GEUS

Pesticide sorption in fractured clayey tills varies substantially depending on soil domain and manure addition

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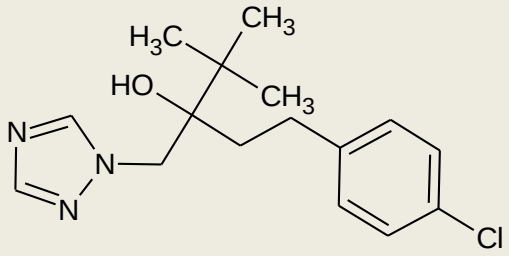
Background

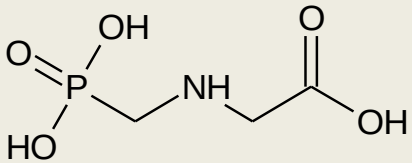
- The observed unexpected leaching of strongly sorbing pesticides, especially in clayey areas
- Knowledge that water transport may be fast through macropores in such soils
- Our hypothesis that sorption behaviour is different in macropores
- Our hypothesis that dissolved and colloidal material from manure may influence sorption

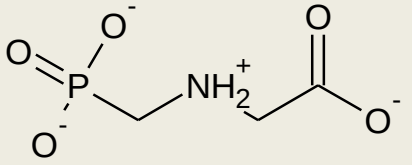
The pesticides

Tebuconazole
Fungicide
Hydrophobic (Log K_{ow} 3.7; 36 mg/L water)
No charge at neutral pH (pKa 5.0)

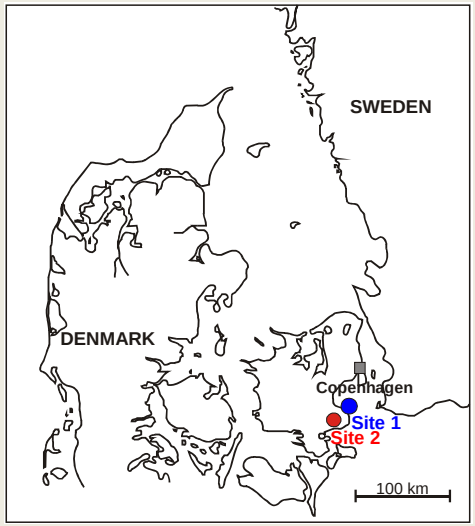


Glyphosate
Herbicide
Very hydrophilic (Log K_{ow} -3.4)
Negatively charged at neutral pH





Excavation pits



To 4.5 m at site 1

To 6 m at site 2

Eight visible soil domains

Plough layer

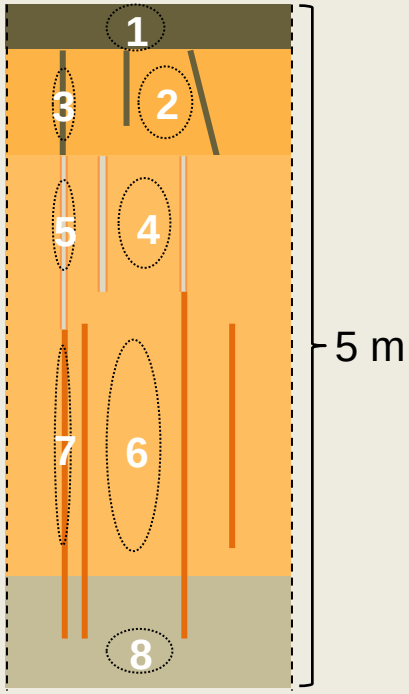
Oxidized with brown macropores

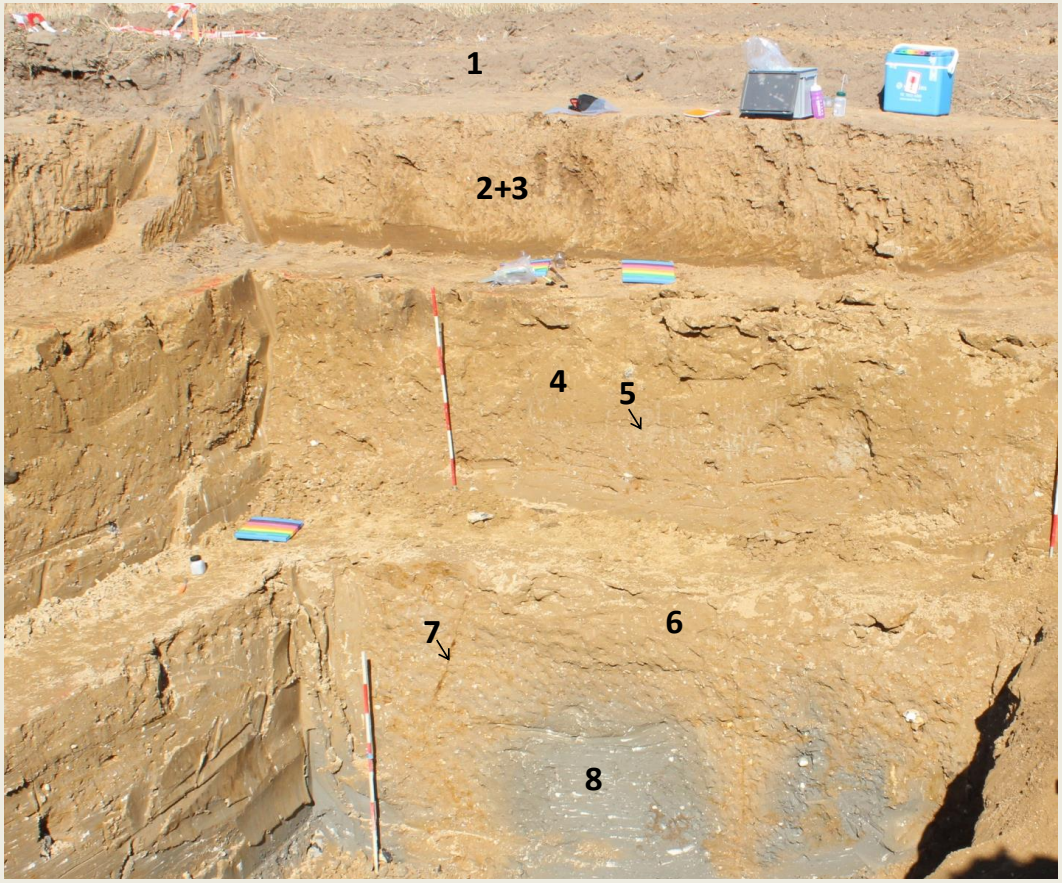
Oxidized with grey macropores and fractures

