Pigment and Ink Analyses of manuscripts and Miniature paintings on parchment

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Abstract_Schreiner-Vetter_Workshop (1.57 MB) In several research projects dealing with glagolitic (old-slavic) manuscripts of the 11th century as well as miniature paintings of the medieval periods X-ray fluorescence analysis (XRF) has been used for the material analysis of pigments and inks. The high advantage of XRF in comparison to other analytical techniques is its applicability in air. In most cases the analysis is non-destructive (without taking original sample material) or even non-invasive, which means that no changes or alterations occur before, during or after the investigation at a manuscript. Furthermore, the miniaturization in the field of electronics yielded x-ray tubes as well as x-ray detectors of less than a kilogram. Therefore, devices can be easily transported to an archaeological site or into museums, libraries and galleries for analytical investigations. Unfortunately, only elements with an atomic number higher than 16 (sulphur) can be detected by XRF in air, which gives the possibility to characterize just inorganic components. Furthermore, only the elements present can be determined and no compound specific information is obtained. For these reasons, compound-specific methods such as Fourier transform infrared spectroscopy (FTIR) and Raman spectrometry as well as techniques in the UV and visible range (UV-Vis) seem to be promising complementary methods, as such measurements also can be carried out in air and in a non-destructively. Instruments Applied for Analysis of Manuscripts A transportable X-ray fluorescence (XRF) analyzer was developed and assembled at the Academy of Fine Arts in Vienna, in order to permit in-situ examinations in museums, libraries and even at archaeological excavation sites [1]. The system is based on energy dispersive XRF using an Oxford XTF5011 50W-Rhodium x-ray tube, a Röntec XFlash 1000 silicon drift-chamber detector and two lasers for positioning (Fig.1). Furthermore, so-called handheld devices are available for XRF, which can deliver results and help the philologists in the interpretation of the materials used for the manuscript. Additionally, a novel external reflection-FTIR unit of Bruker Optics, Ettlingen, Germany, could be applied to various manuscripts [2]. The reflection module, which can be mounted to the portable Bruker ALPHA FTIR spectrometer focuses the IR beam via mirrors to the object (Fig.2). The analyzed area is in the range of approximately 5 mm in diameter. The reflected radiation (4000 – 450 cm-1) is focused again by mirrors to the DTGS-detector and has to be mathematically treated by Kramers-Kronig-Transformation (KKT) in order to achieve a so-called absorption index spectrum, which can be compared with an IR spectrum obtained in the transmission mode [3]. References 1. Desnica V., Schreiner M. A LabVIEW-controlled portable x-ray fluorescence spectrometer for the analysis of art objects. X-ray Spectrometry 2006; 35: 280-286. 2. Vetter W., Schreiner M. Characterization of pigment-binding media systems – comparison of non-invasive in-situ reflectance FTIR with FTIR-microscopy. ePS (e-PreservationScience) 2011; 8: 10-22. 3. IRUG database 2007. http://www.irug.org