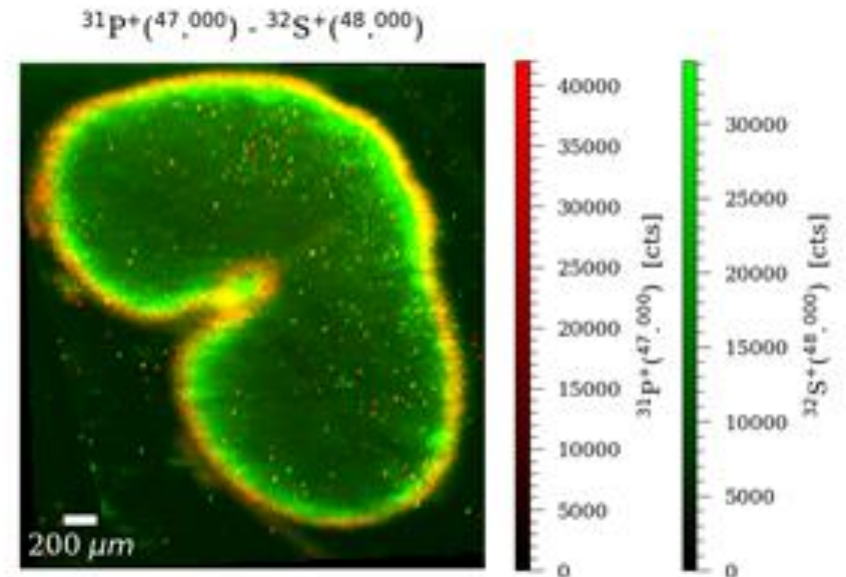# Laser Ablation Inductively Coupled Plasma Mass Spectrometry

High Resolution Imaging and Bulk Analysis

Wheat grain, picture Claudia Moens

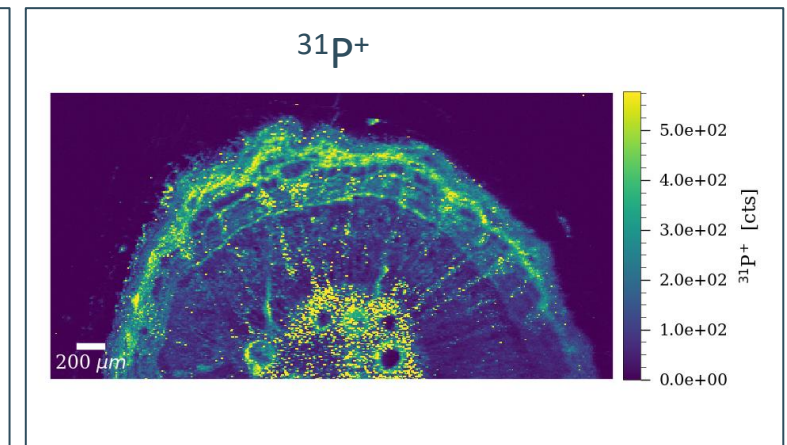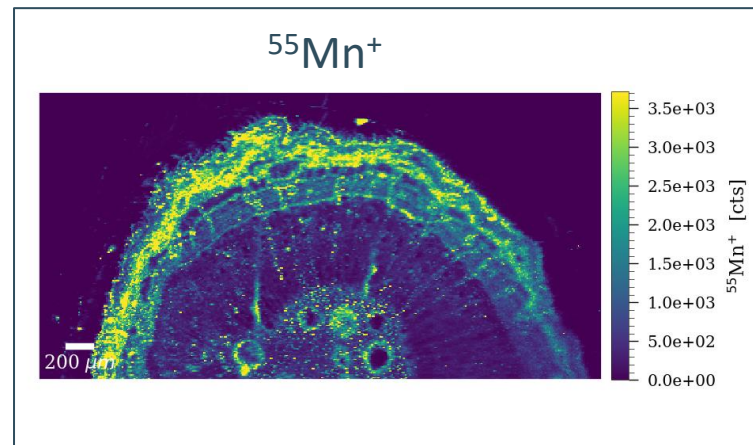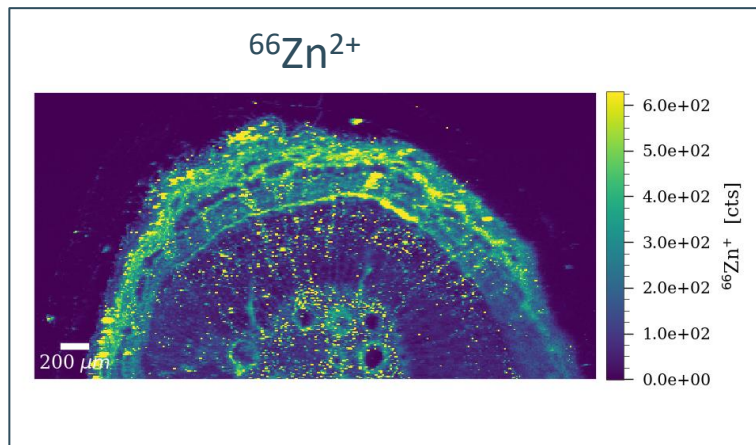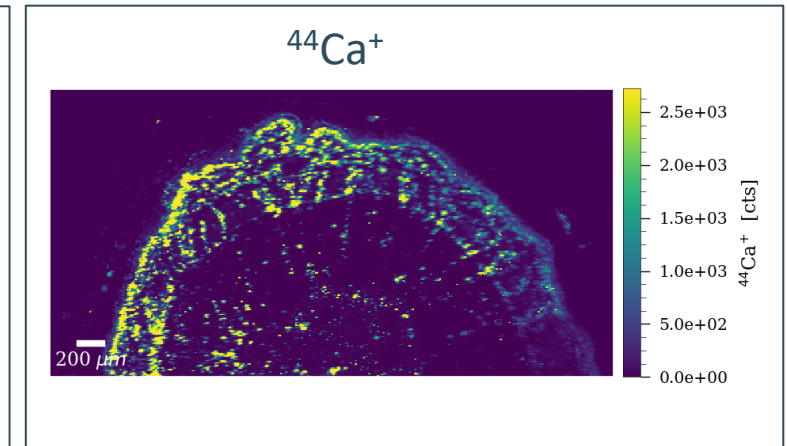# Complete set-up LA-ICP-MS

Source: Teledyne Cetac technologies

Source: Agilent

Division of Soil and Water Management
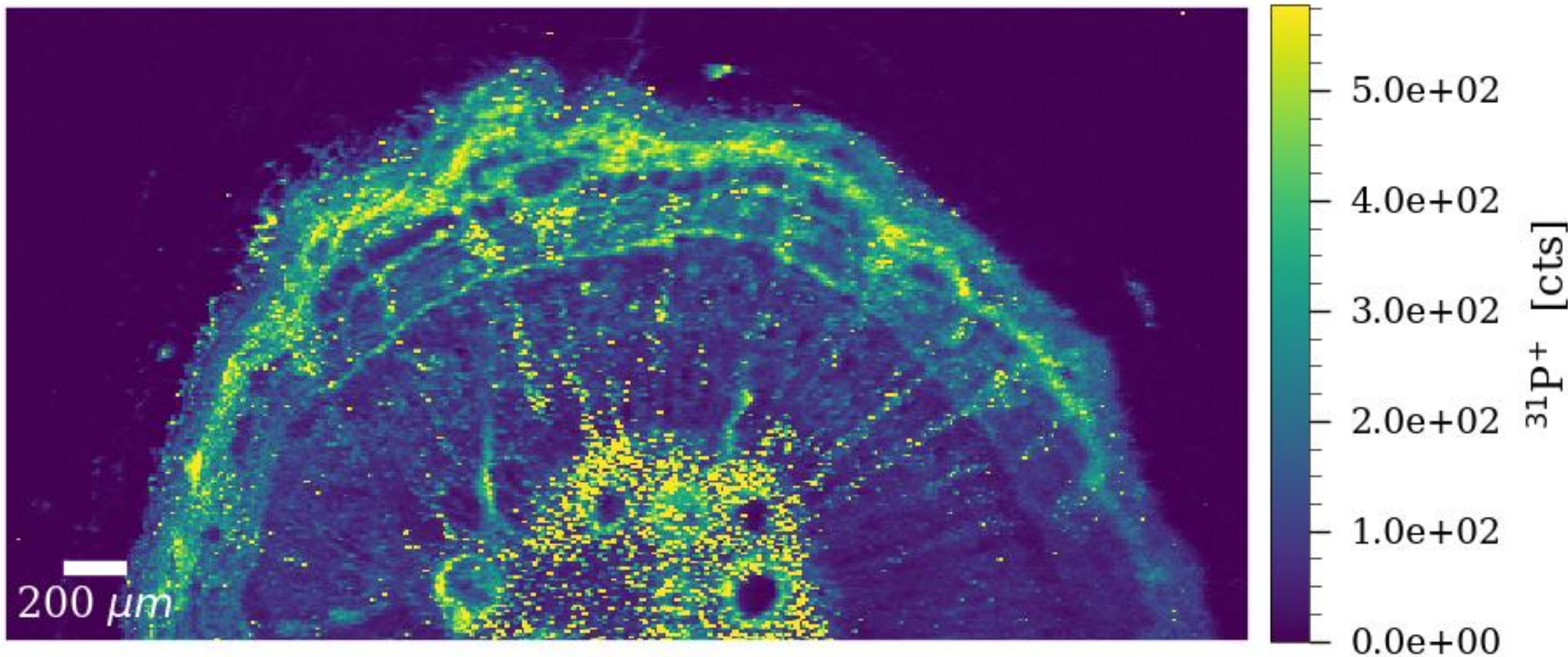
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Example 1: wood core

