

Enabling PALSA agriculture users through a unique collaboration: the MAPLE project

Zuin, L¹; Karunakaran, C¹; Hesterberg, D²; Botton, G¹

¹ Canadian Light Source, Canada

² Brazilian Synchrotron Light Laboratory, Brazil

Abstract: Boron (B), phosphorus (P) and sulfur (S) are some of the essential elements for agriculture and environmental sciences research. The VLS-PGM beamline at the Canadian Light Source (CLS) is one of the few beamlines in the Americas that is built to optimize the delivered flux below 250eV. The beamline endstation has also been improved to perform XAS measurements over the B K-edge, and P and S L-edges by the use of a recently commissioned silicon drift detector (SDD) for partial fluorescence yield (PFY), a multichannel plate detector (MCP) for total fluorescence yield (TFY) and total electron yield (TEY). Micro image capability is presently under commissioning. The CLS has recently started a collaboration, the MAPLE project, which provide to the Sirius Users access to the VLS-PGM beamline through a rapid access mechanism. The capabilities of the beamline and the potential use of this beamline for CHESS users are highlighted in this poster with relevant examples.

Why a CLS - LNLs ... - CHESS Collaboration?

- To help secure global food security by inspiring greater use of synchrotron techniques in overcoming challenges in agriculture sciences
- To provide opportunity to Users of one facility to access complementary techniques available in the other facility/facilities

The Maple Project

- Proposal submission via CLS and LNLs proposal portals for Rapid Access mail-in services for analysis at the VLS-PGM Beamline at CLS facility
- Review of Maple project proposals by CLS and LNLs scientists
- Data collection at the VLSPGM Beamline by CLS scientists
- Support for data analysis and interpretation by CLS and LNLs scientists
- More info at <https://vlspgm.lightsource.ca/maple-project/>
- First paper published doi.org/10.1016/j.chemosphere.2023.138759

VLS-PGM Beamline capabilities

With an energy range of 15 - 250 eV, the VLS-PGM Beamline can access the K or L edges of boron, aluminum, phosphorus, sulfur.

The current configuration is well suited for speciation analysis in concentrated samples such as soil amendments and foliar-applied nutrients, and the planned focusing capabilities will enable spatially resolved analyses of these elements at dilute concentrations.



Magnesium-enriched poultry manure enhances phosphorus bioavailability in biochars

Aline do Amaral Leite^{a,b}, Leônidas Carrijo Azevedo Melo^{a,b}, Luis Carlos Colucho Hurtarte^c, Lucia Zuin^d, Cristiano Dela Piccola^e, Don Werder^f, Itamar Shabtai^g, Johannes Lehmann^{b,h,i,*}



