Relationships between soil properties and contents in trace elements in a landscape impacted by atmospheric fallouts in Belgium

Vienna (Austria), 8th April 2013

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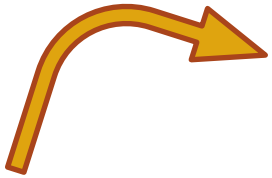
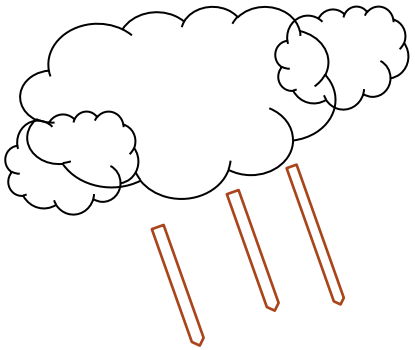
European Geosciences Union General Assembly 2013
Vienna | Austria | 07 – 12 April 2013

Université de Liège

STUDY CONTEXT

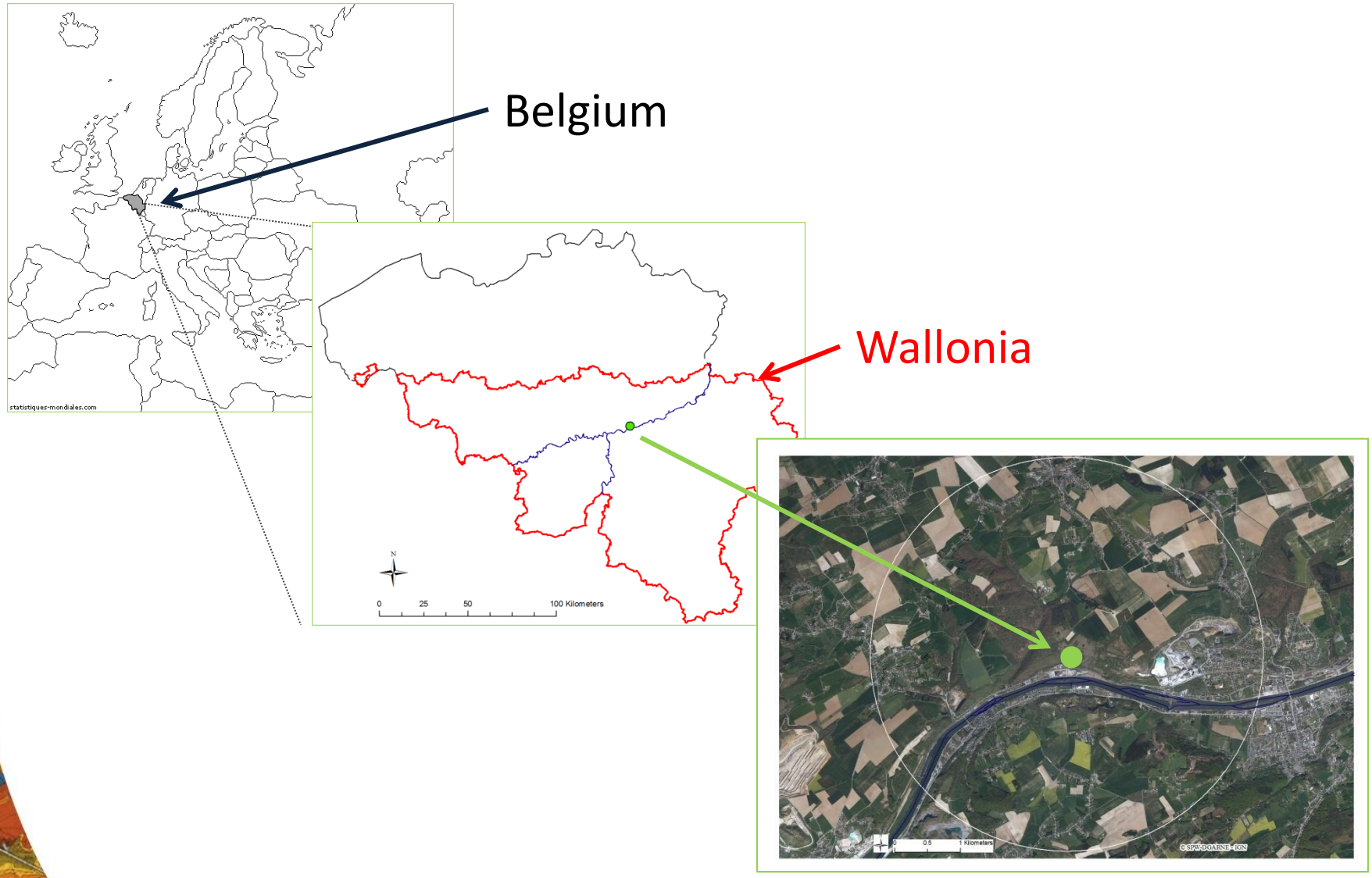




Contaminated fallouts by
metallic trace elements (MTE)
Cd-Cu-Pb-Zn

Hosted ore
treatment factory

STUDY AREA - LOCALIZATION



STUDY AREA - CHARACTERISTICS

Forest

Crop

Grassland

Village

AIMS

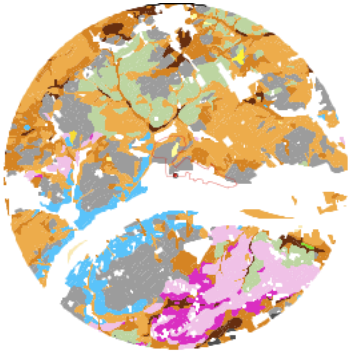
Fate of MTE in contaminated landscape

Impact of landscape factors on MTE distribution in soils

Factors of variation MTE mobility

Interaction between soil properties and MTE contents in soils