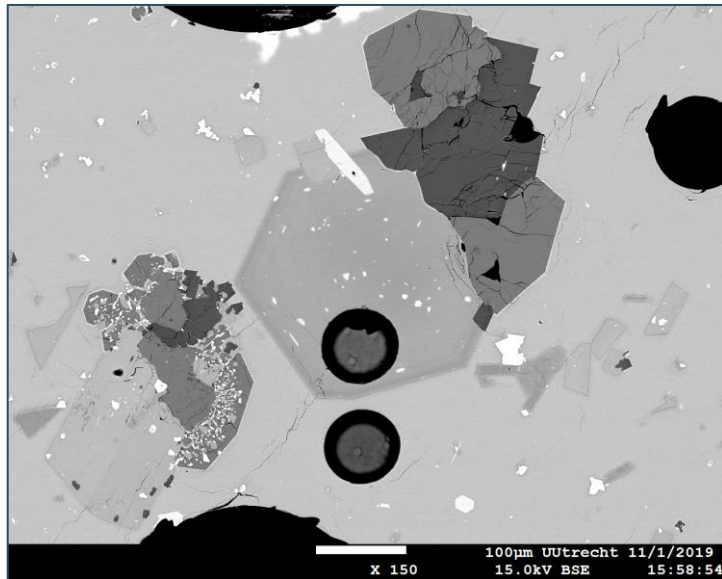*Pictures: Hester Blommaert and Jesse Dekeyerel*

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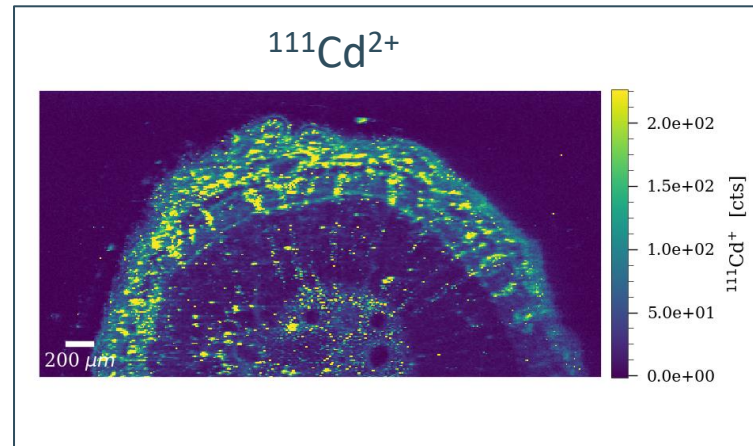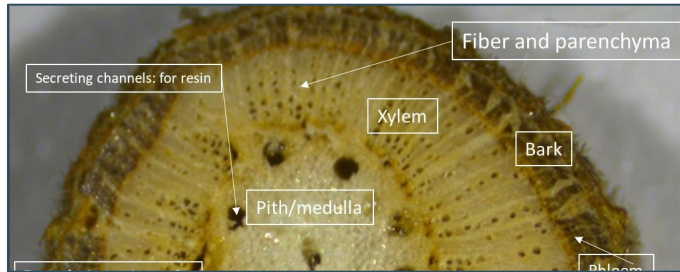
$^{31}P^+$

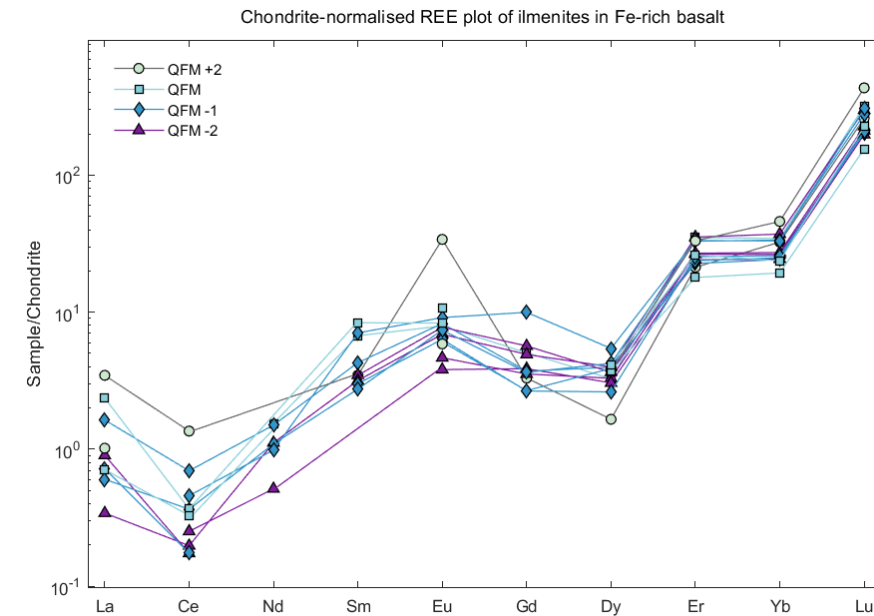*Pictures: Hester Blommaert and Jesse Dekeyerel*

Example 2. analysis of REE in polished section

- Spatially resolved elemental analysis

Spot analysis on polished section: crystal and melt
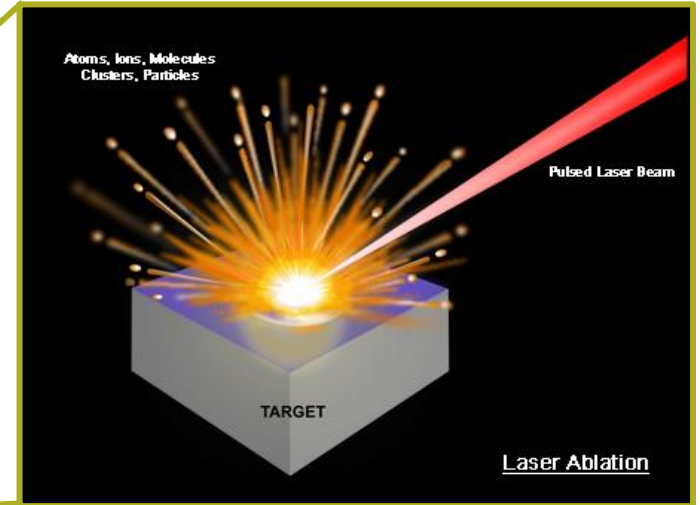
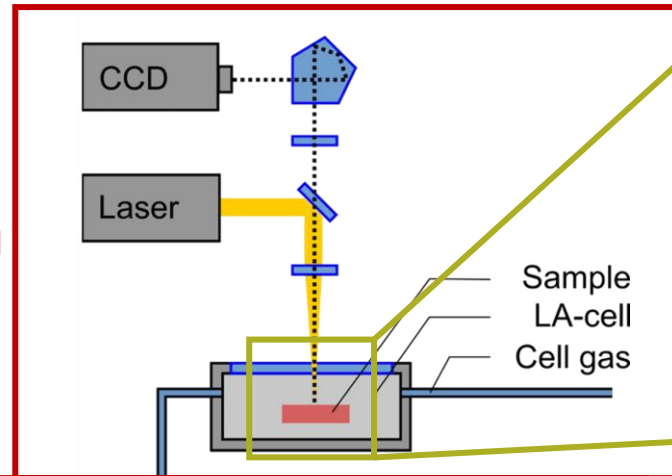*Pictures: Alicia Van Ham-Meert*

