

# DETERMINATION OF THE PROVENANCE OF VINICA TERRA COTTA ICONS USING SUPPORT VECTOR MACHINES

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Vinica terra cotta icons were found during the systematic archaeological excavations in the Vinica Fortress, Southwest of the town of Vinica, in the Eastern part of Republic of Macedonia. They are all dated from the 6<sup>th</sup> – 7<sup>th</sup> century and they represent exceptional examples of our Christian cultural heritage.

Detailed chemical examinations have been performed in the years after their excavation. Ten samples of partially preserved fragments of terra cotta icons and thirty three clay samples from eight different sites in the region have been analyzed using different instrumental techniques: X-ray fluorescence, atomic absorption spectrophotometry and flame photometry. The simple comparison of the obtained data was not able to determine the exact location of the clay used for the terra cotta icons.

In this work, the attempt to develop a reliable chemometric method for determination of the origin of these unique terra cotta icons based on support vector machines (SVM) is demonstrated. For this purpose, non-linear SVM with Gaussian kernel function were used. By changing the parameters of the SVM models (the width of the Gaussian kernel function and the value of the penalty parameter), the models with the smallest number of support vectors and at the same time, with the best generalization performances, were searched.

Using the models with the best generalization abilities, it was possible to determine that the analyzed samples of the terra cotta icons found in the Vinica Fortress were produced locally by masters of the Early Christian art. Our results were also confirmed using principal component analysis and self-organising maps<sup>1</sup>.

<sup>1</sup>Vinka Tanevska, Igor Kuzmanovski, Orhideja Grupče, Provenance determination of Vinica terra cotta icons using self-organising maps, *Ann. Chim-Rome*, 97 (2007) 541-552.