

Objectives

Portable X-ray fluorescence spectrometry (pXRF) has revolutionized the gathering of geochemical data for mineral exploration, environmental surveys and opened new avenues of research and applications in chemostratigraphy.

Demonstrate pXRF Spectrometry to quantify the invisible on a budget

- 1) Enhance the understanding of geochemical controls on groundwater chemistry
- 2) Guide, refine and enhance cost effectiveness of field sampling
- 3) Define changes in sediment lithology and provenance
- 4) Define unrecognizable formational boundaries

Methods

Quaternary Sediments

- 1) Dry and disaggregate sample
- 2) Sieve to <63 μm (silt + clay)
- 3) Place sample in 23 mm diameter plastic vials, to a height of 30 mm, to obtain sufficient density and "infinite thickness"
- 4) Seal vials with 4 μm thick Chemplex Prolene
- 5) Analyzed sample using Thermo Scientific, Niton XL3t GOLDD spectrometer in Soil mode with a 60 second dwell time per filter
- 6) Insert a Teflon and silica blank, plus multiple CRM's, at the beginning and end of every session and after every 10 samples

Bedrock Core

- 1) Core was washed with distilled water to remove contaminants
 - 2) Analyzed samples using Thermo Scientific, Niton XL3t GOLDD spectrometer in Mining mode with a 45 second dwell time per filter
- pXRF was mounted on a modified drill press with an external roller system to move core boxes under the spectrometer window
- 3) Insert a Teflon and silica blank, plus multiple CRM's, at the beginning and end of every session and after every 20 samples

Conclusions

pXRF analyses can be used as a low-cost analytical tool when traditional geochemical analysis (ICP/MS-ES) are beyond project scope and budget.

Our data supports the application of pXRF spectrometry to provide near-instantaneous elemental composition of major and trace elements of rock and unconsolidated sediments for chemostratigraphic studies. Research at the Geological Survey of Canada (published in Applied Geochemistry 2021) identifies ~17 elements with near definitive or quantitative results.