Oxidized with reddish fractures

Reduced with reddish fractures

Reduced





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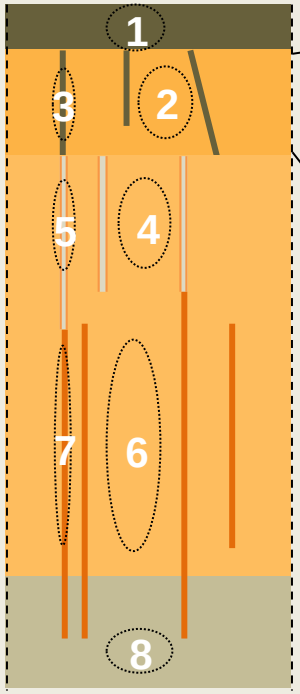

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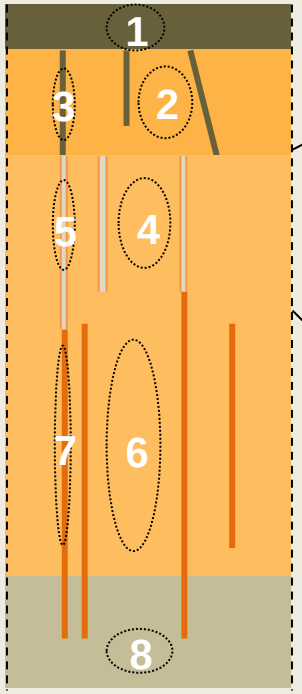

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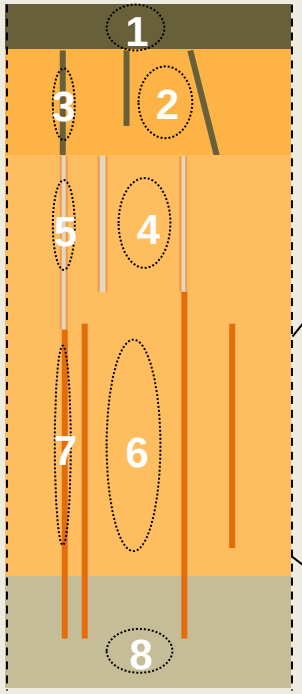


Visible differences in samples

Plough layer

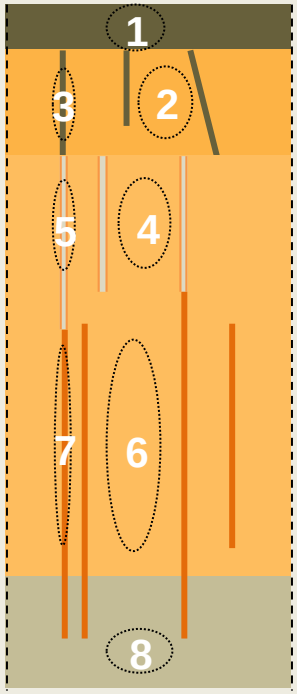
Oxidized with brown macropores

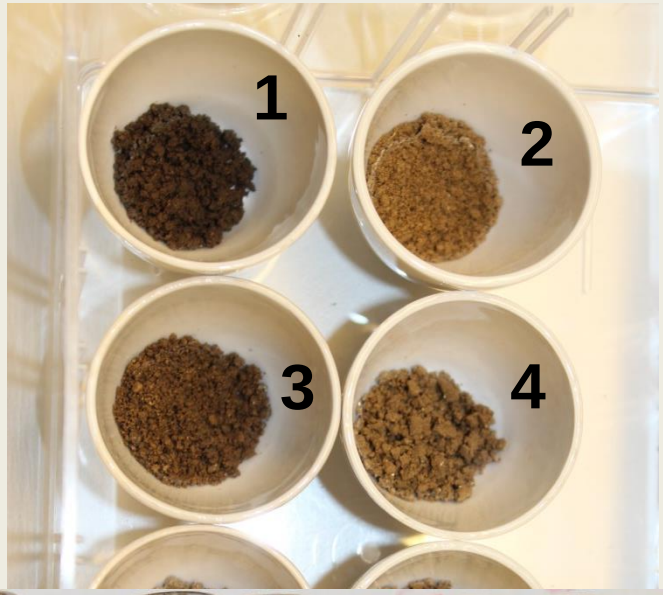
Oxidized with grey macropores and fractures