SAMPLING STRATEGY



1. Main soil types

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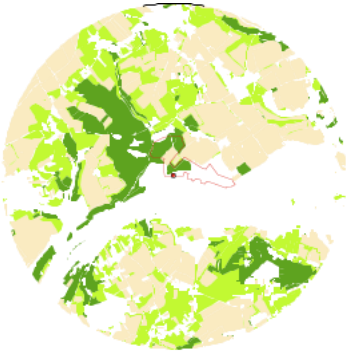
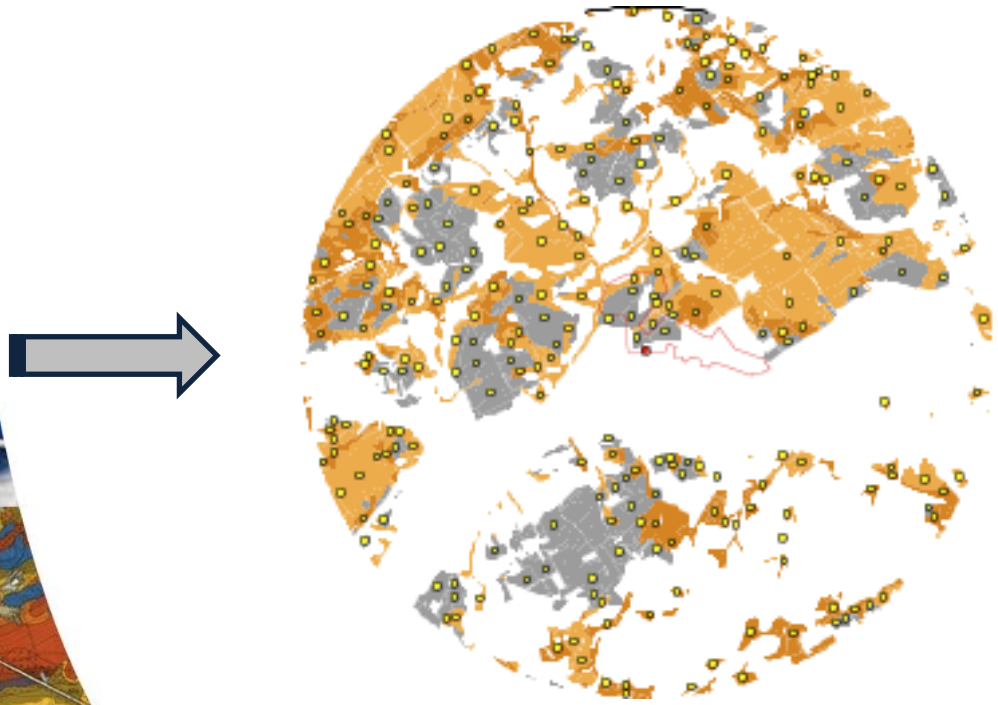


2. Land use

+

3. Wind directions



Sampling points are distributed between 3 distinct soil types, 3 land uses and 4 wind directions (36 combinations)

- Loamy soil with good drainage
- Loamy soil with poor drainage
- Loamy-stony soil with silexite and gravels

METHODOLOGY

i) 247 topsoil (0-20cm) samples are collected

ii) Chemical analyses :

- Pseudo-total (Aqua regia) and available (AA + EDTA (pH4.65)) contents in Ca-Mg-K-Fe-Al-Mn & Cd-Cu-Pb-Zn
- pH_{water} and pH_{KCl}
- Total Organic Carbon
- N

iii) Statistical analyses :

- log transformation of all parameters excepted pH
- Ancova (2 or 3 ways) with distance as covariate
- Correlation
- PCA

