THE UNIVERSITY OF SYDNEY

Sydney Analytical Vibrational Spectroscopy

X-ray fluorescence analysis and cultural heritage

Supporting scientific excellence in cultural heritage studies

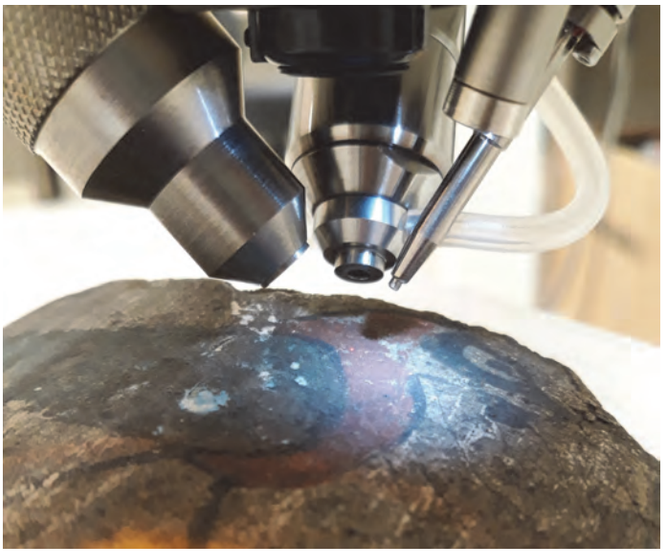
X-ray fluorescence (XRF) spectroscopy enables researchers to determine the elemental composition of samples, identifying the elements present and their concentrations. XRF can be applied to solids, liquids and powders, over a wide range of material types spanning the organic and inorganic. Elements from Na to U are identifiable and analysis is non-destructive, and can be rapid, requiring minimal to no sample preparation. XRF spectroscopy is highly complementary to other techniques, including infrared and Raman spectroscopy, and X-ray diffraction.

Portable XRF Spectroscopy

Portable instrumentation enables rapid *in-situ* analyses, particularly valuable for museums and cultural heritage-related work, where sample location, access, size and/or fragility make it otherwise impossible to perform laboratory-based investigations.

Syndey Analytical houses two types of portable instrumentation: a Bruker Tracer 5i handheld and a Bruker ARTAX800 micro- XRF spectrometer. Both instruments are available for training and loan, with our staff able to travel to conduct on-site analysis. Calibrations can also be developed on an as needs basis, enabling researchers to obtain quantitative information.

On-site pigment and ink analysis of antiphoner manuscript Add.Ms.413 held in the Rare Books and Special Collections Library, University of Sydney, using the Bruker Tracer 5i.



Analysis of pigments on a Ptolemaic sarcophagus fragment using the Bruker ARTAX800.

Bruker Tracer 5i XRF Spectrometer

The Bruker Tracer 5i XRF spectrometer is a highly portable tool ideal for analysing specimens *in-situ*. Notable features of this instrument include:

- in-built camera to pinpoint the exact area for analysis
- 3mm and 8mm spot sizes are available
- minimal to no sample preparation possible
- current calibrations include: soils, ceramics, glass, metals

Bruker ARTAX800 micro-XRF Spectrometer

The ARTAX800 is a state-of-the-art portable micro-XRF spectrometer. Highlights of this system include:

- a rotating measurement head for the analysis of oddly-shaped objects and those with restricted setup positions
- micro-scale analysis (70 µm)
- minimal to no samples preparation possible
- spot analyses
- elemental mapping
- analysis under helium for better sensitivity to light elements
- current calibrations include: glazes, glasses

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Sydney Analytical
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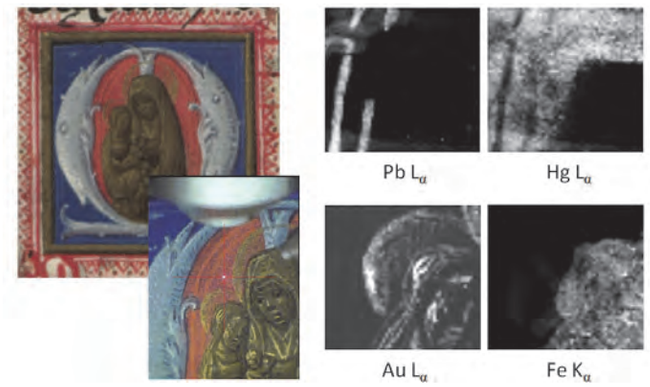
Mapping pigments and revealing hidden text

Analysis of a 15th to 16th Century Augustinian palimpsest manuscript (Add.Ms.411, RBSC Library, Sydney University) by micro-XRF spectroscopy was able to reveal the pigments used in the illuminated letters and borders, in conjunction with Raman spectroscopy. These letters and borders were cut and pasted into the manuscript and pigment analysis along with stylistic studies is being used to better understand the source(s) from which they derive. Moreover, elemental mapping has enabled an understanding of the distribution of pigments in these letters and revealed original text scrubbed from the folios to make way for later work. Visual inspection of this manuscript and subsequent digital alteration of images, showed that much of the original text was not visible, and in some cases only micro-XRF mapping was able to reveal words scrubbed from the parchment.



The pigments in this illustrated letter were mapped using the Bruker ARTAX800 to determine the distribution of elements and thus their related pigments.

Image of a folio analysed with micro-XRF (left) and an example of its digital alteration (middle), with an area of unreadable text outlined in red. A micro-XRF map of Zn (right) reveals the original text.

Contact us

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Taxidermy and heavy metals

Many museum specimens were created and subsequently treated with chemicals that pose health risks. Chemicals containing arsenic, lead and mercury, for example, were commonly used to create these specimens and in many cases their continued curation involved the use of pesticides and poisons to protect them from pests. XRF analysis is a great tool to identify the presence of harmful chemicals on taxidermy specimens, which enables curators to determine the best practices for future curation and object handling.

Analysis of Kakapo (NHB.1749) held in the Macleay National History Collection, Sydney University Museums, using a Bruker Tracer 5i portable XRF spectrometer.

Who are we?

Sydney Analytical is a multidisciplinary facility supporting research excellence across the University of Sydney. Its state-of-the-art research infrastructure supports research and development in many fields, including museum and cultural studies and archaeology. Sydney Analytical houses more than 30 high-end instruments spanning multiple techniques, from infrared and Raman spectroscopy, X-ray diffraction and X-ray fluorescence spectroscopy to nuclear magnetic resonance, amongst others. Many of the instruments are the most advanced of their kind in Australia, with some the only ones available in the country. The facility also actively engages extensively with industry, including a collaboration with ANSTO to support neutron and synchrotron research.

Staff at Sydney Analytical also provide a range of services and expertise to assist researchers during all stages of their project starting with experimental design and sample preparation through to publication. Combined we have over 40 years experience in the analysis of museum and archaeological objects. We also provide guidance and assistance with finding and using external equipment.

For more information about Sydney Analytical

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