UNDER THE MICROSCOPE.
RESEARCH AT THE NATIONAL HISTORY MUSEUM OF LATVIA

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ABOUT

The National History Museum of Latvia (NHML) has been at the forefront of the restoration and preservation of cultural heritage for nearly a century. Early on, experts relied on visual observations and microchemical experiments under a microscope to make assumptions about an artefact's material composition. However, modern methods such as Raman (InVia, Renishaw) and X-ray fluorescence (Artax 800, Bruker) spectroscopy, as well as stereomicroscopes, have revolutionized the identification of materials, making restoration processes and scientific research more effective.

This state-of-the-art laboratory equipment allows for the identification of materials used in the preparation of an object, as well as those that have appeared on its surface due to external circumstances. Moreover, it facilitates the identification of layers on surfaces that have either disappeared, been fragmented or left a footprint, in a more accurate and detailed way. This research is crucial in the preparation stage before restoration, helping to determine the most suitable and effective restoration methods.

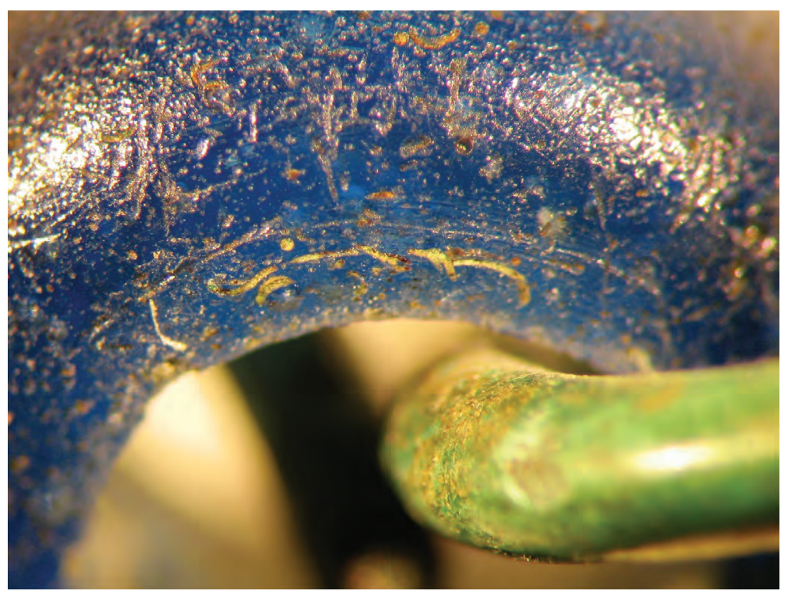

Fig. 2. Detail of the temple ring. Magnif. 20x. Photo: I. T.

Fig. 1. A pair of temple rings, A 5660. Photo: NHML

A PAIR OF TEMPLE RINGS (Gilberti, Mazjumprava A 5660)

A temple ring is a loop with one blue glass bead and an attached pendant decorated with radial rays (see fig. 1, 2). In the body of the blue glass bead, significant amounts of Si, Ca, K, Cu, Fe, Pb, and Co were found, with significant Sr and Zr content. Trace elements such as Ti, Sb, Mn, and Cl were also found. The NHML laboratory results were compared with the Latvian University WDXRF spectrometer S8 Tiger (Bruker, Germany) results and found to be identical except for Na (light elements were problematic to detect with helium-free methods due to small X-ray energy). Copper alloy elements (loops, rings, pendants) have a similar composition with dominant elements such as Cu, Sn, and Pb. Silver was found in trace elements, and it is difficult to conclude whether silver is a lost gilding part or a part of the copper alloy.