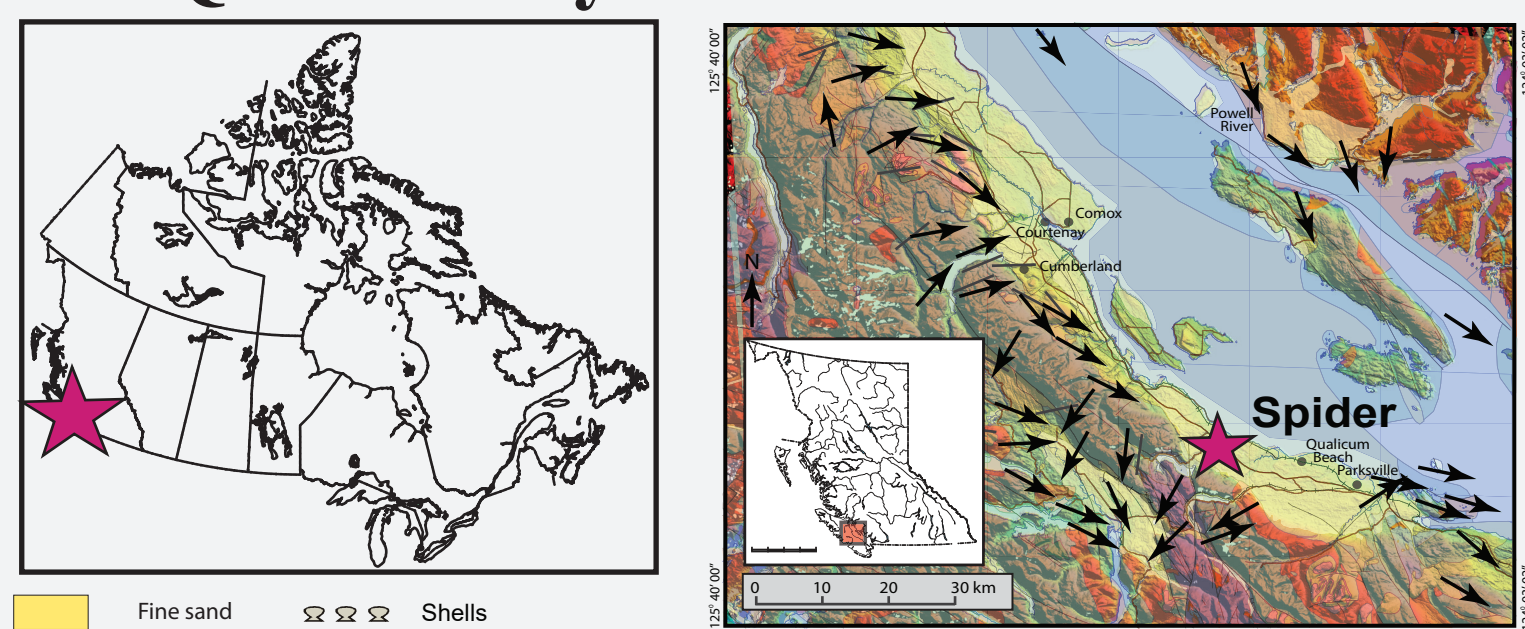
	Near Definitive	Quantitative	Qualitative	Inconclusive
	$r^2 \geq 0.85$, RSD $\leq 10\%$, $y = mx + b$	$r^2 \geq 0.7$, RSD $< 20\%$, $y = mx + b$	$r^2 < 0.7$, RSD $> 20\%$, $y \neq x$	$r^2 \leq 0.6$, RSD $> 20\%$, $y \neq x$
Soil Mode	Ca, Fe, Rb, Sr, Ti, Zn, Zr	As, Ba, Cu, K, Mn, Pb, V	Cr, Mo, S, Se, Th, U	Ag, Al, Au, Bi, Cd, Cs, Hg, Ni, Pd, Sb, (Se) Sn, Te, W
Mining Cu/Zn Mode	K, Ba, Ca, Fe, Rb, Sr, Ti, Y, Zn, Zr	As, La, Mn, Pb, S, U, W	Cu, Mo, Th	Ag, Al, Au, Bi, Cd, Ce, Cl, Co, Cr, Mg, Nb, Nd, Ni, P, Pr, Sb, Se, Si, Sn, V

Applied Geochemistry
An analytical protocol for determining the elemental chemistry of Quaternary sediments using a portable X-ray fluorescence spectrometer

