How are Pb and Zn sequestered in contaminated soils?

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Source of soil contamination

- **>100 years** of Pb & Zn smelting activities
- up to 1982 Pb & Zn daily emissions: **400 kg to 1000 kg**
- **45 km²** of contaminated cropped soils through fallout

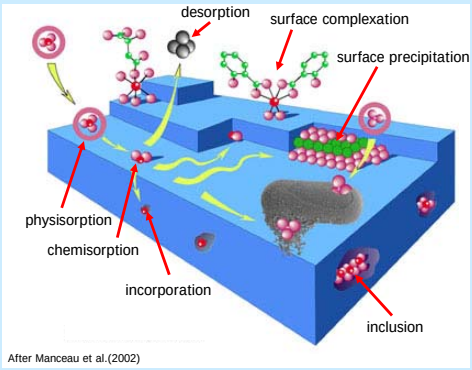
➡ **Pb poisoning**

>10% of children
Area: 15 km² surrounding the smelter (>100 µg/L Pb in the blood)

Pb & Zn contaminated cropped soils

Pb: 160 ppm
Zn: 290 ppm

Uptake mechanisms controlling the fate of contaminants

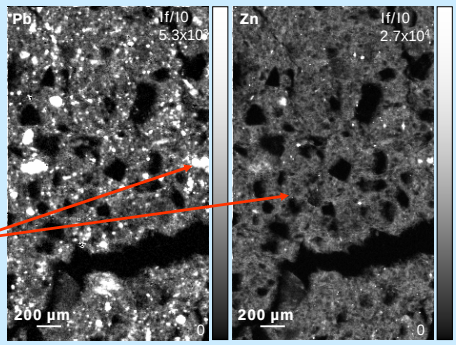


After Manceau et al.(2002)

Lateral distribution of Pb & Zn by micro-XRF

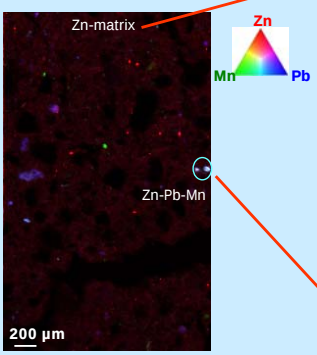
- Pb: high number of Pb-rich regions
- Zn: permeated the clay matrix

➡ Pb & Zn are distributed differently & at least 2 species are present:
- one present in spot-like structures
- one present in the matrix

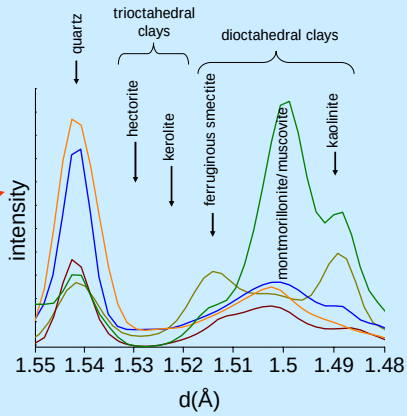


Identification of Pb & Zn species by micro-XRD & micro-XAS

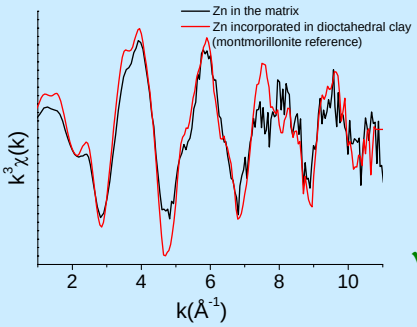
- micro-XRD data of several spots reveal the presence of dioctahedral clays in the matrix
- micro-XAS reveal that Zn is structurally incorporated in dioactahedral clays

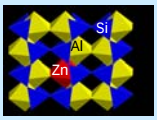


Micro-XRD



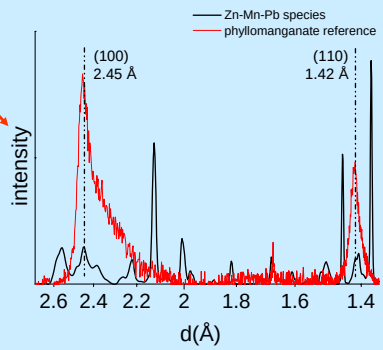
Micro-XAS

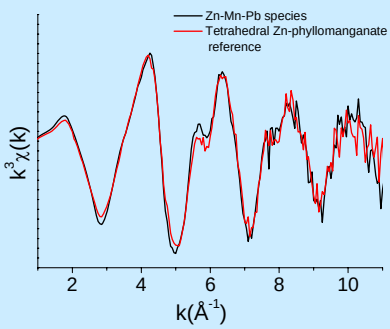




✓ Zn incorporated in dioctahedral clay

- micro-XRD shows that Mn is speciated as phyllomanganate
- micro-XAS reveals that Zn is tetrahedrally coordinated and sorbed on either sides of octahedral vacancies





✓ Tetrahedral Zn sorbed on either sides of the vacancies

Summary & conclusion

- Zn immobilized in the clay matrix => low mobility
- Pb & Zn associated with Mn-oxides precipitates => mobile in reducing conditions
- Assisting the natural attenuation of the mobility of metals is a valuable remediation strategy for this type of pollution
- The combination of micro-XRF/XRD/XAS is a powerful tool to determine the speciation of anthropogenic contaminants

Acknowledgment

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