Predicting soil physic parameters, copper release and transport in a polluted field from X ray CT-images

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Introduction

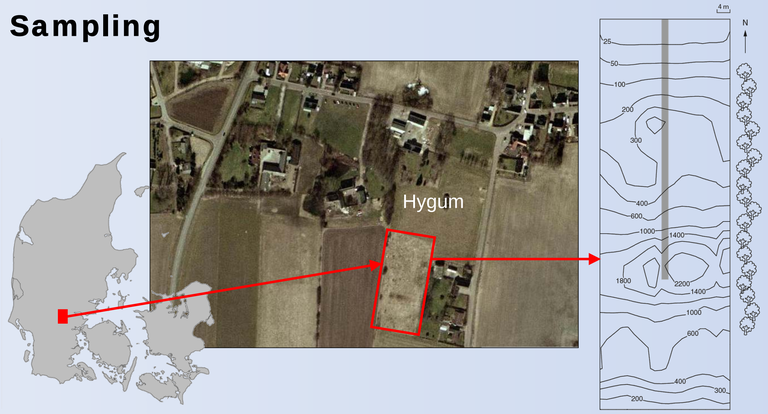
- Copper (Cu) pollution can shift soil functionality and affects, for instance, soil structure and water flow and contaminant transport. Visualization techniques can be useful for linking soil structure and transport phenomena.

Objectives

- To study the risk of copper leaching in a Cu polluted field
- To predict water and contaminant transport from X-ray CT analysis

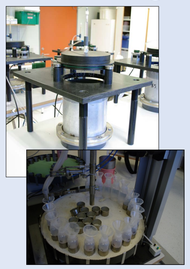
Methods

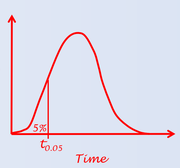
Sampling



- Copper polluted field, Hygum (Denmark). Sandy loam, SOM from 3.3 to 6.0 g 100 g^{-1}
- 4 points along a gradient in Cu concentration with 22, 466, 2228 and 3837 mg Cu kg^{-1} soil.
- 4 columns (10x8 cm) in each point. Scanned by X-ray CT

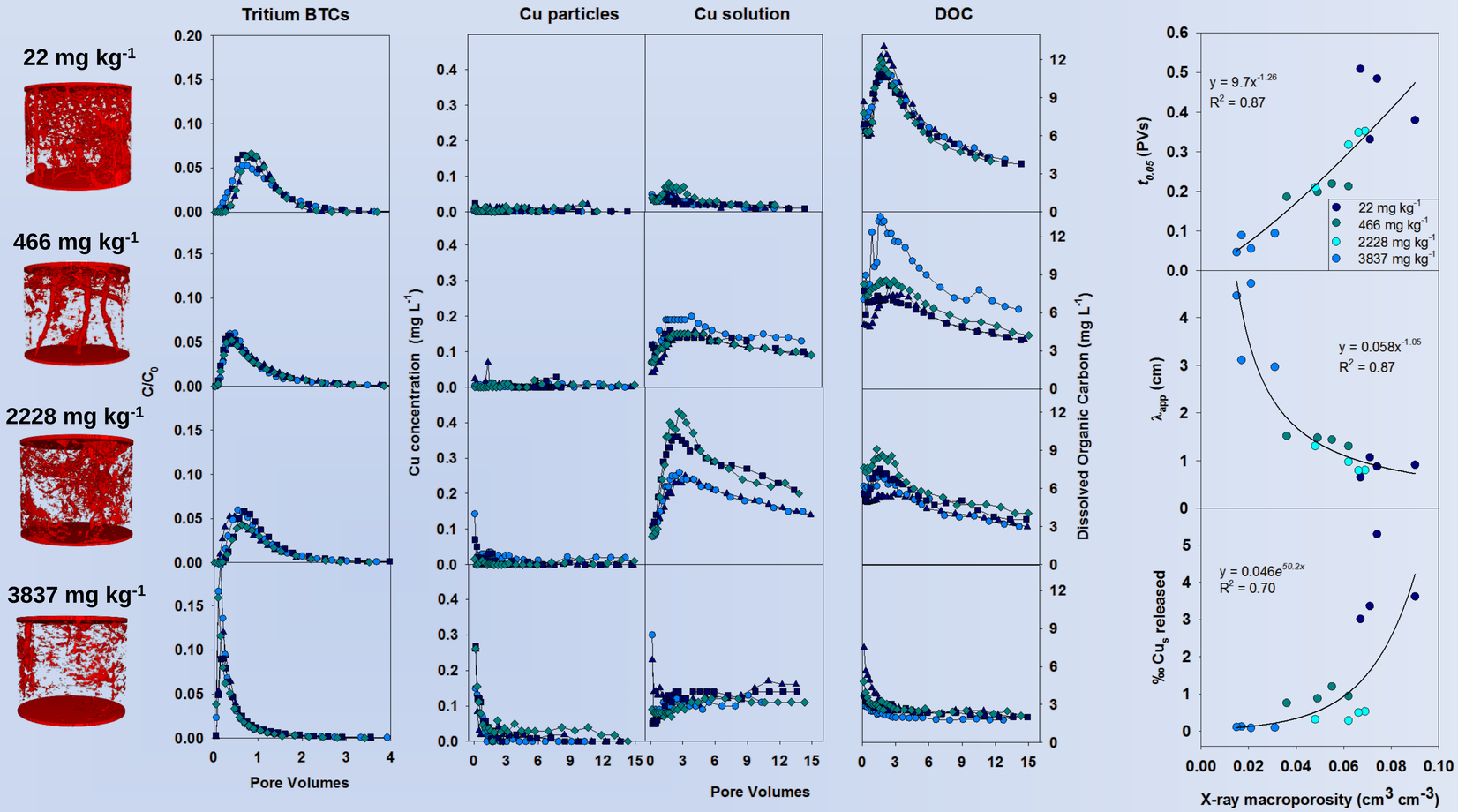
Leaching Experiments





- Rain intensity of 10 mm h^{-1}, tritium as inert tracer
- Measures in the effluent: tritium, copper associated with particles (Cu_p), copper in solution (Cu_s), dissolved organic carbon (DOC)
- 5% arrival time ($t_{0.05}$) and apparent dispersivity (λ_{app}) were calculated from tritium breakthrogh curves (BTCs)
- X-ray CT macroporosity (pores > 0.2 mm) was calculated from the CT images

Results



- Point 3837 presented the highest preferential flow -> massive structure with small cracks due to freezing and thawing. Earthworm burrows in Point 466 induced preferential flow. Points 22 and 2228 showed more matrix flow -> well connected porous system
- Cu leaching was facilitated by particles in the 1st flush (1 PV) and by DOC after 1st flush
- Strong preferential flow prevented DOC leaching and Cu associated with DOC (Point 3837)
- X-ray macroporosity gave good predictions for the transport parameters $t_{0.05}$ and λ_{app} . Preferential flow decreased with increasing X-ray macroporosity. It was also able to predict the ratio of Cu released . Higher macroporosity enhanced Cu mobility

Conclusions

- Water and solute transport changed dramatically along the Cu gradient - likely due to Cu-induced changes in the magnitude and interactions of the biophysical functions important for soil structure formation
- X-ray macroporosity seemed a good parameter for predicting solute transport and contaminant mobility from CT images

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