Microscopy and X-ray Microanalysis in the investigations of archaeological materials from Rogaland, Norway

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The determinations of the chemical compositions and microstructures of archaeological and other cultural heritage materials are essential for better understanding of the raw materials used and the technologies employed to produce them. They can be used for attribution, dating, and provenance purposes. In doing so, insights into material and technology exchanges, and human interactions with nature in the past can be acquired. Compositional and microstructural analyses are also vital in the characterization of the deterioration of these materials and the subsequent well-informed conservation interventions. There are an array of analytical methodologies, such as X-ray fluorescence (XRF), that can be applied for the elemental determination of the surfaces of these materials in a rapid, cost-effective, and non-destructive manner without compromising the physical integrity of the archaeological materials. However, these methods, though very helpful in the surface composition determinations, they often do not directly reflect the composition of the bulk material that is not affected by surface depositions, corrosions, and weathering over extended period. Microstructural information could not be acquired either with these approaches. As a result, the elemental determinations need to be complemented by the microanalyses that combine imaging at very high magnifications using optical\electron microscopy with X-ray-based or molecular spectroscopic investigations of the diverse grains and microstructures. Analysis on micro-samples is possible with such analytical approach. This presentation covers some examples of microscopic and X-ray microanalysis of metallic materials, vitrified ceramics, slags, coins, gildings, mortars, plasters, etc. from different periods found in the Rogaland region, Norway. The characterization of the compositions and microstructures of these materials to support archaeological interpretations, documentation of the objects and assessing their conservation states are highlighted. So does the necessity to combine diverse imaging methodologies (such as optical and electron microscopy) with spectroscopic and mineralogical analyses counterparts.

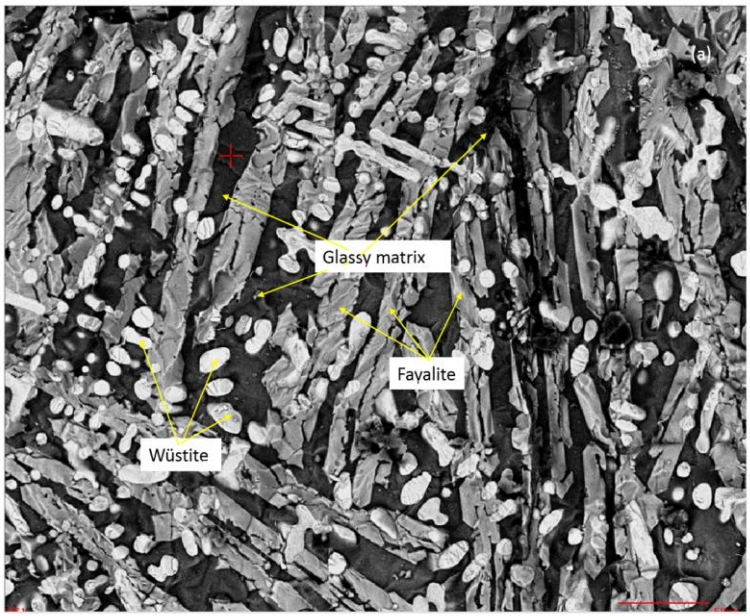

Figure 1. BSE image of the microstructure of an iron smelting slag sample indicating its main components from an archaeometallurgical investigation

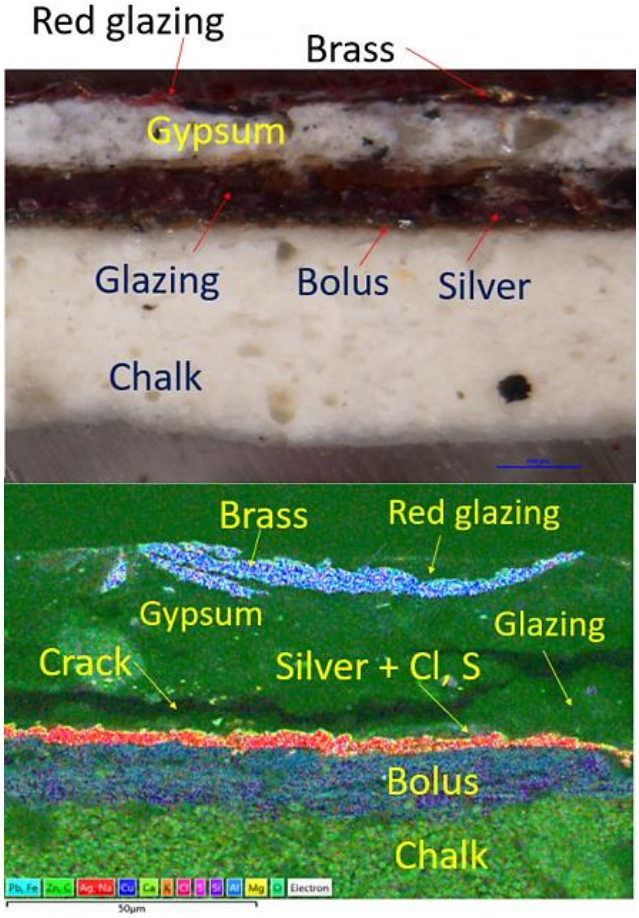

Figure 2. Optical micrograph (top) and overlayered EDS elemental mapping (bottom) of a sample from a polychrome sculpture displaying the original materials in the lower layers with a silver applied in a water gilding method along with signs of deterioration products, and materials introduced due past conservation interventions in the upper layers.