University of Padua
Department of Geosciences, Inter-Departmental Research Centre for the Study of Cement Materials and Hydraulic Binders

Mechanisms of in-situ remediation of soil with lead and sulfate contaminants using multiple binder strategies: experimental and numerical studies

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Abstract Information

Lab Webpage

1 Motivation **2** Methodologies **3** Preliminary Results **4** Main Conclusions

1 Motivation

Contaminated soil : From business to solid waste

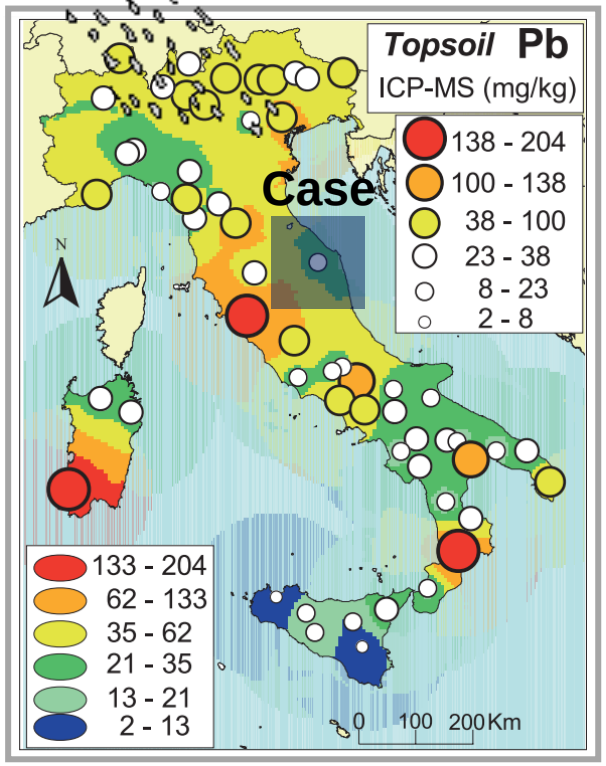

Figure. Interpolated concentration maps of Pb in Italian topsoil. (Limit in soil: **85 mg/kg**; Limit in water: **0.01mg/L**) (Ref. De Vivo et al. (2008)).

Objective 1 Fate of lead in contaminated soils:

☞ Effects of weathering process on lead distribution;

Objective 2 Remediation strategies determination:

☞ In-situ, High performance, Low-carbon footprint, Profitable;

Objective 3 Monitoring and predicting the leaching behavior:

☞ Using the geochemical modeling to prove the binder-soil system is stable and long-lasting in a less cost and time-consuming way.

In-situ remediation: from lab to land

1. De Vivo, Benedetto, et al. "Environmental geochemical maps of Italy from the FOREGS database." Geochemistry: Exploration, Environment, Analysis 8.3-4 (2008): 267-277; 2. Ausili, Antonella, Luisa Bergamin, and Elena Romano. "Environmental status of Italian coastal marine areas affected by long history of contamination." Frontiers in Environmental Science 8 (2020): 34.

Presented by: Yikai Liu, yikai.liu@phd.unipd.it
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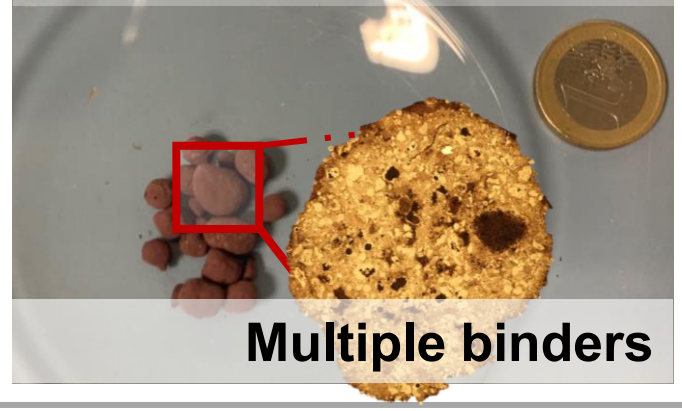
2 Methodologies

