I. INTRODUCTION

The results presented in this report are a continuation of some preliminary measurements performed in 2003 at AN2000 accelerator of Laboratori Nazionali di Legnaro (LNL) in the frame of EU FP5 TARI action [1].

Several small fragments of ancient gold objects from The National Museum of Romania’s History, Bucharest, and several geological gold samples of known origin - to be more specific, from Transylvanian Carpathian Mountains - were studied with the LNL AN2000 proton microprobe using the micro-PIXE technique. The goal of the study was to clarify the gold provenance using trace elements information: inclusions of Platinum Group Elements (PGE) - Ru, Rh, Pd, Os, Ir, Pt - or other high temperature melting point metals (Ta, Nb, Cr). The nuggets fragments from Transylvania mines were measured in order to fully characterize them from the compositional point of view and to check whether the hypothesis of local (Carpathian Mountains) gold source is verified. Four fragments of artifacts belonging to the Visigothic Pietroasa hoard “Closca cu Puii de Aur”, found on Romanian territory - the tray, the simple girdle, the middle fibula, and the girdle with runic inscription, and six pieces from Transylvanian gold nuggets, coming from Valea Morii, Bradisor-Brad, Musariu-Brad, Ruda-Brad, Valea Pianului and Valea Morii Transylvanian mines were analyzed.

II. EXPERIMENTAL SET-UP

The micro-PIXE experiment was performed using a 2 MeV proton microbeam (9 µm² beam area) at the AN 2000 Van de Graaff accelerator of LNL [2]. The maximum beam current was around 1 nA. The detection of the characteristic X-rays was performed by using an Ortec IGLET-X HPGe detector, with 147 eV FWHM at 5.9 keV. To reduce the intensity of the peaks in the low spectral region (below 4 keV), a funny filter of aluminum (102 µm thickness, 0.4 % hole) was employed in front of the X-ray detector. The maps were scanned on areas of up to 6.25 mm². Both maps and point spectra were acquired – the points were chosen when featuring a high content in an element of interest. The quantitative analysis of the X-ray spectra was performed using GUPIX software [3].

III. RESULTS AND DISCUSSIONS

The first results indicated that the Transylvanian gold contains Te and Sb as trace elements; Sn was not detected in any of the geological samples. Sn is of special interest for this archaeometrical study since it can be considered a characteristic trace element for the Mediterranean gold composition. This trace element was found in the composition of some of the Pietroasa gold samples. Another interesting finding was the presence of Ir in the tray composition: this element being characteristic for the Pactolus River in Anatolia, a gold source that was exhausted since the ancient times. The data analysis is still in progress, since a newer version of the GUPIX software (GUPIXWIN) was employed, therefore several runs of fits have to be performed in order to obtain the most reliable results. This involves further collaboration between the Romanian and the Italian team.

Micro-PIXE maps acquisition is relatively time-consuming and many scans on the surface are required in order to detect the inclusions, therefore further investigations using micro-PIXE technique are necessary, in order to determine different inclusions. As a consequence, some other experimental runs are necessary if we take into account the high number and the diversity of samples (e.g. archaeological gold objects found on Romanian territory, but also geological samples) of interest for this archaeometrical research. The next beam-time at the LNL AN2000 accelerator - to be performed with the EURONS financial support - is scheduled for February 2006, when some other archaeological samples are to be measured to complete the archaeometrical study of the Visigothic Pietroasa hoard “Closca cu Puii de Aur”.

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