Works of art and other objects of cultural heritage significance often are inhomogeneous, multi-layer constructs that require the application of complementary analytical techniques to understand the materials used in their creation, how those materials may have changed over time, and how we may better preserve them for the future. However, because of the precious nature of these objects, sampling is usually severely limited, and commonly employed XRF sample preparation procedures – such as milling, grinding, or even polishing – are not an option. Nonetheless, because of its ability to be employed non-invasively and in situ, XRF spectroscopy has become one of the most widely used analytical tools for the study of cultural heritage materials.

XRF instrumentation has expanded to currently include an impressive array of capabilities well-suited for the study of works of art. Cabinet instruments, while generally only suitable for small objects, such as coins, offer high resolution, sensitivity and speed, and also the ability to control the surrounding atmosphere, facilitating the examination of low-Z elements. Handheld instruments offer portability and flexibility in terms of positioning, allowing large and/or complicated-shaped objects, such as outdoor sculpture, to be examined, but suffer from a relatively large spot size. Micro-capillary optics offer finer control over the spot size and, when coupled with mapping capabilities, allows the characterization of fine details, such as individual paint strokes or solder joins. Interchangeable tubes and filters allow the excitation profile to be tailored for specific needs. Recently developed macro-XRF scanners (lab- and synchrotron-based) allow element maps to be collected over large areas, but the geometry is best suited for flat objects, such as paintings, manuscript leaves, and photographs. The resulting elemental images, easily interpreted by scientists and non-scientists alike, allow unprecedented insight into the working methods and materials of an artist by revealing correlations between areas that would be impossible to detect with spot or small area spectrometers, such as the visualization of hidden paintings. With such a wide selection of instrument capabilities, it is incumbent on the user make appropriate selections in carrying out analyses to answer the questions under consideration.

This presentation will highlight some of the special constraints and challenges encountered in the application of XRF spectroscopy to the wide variety of shapes, materials and complex constructs that comprise works of art – such as paintings, sculpture, illuminated manuscripts, ceramics, metals, glasses, and even a mummy. 1-3