Laboratory measurements

1 SAMPLING PROCESS

National interest
Ancona, Italy

2 IN-SITU REMEDIATION



Multiple binders

3 LEACHING BEHAVIOUR

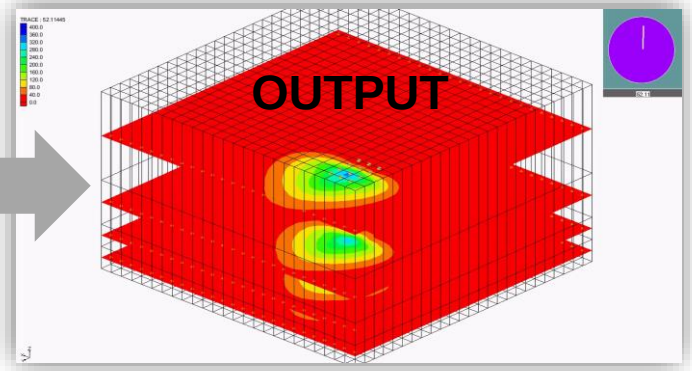
UNI12457-4:2004
UNI14429:2015

Geochemical modeling approach

INPUT
Characterization results
Thermodynamic database

PEST++

MODELING APPROACH
SURFACE ADSORPTION
TRANSPORT
EQUILIBRIUM
REACTION
ION EXCHANGE
SOLUTION SPECIES



1. Image from: https://www.eag.com/zh-CN/resources/whitepapers/evaluate-manufacturer-provided-extractable-information/; 2. Appelo, C. Anthony J., and Dieke Postma. Geochemistry, groundwater and pollution. CRC press, 2004.