Fig. 3. Fibula, 1694/21a. Photo: NHML

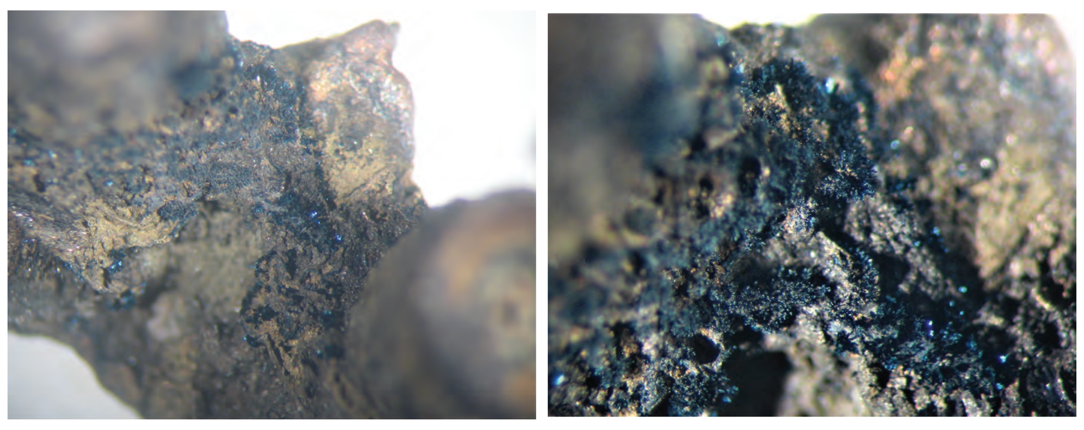

Fig. 4. Detail of the fibula. Magnif. 20x, 60x. Photo: I. T.

FIBULA (Rīga, 1694/21a)

The fibula is circular in shape, and the outer face features ten raised circular turreted collets (see fig. 3). The reverse is flat, and the pin is absent. Two green glass stones and one brown glass stone remain at the collets of the fibula and one of the glass stones (brown) is presented separately. In the glass stones significant amounts of Si, Ca, and K were found, while Mn and Ti were found in trace elements. According to the XRF data, the glass stones are divided into two types: type A (green), where the dominant elements are lead and copper, and type B (brown), where the dominant element is calcium, with significant Zn, Fe, Pb, Sr, and Zr content. Traces of calcium carbonate remain in some of the collets, more often at collets where type B glass stones were found. Zn and Sr were also detected in these white residues. In the body of the fibula, Cu, Zn, Sn, and Fe were found, while Pb and As were found in trace elements. On the surface of the fibula, unique blue copper sulphide crystal aggregates were found, which were the reason for leaving corrosion products on the fibula's surface (see fig. 4, 5).

