

# Synchrotron microscopic and spectroscopic techniques to reveal the fate of Zn in pioneer plants from abandoned mining sites

**Daniela Medas<sup>1,\*</sup>, Carlo Meneghini<sup>2</sup>, Ilaria Carlomagno<sup>3</sup>, and Giovanni De Giudici<sup>1</sup>**

<sup>1</sup>Department of Chemical and Geological Sciences, University of Cagliari, Monserrato (CA), Italy

<sup>2</sup>Department of Sciences, University of Roma Tre, Rome, Italy

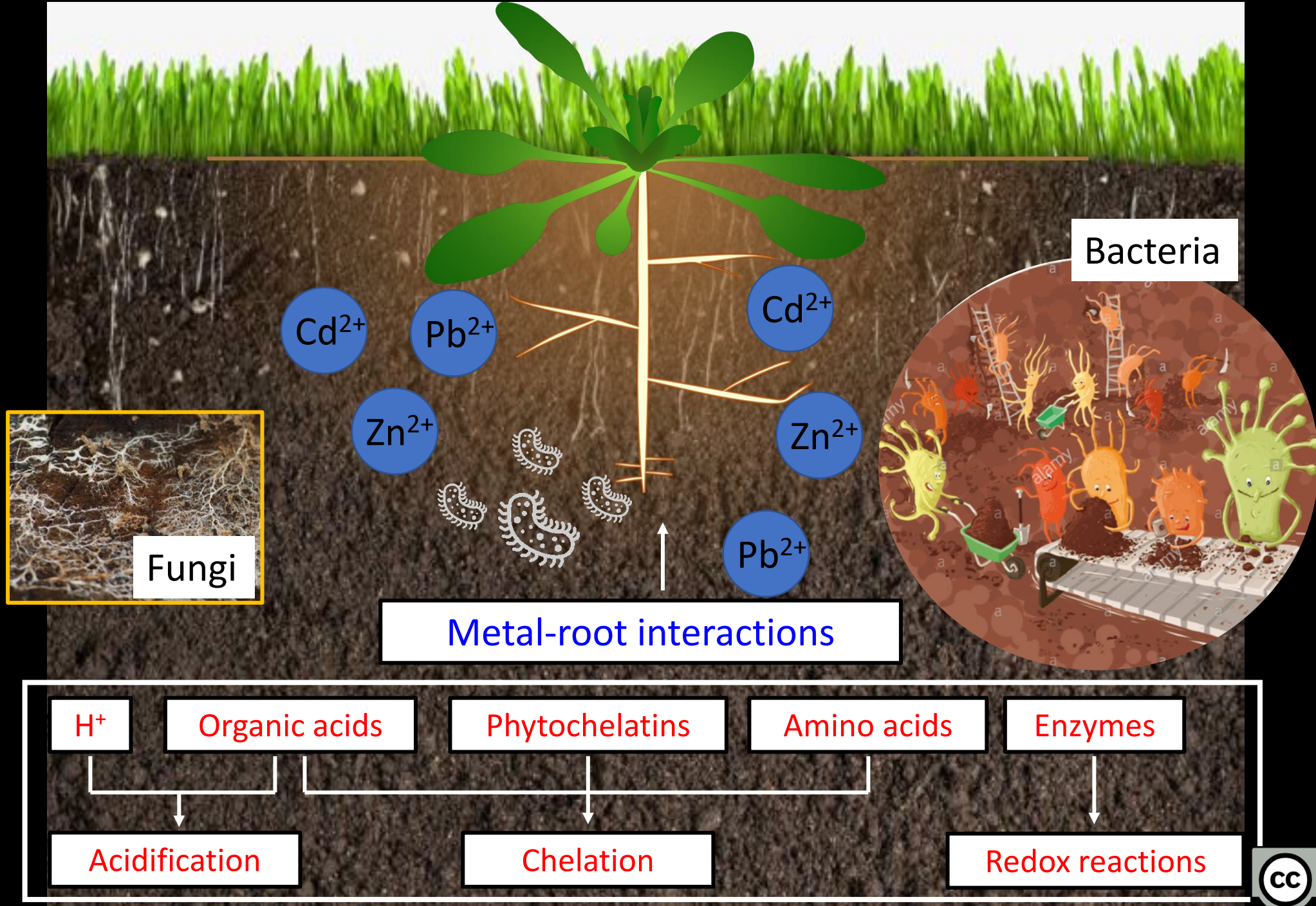
<sup>3</sup>Elettra-Sincrotrone Trieste, AREA Science Park, Basovizza (TS), Italy