REE patterns of ilmenites: partitoning

Overview

- General concepts
  - Schematic overview
  - Laser ablation (LA)
  - Inductively coupled plasma mass spectrometry (ICP-MS)
  - Laser control software (Chromium)

- Applications
  - Imaging
  - Bulk analysis

- Examples

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Schematic overview
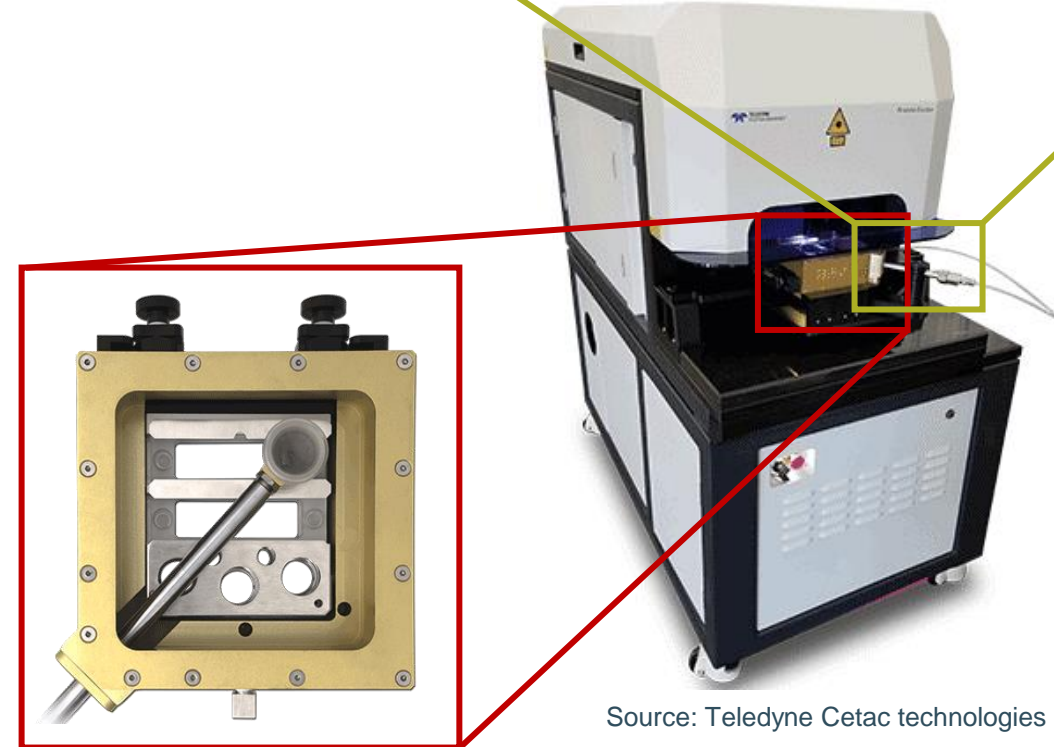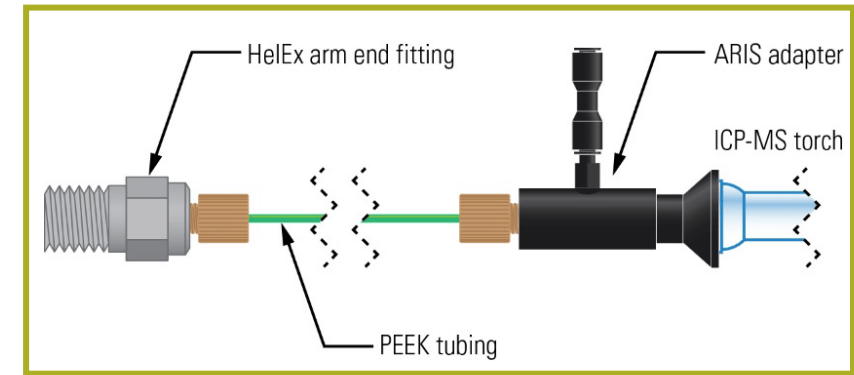
Laser ablation (LA)
Pulsed laser beam across a solid surface

Source: Russo, R. (2013)

Source: tofwerk.com
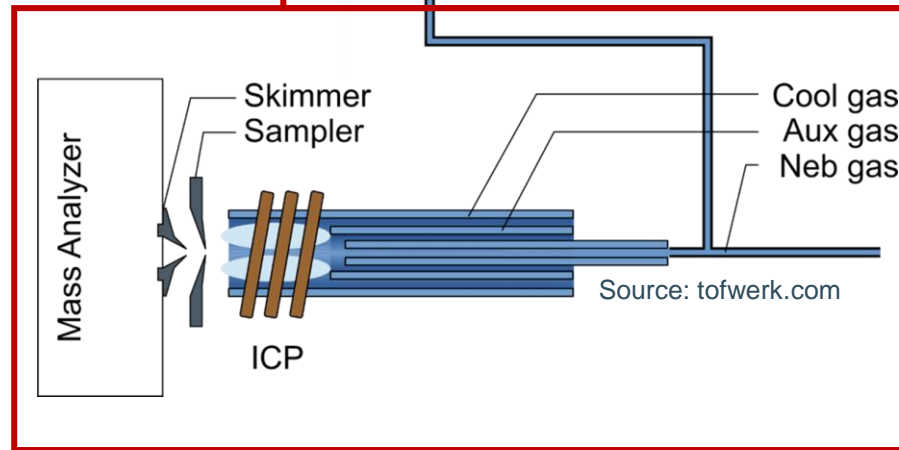
Inductively coupled plasma mass spectrometry (ICP-MS)
Elemental analysis

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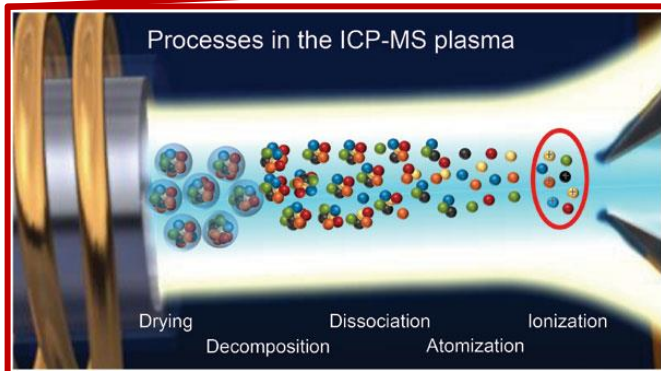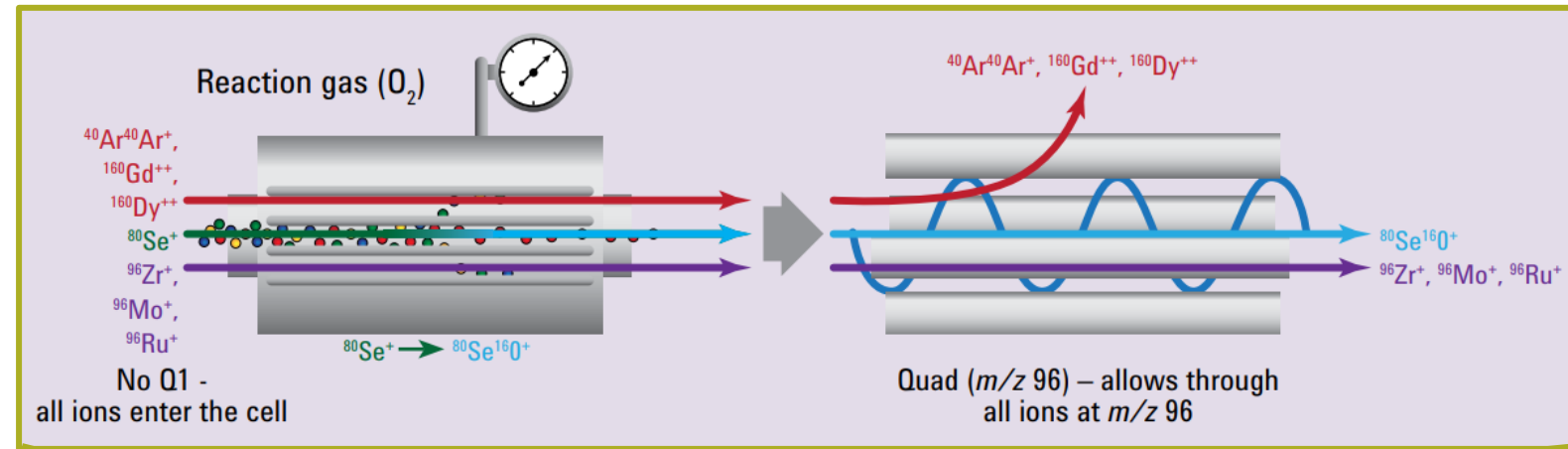KU LEUVEN

