

Macroscopic X-ray fluorescence analysis, a method for non-invasive imaging of painted works of art. Comparison with other methods and some case studies

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Paintings from different historic periods (from Antiquity up to the time when photography was introduced) are considered to be valuable windows on the past. Via Pompeian frescoes, for example, we have a (partial) view on how Roman civil society functioned. The paintings of Brueghel show the life of ordinary citizens in the Low Countries of the 16th century, while those by Rubens and Rembrandt depict many aspects of society in the Golden age.

Hidden below the surface of many works of art, overpainted representations are present that provide additional information on the painter, the painting or its (preservation) history. Traditionally, a combination of X-ray radiography (XRR) and infrared reflectography (IRR) are used to examine the interior parts of paintings. We have recently developed a more powerful analytical method to visualize these hidden layers that is based on X-ray fluorescence (XRF) analysis, called macroscopic XRF (MA-XRF).

While initially, activities were conducted at synchrotron facilities by employing high energy, monochromatic primary beams of X-rays, more recently, several mobile MA-XRF scanners were constructed that made it possible to perform imaging measurements *in situ*. In this presentation, recent MA-XRF results obtained from paintings by Memling, Rembrandt, Flinck and Rubens will be discussed and some of these will be compared to (element specific) images obtained by other methods such as XRR and NAAR (Neutron Radiation Autoradiography). This will highlight a number of the advantages and limitations of this new imaging method

