New Analyses on Romanian Archeological and Native Gold Samples and on Some Bronze Age Artifacts

B. Constantinescu1, C. Pauna1, D. Stan1, D. Ceccato2

1 Horia Hulubei National Institute of Nuclear Physics and Engineering, Bucharest, Magurele, Romania; 2 Istituto Nazionale di Fisica Nucleare, Laboratori Nazionali di Legnaro, Padova, Italy

INTRODUCTION

For historians and archaeologists the information about the provenance of metals used to realize ancient coins, jewelries, tools and weapons is extremely important for the knowledge of commercial, military and political historical aspects. Provenance for metals especially means mines, deposits – inclusive alluvial. Each metal source is characterized by main metals content (e.g. Au, Ag, Cu for gold) and by some trace elements used as fingerprints (e.g. As, Sb, Ag for copper). Micro-PIXE is a very efficient tool in such provenance studies performed especially on very small samples.

ANCIENT DACIAN GOLD STATERS - KOSONS

Very small fragments (less than 200 microns diameter) from 30 gold coins type Koson (20 without monogram and 10 with monogram) were analyzed. The monogram coins are made from refined gold (3-5% Ag, less than 0.5% Cu). The without monogram coins are made from native Transylvanian gold (5-20% Ag, 0.5-2% Cu). The native gold is mainly alluvial, because we detected Al, Si, Fe impurities embedded in the gold native alloy. Our analyses suggest the Kosons were emitted in different workshops: the monogram coins from refined gold somewhere in the Balkans, the without monogram coins in improvised local (Dacian) workshops [1] from alluvial mixed with primary gold, as copies of the monogram coins.

ROMANIAN NATIVE GOLD

15 samples of primary (Hondol mine) and alluvial (Lipova Arad and Pianu de Sus) gold were analyzed to study their homogeneity concerning Au/Ag ratios and trace elements presence [2]. We observed an important difference in silver content of “old” (geologically) alluvial gold - Lipova Arad, situated approx. 200 km from primary Au sources (approx. 98%) – and of “recent” (probably few thousands years) alluvial gold – Pianu de Sus, situated only few tens km from Au deposits (approx. 92%) [3]. The presence of Si inclusions (probably from the rivers sand) was also observed. A very interesting result was obtained for primary gold Hondol sample: the important presence of Pb and Sb mixed with Au + Ag alloy, which means lead and antimony can be used as fingerprints for Transylvanian gold.
BRONZE ARCHAEOLOGICAL OBJECTS

We also started a new study concerning the copper provenance of Bronze Age items (axes, sickles, daggers, swords, celts) found on Romanian territory. The problem consists in their classification from the Bronze Age regional mines point of view – North-East Bulgaria [Ai Bunar – “fingerprints” minor-trace elements As (up to 2-3%), Ni and Sb (hundreds of ppm)], Serbia [Rudna Glava and Majdanpek – “fingerprints” trace elements As, Sb, Ni, Ag, Se (thousands-hundreds ppm)] or Transylvania (e.g. Baia-Mare – “fingerprints” trace elements Sb and Ag – thousands of ppm) [4]. A possibility to use copper from Central Europe – (Austrian Alps mountains – “fingerprints”- As, Bi, Ag, Sb) must be also considered at least for the archaeological sites close to Danube, one of the main commercial connection road during Bronze Age. An interesting case is the Copper-Antimony alloys (e.g. those from Velem – St. Vid - Hungary) – and the possibility of their transport as ingots or tools for re-melting to Transylvania must be analyzed. A special problem is the identification of tin sources and the use of re-melting procedure due to the absence of tin deposits in Hungary and Transylvania. We analyzed 15 very small samples (less than 500 microns diameter) from different archaeological sites in south Romania – especially axes and sickles. The majority presents relevant traces of arsenic and antimony, suggesting the use of copper from north Bulgaria (see figure 6). We intend to continue the study analyzing other items from Transylvania and east Romania (Moldova).