SMIA 2019 Stavanger Workshops 23rd of January

XRF and Cultural Heritage: Quantitative, Qualitative, and everything in between

Full day workshop

By Lee Drake

The growth of portable spectrometry has revolutionized what is possible in conservation and cultural heritage. Historically, compositional analysis required destructive sample presentation. With the advent of handheld spectrometers, not only was non-destructive spectrometry possible, but representative analysis of the object was not constrained to a small sample of measurements. However, this growth in possibility is matched equally by analytical challenges. How many measurements is representative of the object? How do we handle heterogeneous composition? How do we treat pigments, corrosion, patinas, or other surface alterations? Answering these questions requires a deep understanding of both the analytical method and nature of the question.

Please bring instruments, computers, and objects to analyze if you are able. This workshop will be hands-on and guided for both qualitative and quantitative analysis. Open to beginners and advanced users alike.

Introduction to soil analysis using portable XRF

Half day workshop

By Rebecca Cannell and Bettina Ebert

This workshop is designed to give a short introduction to the practical methods and interpretative steps involved in analysing soils and sediments using pXRF. It will cover issues and options during analysis, including an introduction to the use of pXRF on a general level. As soil/sediment analysis poses some unique issues, these will be covered. Data handling, calibration, interpretation, and presentation of results will also be discussed. This workshop is designed as an introduction, therefore some prior knowledge of soil analysis is desirable, but not at all necessary. No prior knowledge of pXRF is required. The workshop will focus upon the use of Niton pXRF's as they are the most common, however we hope to briefly cover the use of Bruker instruments as well.

Participants are encouraged to bring a laptop in order to download the required software (free) for Niton pXRF.

Portable XRF analysis on Archaeological Ceramics: Sample preparation and evaluation of data

Half-day workshop

By Anders Lindahl

Pottery-making can be considered as a complex activity combining technical and social constraints. The study of archaeological ceramic materials bears a cornucopia of insights into behaviour and environment of the people involved into both production and use of pottery. To facilitate subsequent interpretations, a thorough reconstruction of the production technology as well as scientific investigation of the desired use of the ceramic is essential. Both

provenance studies and investigations of production technology involve the determination of compositional characteristics in terms of chemical and petrographic attributes of the bulk ceramic or its constituent compounds.

X-ray fluorescence (XRF) is in itself a non-destructive method for chemical analysis in order to define the elemental composition of a test sample. The method has highly accurate determinations for elements. A limitation in the XRF-analysis with the handheld equipment is that elements in the range from Sodium (Na) and lighter cannot be detected.

Clay, and by default ceramics, consist mainly of oxides of the elements silicon and aluminium as well as quite a large portion of Iron, calcium, potassium, titanium, magnesium and phosphorus. All these are normally found in percentage amounts. Other elements are only detected as parts per million (ppm).

Even though the chemistry of the samples partly depends on the mineralogy of the coarse fractions, a much larger part depends on the composition of the clay (Bergman & Lindahl 2016).

The analyses with the pXRF should always be performed on a clean surface, either a ground powder of the sample, a fresh break or a freshly made cut on the cross section of the sherd.

The element detection is also depending on the duration of the analysis. This means that a higher accuracy in the quantitative analysis is achieved if the object is analysed for a longer time. This is especially true for the lighter elements. To eliminate the impact of the chemical composition of single large grains and to capture the possible variation in the sample several analyses on different parts of the samples is to recommend. The average value from these analyses will thereafter be used as the “true” value.

To interpret correlation and similarities between samples just by looking at tables of data is often difficult and may lead to erroneous results. The different elements could e.g. in an initial stage be compared in two-dimensional plots. To get a better understanding of the relation between the samples a more comprehensive statistical evaluation is achieved by using multivariate analyses e.g. Principal Component Analyses (PCA), involving all the elements found in the pXRF analyses.