Laser ablation

- Analyte Excite+ laser ablation system
  - Deep-UV ArF laser (193 nm)

  - HelEx II Sample Cell

  - Sample introduction
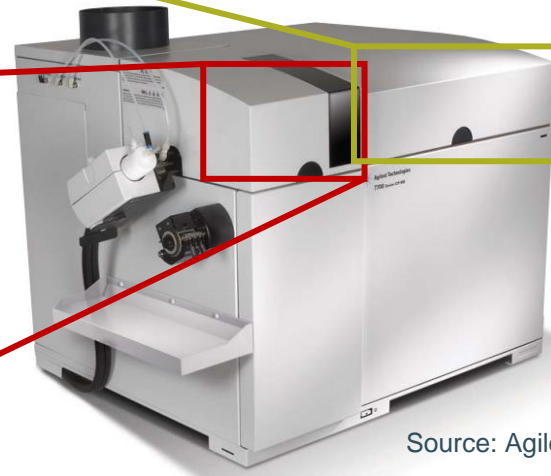   - e.g. ARIS for imaging

Source: Teledyne Cetac technologies

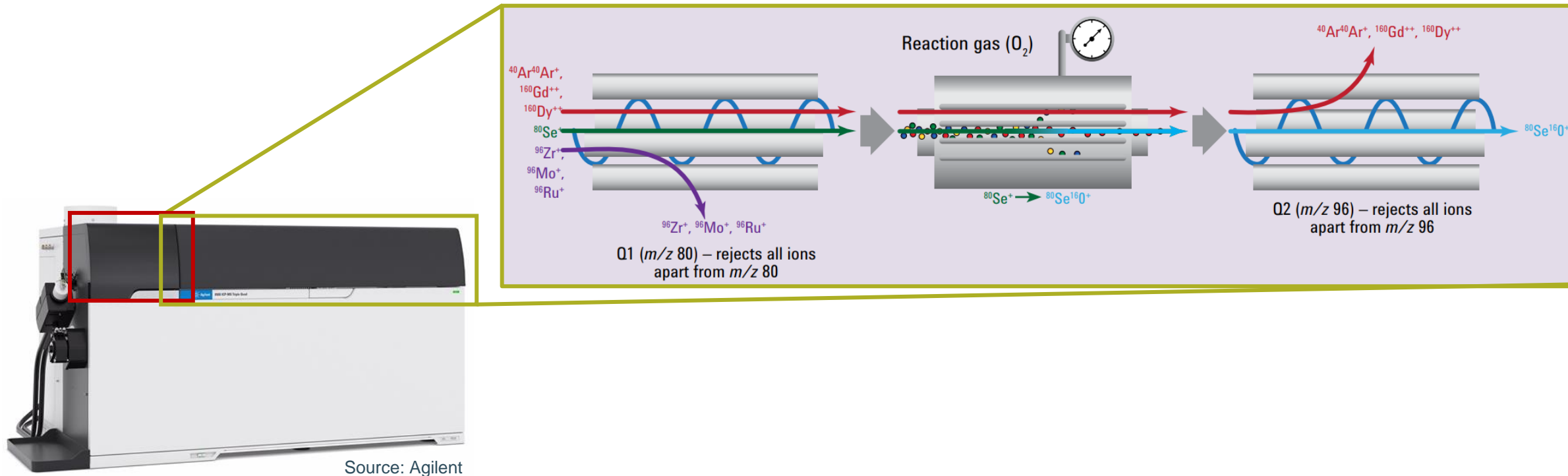# Inductively coupled plasma mass spectrometry (ICP-MS)

• Conventional ICP-MS

Source: Agilent

Source: Spectroscopy Online

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Inductively coupled plasma mass spectrometry (ICP-MS)

- 8900 Triple Quadrupole ICP-MS

Source: Agilent

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1. High resolution imaging

Raw results

HDIP software

Image

1. High resolution imaging

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1. High resolution imaging
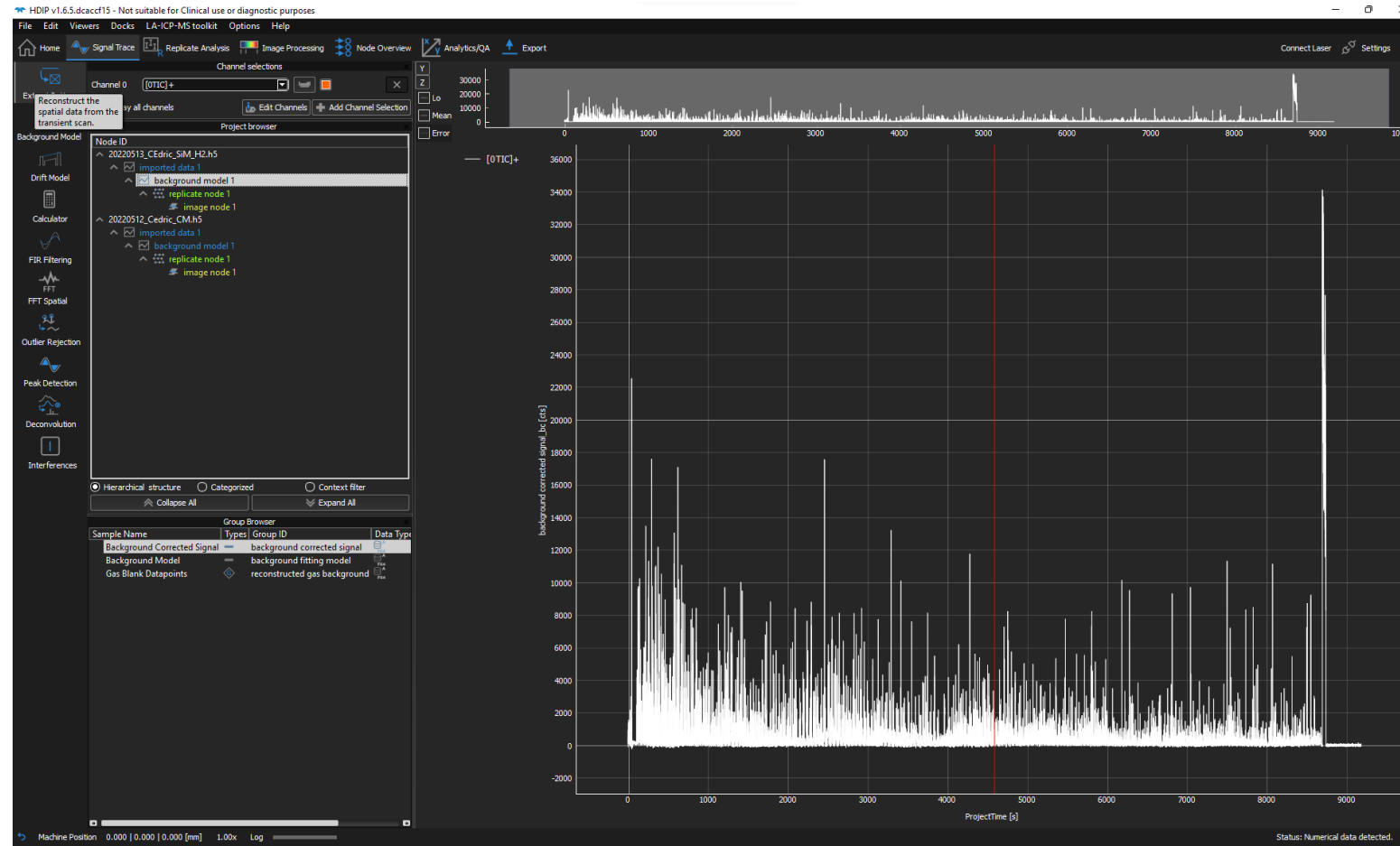
Division of Soil and Water Management

