

Radiocarbon dating and PIXE analysis of historical paintings

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Cosmogenic radiocarbon, produced by interactions of cosmic rays with atmospheric atoms, is incorporated into environmental biochemical cycles and thus appears as a tracer in all living organisms. Consequently, materials used in the production of paintings that contain naturally derived carbon (e.g., canvas) can be subjected to radiocarbon dating. This is an important prerequisite for determining the true age of a painting, which may differ in the case of forgeries, commonly encountered on the art market.

We present results from the radiocarbon dating of old, mostly religious paintings, using accelerator mass spectrometry (AMS). The resulting radiocarbon ages span the 16th to 19th centuries, consistent with the expected historical origins of the analyzed paintings.

To further validate the authenticity of the examined artworks, we also developed a method for elemental analysis using particle-induced X-ray emission (PIXE). The bulk samples (oils on canvas) used for the nondestructive PIXE analysis were cut from the paintings prior to their use in the destructive AMS analysis. The PIXE results showed in some paintings a presence of several elements (Mg, Al, P, S, Ca, Ti, Fe, Zn, Ba and Pb) at concentrations $\geq 1\%$, while the other elements (Na, Cl, K, Cr, Mn, Co, Ni, Cu, Sr and Cd) were present at lower levels. A potential correlation between radiocarbon ages and elemental compositions will be discussed as a novel approach to identifying forged paintings.