\*email: [dmedas@unica.it](mailto:dmedas@unica.it)





Environmental problem:  
abandoned mining sites and metal mobility





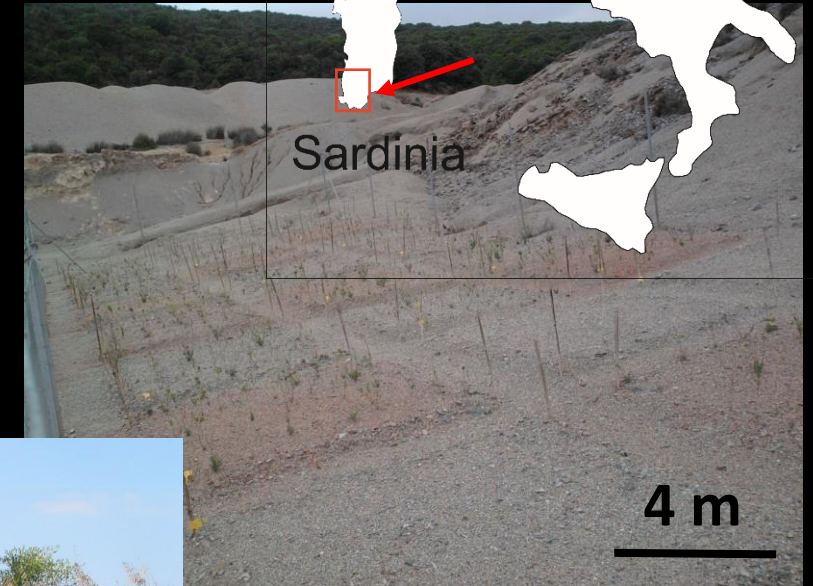
# Some pioneer plants in Sardinia (Italy)



*Euphorbia pithyusa*



*Pistacia lentiscus*



*Juncus acutus*



*Helichrysum tyrrhenicum*



*Phragmites australis*

- ✓ **Field experiment:**
  - ✓ bacteria
  - ✓ mycorrhiza
- ✓ Inorganic amendments

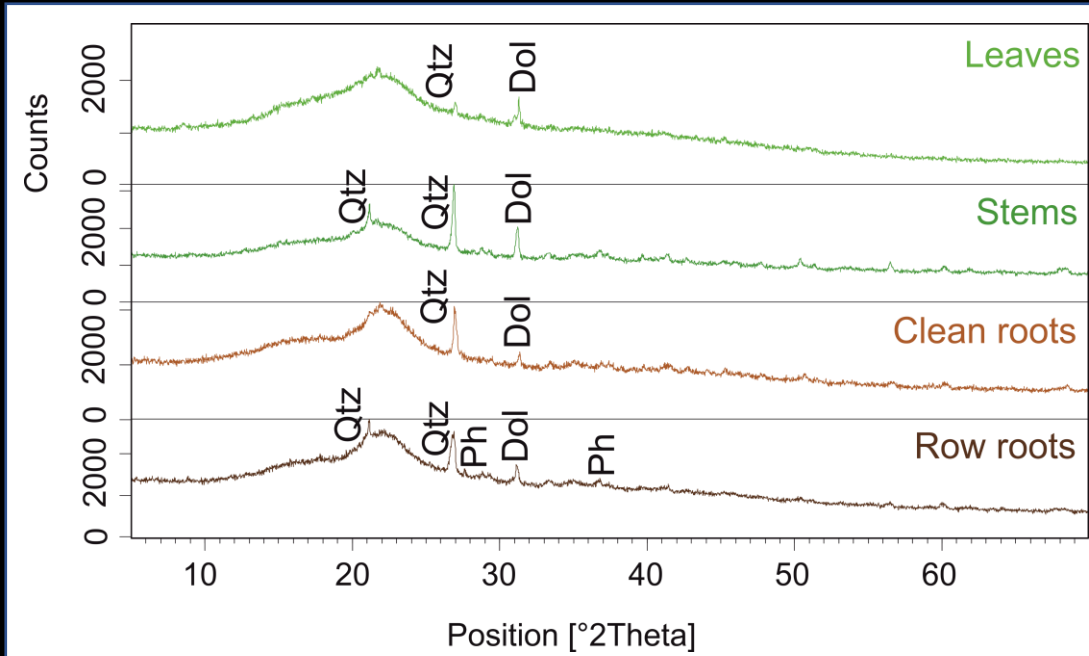
# Investigation scopes and analytical techniques