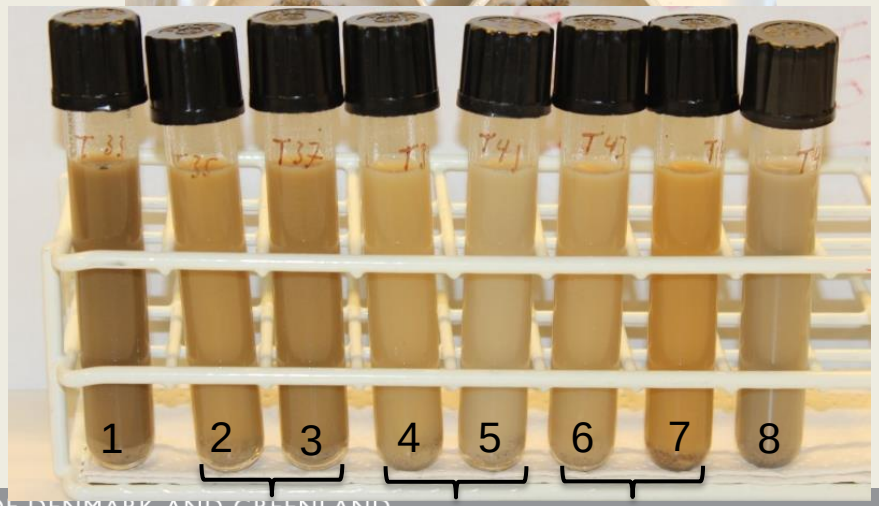
Oxidized with reddish fractures

Reduced with reddish fractures

Reduced



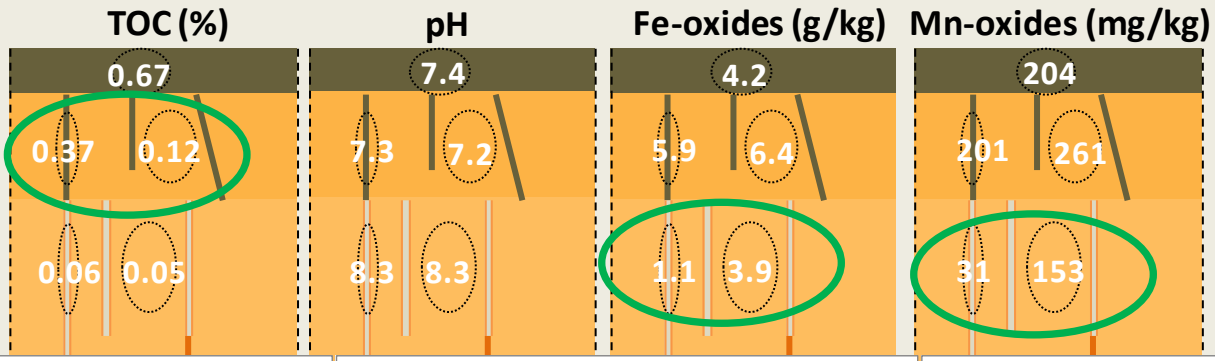


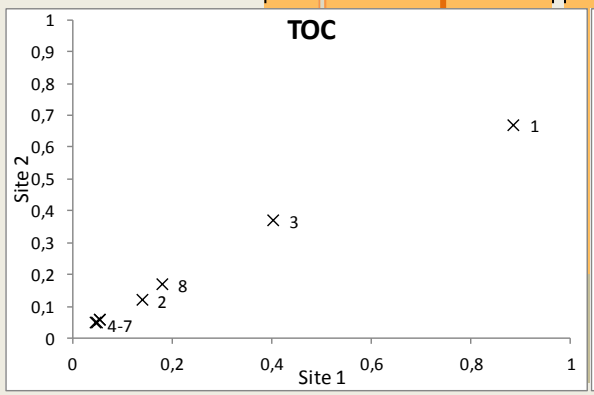


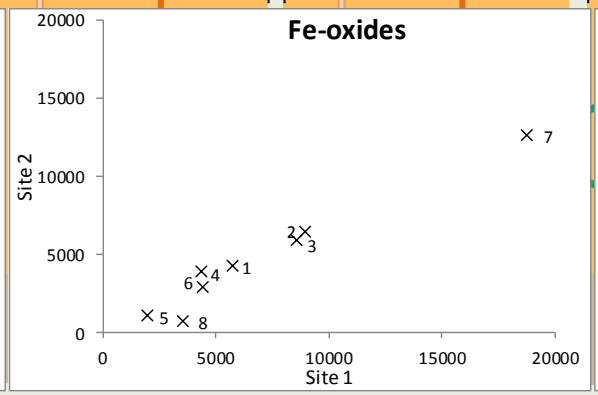
Soil domain characteristics

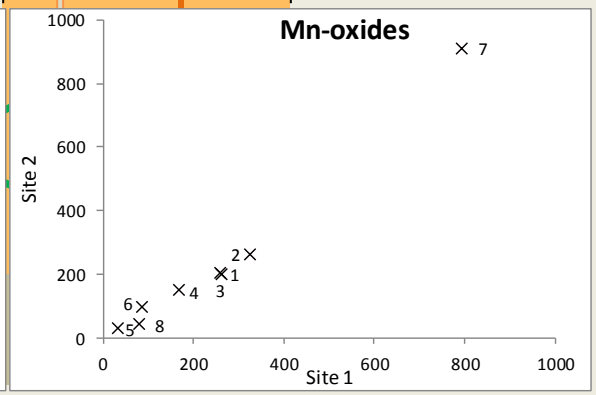
Texture, pH, TOC, TIC, different fractions of Fe, Mn and Al, surface area, CEC, exchangable cations…