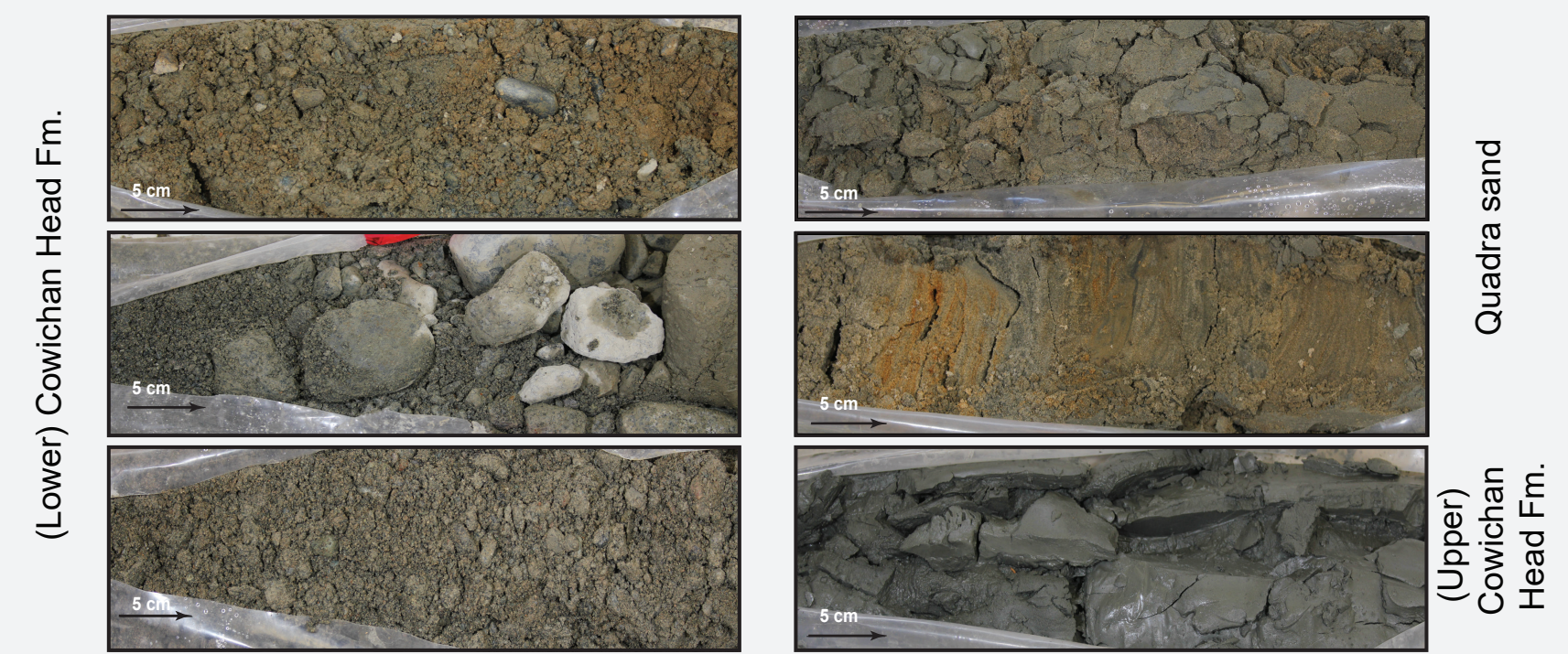
Ross D. Knight¹, Bruce A. Klappaud, Hazen A.J. Russell
Geological Survey of Canada 601 Booth Street, Ottawa, Ontario K1A 0H8, Canada

ABSTRACT
The modern portable X-ray fluorescence (pXRF) spectrometers offer a low-cost, rapid, and accurate method for determining the elemental chemistry of Quaternary sediments. This paper presents an analytical protocol for the determination of Quaternary geochemical data using a portable X-ray fluorescence spectrometer. The protocol outlines best practices for the collection of geochemical data using pXRF from geochemical sediments with varying degrees of consolidation and moisture content. The protocol includes sample collection, sample preparation, instrument calibration, and data processing. The protocol includes a list of elements that can be determined with near definitive or quantitative results. Research at the Geological Survey of Canada (published in Applied Geochemistry 2021) identifies ~17 elements with near definitive or quantitative results.