- Mineralogical characterization: **XRD** (X-ray diffraction).
- Metal distribution: **bulk chemical analysis**, **SEM EDS** (scanning electron microscopy energy dispersive X-ray spectroscopy), **μXRF-STXM** (μ-X-ray fluorescence scanning transmission X-ray microscopy).
- Metal (Zn) speciation: **XAS** (X-ray absorption spectroscopy).

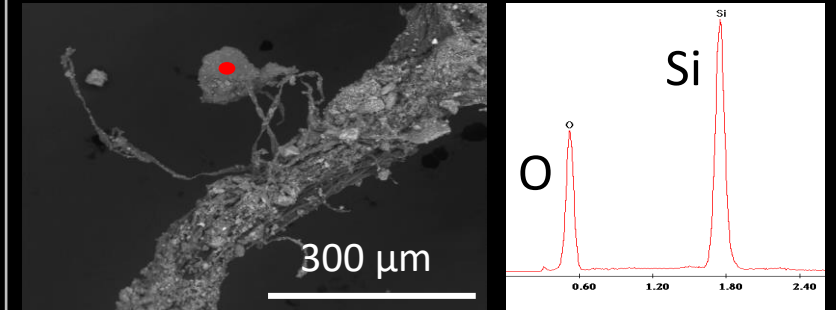


# Biominingerals from the roots to the leaves

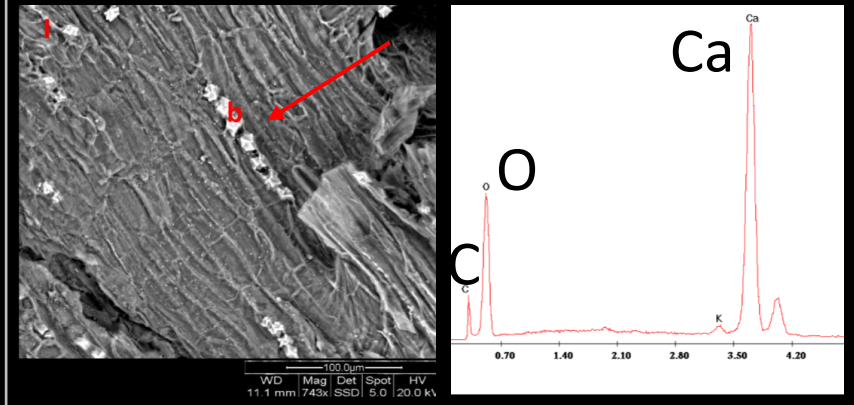
## XRD



## Soil-root interface

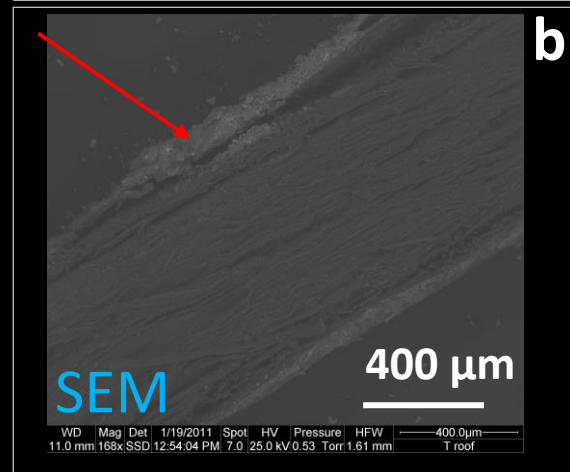
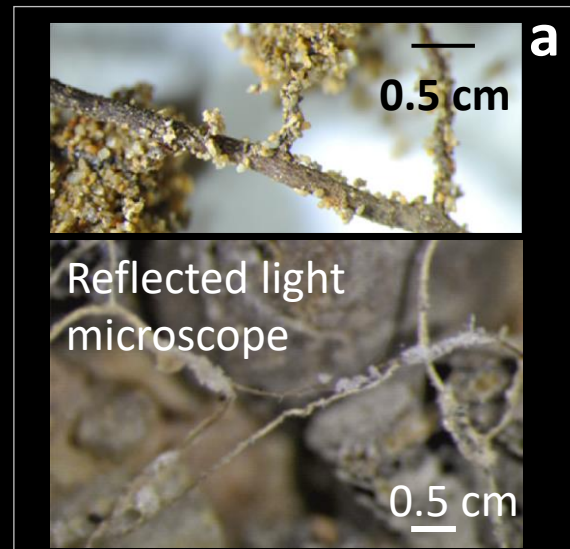