First aim

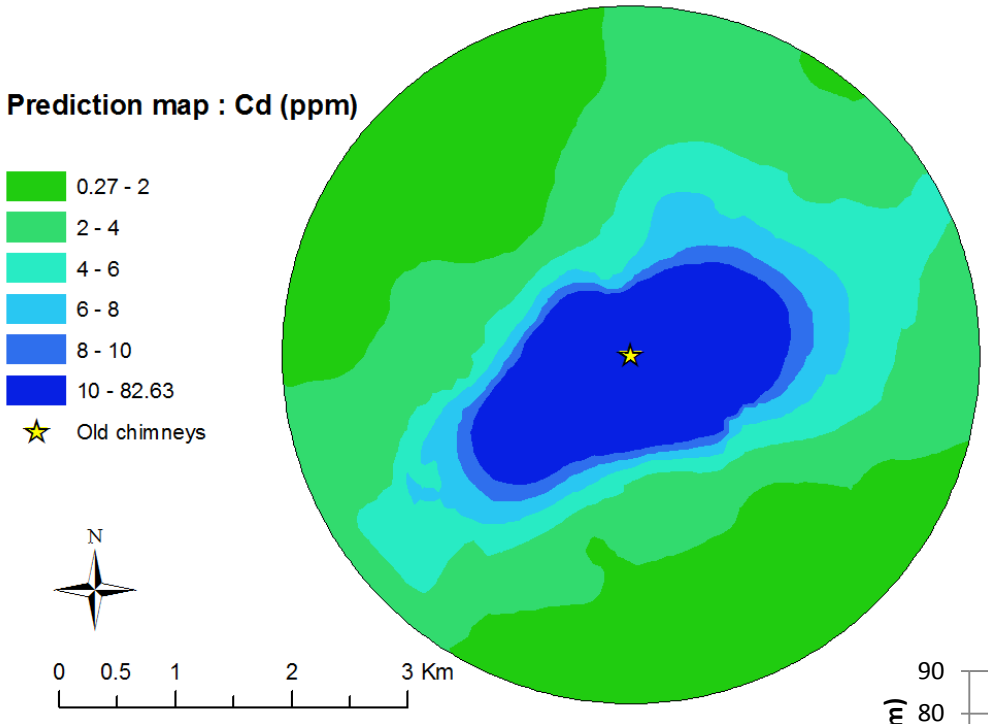
Fate of MTE in contaminated landscape

Impact of landscape factors on MTE distribution in soils

Variation factors of MTE mobility

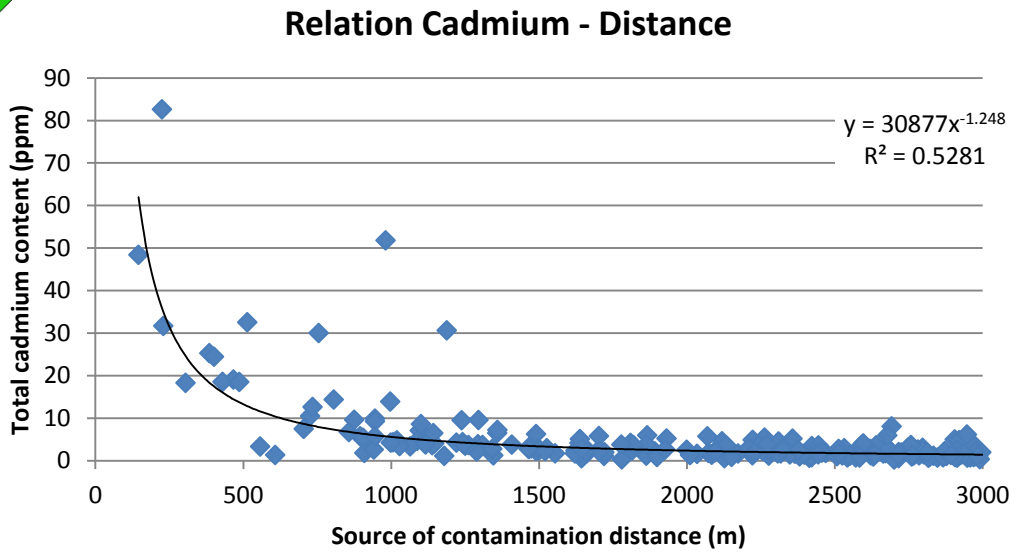
Interaction between soil properties and MTE contents in soils

Distance from source: The main factor influencing MTE content

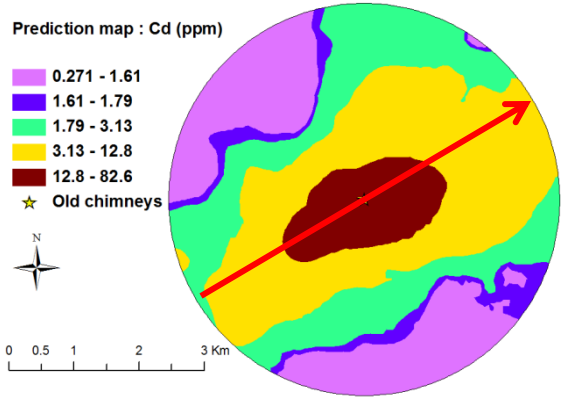


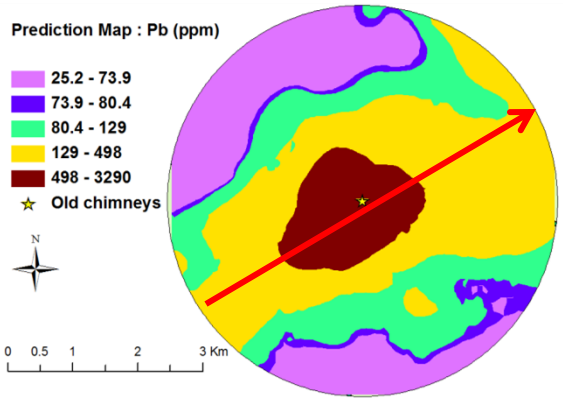
- Content in each MTE decreases with distance