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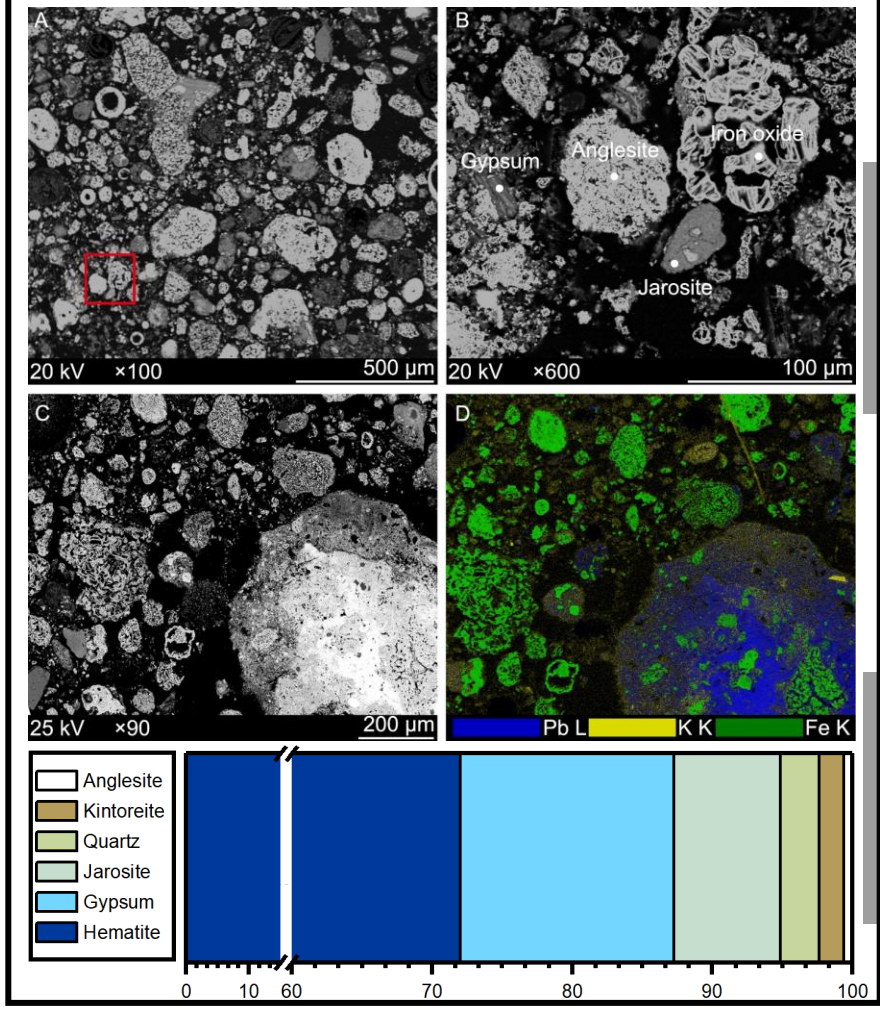
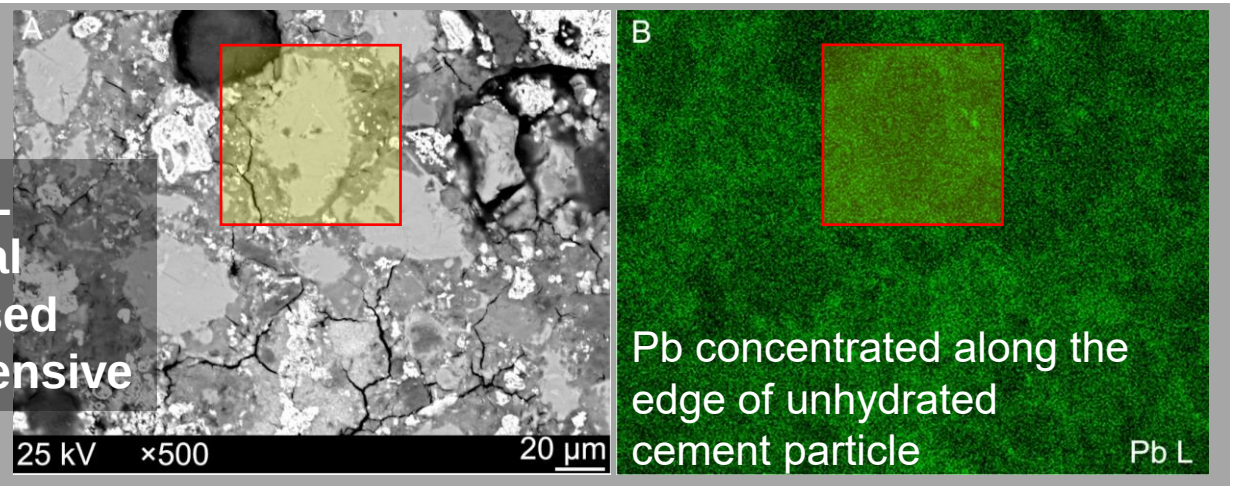
3 Preliminary Results