## Ca oxalate biomineral

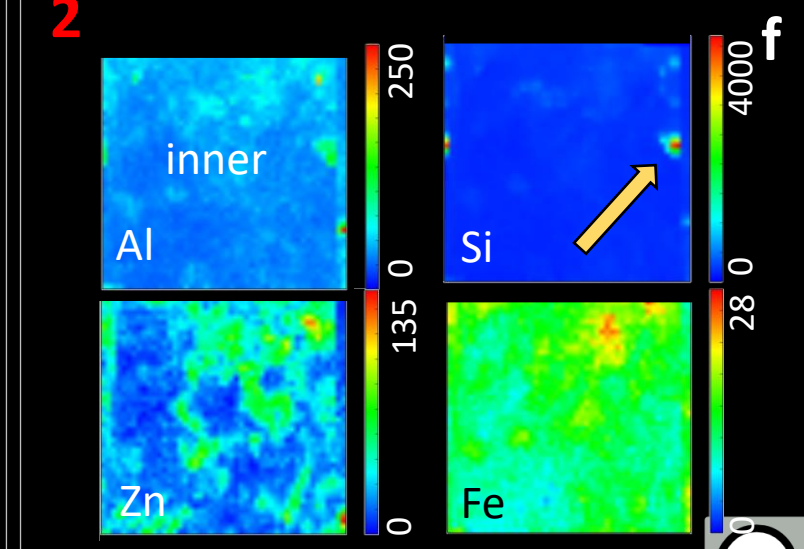
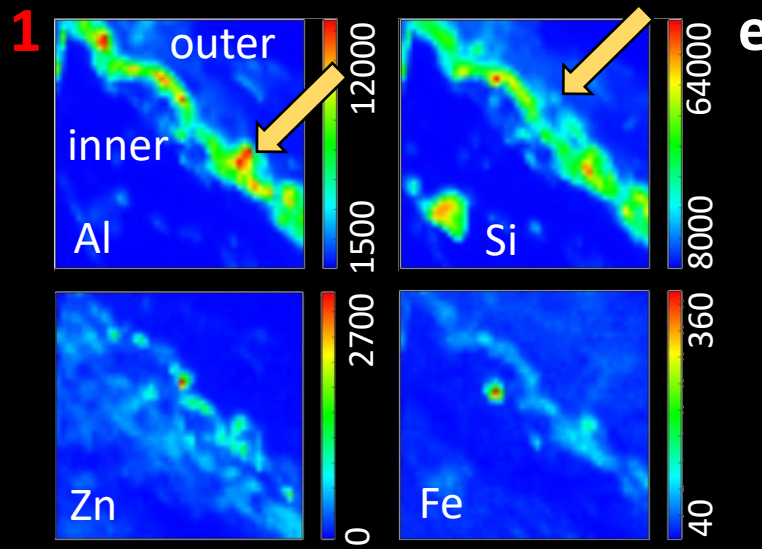
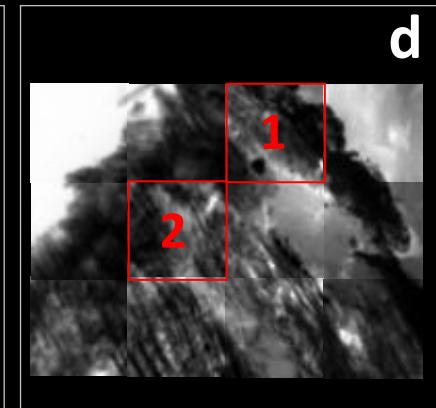
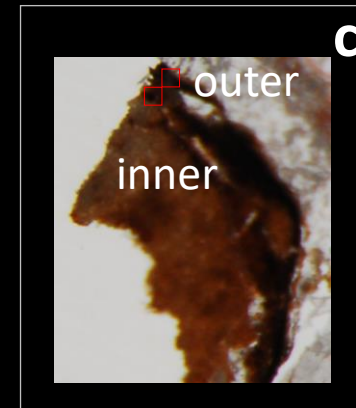