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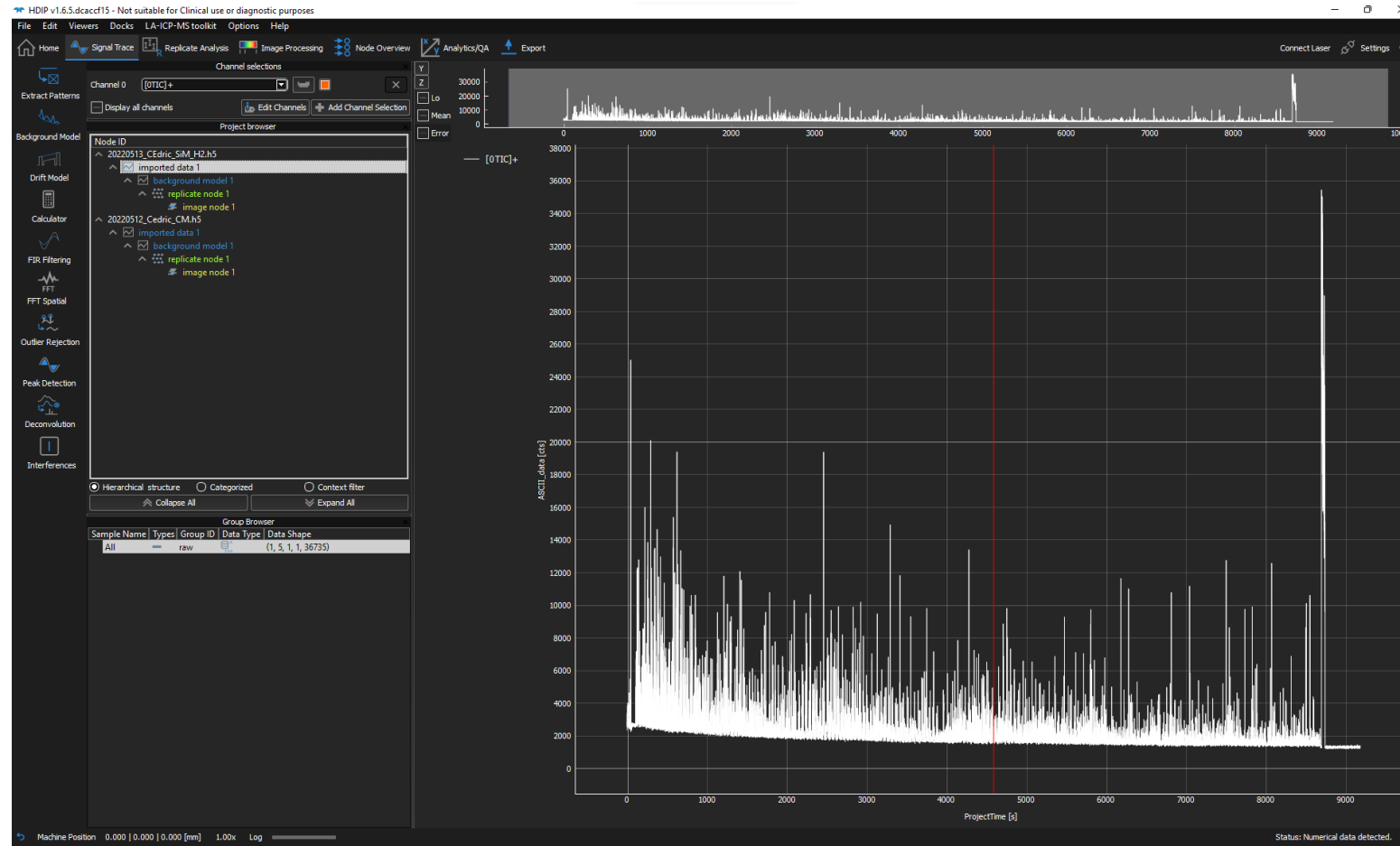
1. High resolution imaging