Site 2:



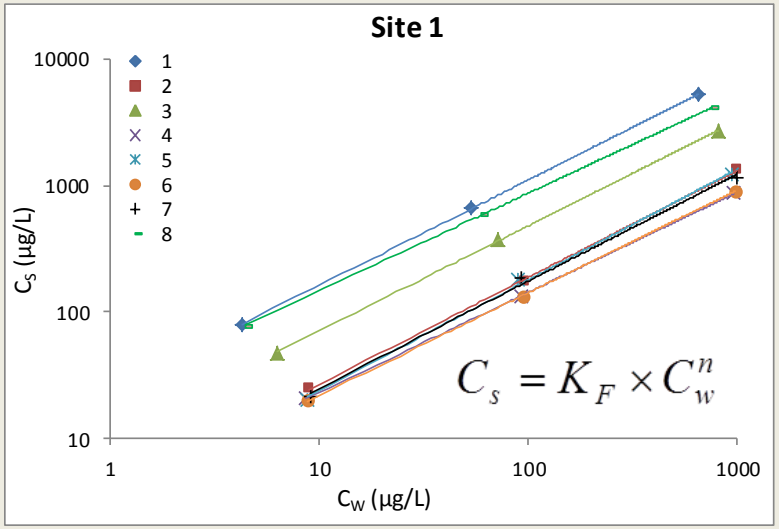


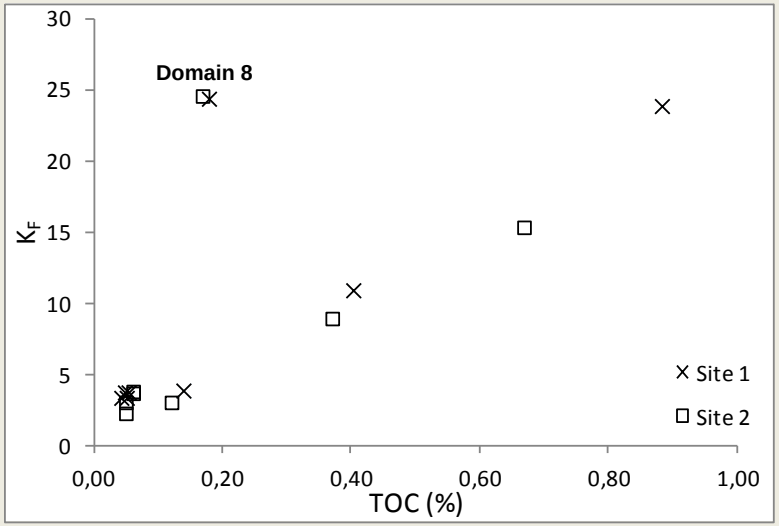


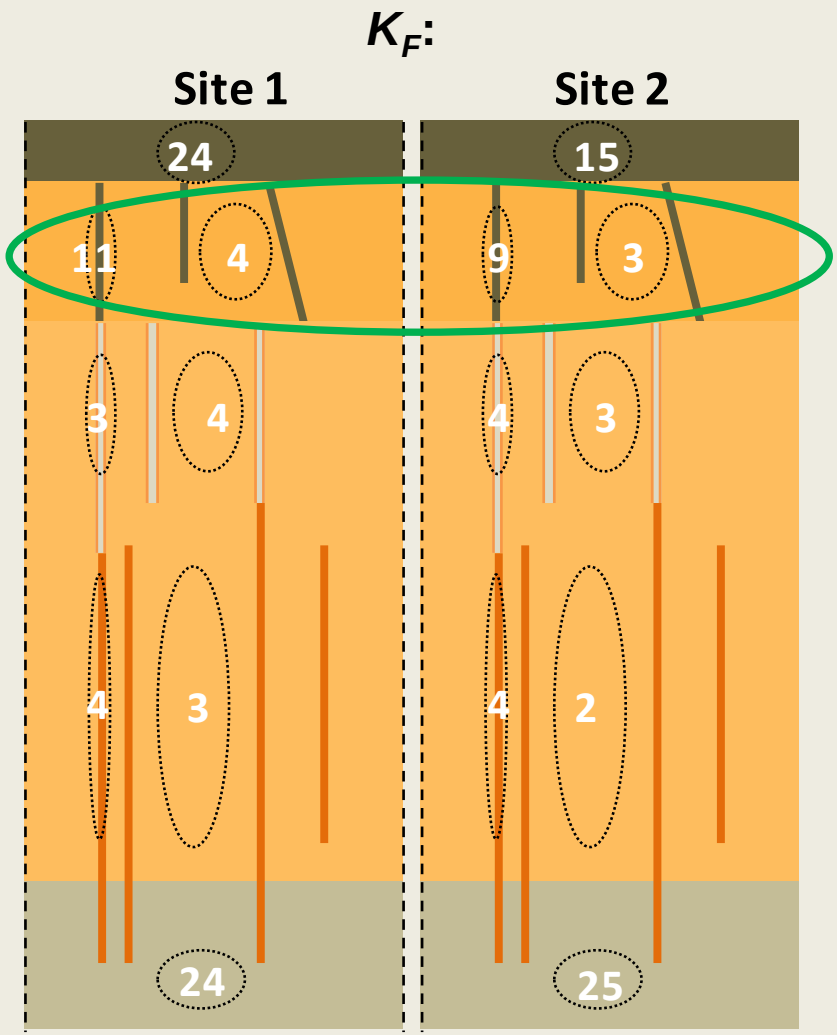


Site 1 very similar

Tebuconazole sorption



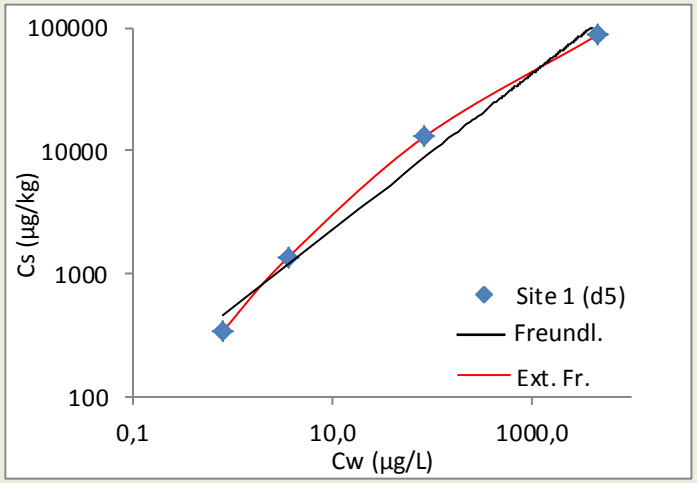




n = 0.77-0.87

