

## XRF ANALYSIS OF THE PHILIP III TETRADRACHMAS FROM CHISELET HOARD

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**Abstract.** *By the XRF analysis it was meant to answer to the question: are the Philip III tetradrachmas from the Chiselet hoard original or Geto-Dacian imitation coins? These coins have been compared with an original Philip II (post-mortem issue) coin and an imitation Philip II coin. The Philip III tetradrachmas differ dramatically of the original coin and is closed by the imitation coin. This refers to the raw material used as well as to the separation technology for getting silver. In the paper the method of obtaining the element concentration is also shown.*

### 1. Introduction

In the course of several years four silver coins were found in the yard of the citizen Tudoran Ion from Chiselet. Three of them entered in the patrimony of the Museum of Archaeology from Oltenița but the fourth was lost. A summary investigation on the spot shown that the inhabitant leveled the ground of his yard with earth taken from a neighboring pit on a vacant land. The place is situated at the end of an affluent valley of the former Marotin marsh, from the flood plain of Danube. At the present hydro-amlioration works dried up the marsh and the land entered in the agricultural circuit. The investigation of the surface indicated no Geto-Dacian settlement excepting some isolated pottery fragments. The three coins are silver Geto-Dacian tetradrachmas of Pielești type, belonging to the first issues. They are as follows:

Nr. 1. Obverse: the head of Heracles on the right with the Nemean lion skin in the pearled circle. Revers: ΦΙΛΙΠΠΟ (the last letter only partially seen), Zeus on the throne, keeping Aquila in the right hand and the sceptre in the left one; under the throne there is the sigle H in laying position, and in the left two monograms - all in the pearled circle; 16.35 g; 26.5 - 27 mm.

Nr. 2. Obverse: the same as the coin Nr. 1 but double strike. Reverse: the same as Nr. 1 but ΦΙΛΙΠΠΟΥ and under the throne there is the incorrect legend ΒΙΑΣΙΛΕΥΣ (the last Σ is inverted); 16.35 g; 27.5 mm.

Nr.3. Obverse: the same as Nr. 1. Reverse: the same as Nr.1 but the legend is ΦΙΛΙΠΠΟΥ; 16.85 g; 25 - 26 mm.

If the coins Nr. 1 and 3 are very near of original, Nr. 2 is clearly an imitation of the tetradrachmas emitted by Philip III Arrhidaios (323 - 317 BC), which are enrolled, according to C. Preda [1] in the group “a” of the first series. These were widespread between Balkan and Carpathian Mountains but especially in the South of Danube where it is thought to be their emission center. Totally, at the North of Danube there are about 20 discovers of this type and about 150 coins, most of them being evidently stylized. But the tetradrachmas presented higher are fairly near of originals. One can conclude that there are many uncertainties about these coins. Are they originals or only Geto-Dacian imitations? The present analyses try to answer to this question.

The advantage of the atomic analyses is their nondestructiveness and they are able to indicate the mineral from which silver has been separated, the separation technology, the economic situation of the emitter and so on [2].

## 2. Experimental Method and Results

X-ray fluorescence (XRF) was the method used in this work. Radioisotope (30 mCi -  $^{238}\text{Pu}$ ) source as well as X-ray tube were used for atomic excitation.  $^{238}\text{Pu}$  is very convenient for the silver coins study since it excites silver with only a reduced yield (the spectrum is not overload by the major component) but it excites very strong the minor components such as Fe, Cu, Zn, Au, Pb, Bi, Hg, As, Br which are very important for the provenance studies. An X-ray spectrometer with Si(Li) detector of 180 eV resolution was used.

Two measuring variants were used: (i) a collimator with 18 mm diameter in order to define an exact surface of the coin and the standard elements (pure metals or modern polished coins with known composition), and (ii) for annihilation of the effect introduced by the coin relief (which is very pronounced) the coin was measured as such and also the coin wrapped in the pure silver 60  $\mu\text{m}$  MERCK foil as well as in lead 40  $\mu\text{m}$  foil which were been perfectly molded on the coin relief. In this way an authentic standard replica is obtained but with known composition. The coin is compared with a standard replica instead of flat standards.

For the other elements in coin, the yields of the pure elements are taken from a calibration  $Y_{K\alpha} = f(Z)$  and  $Y_{L\alpha} = f(Z)$  done in this aim. In this way the relief effect is annihilated in the elemental concentration measurements. A part of an X-ray spectrum is given in Fig. 1. More details about the processing method of the spectra are given in ref. [2].