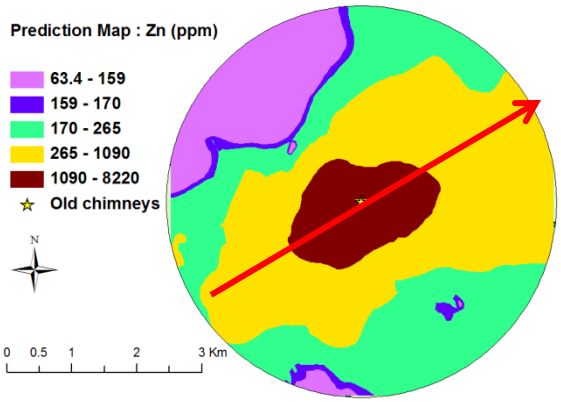
- P-value < 0.001 and $R^2 > 0.5$

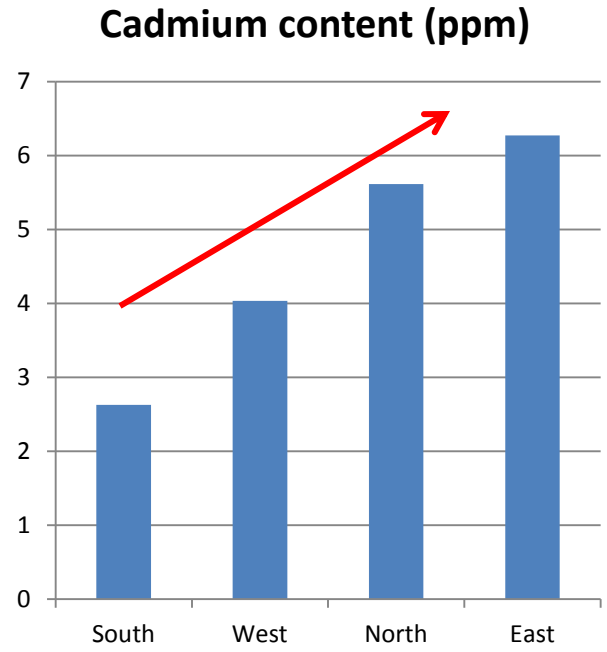


DIRECTION OF DOMINANT WINDS : A SECOND FACTOR WHICH INFLUENCES MTE CONTENT





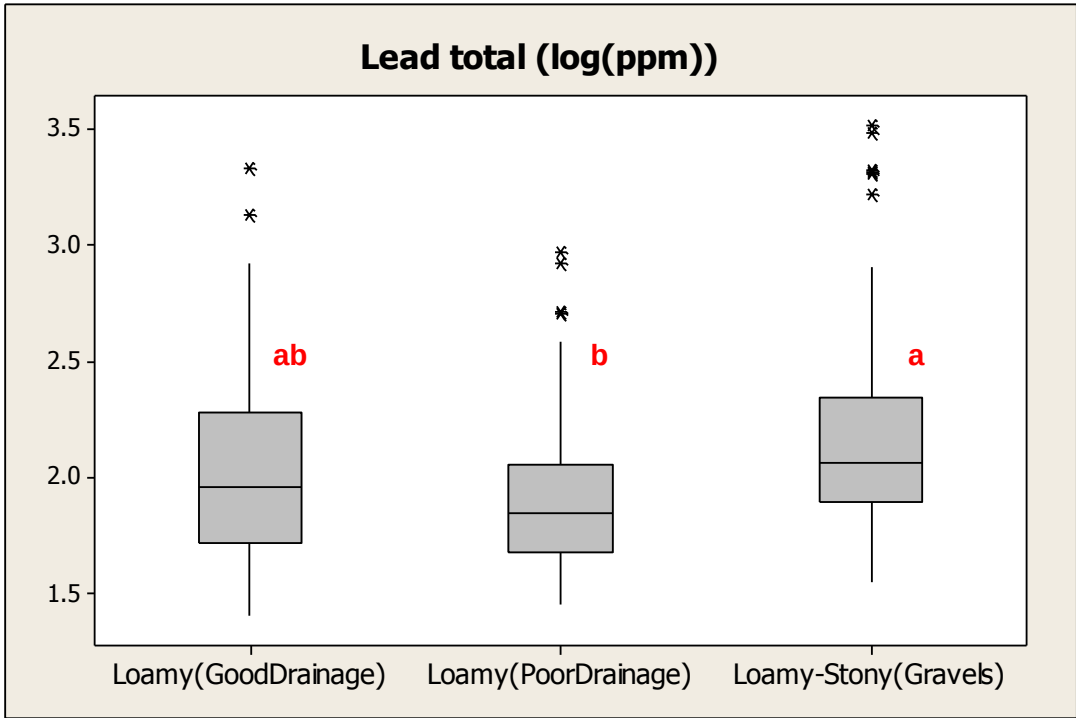




- Typical wind direction in Wallonia is South-West toward North-East

- MTE dispersion is higher along this axe

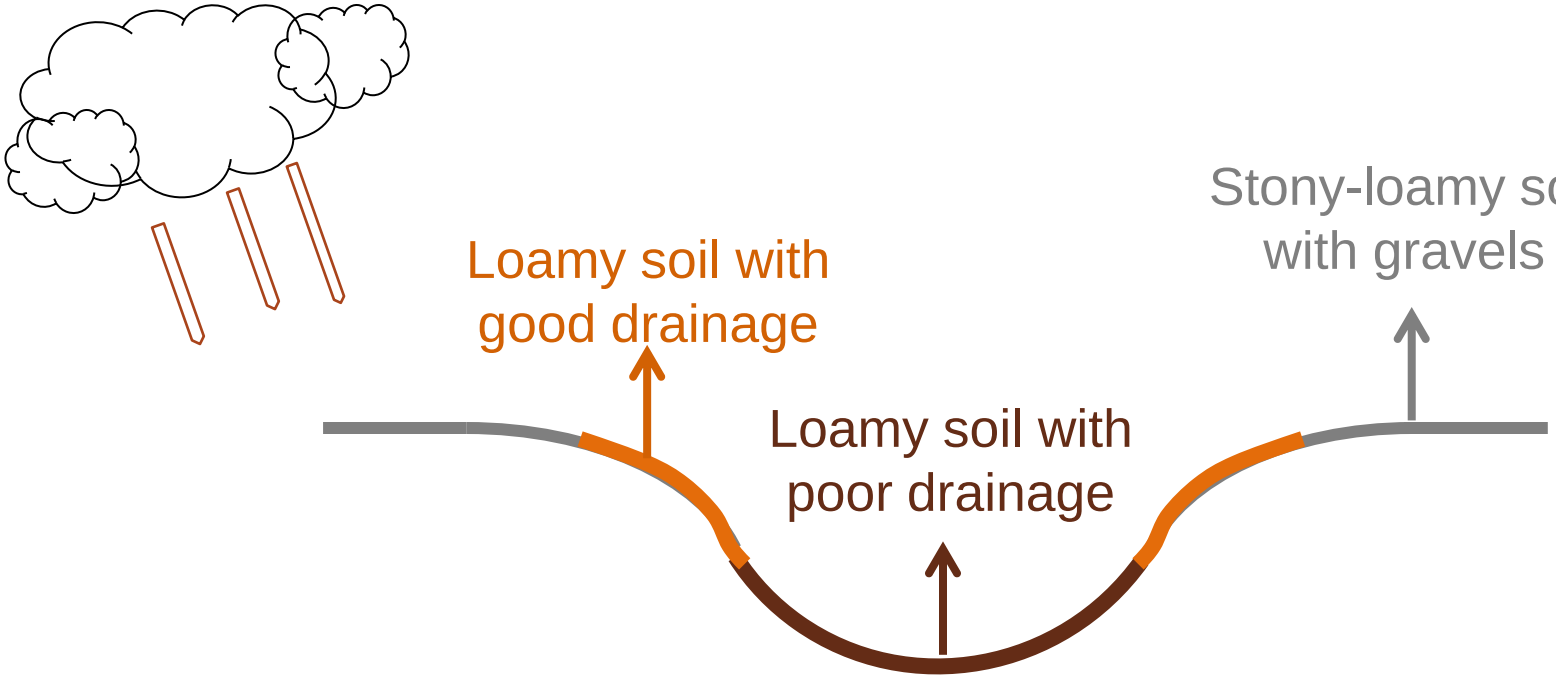