Quaternary Sediments - Southwestern British Columbia

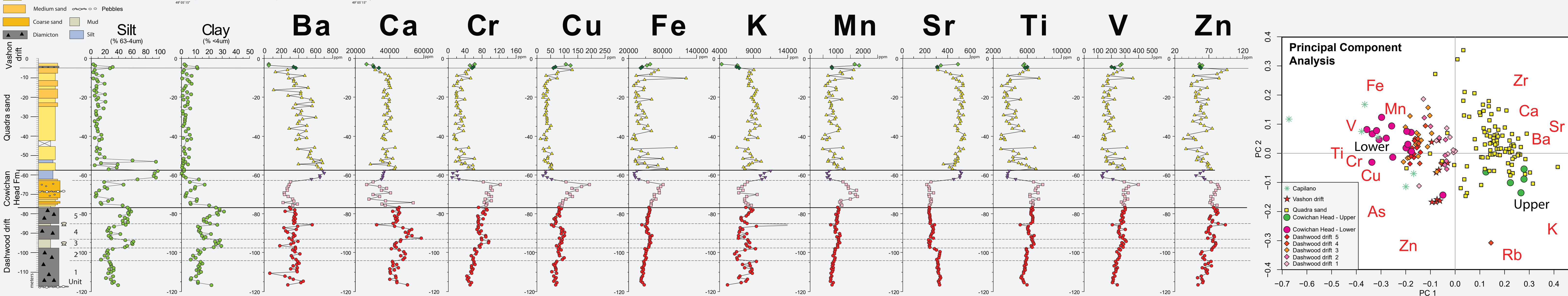


The Cowichan Head Fm. consists of a lower and upper member; however the geochemical signature shows that the provenance of the lower member is similar to the