1. High resolution imaging
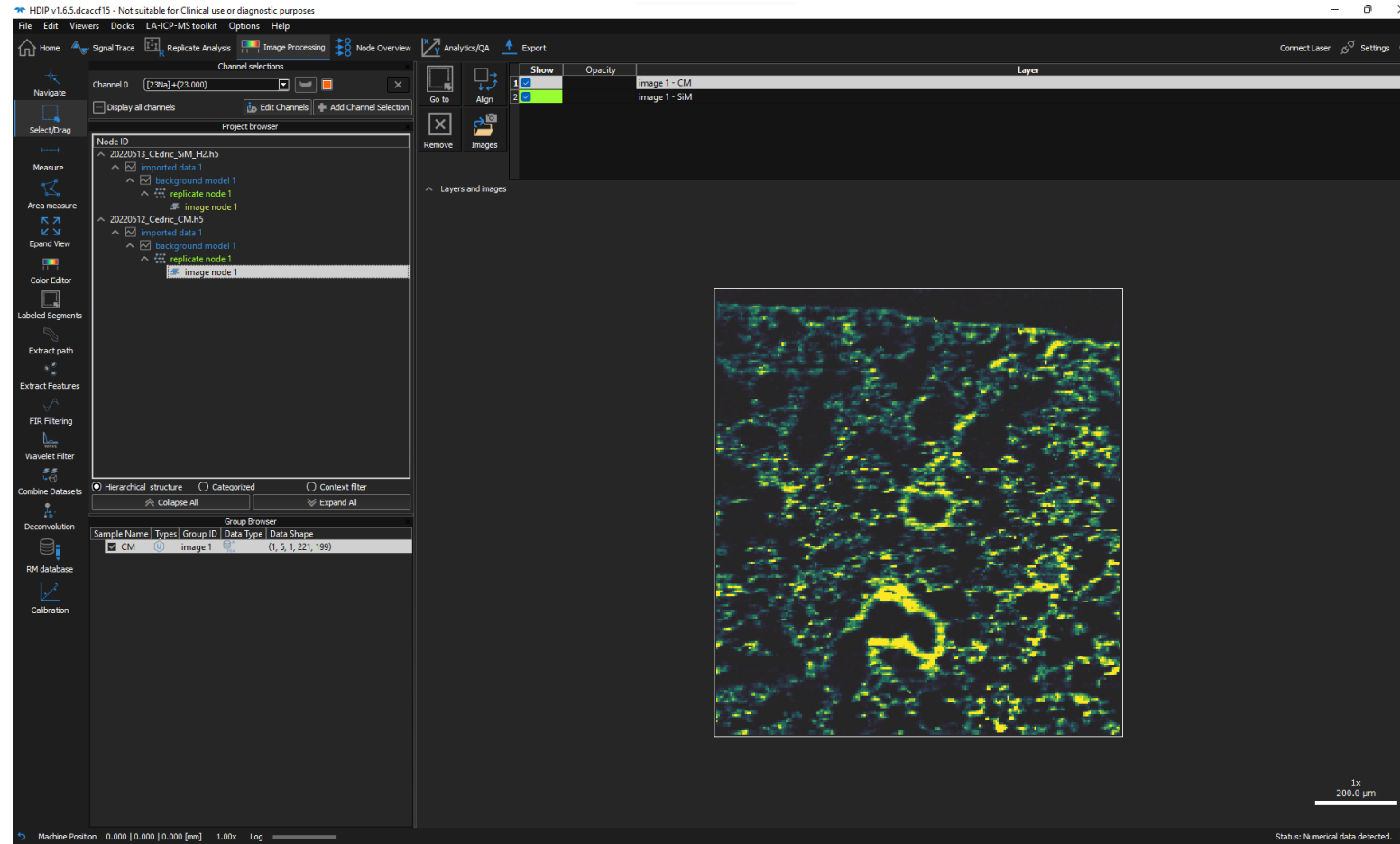
Imaging vs bulk

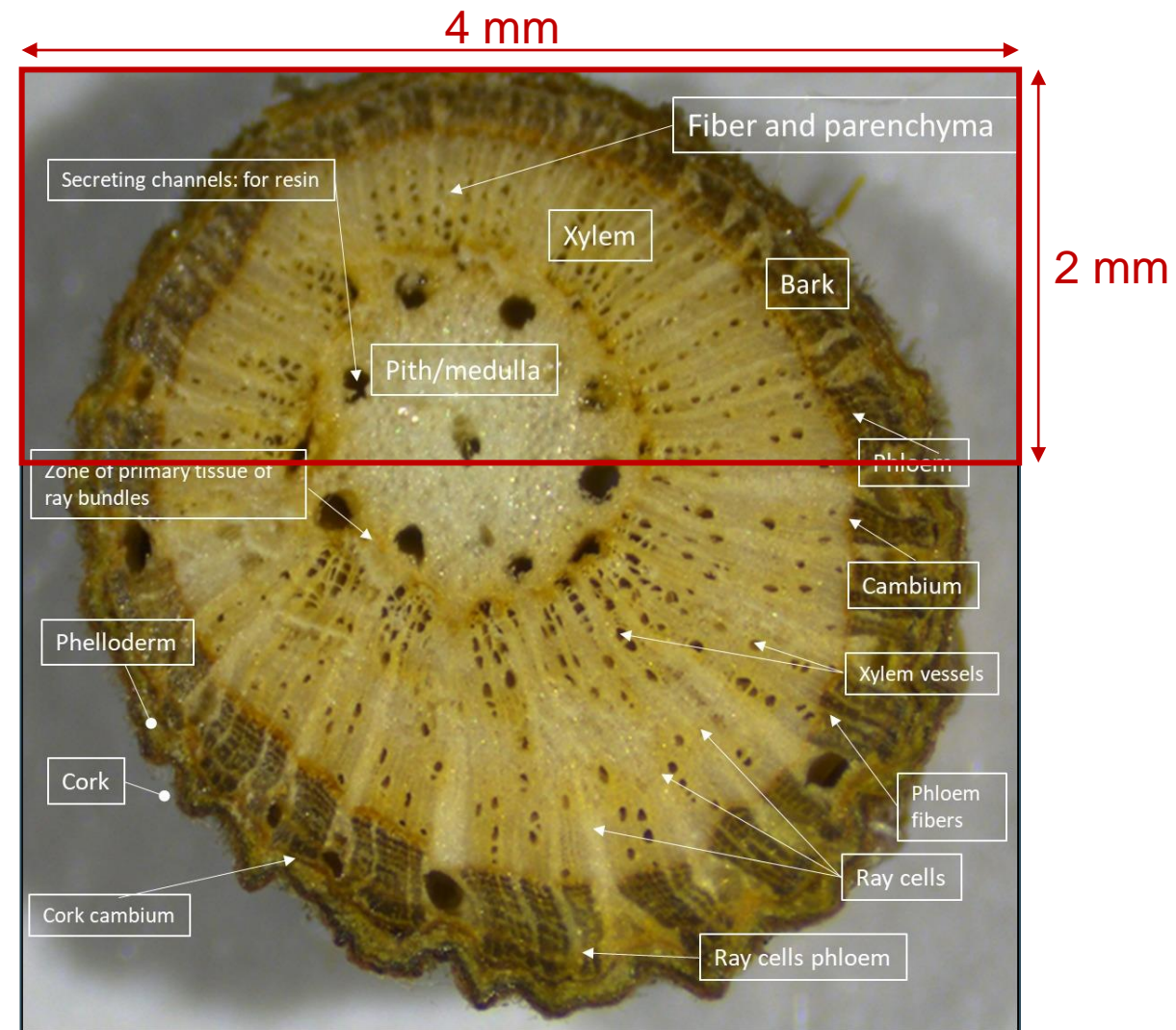| Imaging	Bulk
Mostly qualitative	Quantitative
Mapping	Spatially resolved, localized
HDIP – background correction + imaging	HDIP – quantification (ref materials, EPMA data)
Applications: imaging of various materials	Applications: thin sections, polished sections, archaeological glass, metal, …

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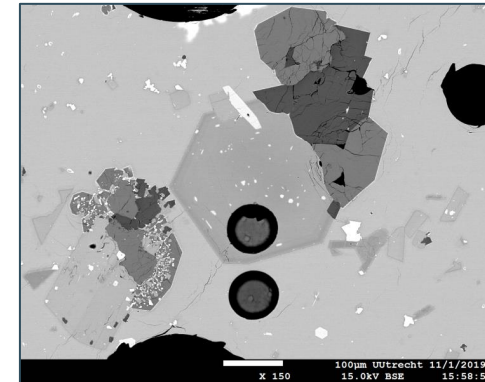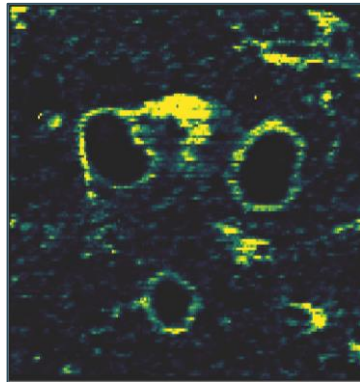
Example: wood core

- Fluence: 3.5 J cm^{-2}

- Laser frequency: 50 Hz

- Spot size: 10 μm square

- Scan speed: 50 μm s^{-1}

0.2 s per spot, divided in:

0.018 s for C	0.028 s for P
0.010 s for Ca	0.007 s for Mn
0.0075 s for Ni	0.0075 s for Cu
0.0070 s for Zn	0.100 s for Cd

4 mm

2 mm

Fiber and parenchyma

Secreting channels: for resin

Xylem

Bark

Pith/medulla

Phloem

Zone of primary tissue of ray bundles

Cambium

Phelloderm

Xylem vessels
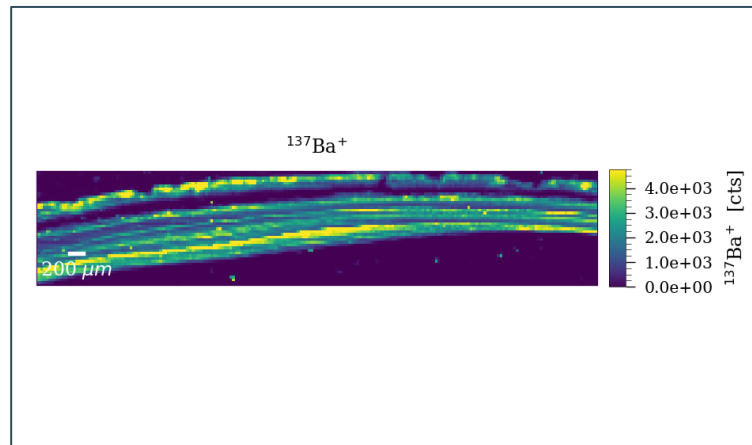
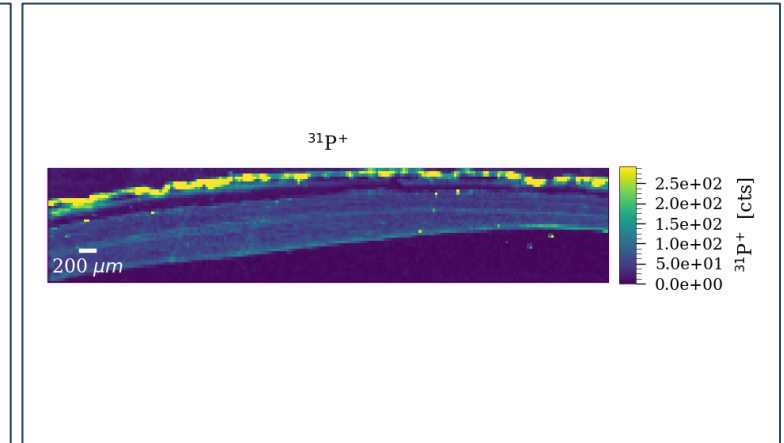Cork

Phloem fibers

Ray cells

Cork cambium

Ray cells phloem

Example: freshwater bivalve (Swan mussel, *Anodonta cygnea*)