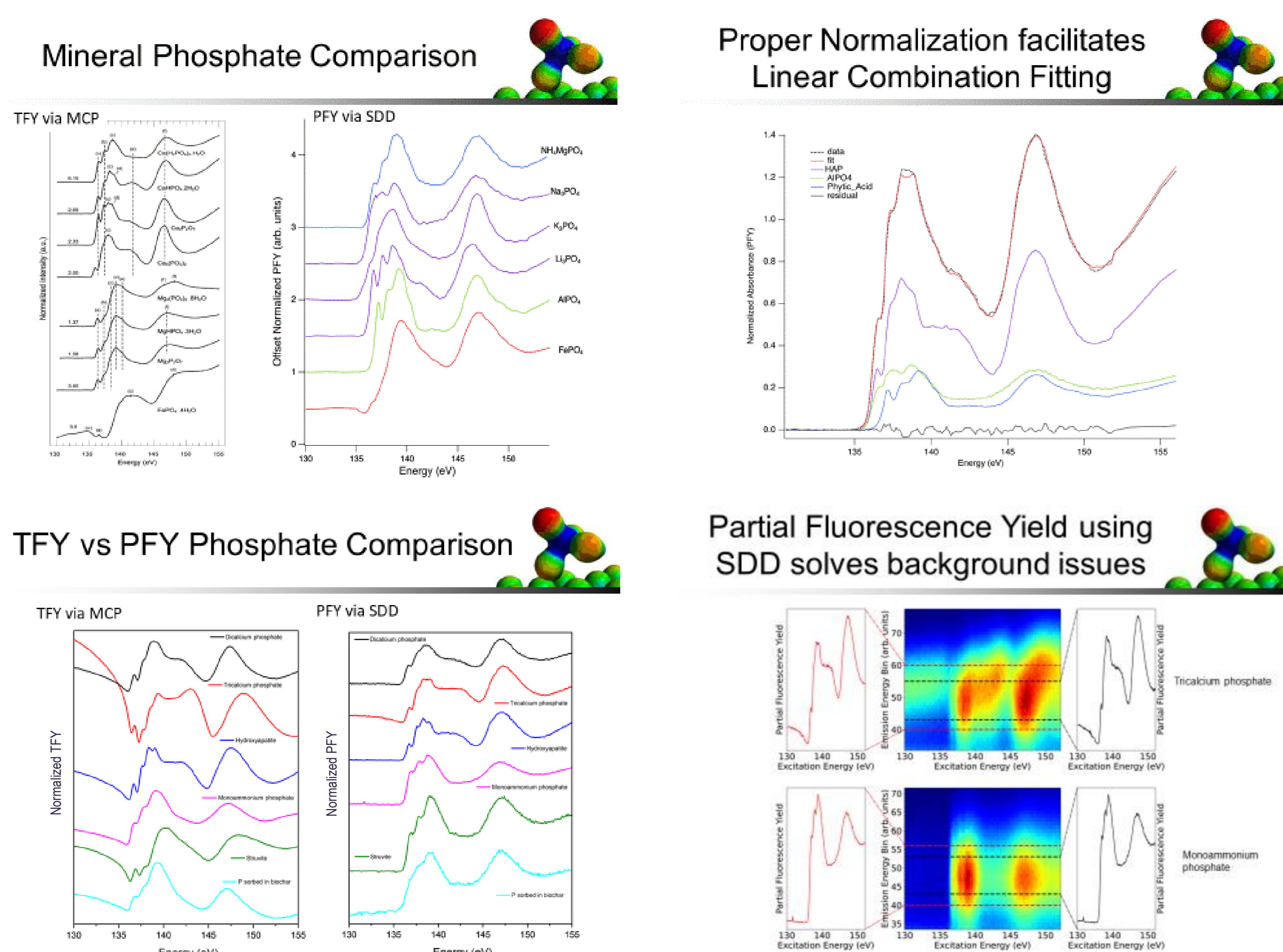
VLSPGM SPECIFICATIONS

Source	Elliptically Polarizing Undulator
Spectra resolution	Better than 10000
Spot Size	Branch A < 500 μm x 500 μm; Branch B 20 μm x 200 μm
Photon Flux	>2 x 10 ¹² at 220 mA ring current (with 50 μm x 50 μm slits) >1 x 10 ¹³ in the 120 – 200 eV region
Techniques	XAS (Total Fluorescence Yield, Partial Fluorescence Yield, Total Electron Yield, Optical Luminescence)
Detectors	MCP, SDD, optical spectrometer
Sensitivity	~2% element concentration

Case-study data

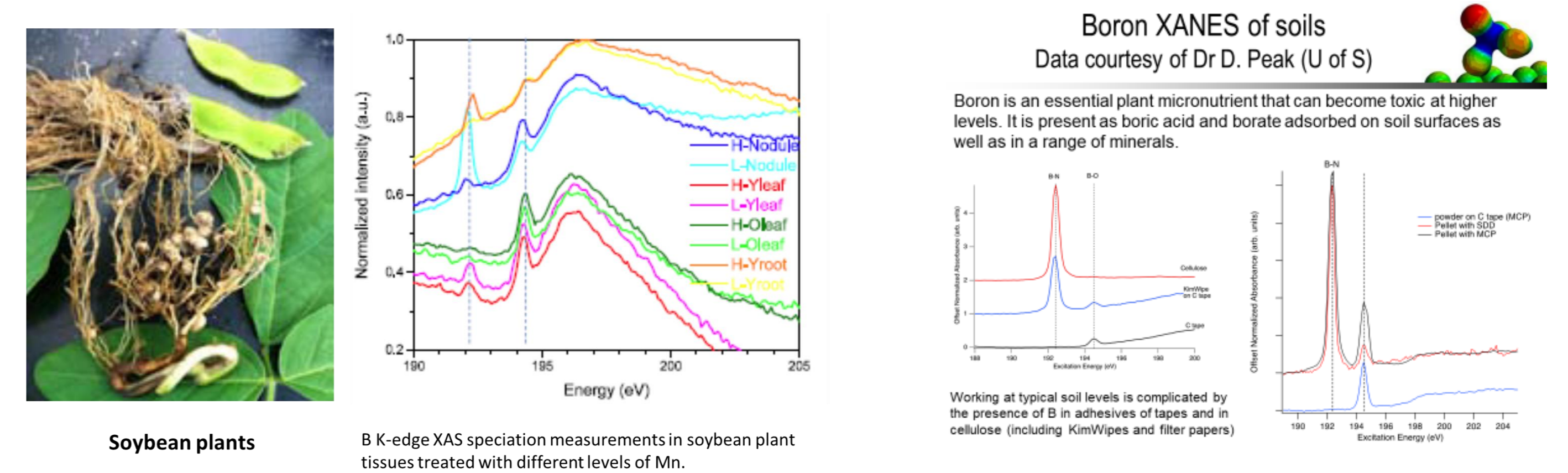
Improvements in Phosphorus L-edge Speciation using Partial Fluorescence Yield

Data courtesy of Dr D. Peak (U of S) and Prof E. Lombi (U of South Australia)



Boron in Plants & Soil

B speciation measurement in soybean plant tissues treated with different levels of manganese (left), and in soil (right).



Micro image capabilities

Elemental distribution maps: at the P L-edge on Poultry litter (left, data courtesy of Dr D. Peak), and at the B K-edge on an Alfalfa leaf (right).

