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Assessment of elemental heterogeneity by means of LA-ICP-MS imaging approach in artwork studies

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LA-ICP-MS (Laser Ablation Inductively Coupled Plasma Mass Spectrometry) is an analytical method eagerly used in artwork studies. Beside multi-elemental analysis, this method offers ability for acquiring information about spatial distribution of selected elements over the sample's surface. These advantages of LA-ICP-MS were decisive in undertaking research devoted to analysis of heterogeneous samples, e.g. pottery shards and pigments. The aim of the pottery study was to evaluate the degree of heterogeneity as well as to assess the correlation between samples, which could be used for their provenance determination. Heterogeneity of collected pigments particles was also the aim of pigments analysis focused on searching for coexistence of particular elements.

Analyzed samples included pottery sherds from different excavation sites (e.g. Topaz Gala Depe, Ara Depe, Atsyz Depe) from Sarakhs oasis in Turkmenistan and particles of pigments carefully collected by a conservator on the occasion of exhibition of works painted by Olga Boznańska in the National Museum in Warsaw in 2015.

LA-ICP-MS procedure was optimized separately for ceramics and pigments to allow comparison of important chemical information available for various analytical scenarios:

(a) pottery samples were ablated by using pattern of 11 parallel lines selected to obtain elemental distribution on a relatively large area of each sample and monitoring of transient signals for 42 selected isotopes;
(b) particles of pigments were ablated by using more moderate approach and only 3 lines were defined for micro-sampling step with 36 isotopes taken into account. The interpretation of LA-ICP-MS results of analysis of pigment particles were supported by using Raman spectroscopy and collection of respective molecular information.

Although at first glance the purposes of these analysis differed considerably, in fact they represent general and very flexible possibilities of using LA-ICP-MS in the study of heterogeneous materials.

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