

X-Ray Fluorescence Spectroscopy (XRF) and Mapping Capabilities for Agriculture at the CLS

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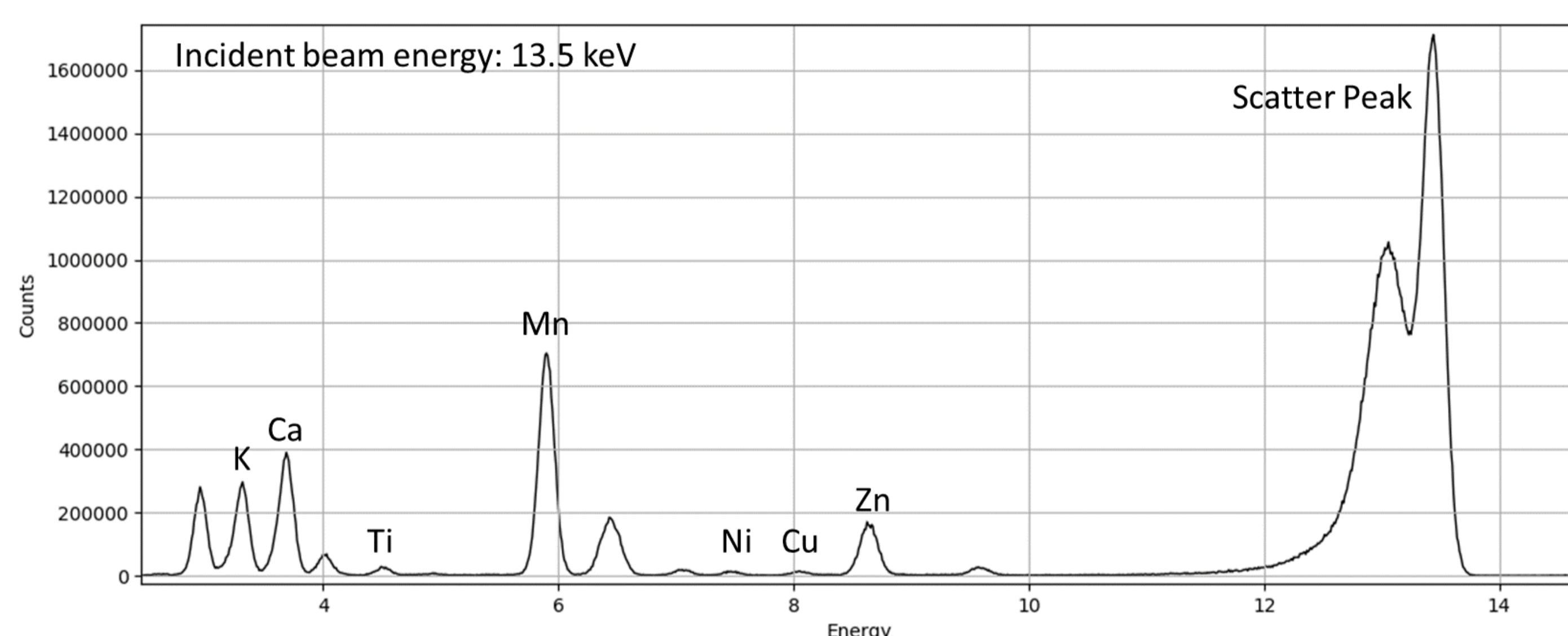
Introduction

There are many opportunities for agriculture research using X-ray Fluorescence spectroscopy (XRF) at CLS:

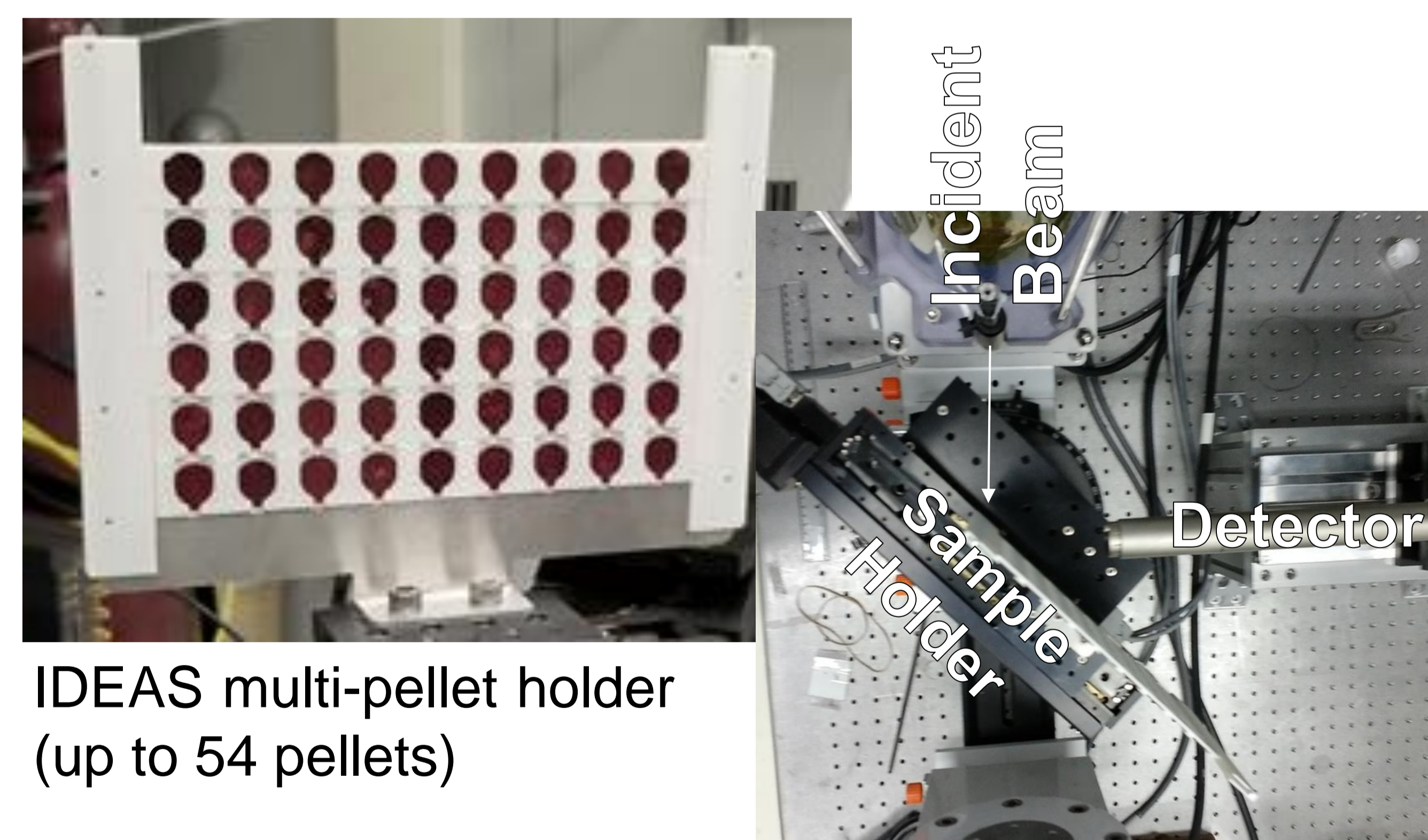
- Wide variety of samples (leaves, roots, berries, bees, etc.)
- Many elements at once (K, Ca, Mn, Fe, Se, etc.)
- Bulk XRF – large numbers of samples analyzed quickly
- XRF mapping – location of elements within a sample

Bulk XRF

There are a few beamlines at CLS that are suitable for agricultural bulk XRF measurements. A few hard X-ray beamlines are IDEAS, BioXAS – side, and VESPERS. A couple of soft X-ray beamlines are SGM and SM.