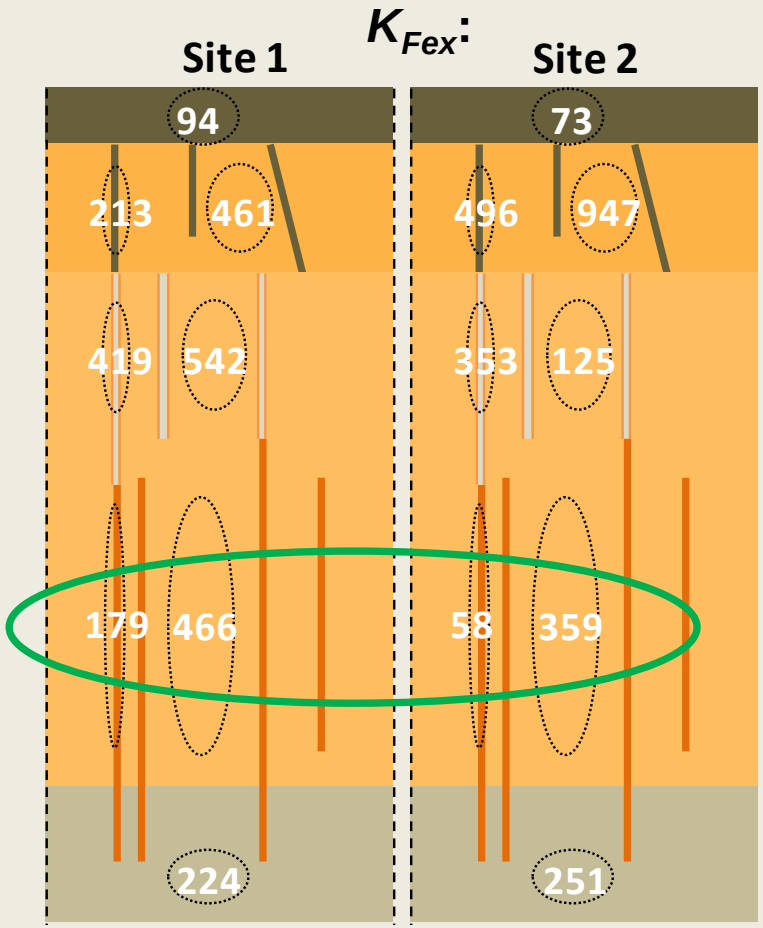
Glyphosate sorption

Data fit poorly to the Freundlich isotherm due to high concen-tration dependency:



$$C_s = K_{Fex} \times C_w^{n_{ex} C_w^{-D}}$$

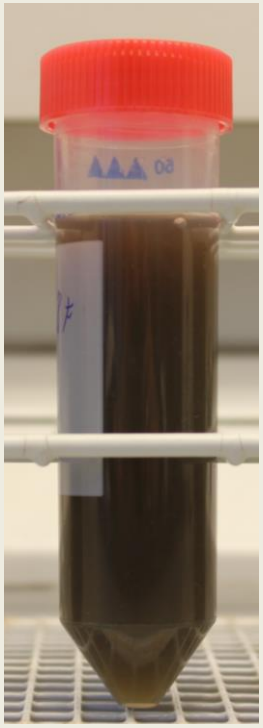
[Sibbesen, 1981; De Jonge et al., 2001]



