



Macropore distribution in a drain field and the effects on filtration of Contaminated Colloids transported through the pores to drain and subsoil

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Slide 1



Presentation outline

- Research in RACS course context (1 slide)
- Introduction (2 slides)
- Experiments carried out (4 slides)
- Results obtained (3 slides)
- Conclusions/perspectives (1 slide)
- References (main literature) (1 slide)

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Research in RACS course context

- My project
 - Is a part of a larger risk assessment of strongly sorbing pesticides from arable soil to ground- and surface water.
 - The project is carried out in collaboration with the Danish Ministry of the Environment; Environmental Protection Agency.
- Main research focus
 - The focus of my research is on agrohydrology/ soil physics elements: Transport and filtration from source (surface) to water resources (ground- and drainage water)
- Course expectations
 - I hope that this course will provide a insight in the field of chemistry of contaminated systems. This insight will be useful for my future research.

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Introduction

- Contamination sources and pathways to water resources in arable soil.
- Contamination sources
 - Different kind of pesticides
 - Object in this case are strongly sorbing pesticides as Glyphosate
 - Glyphosate is the active part of Roundup which is a herbicide.
 - Glyphosate makes herbs wither and is used between rows of trees, (e.g. coffee, nuts and wine), before harvesting of e.g. grain, sugar cane, soybeans, cotton and corn
 - Constitute 25% of global herbicide use
- Contamination problem
 - Political issue or real health risk

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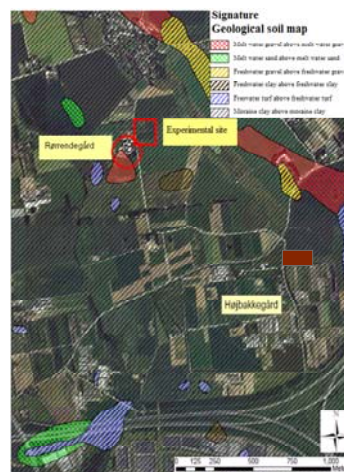
Introduction

- From source to water resources
 - Two different mobilising approaches of contaminated colloids
 1. Release from an exchange layer in the topsoil
 - Vegetation cover, management practice, soil texture ect.
 2. Desorption in soil matrix followed by diffusion to macropores
 - Electrical conductivity, pH, soil water content, organic matter content, soil texture ect.
 - Transported by preferential flows
 - Biopores; earthworms (*Lumbricus terrestris*) and soil roots
 - Fractures; glaciotectonic, desiccation fractures and human induced fractures along drains.
- We need to know more about:
 - Filtering in the macropores in depth and between biopores and fractures
 - The differences in flow systems between and in drain trenches.
 - Sorption and desorption kinetics
- Research perspectives:
 - In modelling
 - To assess the transport of contaminated colloids to drains and thereby to surface water and the transport to groundwater

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Experiments carried out



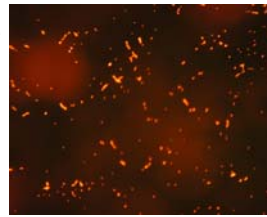
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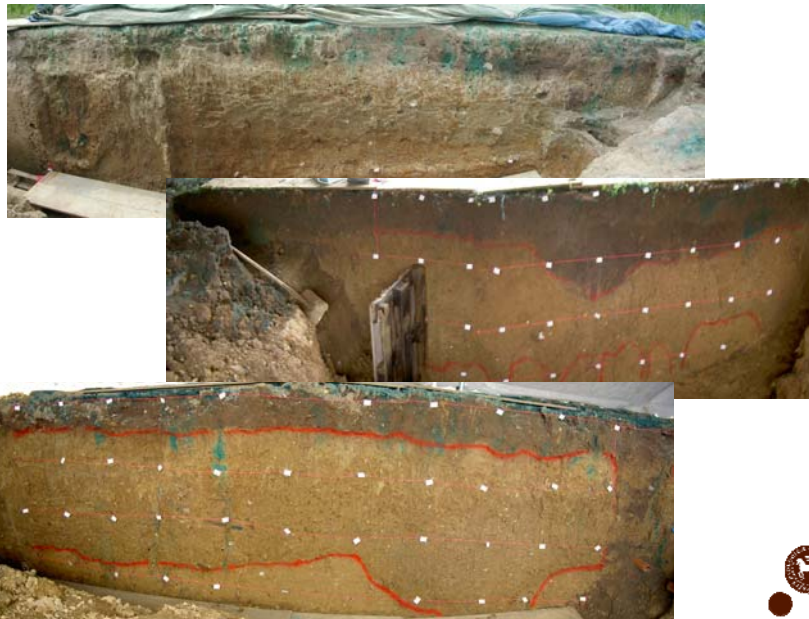
Experiments carried out