**Rhizosphere:** quartz, phyllosilicates, cerussite, galena, sphalerite

# Element distribution and the biomineral rim at the soil-root interface: SEM and $\mu$ XRF-STXM

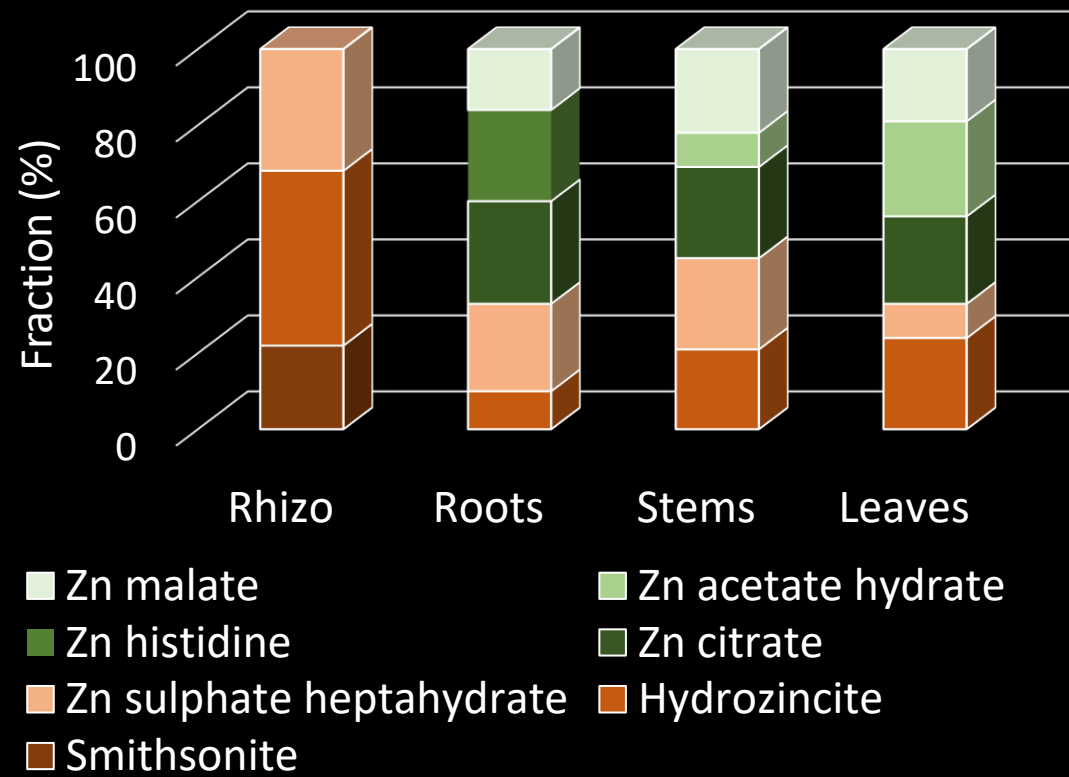


- **Si** and **Al**: mainly concentrated in the epidermis.
- **Zn** and **Fe**: more homogeneously distributed, decrease in the inner part.



# Zn speciation (XAS) from the rhizosphere to the leaves

## Linear combination analysis of XANES spectra



- ✓ Zn is hosted in several coordination environments.
- ✓ Evolution of Zn chemical species from the geosphere to the biosphere.



# Conclusion

Synchrotron radiation-based techniques are a useful tool for investigating processes at the soil-root interface



Fundamentals for remediation actions