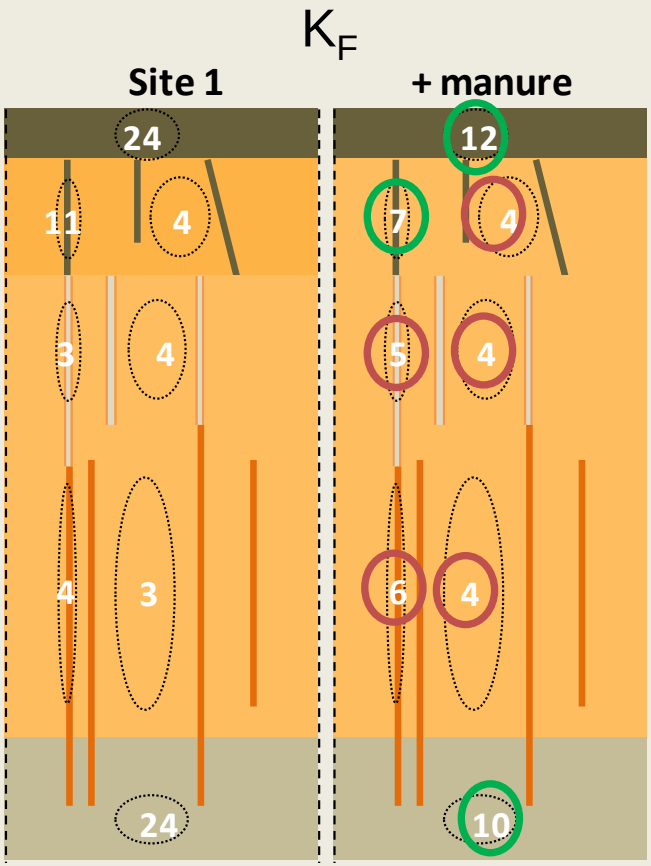
Also variation in *n* and *D*

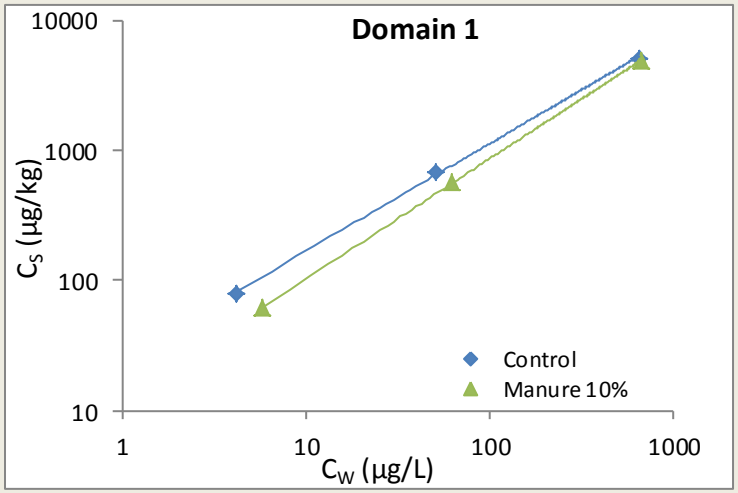
No single soil parameter influenced this distribution much