underlying Dashwood drift whereas the provenance of the upper member is similar to the overlying Quadra sand.



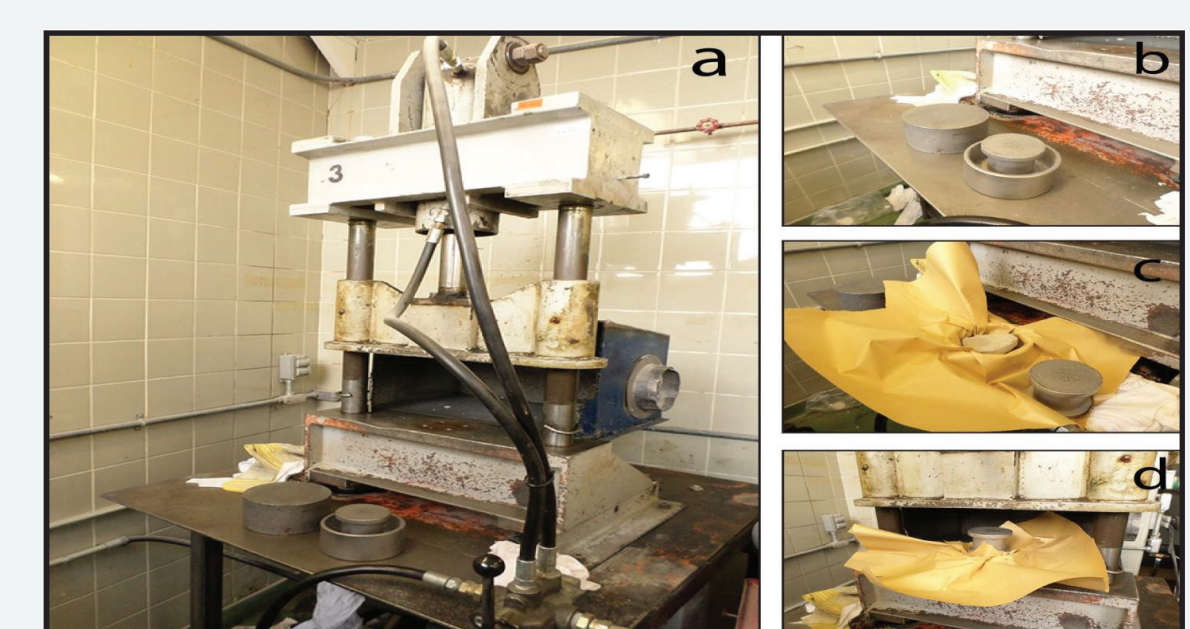
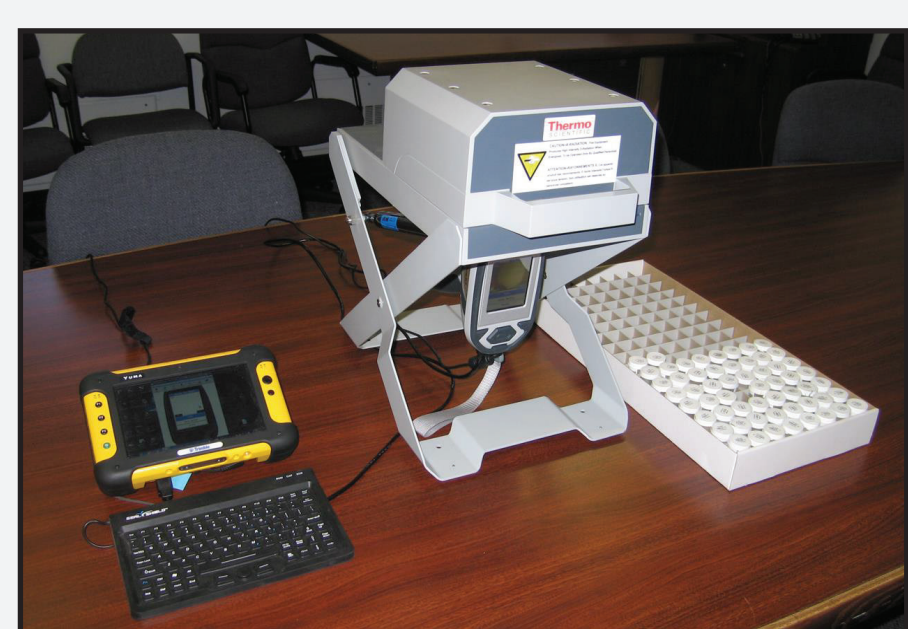
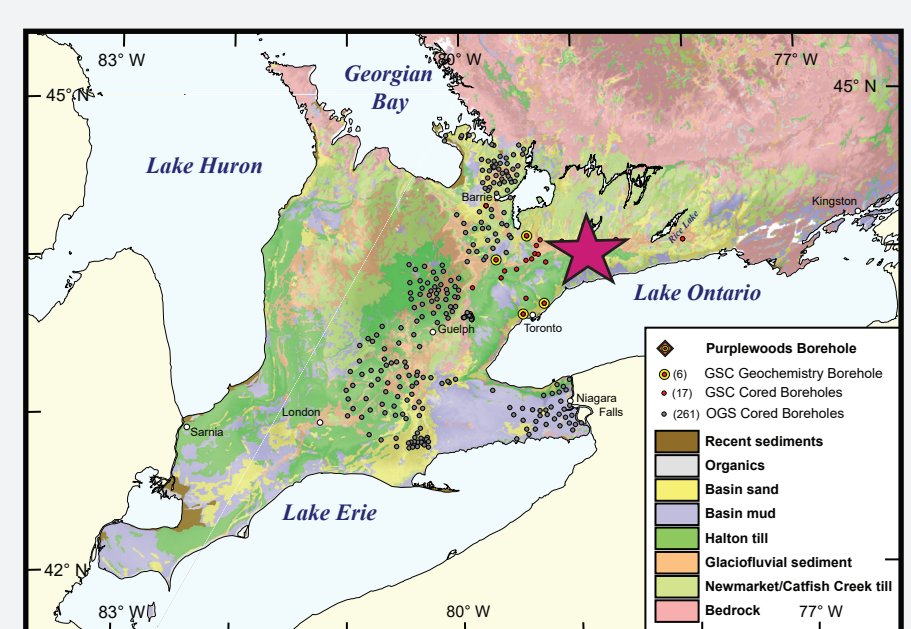
Nanaimo - Spider Soil Mode