XRF spectra of a plant sample

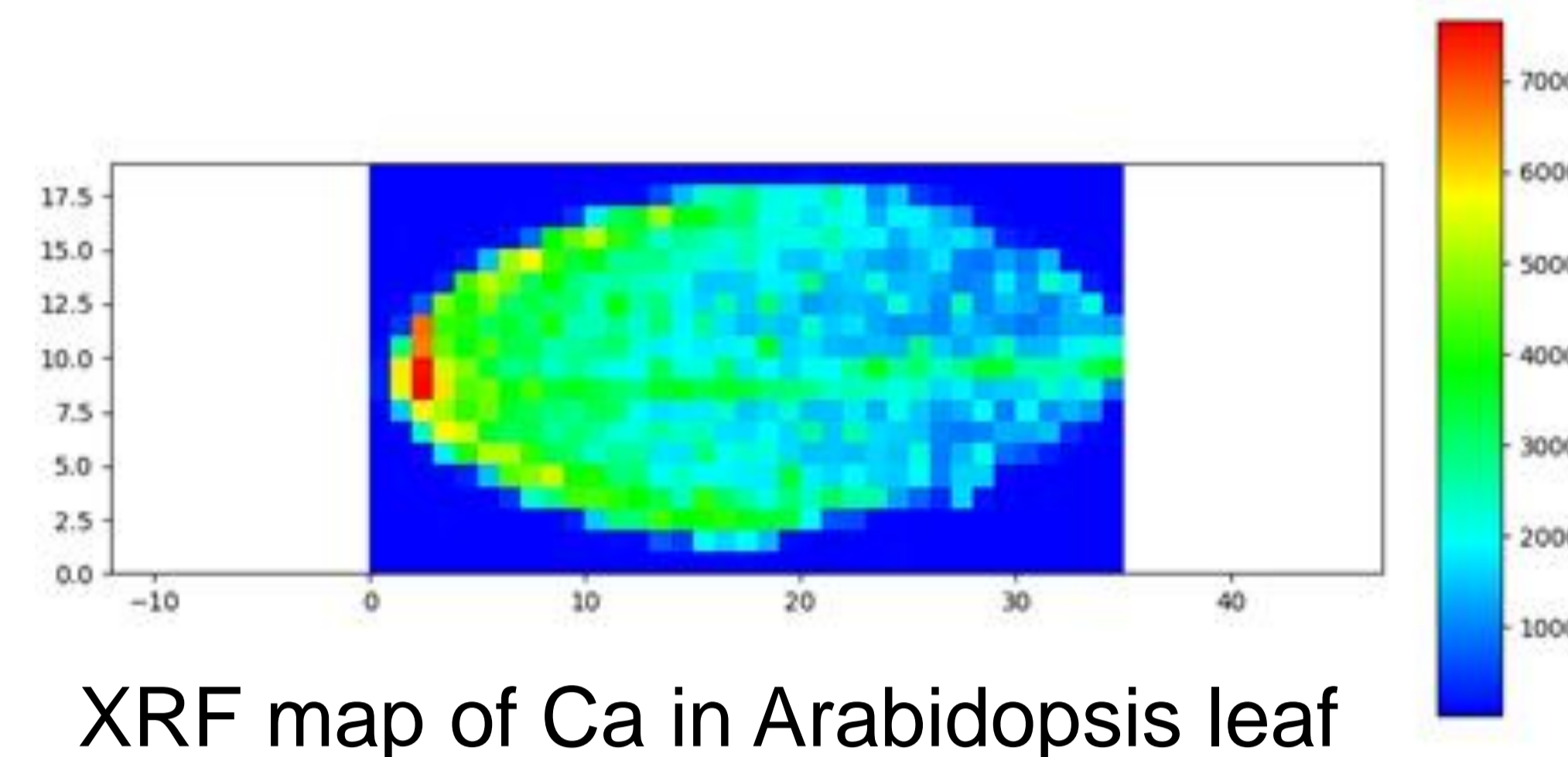


IDEAS multi-pellet holder (up to 54 pellets)

