

Archaeometry at the 3MV Tandetron Particle Accelerator

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Abstract

We propose an experiment aimed at aiding the archeological teams from Museum of Dacian and Roman Civilization in an alternative identification and classification of some artefacts discovered in a large archeological site, compared to the conventional methods used in archeology. Information over the elemental composition of pigments used to decorate pottery and also the ceramic paste composition and trace elements can be obtained following this test and with it, the opportunity to unveil possible trading routes and pigment recipe.

1. Study motivation

Spread over a period of approximately 800 years, the chosen ceramic samples still represent a blank spot, lacking information, in the Museum of Dacian and Roman Civilization collections. Apart from radiocarbon dating procedures, no other tests were performed on the samples, leaving the archaeologists with a perfect enigma.

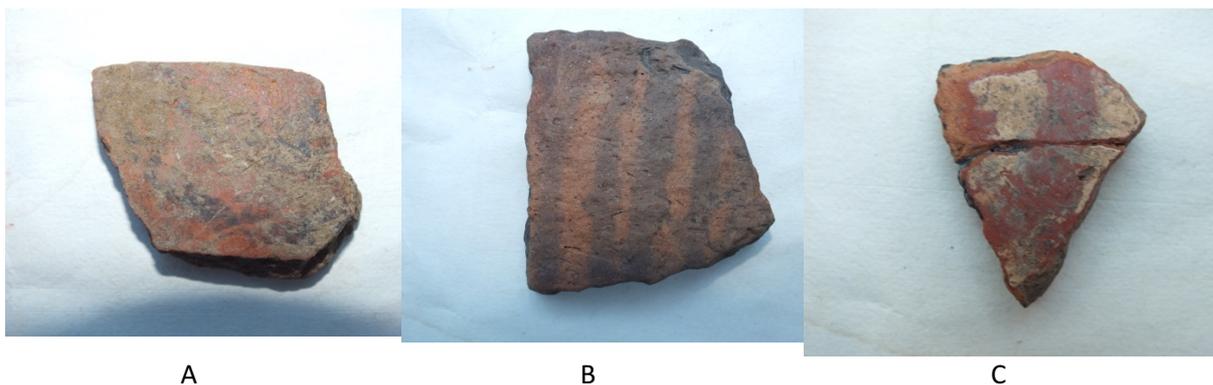


Figure 1. Examples of the pottery samples to be subjected to “in-air” PIXE analysis. A – pottery sample, not decorated, unmarked; B-C – decorated pottery samples

The Particle Induced X-Ray Emission (PIXE) is a material analysis technique that can provide information about the analyzed sample in terms of elemental composition for the main elements and also for minor and even trace elements. With respect to this information, the archeologists engaged in analyzing each artefact can be aided in obtaining valuable information about each sample.

The proposed study aims at focusing firstly on analyzing the elemental composition of the pigments used to decorate the pottery and later on the composition of the ceramic paste used. The study of pigments used could unveil recipes used and their evolution over time, while the ceramic paste elemental composition, as well as the trace elements found, may clarify whether the pottery was created locally, or “imported” *via* various trading routes.

2. Experimental proposal

Applying one of Ion Beam Analysis techniques, in-air Particle Induced X-ray Emission, to a wide range of pottery samples at the 3MV Tandetron particle accelerator.

Studied samples: 52 pottery samples, fixed over a period of over 800 years, uncovered from the same archaeological site. 32 pottery samples carrying pigment marks, for the pigments to be studied and 20 pottery samples with no marks of pigment decoration, to study the ceramic paste.

Elements expected to be investigated: Al, Si, P, S, Cl, K, Ca, Ti, V, Cr, Mn, Fe, Ni, Cu, Zn, Sr, Pb

3. Experimental setup

The pottery samples received will be tested using the in-air PIXE analysis technique. Considering the patrimony statute of the samples proposed for analysis, no intervention should be performed over. Therefore, in order to preserve the samples, they can not be subjected to vacuum conditions, the in-air PIXE setup has to be used.

Since all the samples expected to be tested are non-biological, no significant sample preparation will be performed. With respect to the analyzed samples, one of the two test options will be used. The archeologists will be responsible with the cleaning, preparing and choosing the surfaces that will be tested using PIXE.

Summary

Requested 3MV Tandetron line: *IBA*

Desired beam and energy: ^1H – *protons, 3MeV*

Requested beam time: *5 days of beam time*