Lead in the contaminated soil

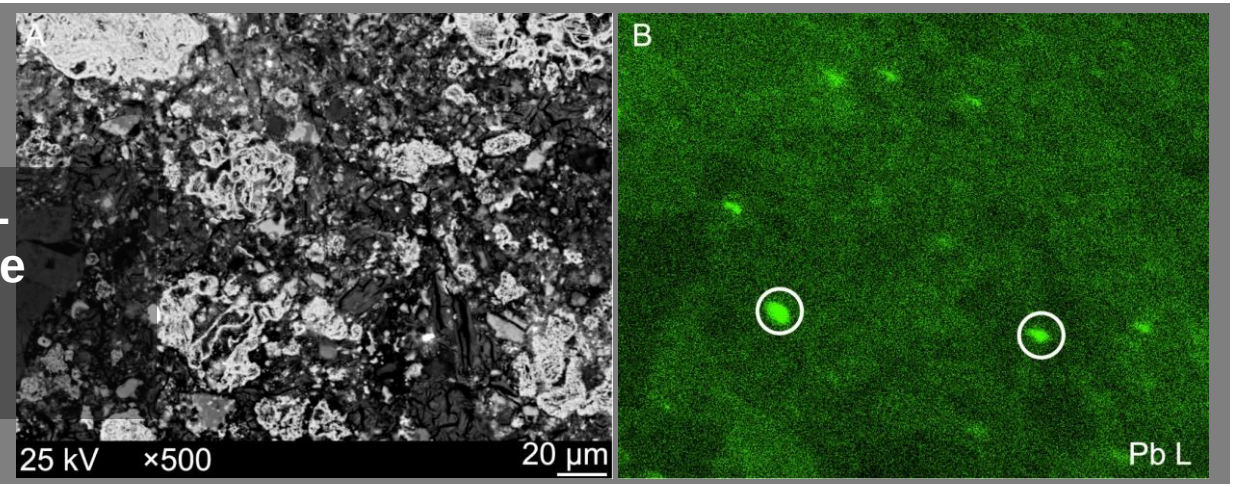


Lead in the pellets (Traditional and alternative binder)

OPC-SOIL
Traditional
Widely used
Less expensive



CAC-SOIL
Alternative
OPC free
Costly



OPC: Ordinary Portland cement
CAC: Calcium Aluminate cement

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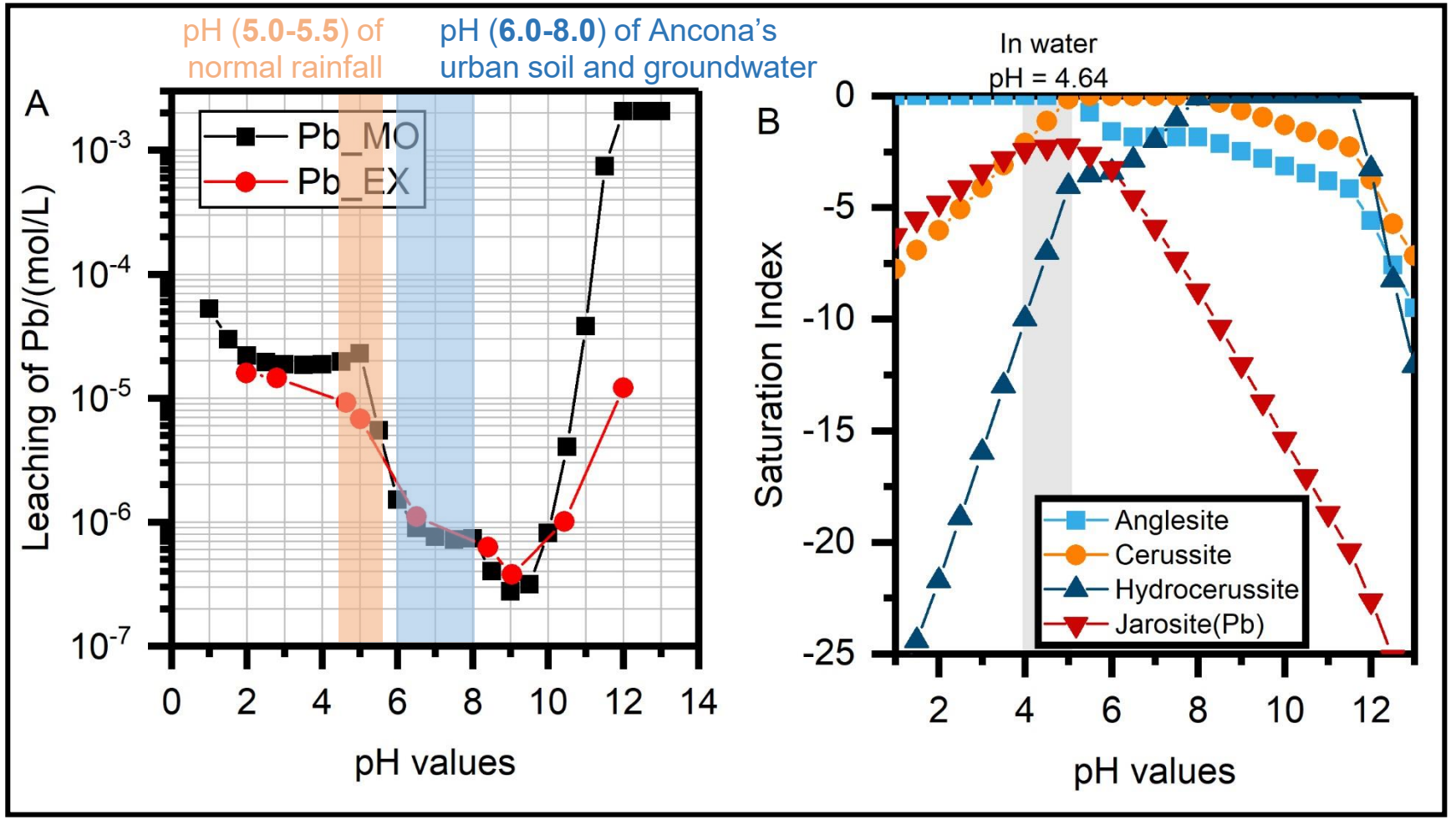
3 Preliminary Results

