WP2.1 The role of microbial peat decomposition in land subsidence

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PEAT

- Peat is the accumulation of dead plant materials under oxygen limited environments
- Peat matrix consists of high organic matter (OM)
- OM is carbon based materials which are valuable for agriculture but also important for microorganisms

Figure 1. Peat colum from Bunschoten, Netherlands and microscopic image of plant material (*sphagnum*)

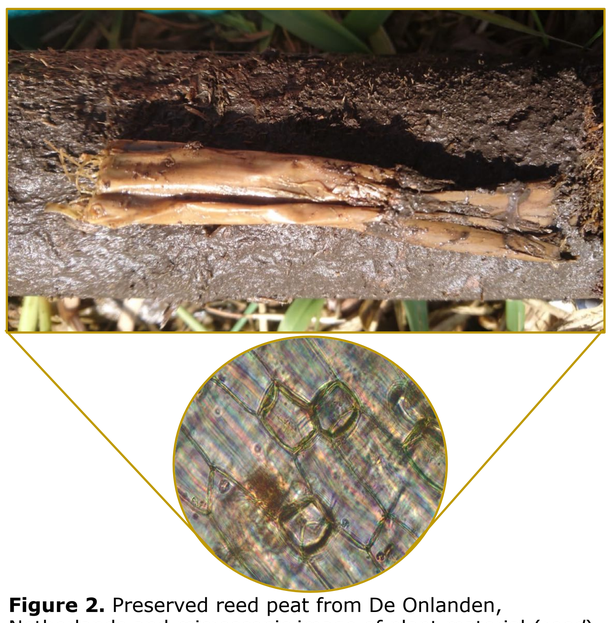


Figure 2. Preserved reed peat from De Onlanden, Netherlands and microscopic image of plant material (*reed*)

MICROORGANISMS[1,3]

- Microorganisms can degrade OM (*decompostion*) to gain energy, to survive, to reproduce and also to sustain nutrient cycling.
- They produce special units called exoenyzmes to degrade OM. These units are sensitive to environmental changes such as oxygen and water availability
- Phenolic compounds which are produced by plants might affect exoenzme activities.
- Since peat consist of dead plant materials, it is rich in different phenolic compounds

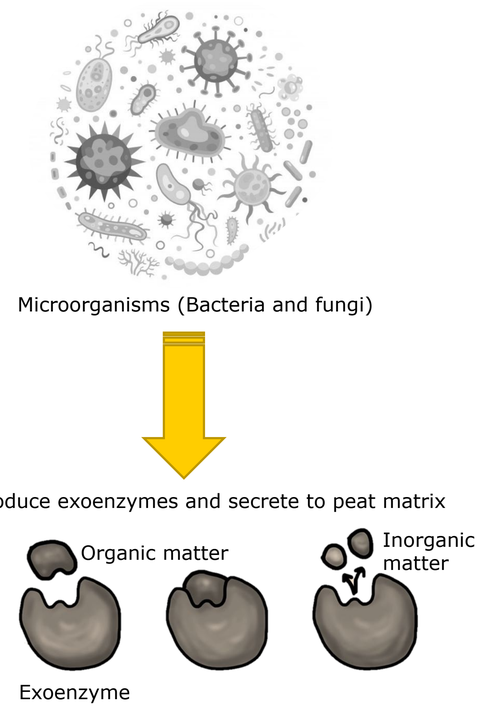


Figure 3. Function of exoenzymes in OM decomposition

WHAT HAPPENS

- Water level in the Netherlands is altered throughout the year
- This creates three different zones in peat matrix based on the oxygen availability
- Oxygen presence activates more microorganisms
- They start decomposing the peat to gain energy and to reproduce
- Then, OM is converted into CO_2 or other inorganic products which increase the greenhouse gas emissions from peatlands also cause land subsidence

