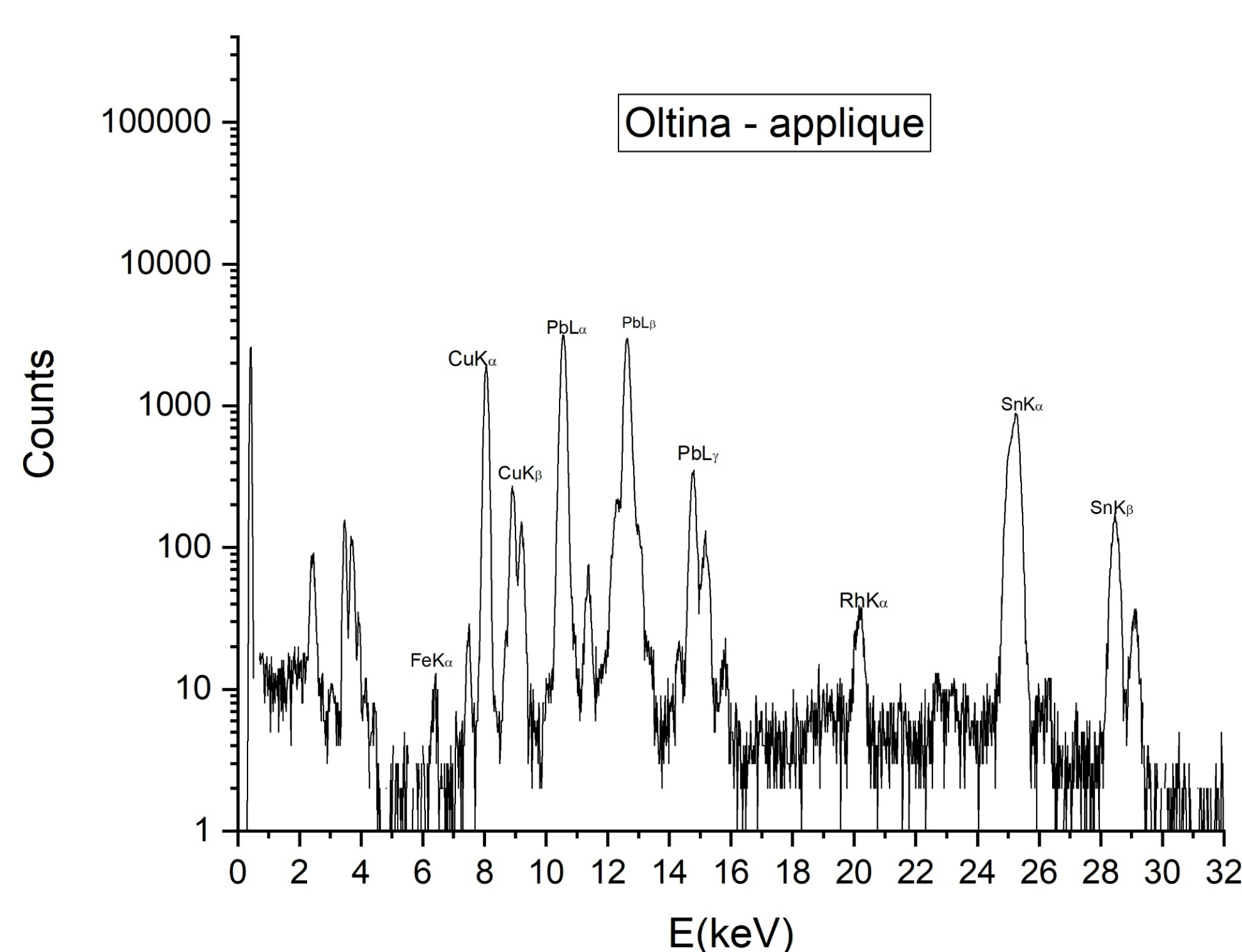
Samples of bronze artefact



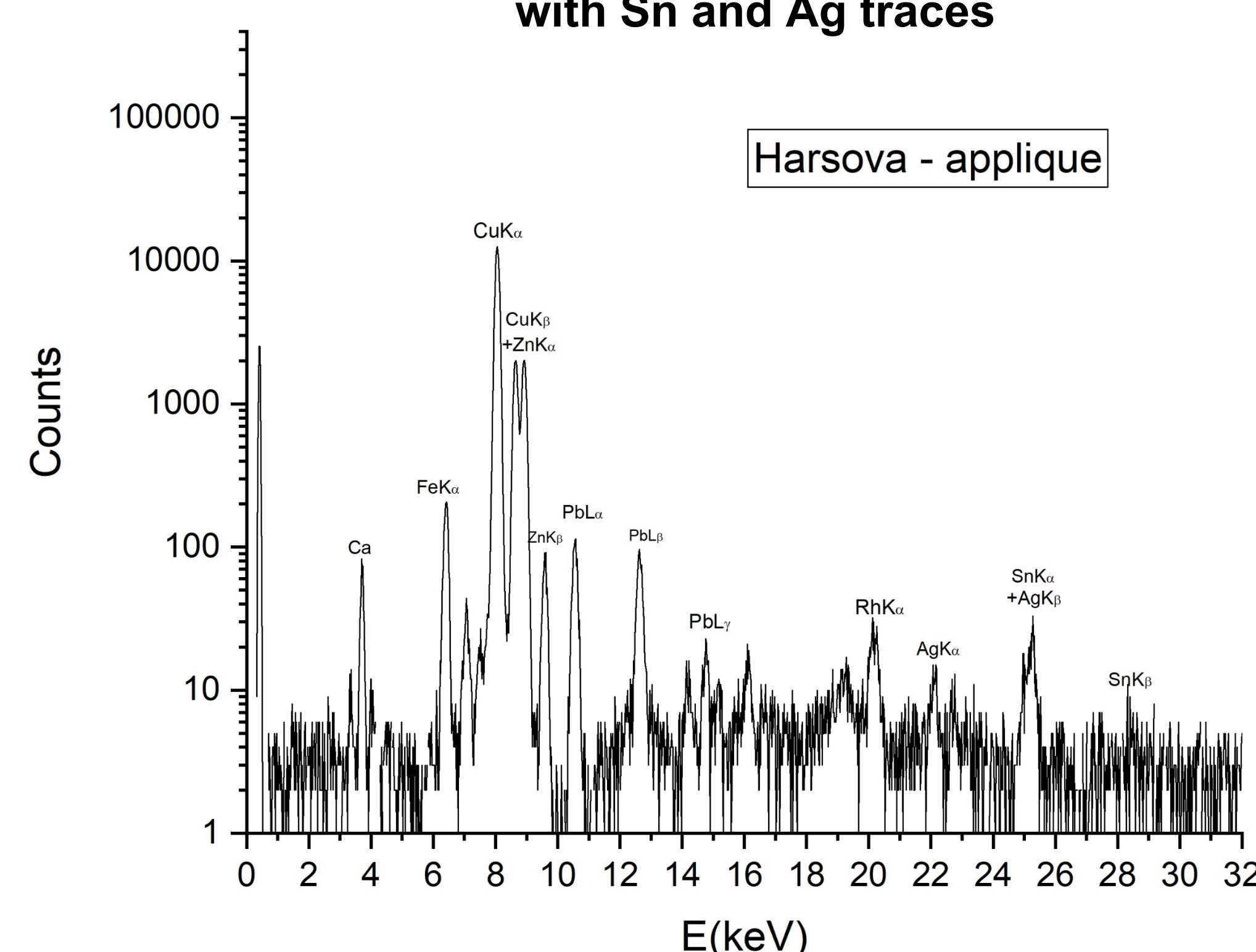
Bronze artefacts



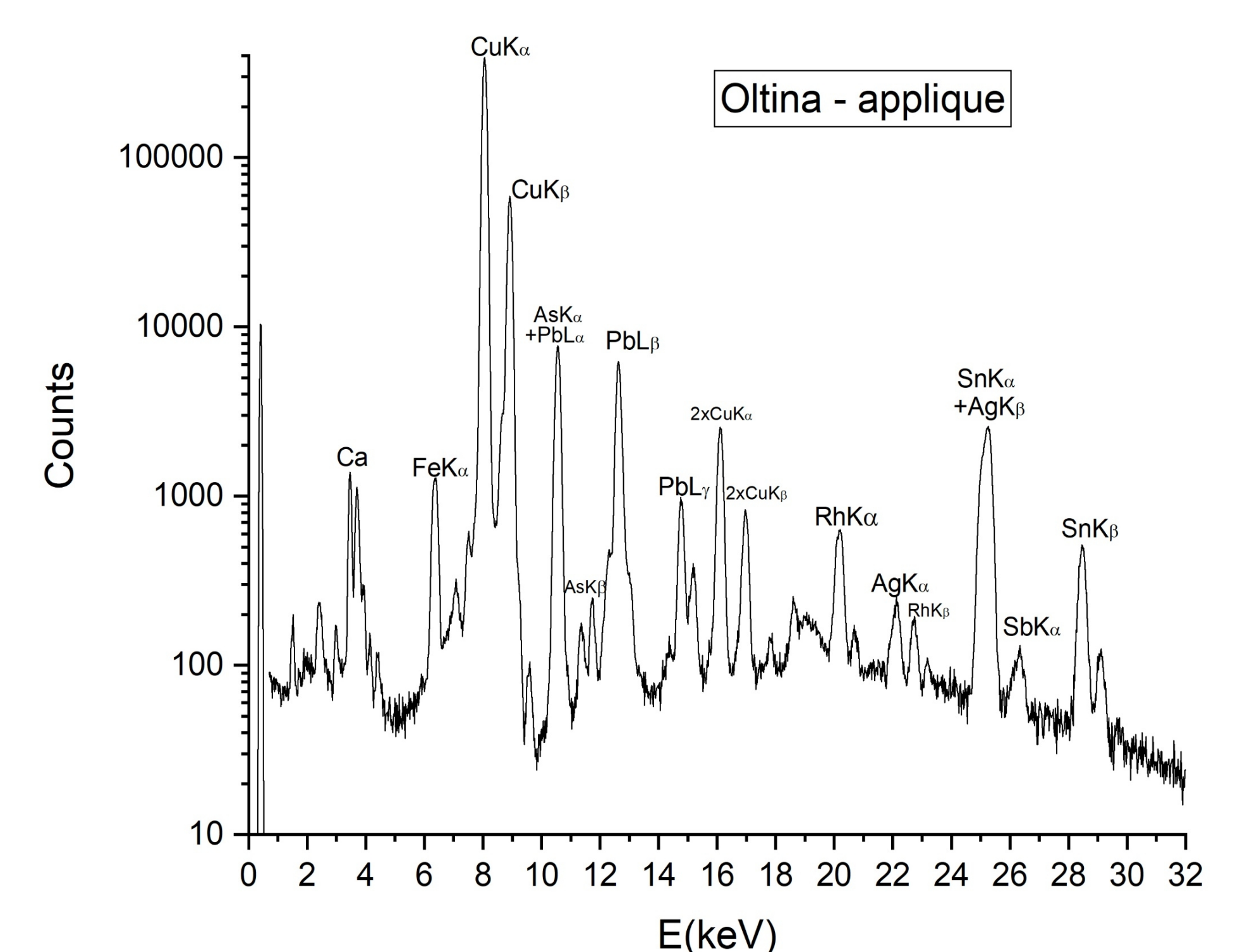
XRF spectrum – Cu-Sn-Pb composition



XRF spectrum – Cu-Zn-Pb composition with Sn and Ag traces



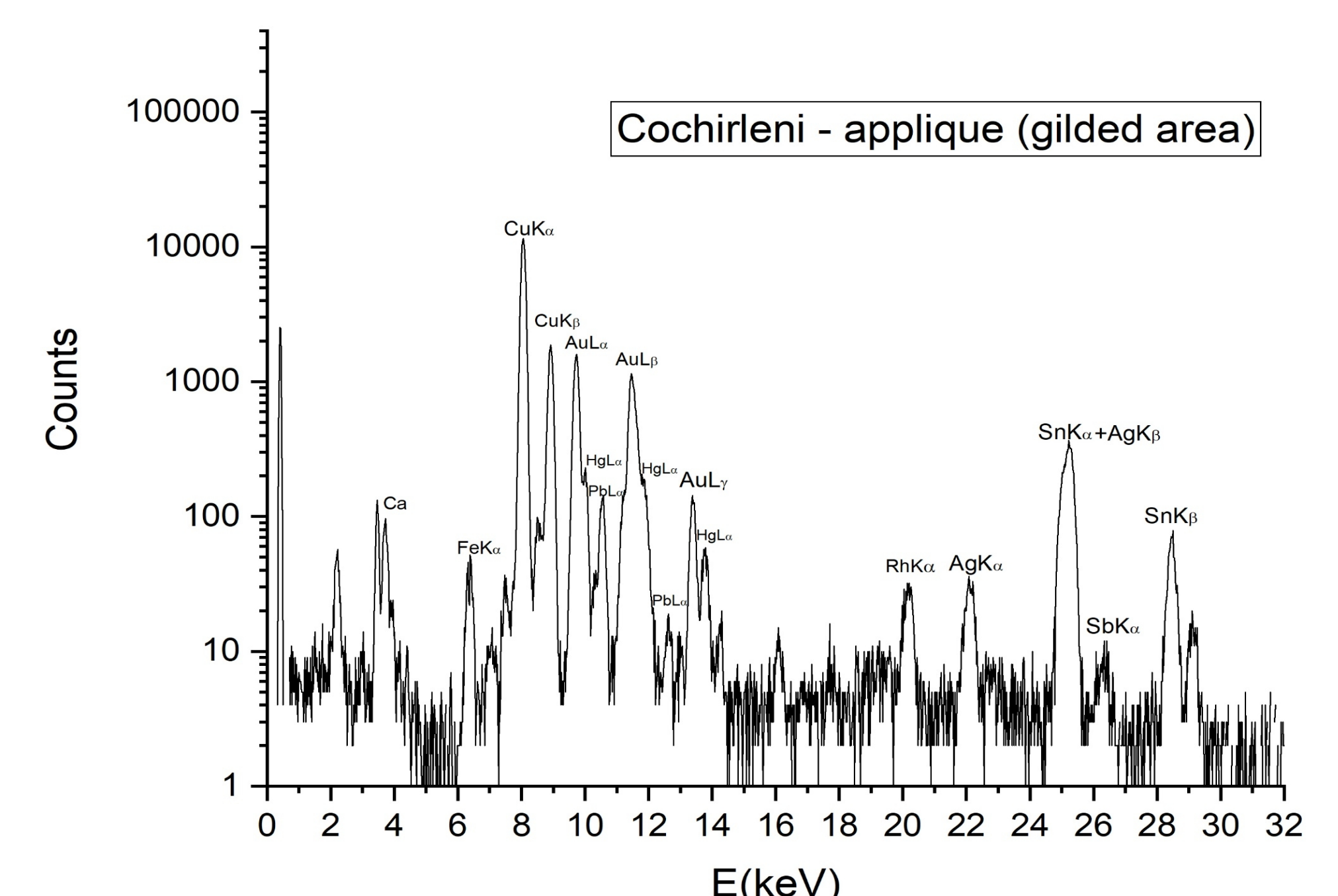
XRF spectrum – Cu-Sn-Pb-Ag composition



În order to determine the origin of the archaeological artifacts, the aim is to identify the source of copper from the minor elements and the specific trace. From the analysis of bibliographic resources we found that for copper from Altan Tepe (Dobruja) were identified as distinctive elements Hg, Ag, Pb, Sn, As, for Eastern Bulgaria we have as element the specific trace Se, Ni, As, Ag, Sb. The historical "bronzes" have an extremely variable composition, because most metalworkers probably used any scraps they had at hand.

Another way to obtain the raw materials needed to make bronze products was remelting artifacts made of this metal, a process known widely in prehistoric times. Some bronze ornaments can be gilded (the case of the Cohirleni applique) where we can observe the presence of gold and mercury. In antiquity, mercury gilding was a rare and expensive process, but it became the standard method of gilding, being described in a series of technological treatises, remaining undisputed over time until the medieval period when its use is attested by a large number of gilded objects.

XRF spectrum – Cu-Sn-Sb composition



As a general conclusion, these are objects from the remelting of ancient artifacts, so the copper sources are multiple for the same object, the procedure being generalized since the Middle Bronze Age.

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