50mm irrigation with 3 tracers to a 6m² plot

- Dye: Brilliant Blue (food colour)
 - Colouring the hydraulically active macropores
- Artificial colloids: 1µm red melanin resin fluorescence microspheres, carbonated surface.
 - Other microspheres have been used without success.
- Conservative tracer: Bromide 0.14g/L
- Glyphosate or other pesticides has not been used



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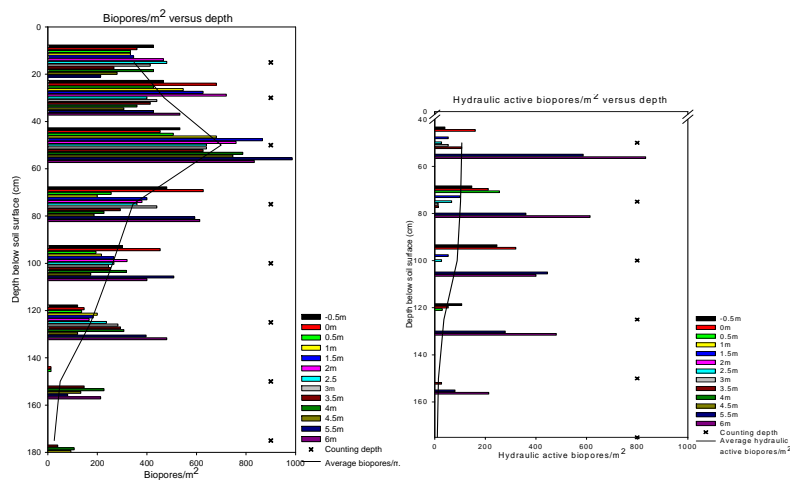
Experiments carried out

- Counting biopores
- Analysing types of fractures
- Drain water samples
- Soil samples
 - Bulk density, texture, "tracer samples"
- Picture documentation



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Results obtained: Biopore counting



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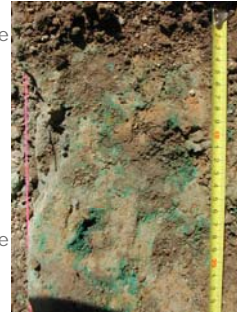
Results obtained: Biopores in drain trench and transport in drains

Experiment 1:

- 320 biopores/m² in 100cm depth
- In addition other macropores were hydraulic active (coloured blue):
 - Surfaces between different kind of filling material.
 - Desiccation fractures
 - Human induced fractures when constructing the drain
- Direct connection to drain pipe, but no colouring inside the pipe
- Largest number of hydraulic active biopores in 100cm depth were: 446 biopores/m²

Experiment 2:

- 67 biopores/m² in 100cm depth
- In addition other macropores were hydraulic active (coloured blue) like experiment 1.
- Direct connection to drain pipe, but no colouring inside the pipe
- Largest number of hydraulic active biopores in 100cm depth were: 67 biopores/m²



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Results obtained: Biopores in drain trench and transport in drains

Experiment 3:

- The number of biopores wasn't counted, but the drain trench was tipped and examined very carefully
 - Few pores connected to a human induced fracture which was hydraulic connected to the drain.
 - 1. active pore was found after 85 cm of tipping
- Direct connection to drain pipe, and a lot of colouring in the drain pipe.
- The concentration of bromide in drainage water 10m from the study area was around 122mg/L
- The concentration of irrigation water was measured to be around 129mg/L.
- Preliminary conclusion:
 - The total numbers of biopores can not be used as a measure for preferential pathways
 - The number of hydraulic active pores is a better measurement, but no connection between distance to drain and numbers of active biopores has been found
 - A few pores with very good connection to the drain system can give a significant and fast responds in the drainage water.



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Conclusions/perspectives

- The hydraulically active biopore distribution appears to be random; it is unaffected by the drain trench and the distance to the drain.
 - Some correlations with bulk density is possible, though
 - A sandy layer between the A-horizon seems to change the flow pattern from clustered hydraulic active biopores to single biopores.
- In the wettest situation few biopores were active, but most of those did continue from biopores to fractures
- When the analysis of the colloids has been carried out and interesting data results has been obtained, the next step in understanding the leaching would include some more chemistry. If that is going to happen I need some knowledge of kinetics, degradation etc.

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