SOIL TYPES :
A THIRD FACTOR WHICH INFLUENCES THE MTE CONTENT



- Presence of a soil type effect for Cd – Pb – Zn total content

- Loamy-stony soils with gravels contain more MTE than loamy soils

SOIL TYPES :
A THIRD FACTOR WHICH INFLUENCES THE MTE CONTENT

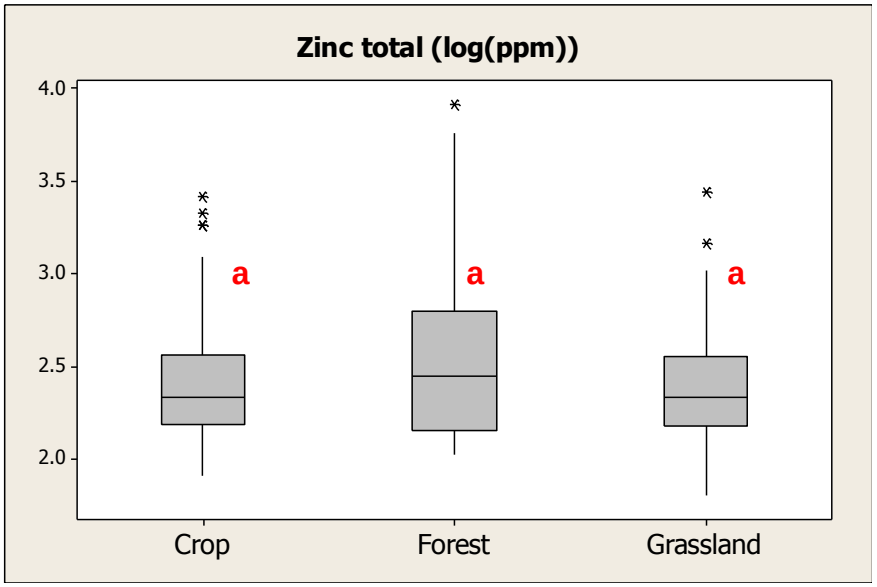


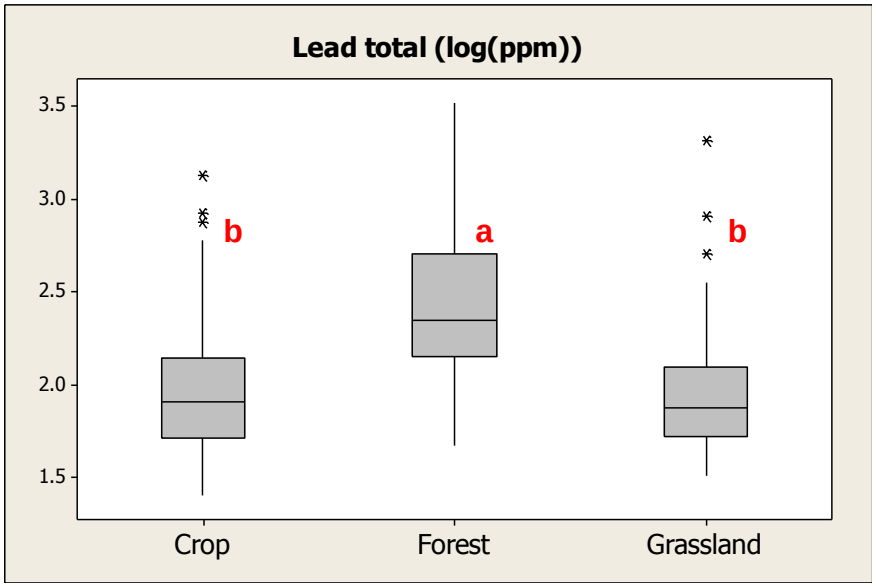
Effect maybe due to their position in the landscape