IDEAS bulk measurement set up

XRF Mapping

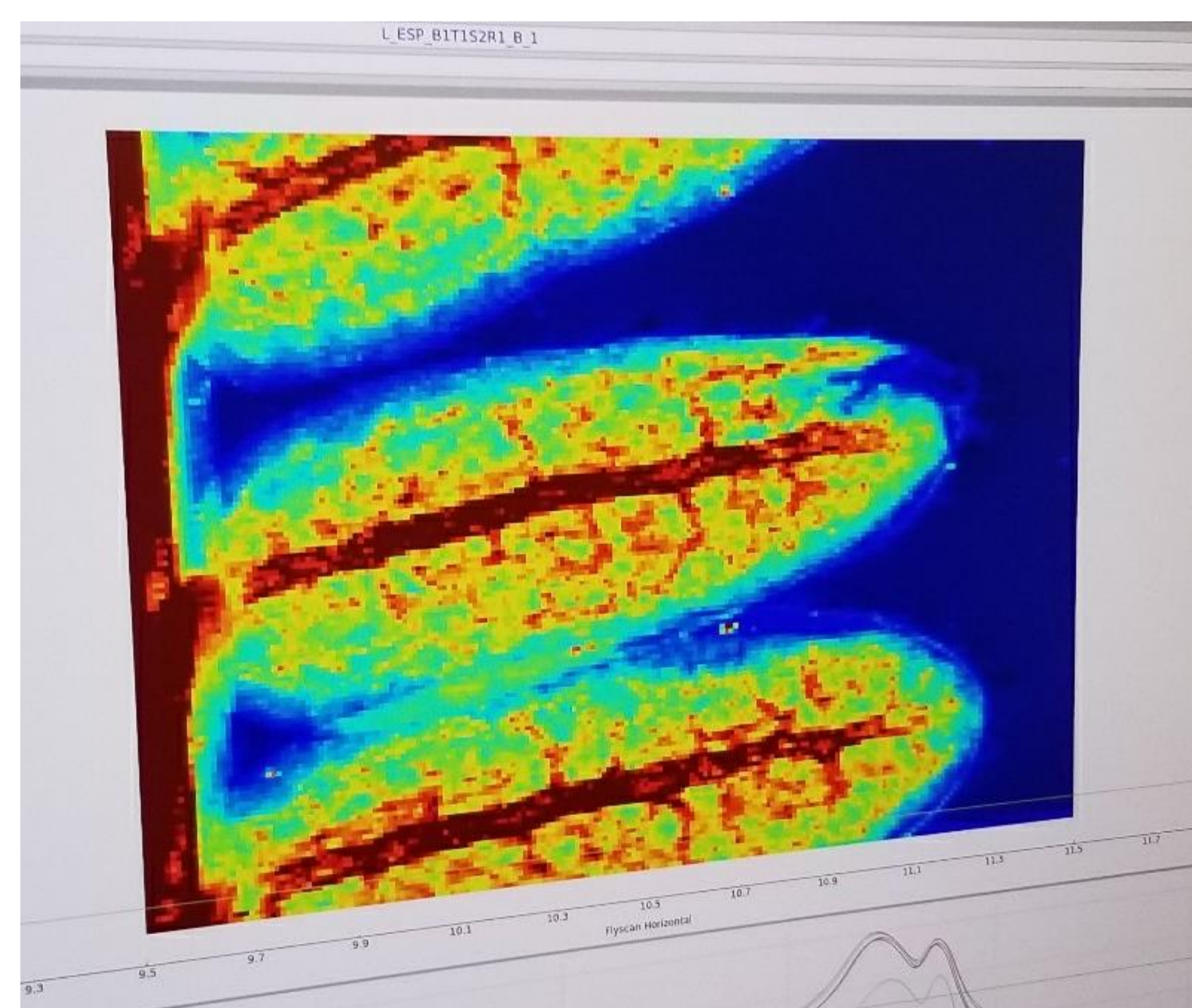
Several beamlines at CLS are suitable for agricultural XRF mapping: IDEAS, BioXAS – Imaging, and VESPERS. Localization of elements within samples from micron to nano scales.



