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µXRD for the identification of pigments in cross-sections of paintings

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One important requirement for material analysis in the fields of art and archaeology is at the best a non-invasive and non-destructive method, like XRF, Raman, or FTIR [1]. However, in specific cases tiny samples can be taken from e.g. a painting, which are embedded and cross-sectioned perpendicular to their surfaces, in order to study the structure of the paint layers as well as the pigments and binding media. The identification of pigments is usually performed by using light microscopy (LM) and scanning electron microscopy in combination with energy dispersive x-ray microanalysis (SEM-EDX) [2]. The results of such investigations yield information about the number of paint layers (stratigraphy), their colors and sometimes also about the binding medium. Based on the elements present, an identification of the pigments can be gained. However, in many cases a clear identification is hindered by the fact that some of the most interesting pigments can occur in different crystalline structures e.g. chalk as calcite, aragonite or vaterite, or green pigments based on copper (Cu) like malachite, atacamite, brochantite or posnjakite. Because of the great variety of existing structures based on iron (Fe) or calcium (Ca) a clear proof is here impossible too.
XRD has been proved to be a valuable tool for the clear identification of pigments. As the thickness of the paint layers is in the range of several tens microns or even below µXRD is the best method to be applied therefore. As synchrotron induced µXRD showed good results [3], it was the aim to identify pigments in the cross-section layers by µXRD with a GADDS system. These measurements helped to identify the historic material, although it was not always easy to correlate the information with the layer.

Figure: Cross-section of a paintlayer seen with optical microscopy, UV-fluorescence microscopy and SEM

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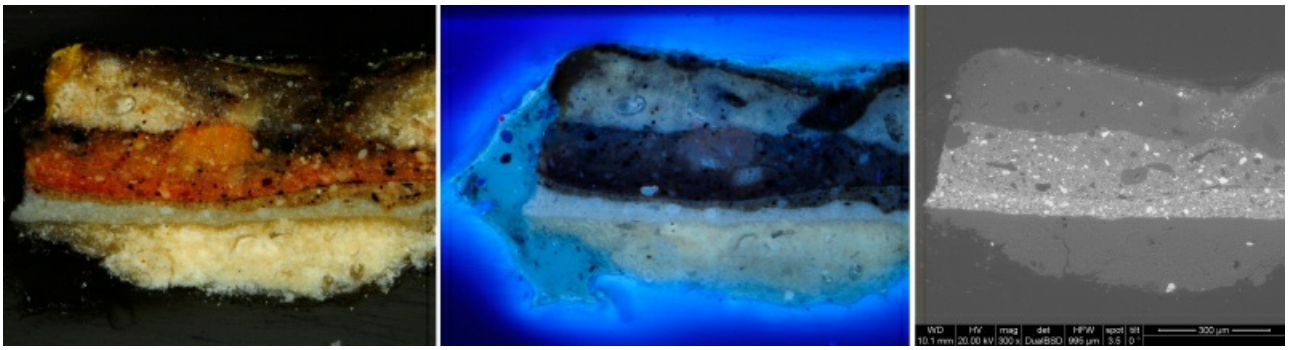

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