LAND USE : A LAST FACTOR WHICH INFLUENCES THE MTE CONTENT

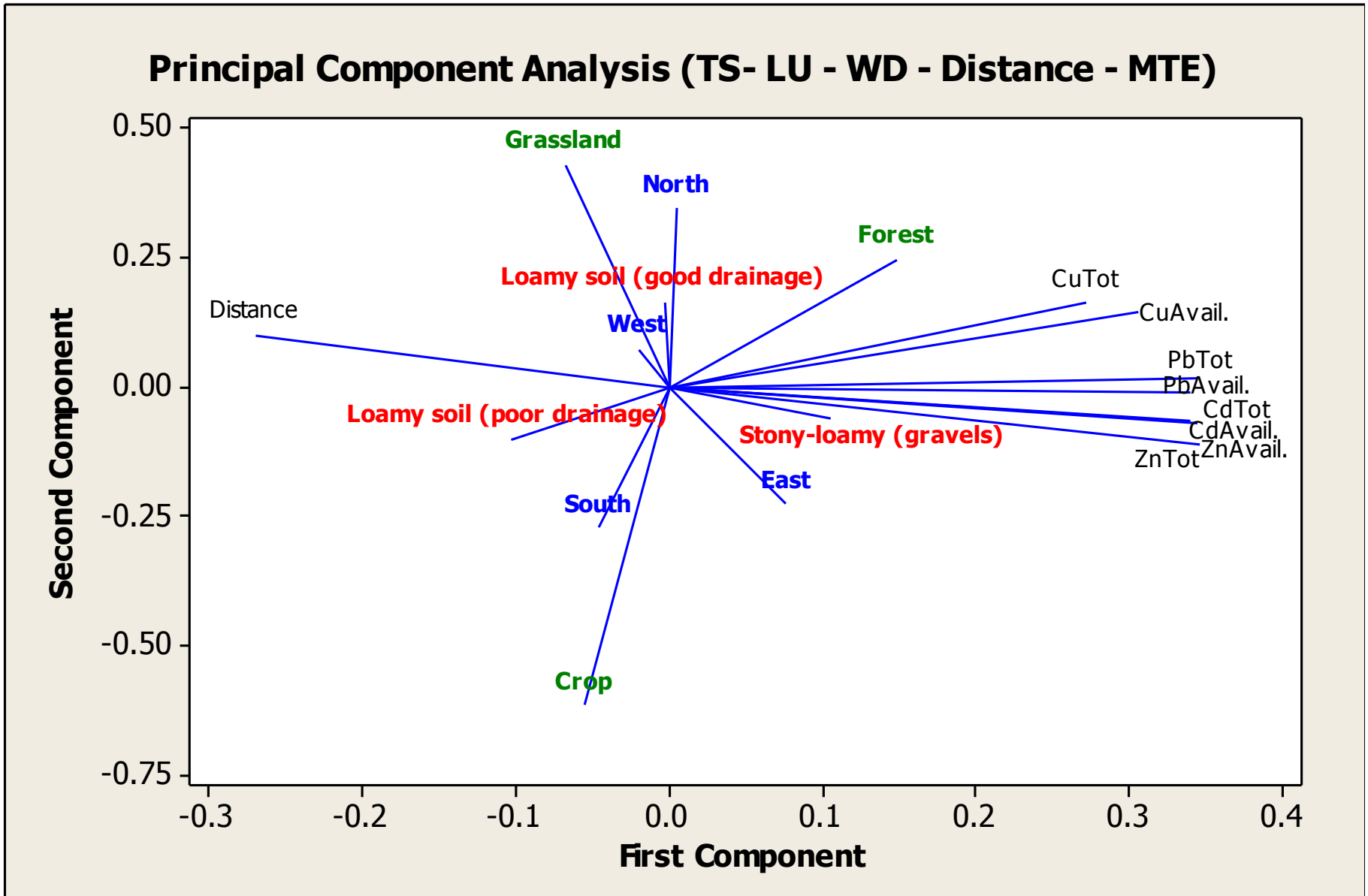
- Two different situations of MTE according to land use

- Cd and Zn total content are not impacted by land use in opposite to Cu and Pb total content