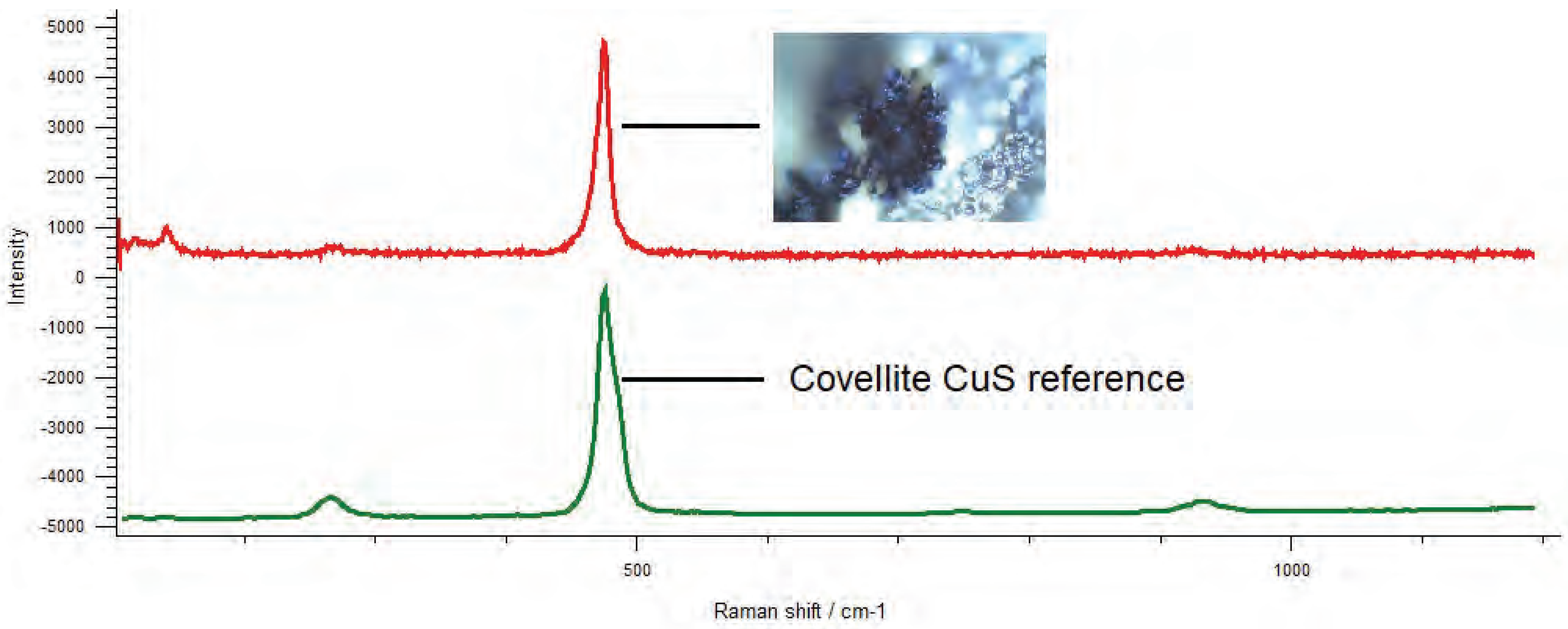

Fig. 5. Comparison of the Raman spectra of cupper sulphide CuS with the Raman spectrum of the blue corrosion layer.

Fig. 6. Metal binding, VI 146:916. Photo: A. S.

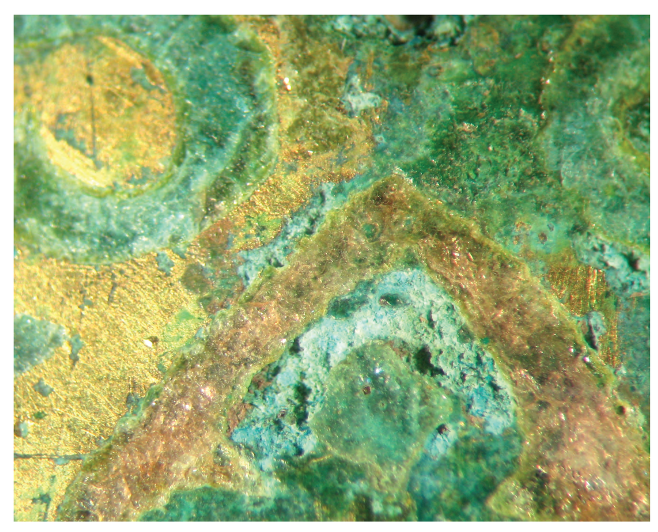

Fig. 7. Detail of metal binding. Magnif. 20x. Photo: A. S.

METAL BINDING (Doles Rauši, VI 146:916)

The metal binding is in the shape of a heart with two spiral and four drop-shaped glassy elements and traces of gold gilding on the outer face (see fig. 6, 7). The reverse is flat, and the pin's fragment is present. At the body of the metal binding, Cu, Sn, Pb were found, and the precision detection of the alloy's content was problematic due to gold gilding, corrosion products present, and the interreaction of enamel's elements. At the enamel's content, different quantities of Si, Ca, K, Cu, and Mn were found, while Ti was found in trace elements. According to the XRF data, the enamels were divided into four types: type A (brown), where the dominant elements are Pb and Mn; type B (green), where the dominant elements are Pb and Cu; type C (dark green I), where the dominant elements are Ca and Cu; type D (dark green II), where the dominant elements are Pb, Cu, and Mn (see fig. 8).