Location: Quatam, British Columbia
Project: Groundwater Assessment
Study Area: Nanaimo Lowlands
Size Fraction: <0.063 mm
Original Material: Freeze-dried, disaggregated, sieved
Vial Window Material: 4 micron SpectroCertified Mylar polypropylene
pXRF: Niton XL3t GOLDD, 50 kV Cypnet X-ray tube
Dwell Time: 60 seconds per High, Main, and Low filter
GSC Open File 7651



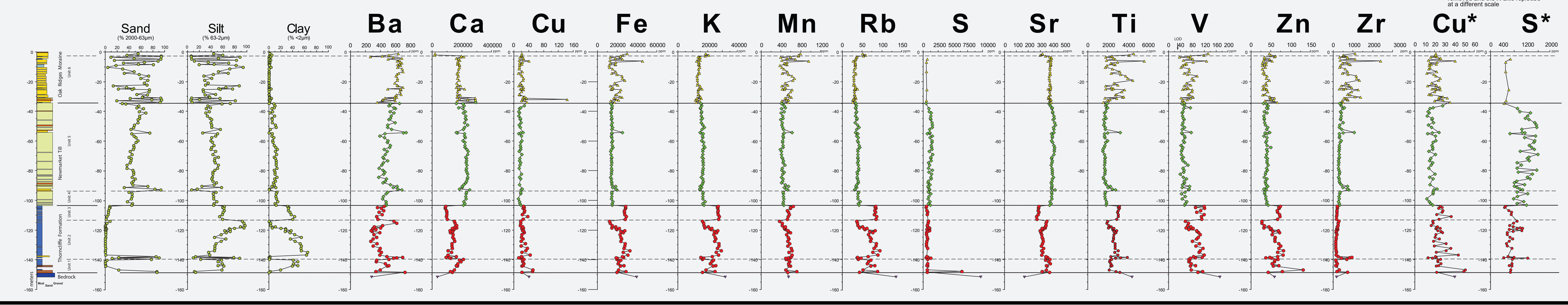
Quaternary Sediments Southern Ontario

There is no visible change in sediment lithology or characteristics within the Thorncliffe Formation at a depth of -113 m.