CONFIRMATION BY PCA ANALYSIS



SECOND AIM

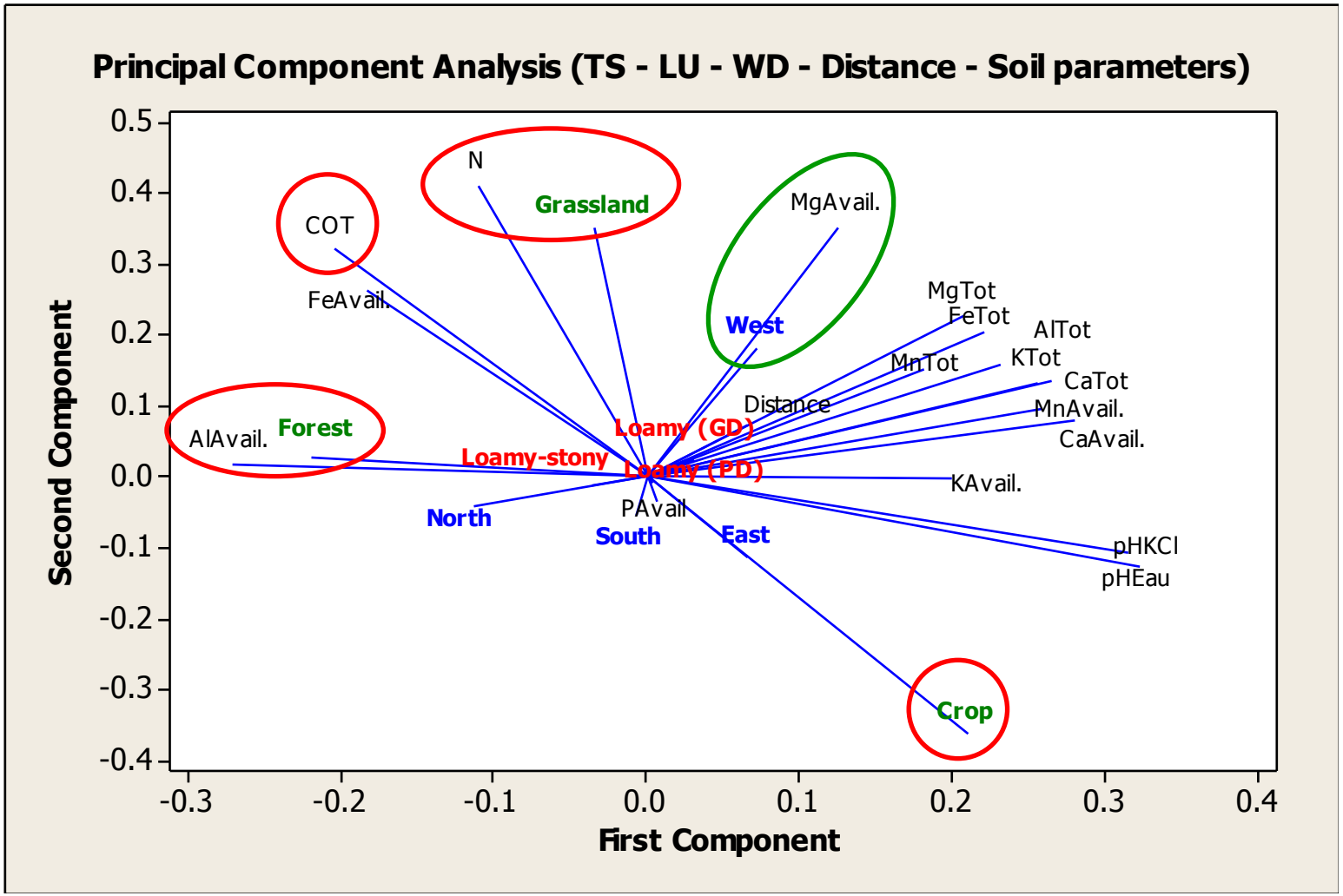
Fate of MTE in contaminated landscape

Impact of landscape factors on MTE distribution in soils

Variation factors of MTE mobility

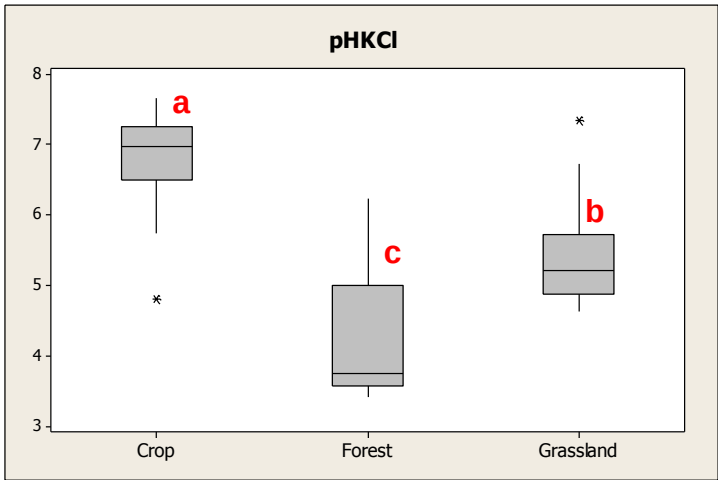
Interaction between soil properties and MTE contents in soils

RELATION BETWEEN SOIL PROPERTIES AND LANDSCAPE FACTORS



- No influence of soil type and distance
- Influence of land uses and one wind direction (a geologic impact)

RELATION BETWEEN pH_{KCL} - COT AND LANDSCAPE FACTORS



- Distance and wind directions factors don't affect pH_{KCl} and COT values in soils

- Soil type and land use influence pH and COT values in soils

Comparison of MTE and pH_{KCl} – COT

	Distance	**Wind direction**	**Soil type**	**Land use**
MTE	Yes	Yes	Yes (Cd-Pb-Zn)	Yes (Cu–Pb)
pH_{KCl}	No	No	Yes	Yes
COT	No	No	Yes	Yes

THIRD AIM

Fate of MTE in contaminated landscape

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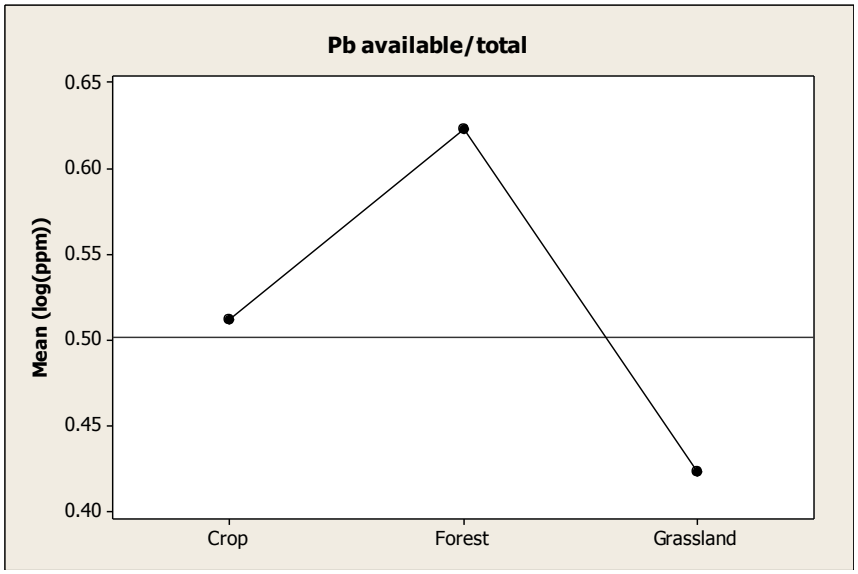
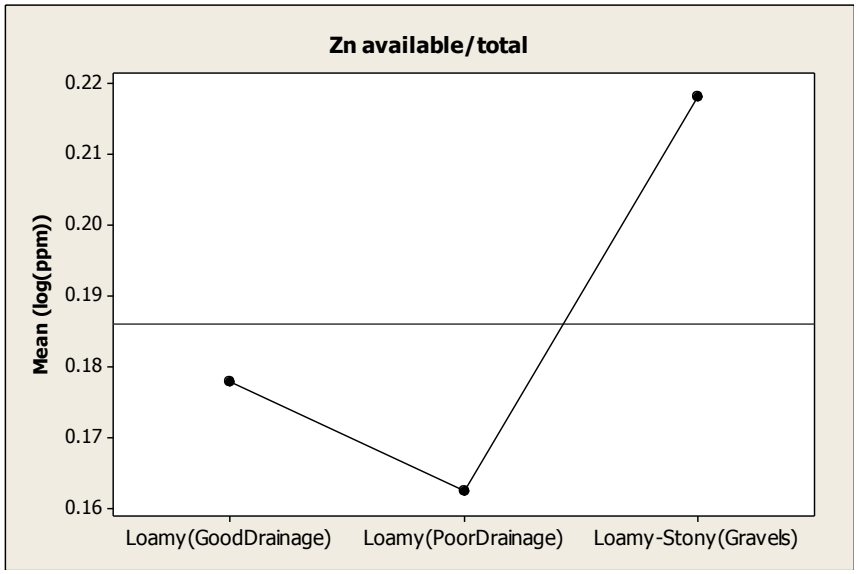
Interaction between soil properties and MTE contents in soils