XRF map of Ca in Arabidopsis leaf



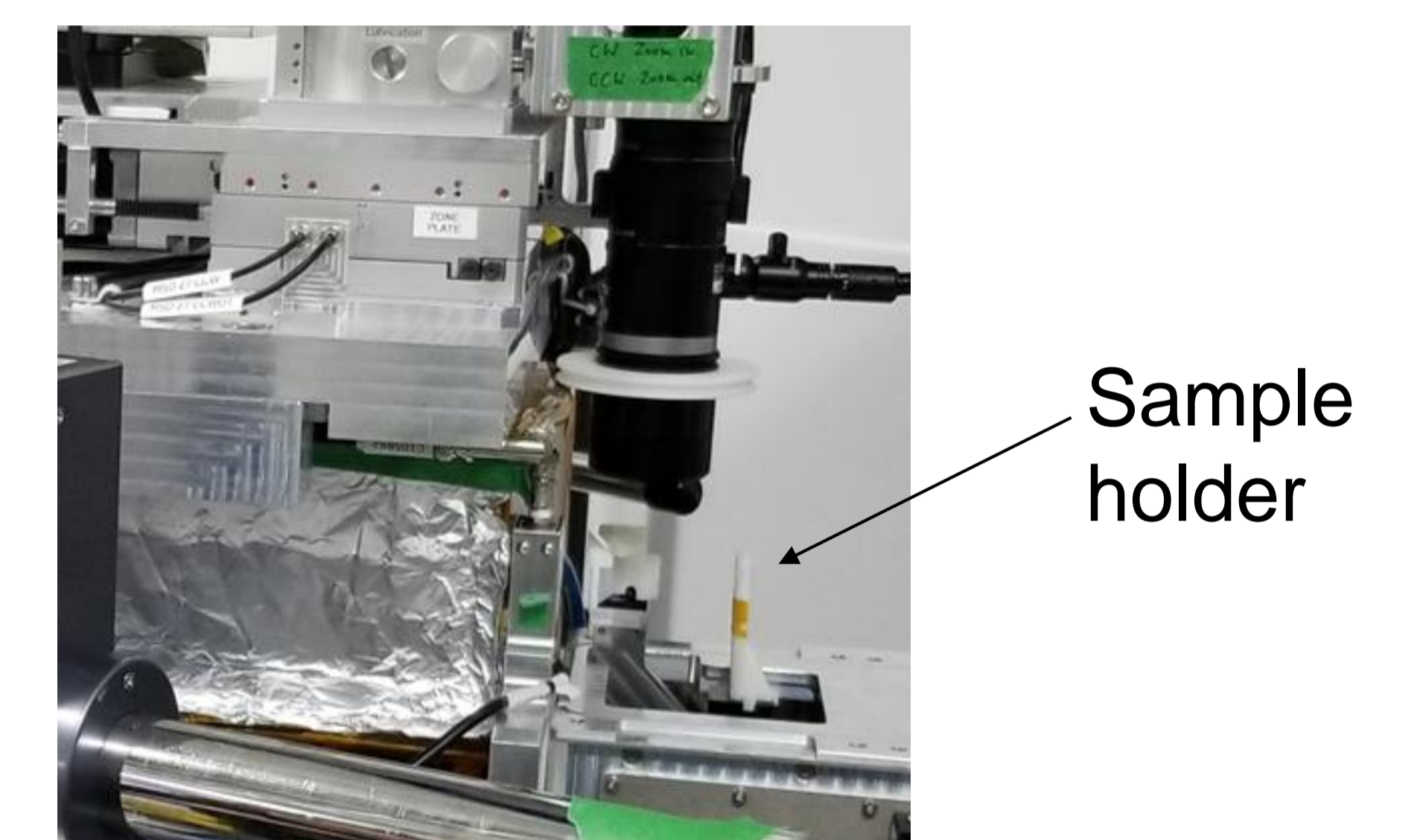
IDEAS mapping set up



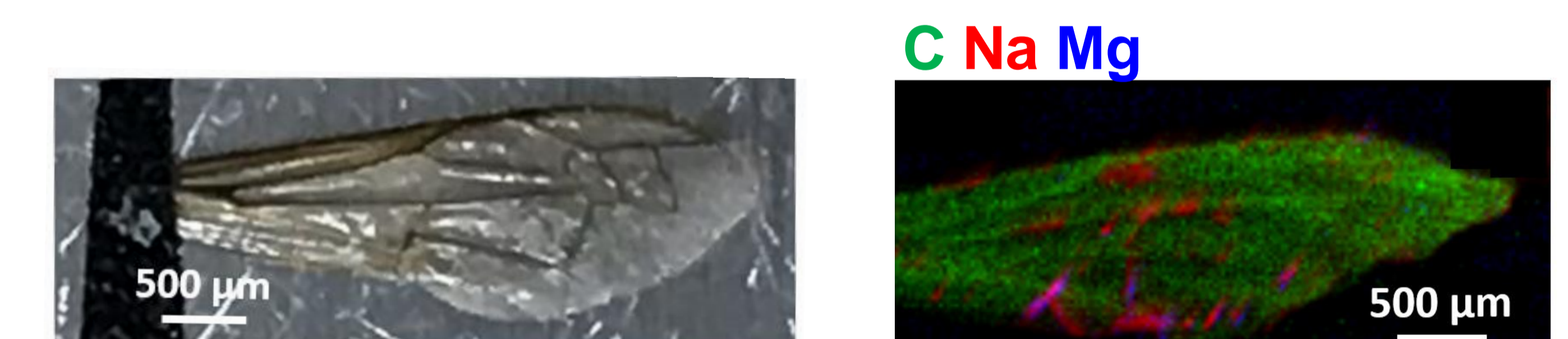
XRF map of leaf from a copper mine site (https://twitter.com/raju_aafc/status/1208492378962702336?s=09)



Thin section of a bumble bee (left) and plant root (right) for XRF mapping at the BioXAS – Imaging beamline



XRF mapping set up at the BioXAS – Imaging beamline



Optical image of wasp wing (left) and XRF map of the wasp wing from the SGM beamline (right)

XRF Mapping Capabilities at Different CLS Beamlines

Beamline	Resolution	Element K-Edge Range	Stage range (H x V)
SXRMB	10 μ m	Si to Zn	25 mm x 25 mm
VESPERS	2-3 μ m (pink beam) 5-7 μ m (monochrom.)	S to Sn	140 mm x 48 mm
CMCF-BM	20, 50, 100, 150, 200 μ m	S to Nb	1.8 mm x 1.5 mm
BioXAS-macro	20, 50, 100, 150 μ m	P to Tc	250 mm x 250 mm
BioXAS-micro	6-10 μ m	P to Tc	10 mm x 25 mm; 30 mm x 20 mm
IDEAS	200 μ m	P to Br	150 mm x 95 mm
SM	50 nm	B to Si	3 mm diameter circle
SGM	10 μ m	B to Si	16 mm x 8 mm



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