Lead in the solution via leaching experiments (EX) and geochemical modeling (MO)



Highly amphoteric Pb leaching behavior

↓

Sensitive to aquatic ecosystems

Precipitation/dissolution of carbonates

↓

CO_2 from the atmosphere

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4 Conclusions

The fate of Pb in contaminated soil:

- Anglesite and kintoreite are the main Pb-bearing crystalline phases, which may be generated from the oxidation of pyrite particles.
- Sulfates (jarosite) were confirmed as the Pb-bearing phases through the coexistence of jarosite-type compound and adsorption.

The fate of Pb in stabilized pellets:

- Pb was well dispersed within the cementitious matrix.
- Different immobilization mechanisms and performances were shown with the applied binders.

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Outstanding Student & PhD candidate Presentation contest

Sharing is encouraged

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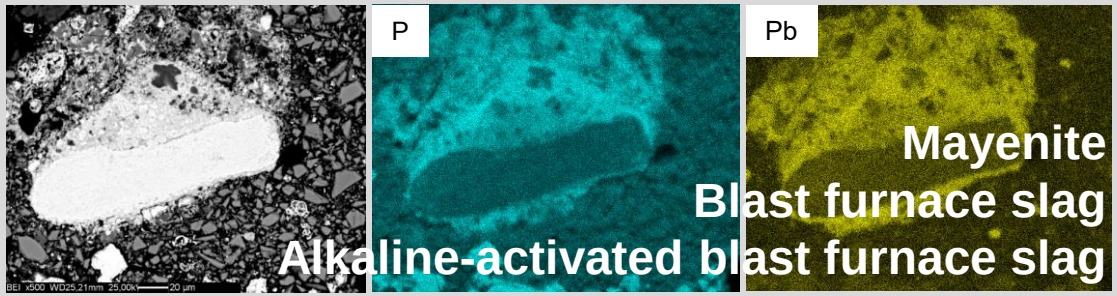
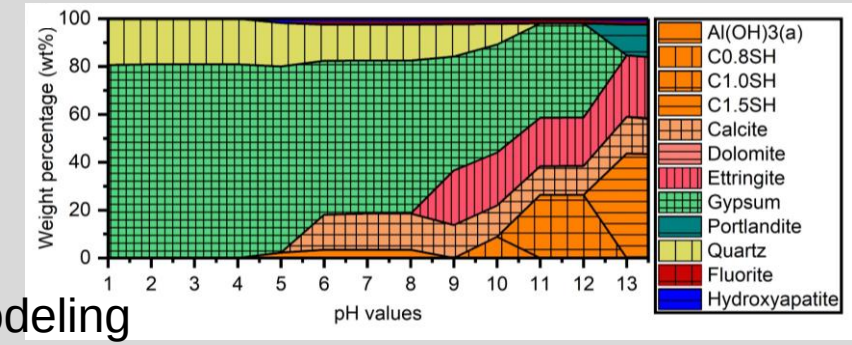
More results. If you have any questions or curiosity, please just drop me an Email (yikai.liu@phd.unipd.it).



Or Modeling



Thanks for your attention!

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