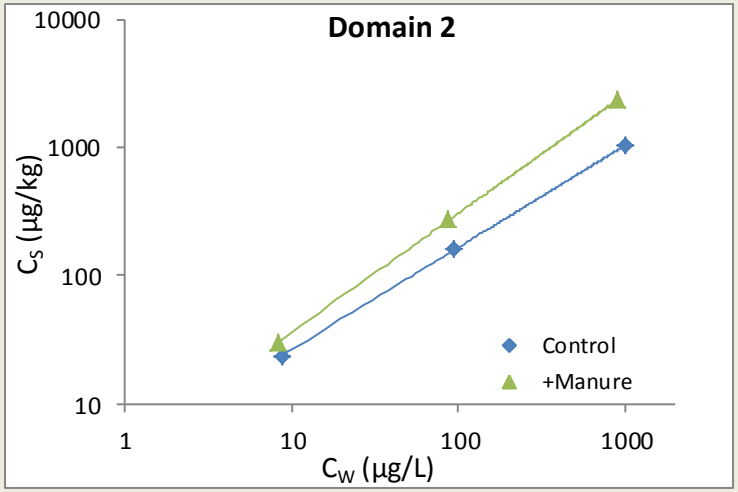
Tebuconazole sorption with manure



Liquid pig manure



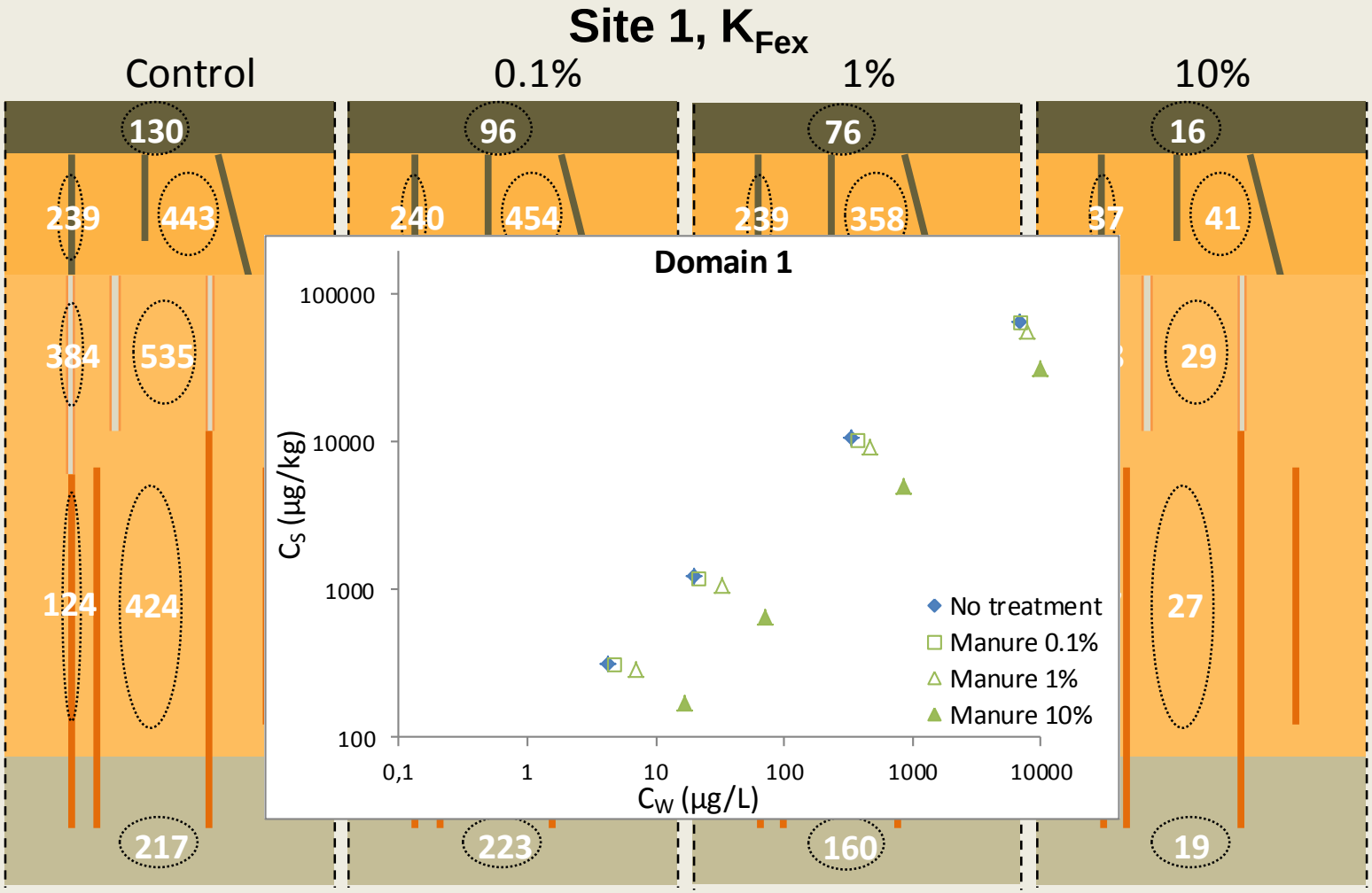




Less sorption as expected from hypothesis

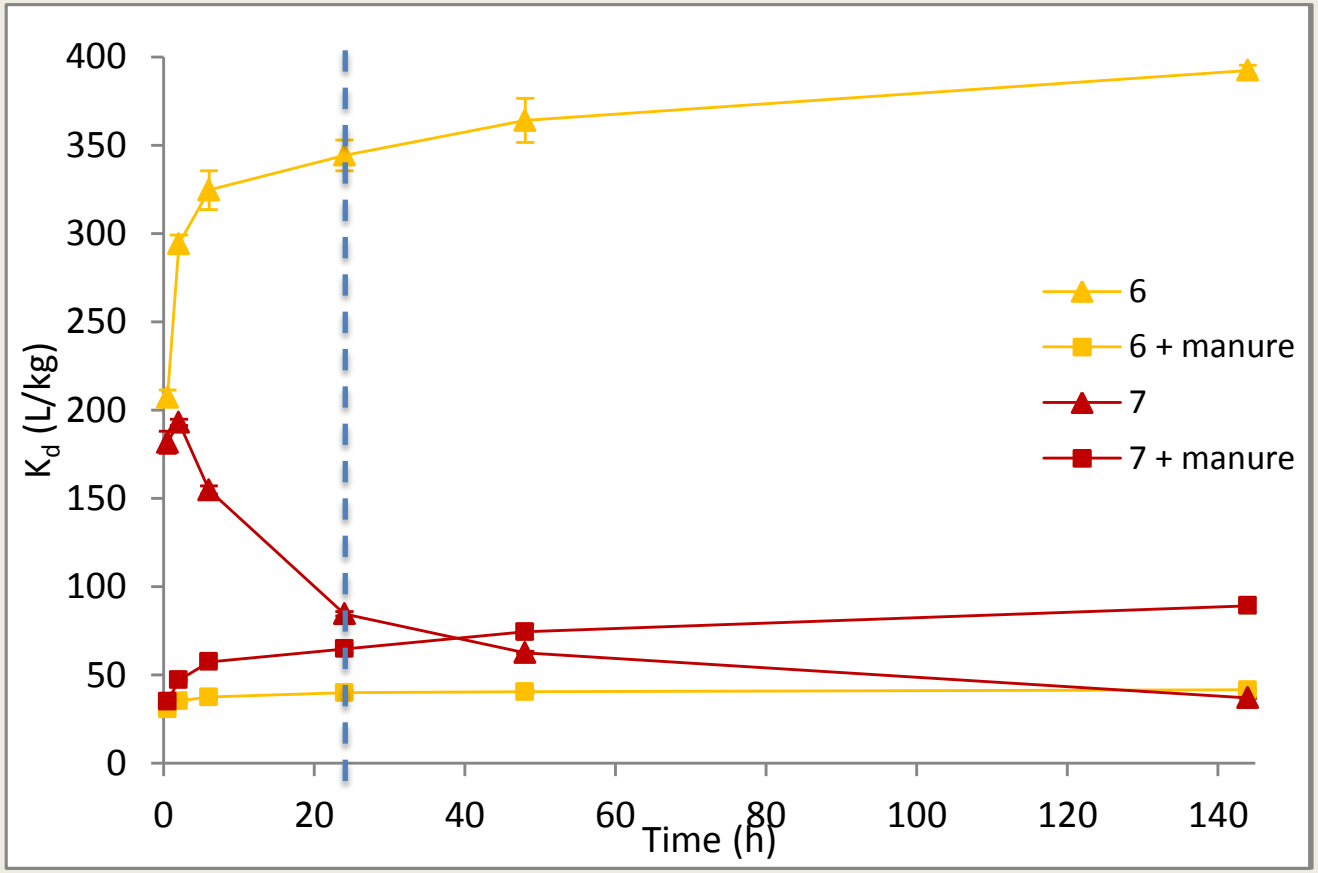
More sorption (reverse of hypothesis)

