The Archaeology Centre and Archaeological Sciences Group Presents:

7-Week Online Practicum: Introduction to the Analysis of Archaeological Materials Using Handheld X-Ray Fluorescence Spectrometry (pXRF)

January 25th, 2021 – March 8th, 2021

Via Zoom (Date and Time TBD)

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**Practicum Description**

Over the last two decades the use of handheld x-ray fluorescence spectrometry (pXRF) in the analysis of archaeological materials has grown significantly. Whether focusing on reconstructions of past technologies, the material characterization of artefacts, or provenance studies, the use of pXRF instruments in addressing archaeological questions is becoming more and more common. While this growth can be largely attributed to the increasing accessibility and low costs of pXRF instrumentation, it also parallels the increasing application of scientific methods to archaeological research as well as more recent interests in “big data” within the social sciences broadly. However, the growing use of pXRF in archaeology has not been matched by a parallel growth in providing archaeologists with training in the analytical sciences or dedicated attention to the integration of these methods within archaeological research designs. This pedagogical disconnect, bolstered by “black-box culture” and the marketing of pXRF instruments as so-called “point-and-shoot” devices, has promoted poor methodological practices as well as the misrepresentation of pXRF-derived data in archaeological research.

This practicum aims to bridge the gaps described above by providing a concise introductory training to the use of pXRF in the analysis of archaeological materials. The practicum provides the required background in physics and analytical sciences essential to producing high-quality pXRF data. However, it is designed first and foremost to provide participants with the fundamental knowledge necessary to design and tailor pXRF methodologies towards answering specific research questions and to further provide participants with the ability to critically evaluate the validity of pXRF studies in archaeological publications. At the end of the practicum, participants will also have an opportunity to pursue obtaining Natural Resources Canada (NRCan) certification in the operation of XRF instruments.

**Learning Outcomes**

By the end of this practicum, participations will have learned the following:

- An introductory understanding of the physical processes and theories that comprise the foundation of XRF as a physical phenomenon  
- What pXRF data can (and cannot) tell us about archaeological materials, and by extension, the archaeological past itself  
- The operation of a Bruker Tracer III-SD pXRF instrument (and relevant software) and how said instrument/software can be optimized and calibrated for the analysis of various archaeological materials  
- Standard practices in the analytical sciences to validate the results derived from pXRF analyses, allow for inter-instrument and inter-laboratory data comparison, and provide a means to critically evaluate the validity of pXRF results published in the archaeological literature  
- The health risks of X-ray radiation and the safety measures employed to operate X-ray emitting devices
Practicum Schedule

Lecture 1: Week of January 25th, 2021

Introductions: pXRF in Archaeology and X-ray Radiation Safety
- pXRF in Archaeological Practice
- “Point-and-Shoot” and “Blackbox” Cultures
- NRCan XRF Certification
- X-ray Radiation Health and Safety

Recommended Preparation:

Lecture 2: Week of February 1st, 2021

XRF Physics
- Fundamental Properties of Matter
- Types of Radiation and X-Ray Physics
- The Process of X-Ray Fluorescence

Recommended Preparation:

Lecture 3: Week of February 8th, 2021

pXRF Instrumentation/Spectra, Qualitative Analyses, and Sample/Matrix Effects
- pXRF Instrumentation
- XRF Spectra and Qualitative Analyses
- Sample and Matrix Effects

Recommended Preparation:
Lecture 4: Week of February 15th, 2021

pXRF Software, Instrumental Parameters, and “Semi-Quantitative” Analyses

- S1PXRF and ARTAX
- Instrumental Parameters
- Spectral Comparison
- Bayesian Deconvolution Analysis

Recommended Preparation:

Watch video at: http://www.xrf.guru/Videos/TracerIIISDVideos/ArtaxVideo/index.html

Lecture 5: Week of February 22nd, 2021

Quantitative Analyses, Quality Assurance, and Data Validation in pXRF Analyses

- Reference Materials/Standards
- Quantification: Fundamental Parameters and Empirical Calibrations
- Quality Assurance and Data Validation

Recommended Preparation:

None

Lecture 6: Week of March 1st, 2021

pXRF Analyses of Archaeological Materials

- pXRF Analyses of Archaeological Metals
- pXRF Analyses of Archaeological Obsidian
- pXRF Analyses of Archaeological Glass
- pXRF Analyses of Archaeological Ceramics and Lithics

Recommended Preparation:


*The following articles on debates in the application of pXRF to provenance obsidian artefacts are also worth reading*


Lecture 7: Week of March 8th, 2021

Wrapping Up and Instrument Operation

- Conclusion of Any Remaining Lecture Material
- Operation of Bruker Tracer III-SD pXRF Instrument

Preparation:
None

NRCan XRF Certification Exam (optional): Date TBD

Further Reading and Resources

Drake, L. http://www.xrf.guru/


Accessibility and Accommodations

This practicum is intended for all students, scholars, or individuals with an interest in the use of handheld X-ray fluorescence spectrometry in archaeology. Individuals who require accommodations or which have accessibility concerns may contact the practicum instructor to discuss specific needs.