

## **IBA investigations of some Byzantine mosaic glass tesserae (11<sup>th</sup> century A.D.) found in Isaccea-Vicina**

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Several coloured glass tesserae (yellow, blue turquoise and green turquoise) excavated in Isaccea-Vicina, dating from the 11<sup>th</sup> century A.D. were investigated using Ion Beam Analysis (IBA) techniques.

The tesserae were discovered in 2005 in the fortified urban settlement under unclear circumstances. The archaeologists who found them suspected that the tesserae belonged to the mosaic decoration of a church located in Isaccea-Vicina. The existence of this church was confirmed by other previously found archaeological artifacts, such as frescoes fragments.

The investigated glass mosaic tesserae are singular discoveries among the archaeological finds from the 11<sup>th</sup> century A. D. that were excavated in Isaccea, as well as in other Byzantine sites situated in Dobrogea. Their uniqueness reinforces the special status of Isaccea – Vicina in this region during the Byzantine period.

IBA measurements were non-destructively carried out on the tesserae using the external 3-MeV proton micro-beam of the AGLAE accelerator facility of Centre de Recherche et de Restauration des Musées de France (C2RMF) in Paris, in the frame of CHARISMA EU FP7 project. The composition of the glass samples was determined by proton bombardment of each glass fragment, simultaneously using Particle-Induced X-ray Emission (PIXE), Prompt-Induced Gamma-ray Emission (PIGE) and Rutherford Backscattering Spectrometry (RBS) techniques. PIXE and PIGE techniques provided the bulk glass composition, whereas RBS was used to identify the superficial metallic layers covering some tesserae.

The main purpose of this archaeometrical study was the determination of the chemical composition of the tesserae, in order to get some hints about the employed glass recipes.

The external IBA analyses showed that analyzed Byzantine glass tesserae can be divided into two main groups: three of them turned out to be soda-lime glasses, while two of them, namely the green turquoise ones (jade-like hue), were soda-lime-lead glass, with a relatively high PbO content ( ~ 7-8 wt%). The low content of MgO and K<sub>2</sub>O (both below 1.5 wt%) indicate that all these objects were *natron*-based glasses.

PIXE and RBS spectra indicated that the yellow tessera was gilded.

The compositional IBA data also evidenced the chromophores providing glass colour – iron for the yellow sample, and copper for the green and blue ones. The determined lead and tin concentrations in turquoise green tesserae indicate the intentional addition of a lead-based alloy, such as leaded bronze, for colouring purposes.