Glyphosate sorption with manure



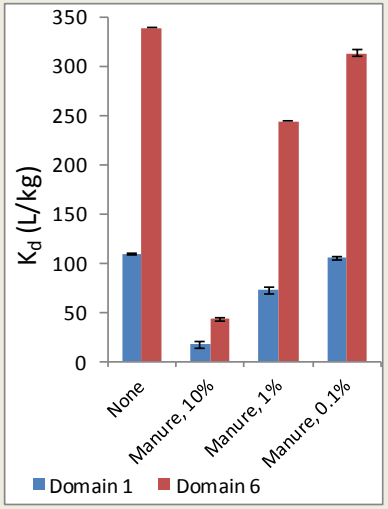
Generally same effect at site 2

Glyphosate sorption kinetics at low conc. (~1 µg/L)

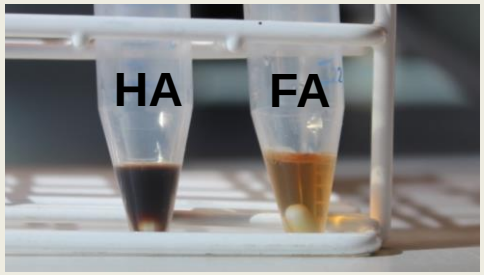


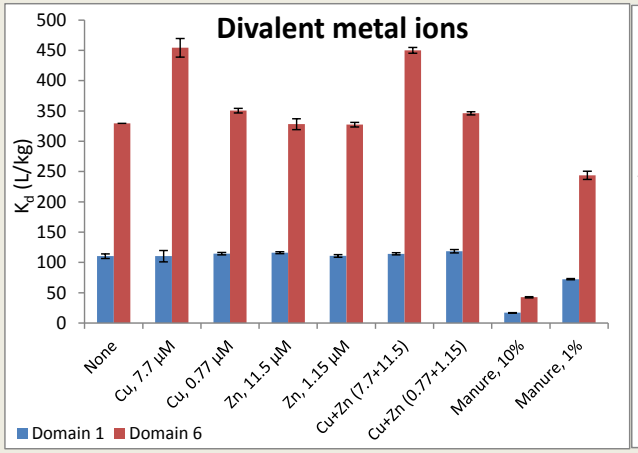
Domains 2 and 7 show odd sorption kinectics – but not when manure is added

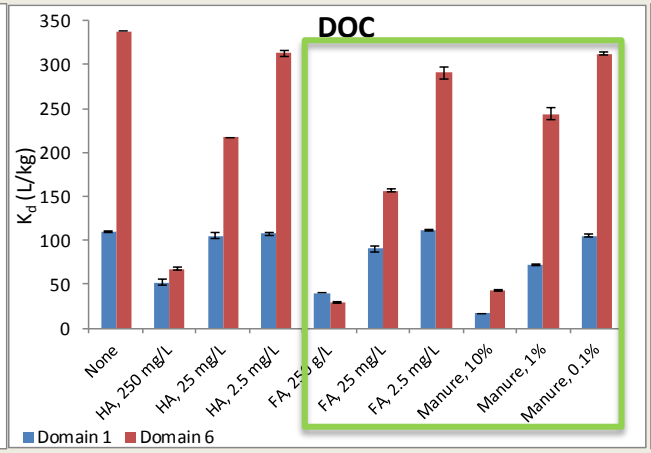
Understanding the effect of pig manure

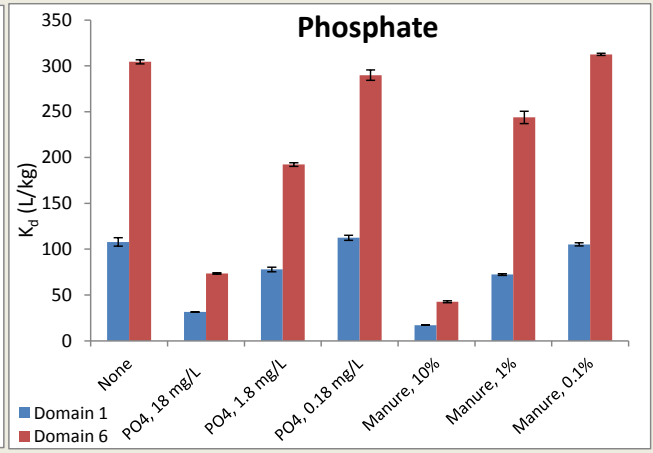


	~~Conductivity (µS/cm)~~	~~Cu (mg/L)~~	~~Zn (mg/L)~~	DOC (mg/L)	PO_4^{3-} (mg/L)
Pig manure	21900	4.9	7.5	2648	182
	Increasing K_d	Minor effect		Likely candidates	









Conclusions

- Preferential flow channels differ geochemically from matrix soil
- Pesticide sorption influenced (Glyph.>Tebuc.)
- Pig manure has big influence on sorption (strength, conc. depend., kinetics) but differently in different soil domains
- In the case of glyphosate, the combined effect of DOC and phosphate
- So what is the effect on leaching (P-28, friday)?