Relation between MTE available/total ratio and Soil type – Land use factors

- Cd ratio is not influenced by the two factors
- Cu -Pb and Zn ratio are different according to land use → ratio on forest is always highest
- Zn ratio is modified by soil type → loamy-stony soil contains a high proportion of Zn available content





In forest, the fraction of potentially mobile Cu – Pb and Zn are more higher as Zn in loamy-stony soil

CONCLUSION

Fate of MTE in contaminated landscape

Impact of landscape factors on MTE distribution in soils

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-Important impacts for distance and wind directions
- Soil and land use are also significant

Interaction between soil properties and MTE contents in soils

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- Classical relations
- pH and COT variability is different than MTE

Factors of variation MTE mobility

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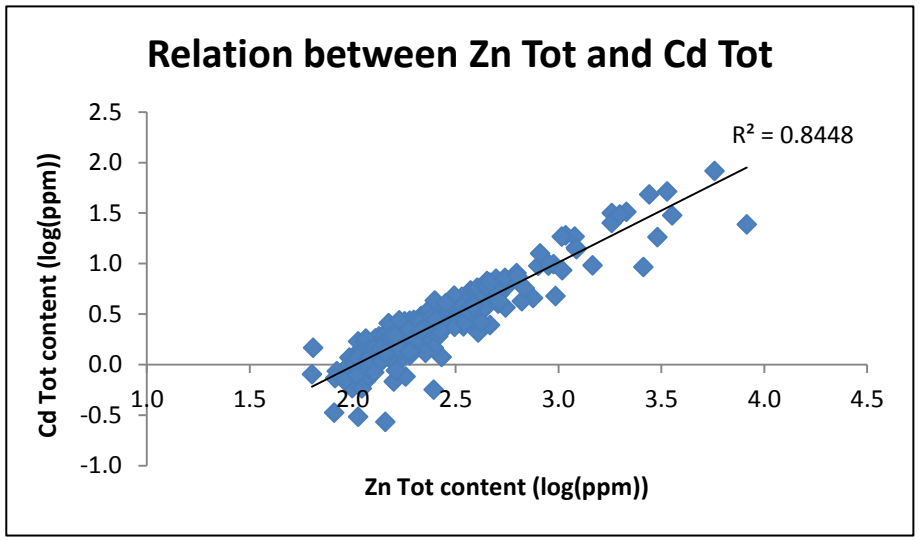
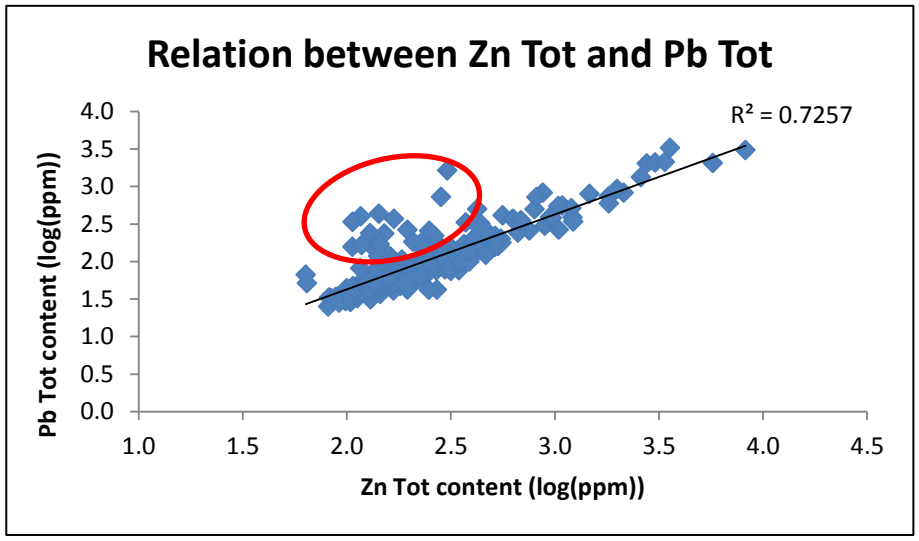
Soil type and land use impact MTE mobility

THANK YOU FOR YOUR ATTENTION…

RELATION BETWEEN ZN/PB AND ZN/CD





-Contaminants contents are strongly correlated one with the other.

- It thus seems that they have the same signature in term of landscape dispersion