



XRF and FT-IR Spectroscopy Analysis for Identification of Pigments and Binders Found on Wall Paintings From the Three Hierarchs Church, Iasi

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Abstract

The radical intervention that has been made in the 19th century on the original monument-dated in the 17th century- changed solidly the appearance of the interior paintings. The analysis of the pigments and binders found in the preserved layers that we study today has been helpful to the identification of the constructive stages and to the establishment of the restoration strategy for the interior mural paintings.

The use of differential X-Ray attenuation can allow to model the various layers: indeed the absorption of x-rays through different layers will result in modification of intensity ratio between the different characteristic lines. Identification of the binder layer of material preparation and the original repair was performed using FT-IR spectrometry.

Introduction

The characterization of cultural heritage materials is essential for the comprehension of their degradation mechanisms. X-Ray Fluorescence spectrometry (XRF) allows a rapid and simple determination of the elemental composition of a material. Whereas it is commonly used for qualitative analysis, recent efforts have been made to develop quantitative analysis even with portable systems. However the interpretation of the results obtained with this technique can turn out to be problematic in the case of layered structures such as easel and mural paintings.

In the case of “Three Hierarchs” Church it was studied the components of the painting layer. This layer is the result of several partial replacement interventions of the mural painting, interventions that were made in different painting techniques. The nature of the binder it would be better to add generally analysed by FTIR is very important for the establishment of the intervention stages and specific work techniques.

Materials & Methods

The goal of this research was to know which pigments and binders were applied in this artwork. For this study non invasive techniques testing were used X-Ray Fluorescence and micro-invasive techniques FT-Infrared Spectroscopy (FT-IR).

The analyses have been made with the help of a portable X-ray fluorescence spectrometer Innov X Alpha Series. Source excitement: X-ray tube, the anode Ag W, 10-40 kV, 10-50 μ A, up to 5 filters. Detector: Si PIN diode, <230 eV FWHM at 5.95 keV Mn K-alpha line and FTIR spectrometer Vertex 70 Bruker, 30 – 25 000 cm^{-1} .

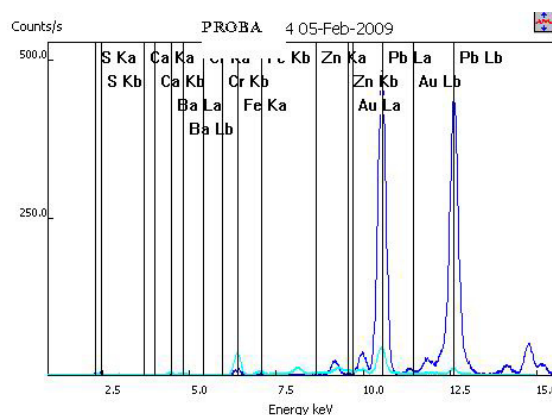


Fig.1 XRF spectrum of the original layer preparation

Results

The samples taken from the original layers, Fig.1 shown the presence of the animal glue as binder, instead of linen oil, used by tradition in the interventions age.

The investigation, concluded also that the materials used for repairs to the layer preparation were compatible with the original support materials, such as calcium carbonate. Gypsum is found in material

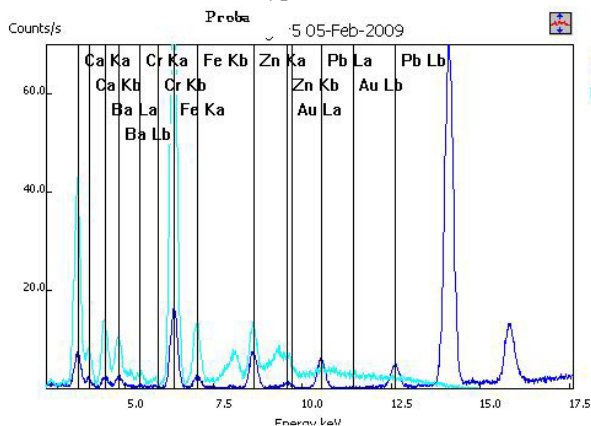


Fig. 2 XRF spectrum of the original painting of brown pigment

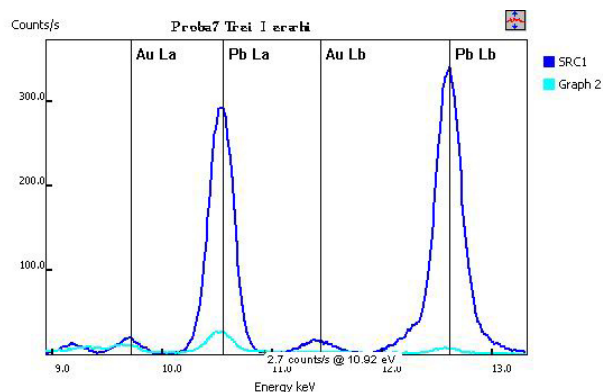


Fig. 3 XRF spectrum of gold from the porch

repair. Figure 2 is the XRF spect of brown pigment identified as sienna. On the porch, fig.7, the pictorial layer was positive for gold. The pigments applied were recognized on the bases of characteristic chemical elements from the XRF spectra. The comparison of the counts per second of different

elements with regard to the background offers the possibility to obtain semi-quantitative results. This comparison allowed the identification of protein peaks in all the icons study (N-H asymmetrical stretching between $3400-3244\text{ cm}^{-1}$).

Conclusions

This method offers multiple advantages as: rapidity, total volume penetration (large objects of any form can be treated), simplicity (the object can be treated in the transport package), applicability to composite objects, reasonable cost.

Investigations carried out by modern techniques and restoration according to authentic fresco showed the Three Hierarchs Church indicating preservation of traditional techniques. Non invasive (XRF) and micro-invasive (FTIR) analytical techniques have enabled the identification of natural pigments, binders, etc. to use and allowed restorers use treatment the conservation-restoration adequate.

Results have contributed to the completion of a given covering pigment, binders and primers used in XVIth centuries.

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