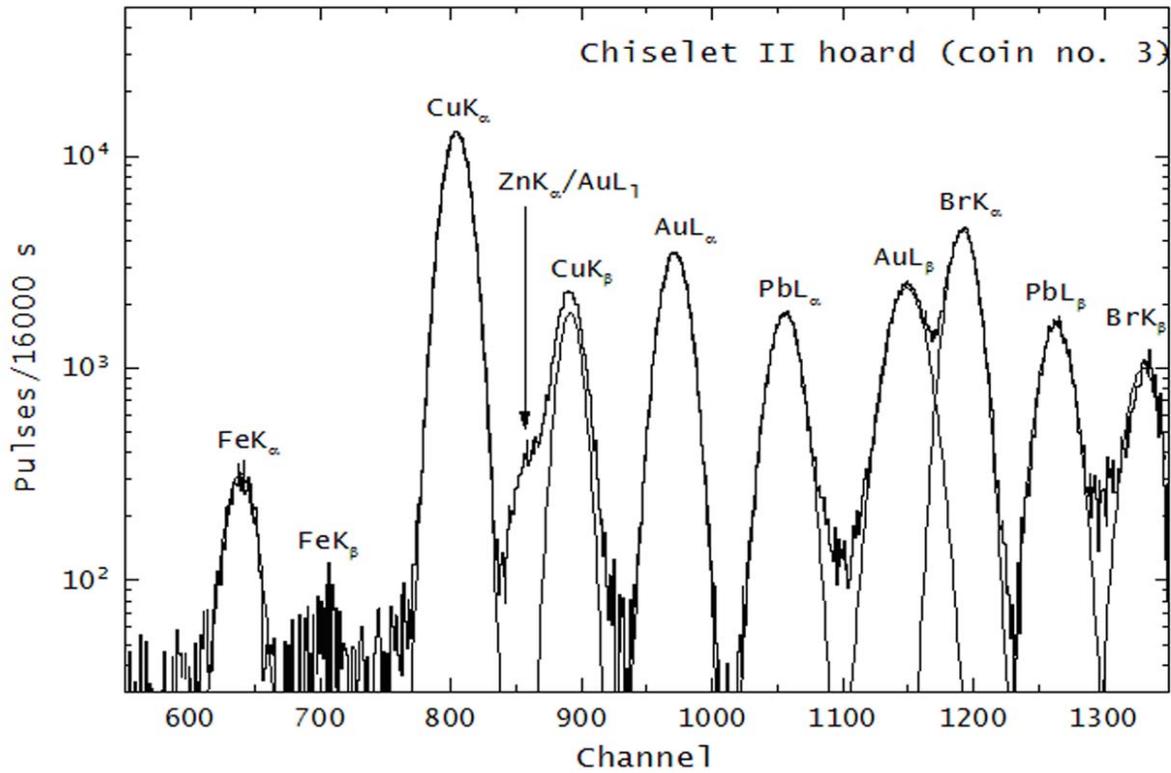


Fig. 1. Part of the X-ray spectrum (10 eV/channel) of a Philip III tetradrachma

The spectra were separated in components by means of the *Origin* program. Two other coins were analyzed for comparison: (i) a silver tetradrachma coined by Philip II king of Macedonia (359 - 336 BC), from a private collection and (ii) a Geto-Dacian imitation (13.99 g, 25 mm) of the posthumous Philip II tetradrachma, found at Sultana-Mânastire and belonging to the Museum of Archaeology, Oltenița. This original type was coined until the end of Cassander reign (301 - 297 BC). The calculated concentrations are given in Table 1.

### 3. Conclusions

1. All the coins were faintly alloyed with copper.
2. Taking into account the traces of bromine found in them, one can suppose that both Philip III coins and Philip II imitation have silver obtained from a mineral containing bromine: bromyrite (AgBr) or embolite (Ag(Br,Cl)).

Table 1. *Element concentrations (%) in the tetradrachmas of the Chiselet-2 hoard*

Coin	Cu	Zn	Br	Au	Hg	Pb	Bi	Ag
1(P.III)	1.30(2)	0.034(15)	0.40(3)	0.709(21)	n.d.	0.104(7)	n.d.	97.4(8)
2(P.III)	1.01(2)	0.286(14)	0.75(6)	0.743(16)	n.d.	0.139(8)	n.d.	97.1(7)
3(P.III)	2.12(2)	0.074(16)	0.35(3)	0.664(15)	n.d.	0.204(8)	n.d.	96.6(9)
P.II(o)	0.82(2)	0.033(15)	n.d.	0.601(11)	0.51(2)	0.139(13)	0.08(1)	97.8(9)
P.II(i)	1.29(3)	n.d.	0.24(2)	2.08(4)	n.d.	0.118(10)	n.d.	96.3(9)

3. All the coins have a high title ( $c_{Ag} + c_{Au} > 97\%$ ).
4. For the three Philip III coins and the imitation Philip II (P.II(i)) one the cupellation has probably been the separation method (no mercury observed).
5. The metal from all the three Philip III coins seems to come from the same source of the ore. Indeed, the gold concentration is practically the same ( $c_{Au} \approx 0.70\%$ ). The Philip II imitation has another source of ore ( $c_{Au} = 2.08\%$ ).
6. It is evident that the original Philip II (P.II(o)) coin differs essentially from the rest by: (i) the presence of mercury which shows that the amalgamation was the separation technique, and (ii) the ore raw material is not any longer bromyrite but an sulfide mineral which contains Bi or Bi-Pb such as benjaminite( $Ag_3Bi_7S_{12}$ ), matildite ( $AgBiS_2$ ), eskimoite, etc. [3].

There is no compositional resemblance between the fourth coins (Philip III and the imitation Philip II) and the original Philip II coin. One can conclude that if the separation technology and the ore sources have not been drastically changed in the period of  $30 \pm 30$  years (they can be yet contemporary) all these four are Geto-Dacian imitations.

Finally, the similarity of the three Philip III coins with the Geto-Dacian ones can be only a coincidence, although it seems to be improbable. It will be necessary to study more Philip III and more Geto-Dacian coins in order to draw a firm conclusion. The comparison of the Chiselet-2 hoard with original Philip III coins should confirm or refute the present conclusion.

1. C. Preda, *Monedele geto-dacilor*, București, 1973.
2. V. Cojocaru, D. Șerbanescu, J. Radioanal. Nucl. Chem., **222** (1997) 15.
3. I. Kostov, J. Minceva, *Sulfide Minerals*, Sofia, 1981.