Pictures: Amber Veelaert and Florian Laurysssen

Division of Soil and Water Management
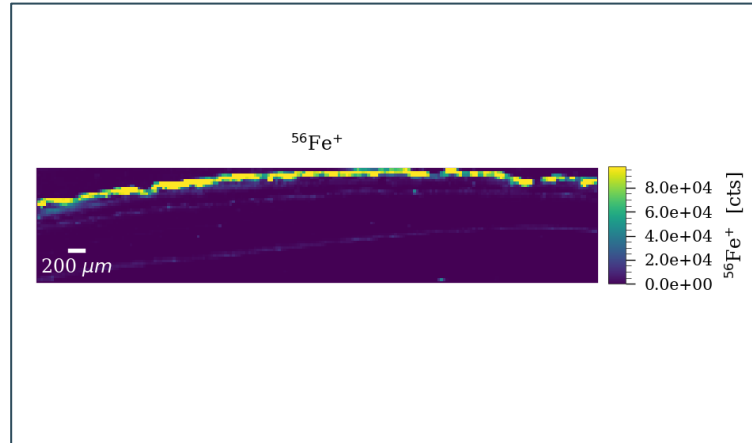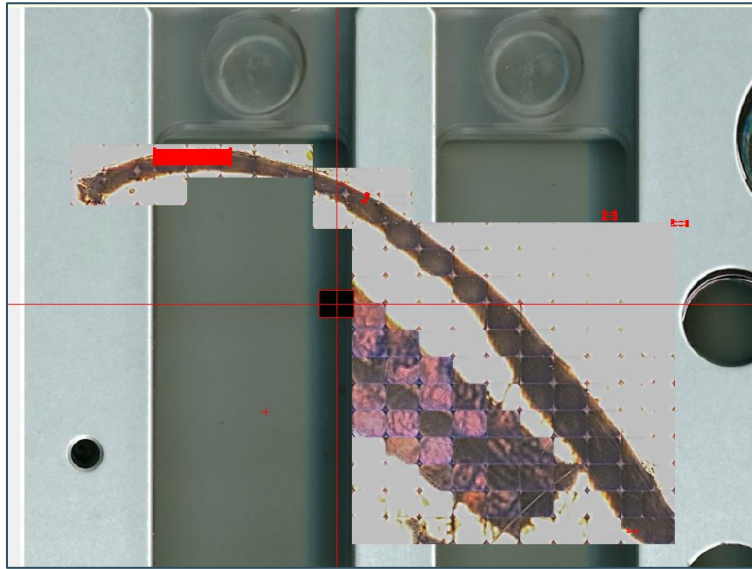
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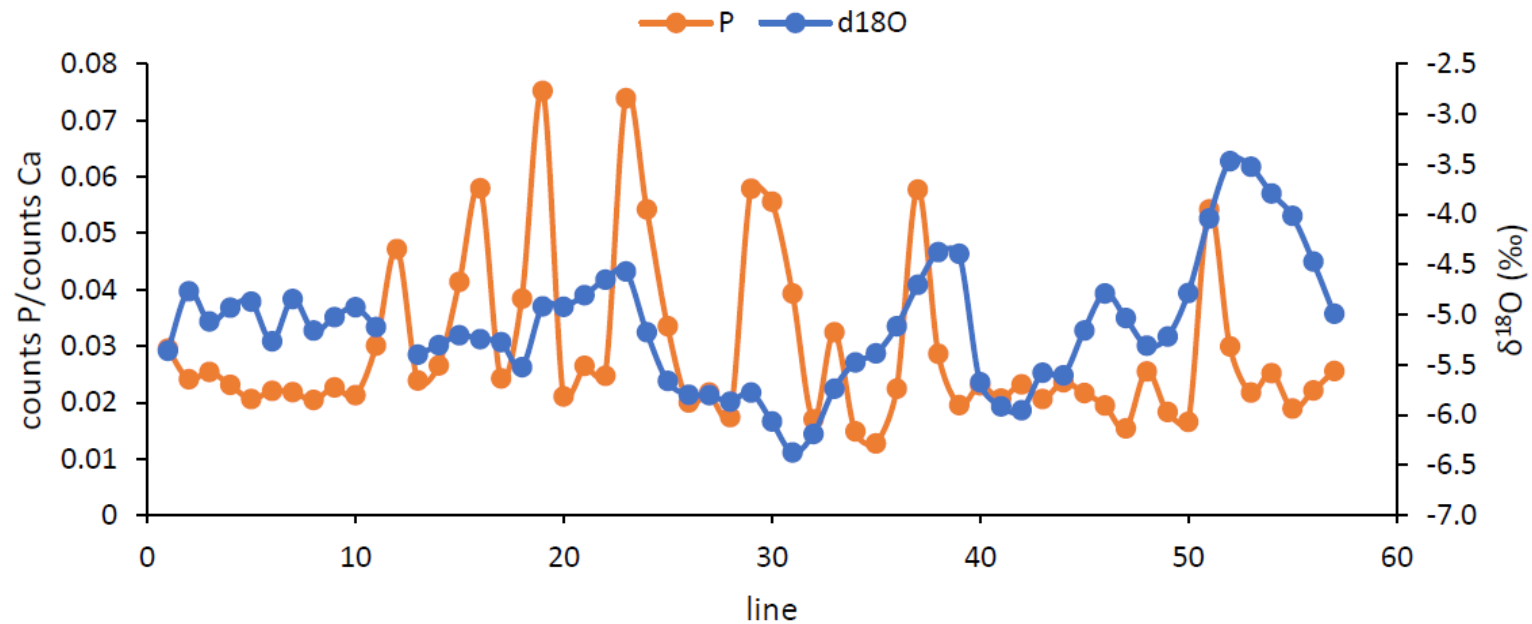# Example: freshwater bivalve (Swan mussel, *Anodonta cygnea*)

Pictures: Amber Veelaert and Florian Lauryssssen

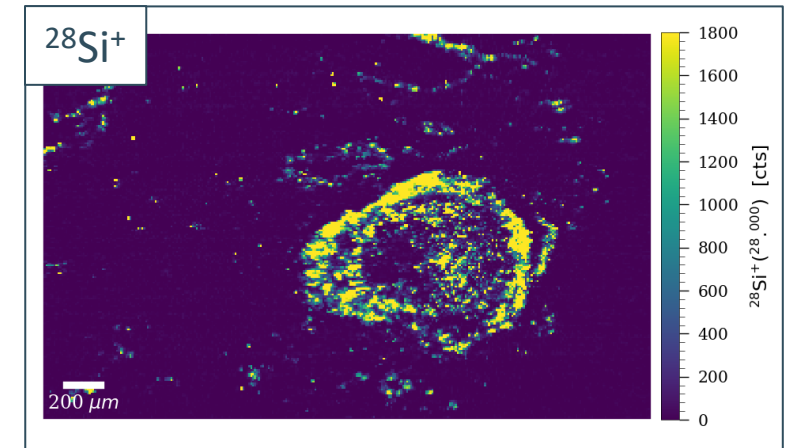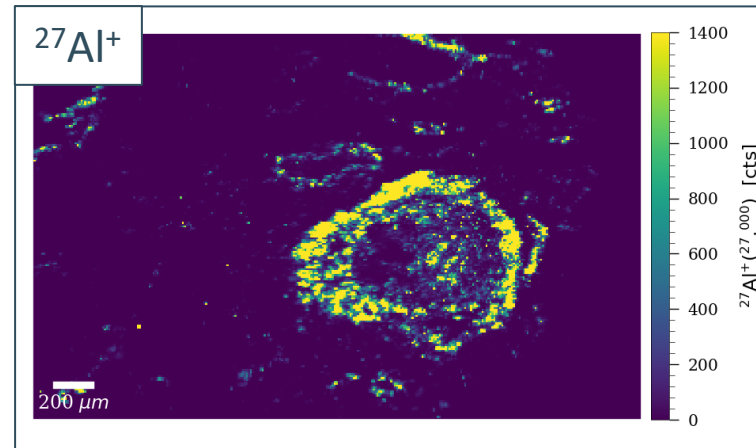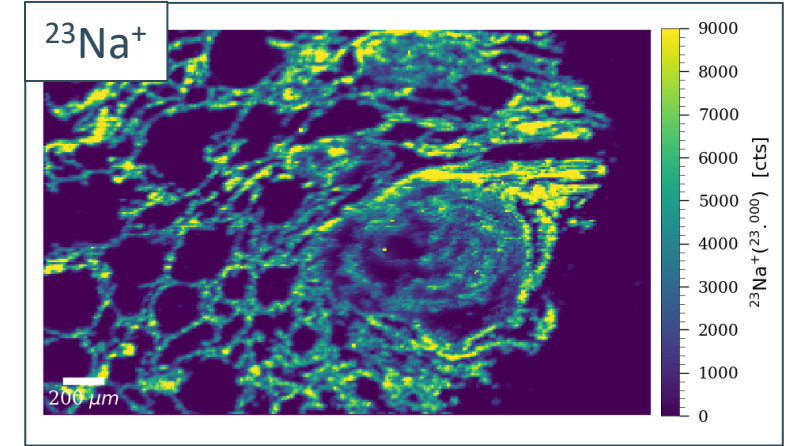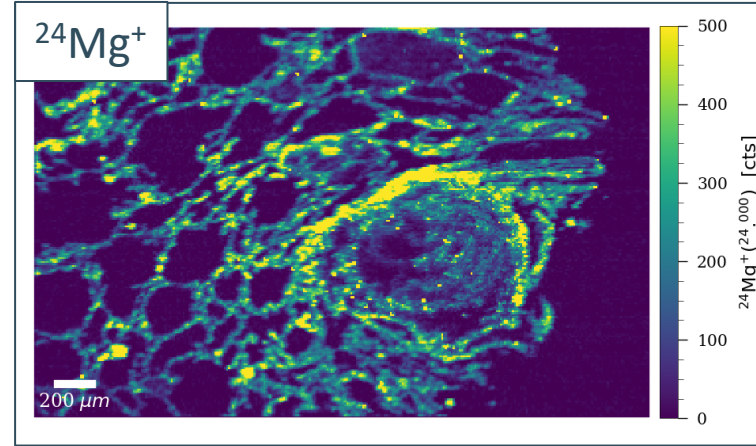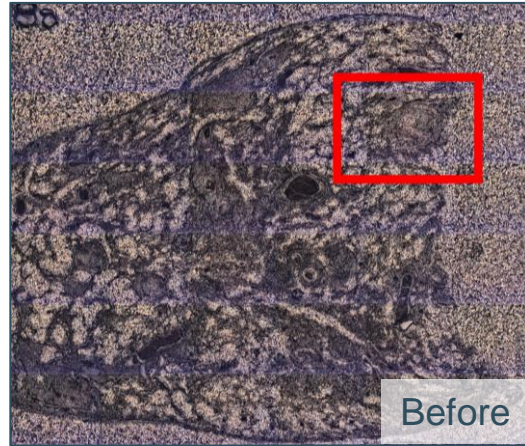# Example: freshwater bivalve (Swan mussel, *Anodonta cygnea*)