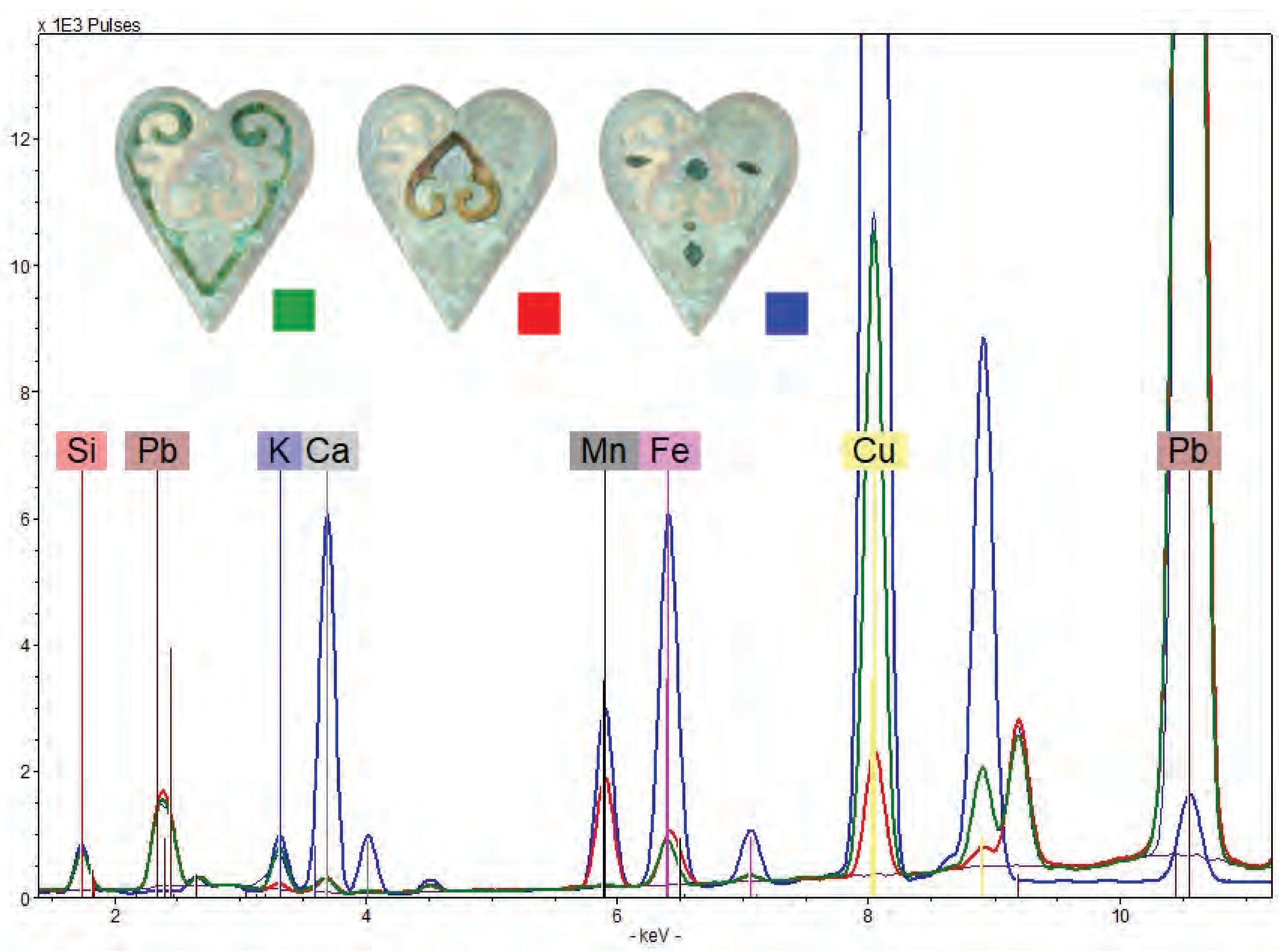

Fig. 8. Comparison of XRF spectra of different enamels.

IN CONCLUSION

The NHML has made significant strides in the restoration and preservation of cultural heritage through its use of state-of-the-art laboratory equipment and contemporary methods. This has enabled the identification of materials used in the preparation of an object, as well as the identification of layers on surfaces, revealing previously unnoticed nuances in Latvia's cultural heritage.

ACKNOWLEDGEMENT

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