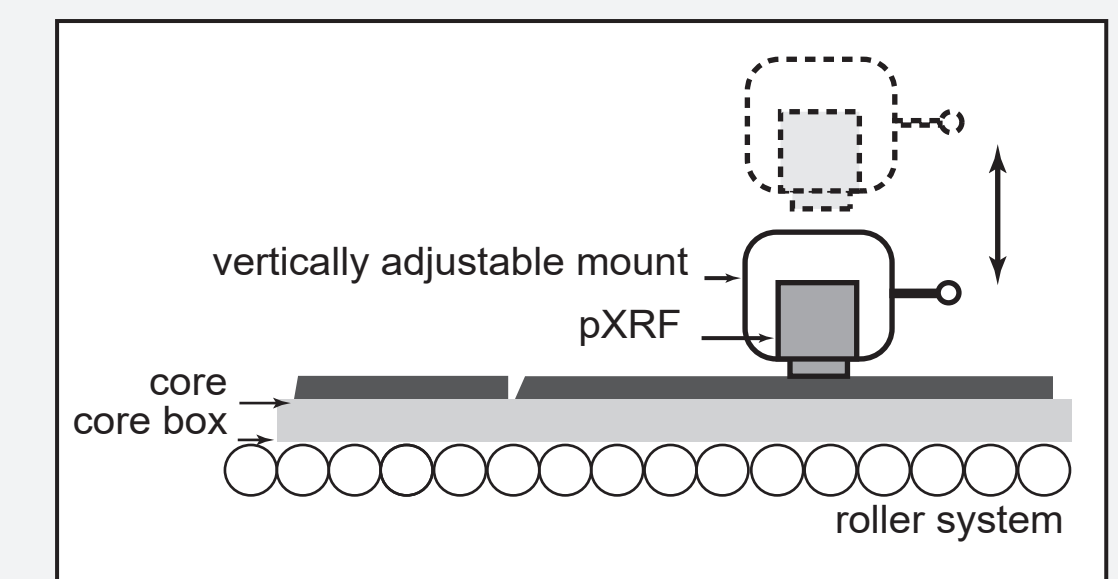
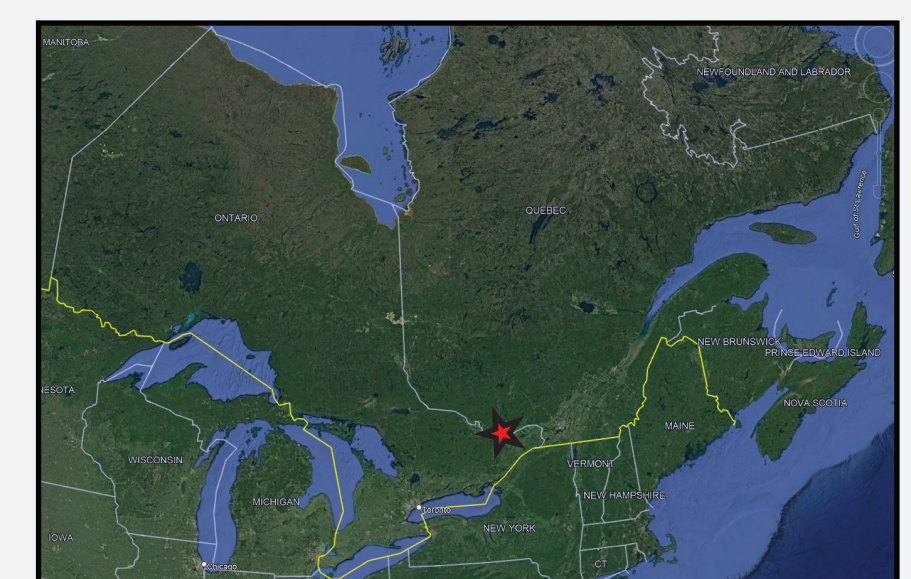
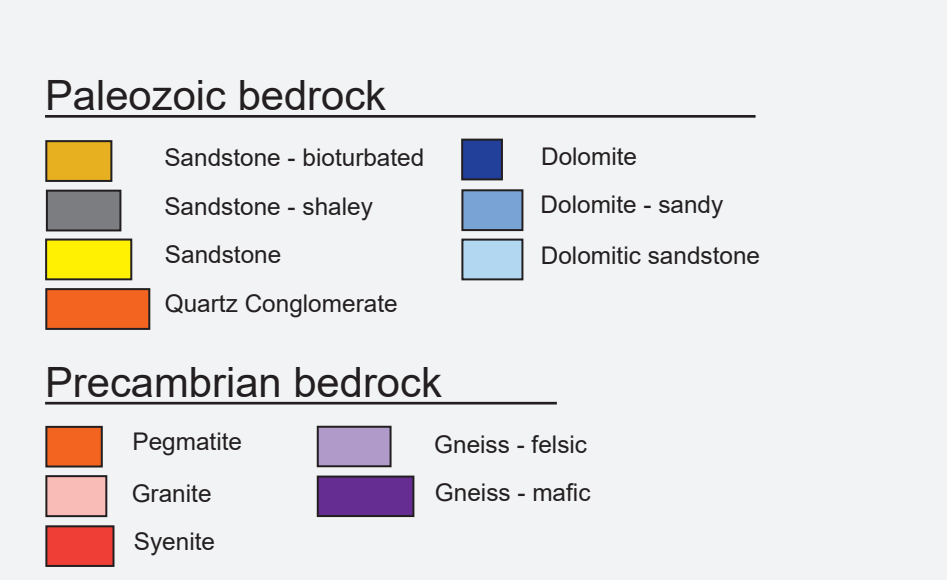


Purple Woods Soil Mode

Location: Purple Woods Conservation Area, Ontario
Project: Groundwater Assessment
Study Area: Oak Ridge Moraine
Size Fraction: <0.063 mm
Original Material: Disaggregated, sieved
Vial Window Material: 4 micron SpectroCertified Mylar polypropylene
pXRF: Niton XL3t GOLDD, 50 kV Cypnet X-ray tube
Dwell Time: 60 seconds per High, Main, and Low filter
GSC Open File 7899



Precambrian and Ordovician Bedrock Southeastern Ontario



Bells Corners BC81-2 Mining Mode

Location: Ottawa, Ontario
Project: Groundwater Assessment
Study Area: Bells Corners
Original Material: Rock
Vial Window Material: 4 micron SpectroCertified Mylar polypropylene
pXRF: Niton XL3t GOLDD, 50 kV Cypnet X-ray tube
Dwell Time: 45 seconds per High, Main, Low and Light filter
GSC Open File 8913