Pictures: Amber Veelaert and Florian Laurysssen

Example: silicosis lung tissue

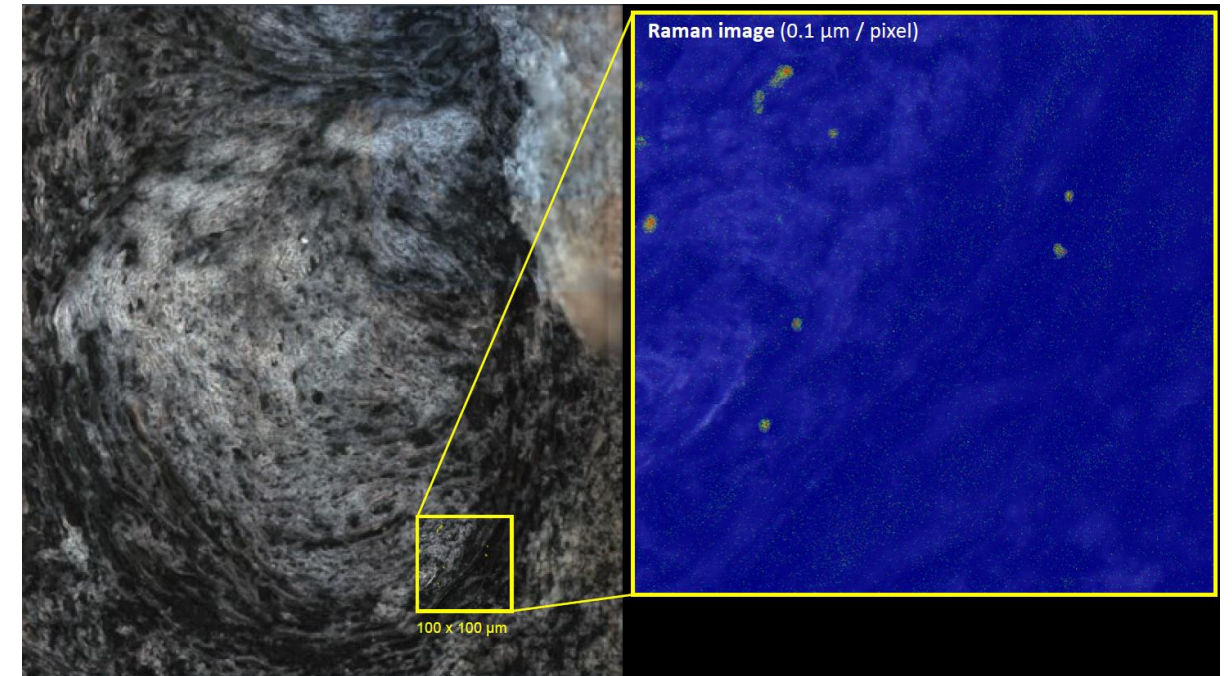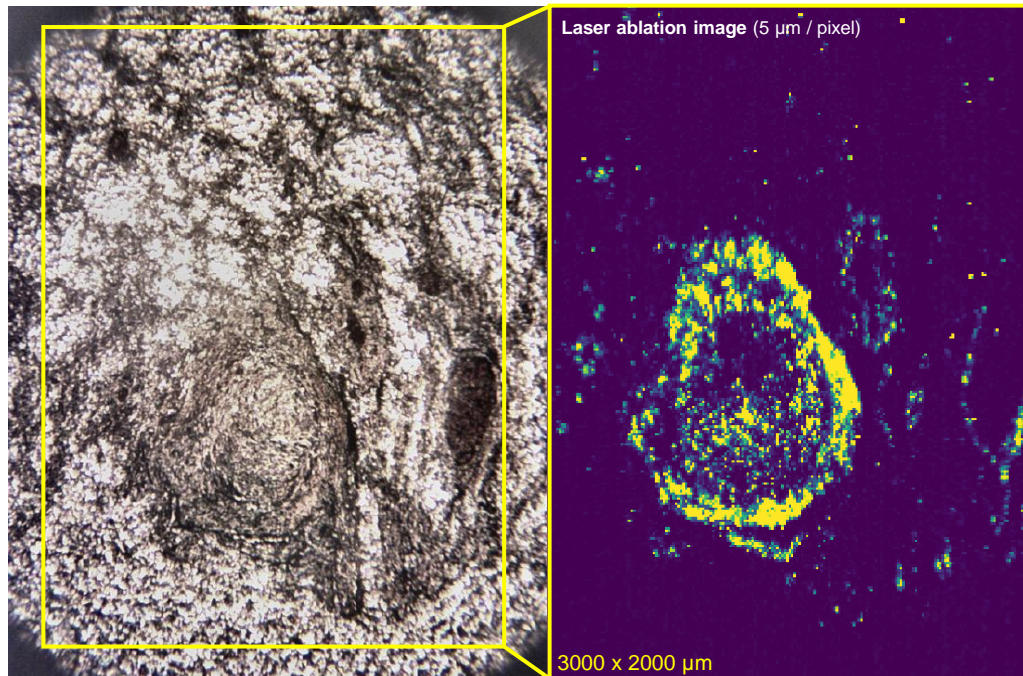*Pictures: Cedric Eelen and Steven Ronsmans*

Example: silicosis lung tissue

Laser ablation   VS   Raman

Pictures: Cedric Eelen and Steven Ronsmans

LA-ICP-MS

+:
Good detection limits
Detects isotopes (tracing experiments!)
Quantititative
"Fast"

-
Spatial resolution bad (5 µm)
Trained personell needed
Expensive: 675 €/day (research collaboration) or 2000 €/day (service)

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Thank you for your attention! Questions?

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charlotte.vermeiren@kuleuven.be
alicia.vanhammeert@kuleuven.be

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