

Laser ablation-based methods in the analysis of the objects of cultural heritage

Eva Zikmundová

Involving scientific methods in the examination of the objects of cultural heritage provides important information on the material composition and the painting technique, which can lead to a better authentication of the object and to the determination of its age and place of origin. Laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) and laser-induced breakdown spectroscopy (LIBS) enable direct analysis of solid samples without the need of previous sample preparation and with a minimal destruction effect. In recent years, these methods have been used frequently in the analysis of the artworks [1, 2].

One of the advantages of LIBS analysis is a good spatial resolution. A possibility of distinguishing different layers in the multi-layered samples was studied based on the depth profiles of the elements present in the layers. The composition of individual layers was known, therefore, characteristic elements representing the compounds present in each layer were chosen. Moreover, the depth and shape of the craters were examined and the average ablation rate per each sample was estimated. Using a handheld X-ray fluorescence spectrometer as a complementary tool to LIBS was also investigated.

LA-ICP-MS enables the quantification of both major and minor elements and the examination of the trace element fingerprints of individual pigments which can help determine provenance and subsequent authentication of the used materials. The aim of our study was to optimize the process to identify and link groups of clay-based pigments to the same region of origin based on their composition and trace element fingerprint using pelletized powdered samples, either commercially available or gathered directly in the locations of interest. A possibility of linking these powders with pigments contained in real painting samples was then studied.

References:

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- [2] A. Botto, B. Campanella, S. Legnaioli, M. Lezzerini, G. Lorenzetti, S. Pagnotta, F. Poggialini, V. Palleschi, Applications of laser-induced breakdown spectroscopy in cultural heritage and archaeology: a critical review, *Journal of Analytical Atomic Spectrometry*, 34 (2019) 81-103.