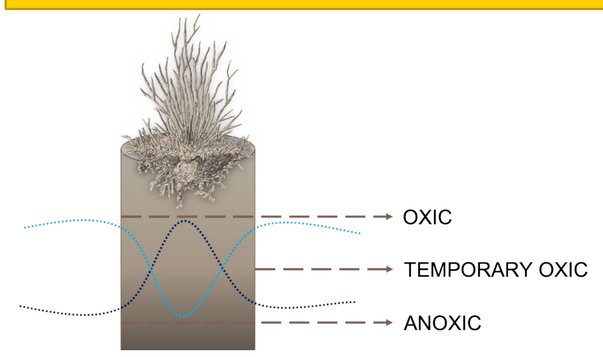


Figure 4. Peat profile based on water level changes

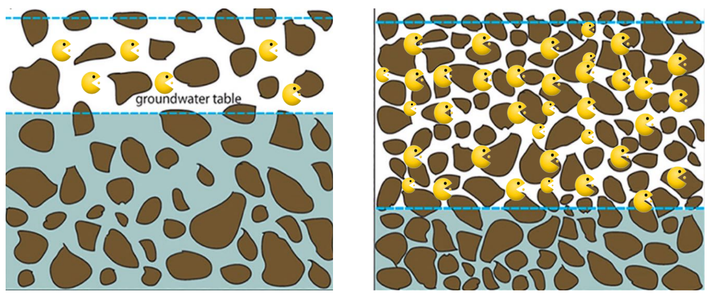
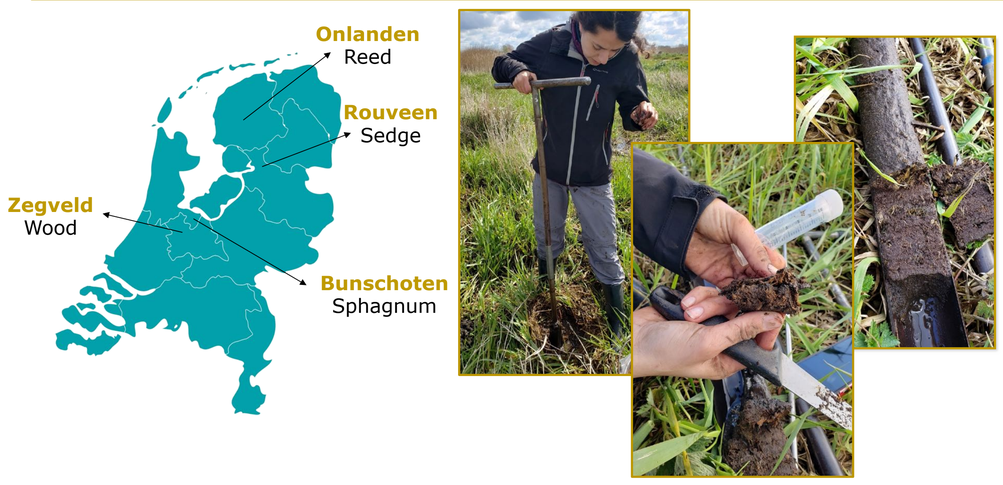


Figure 5. Microbial activity with higher and lower water table (revised from *Ahmad et al 2020*)[2]

RESEARCH FOCUS

- How do microorganisms degrade the peat in a changing environment?
  - ✓ The function of extracellular enzymes
  - ✓ The inhibition role of phenolic compounds
  - ✓ Environmental factors: oxygen presence and absence
- How does microbial decomposition alter physical structure of peat?
  - ✓ Chemical content of peat matrix
  - ✓ Pore space and distribution

WHAT I DO



Visit peatlands with different dominant plant species in their matrix
Collect samples from various depths based on the degradation status

Sort soils out in the laboratory
Keep them under oxic and anoxic coditions

Measure microbial activity
- CO_2 emissions
- Exoenzyme activities

Phenolic compounds determination in different peatlands (HPLC method)
Inhibition experiments: phenolic compounds and exoenzyme interaction
Long term experiments: physical monitoring of peat with high decomposition rate

FOR YOU ☺

"The essence of the independent mind lies not in what it thinks, but in how it thinks." — Christopher Hitchens
Every opinion is valuable, please leave a comment

What do you want to know within the scope of this project?
How can I help you?, What is valuable/important for you?, What are your concerns?

References

1. O. I., O., A. A., A., A. N., M., M. O., A., C. N., N., & A. N., O. (2020). Microbial Diversity: Values and Roles in Ecosystems. Asian Journal of Biology, 9(1), 10-22. https://doi.org/10.9734/ajob/2020/v9i130075
2. S.A., H.L., A.G., J.C., & B.L. (2020). Long-term rewetting of degraded peatlands restores hydrological buffer function. Science of the Total Environment, 749. https://doi.org/10.1016/j.scitotenv.2020.141571
3. Z.U., & T.H. (2021). Revisiting the concept of enzymic latch on carbon in peatlands, 779. https://doi.org/10.1016/j.scitotenv.2021.146384

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For more information: https://nwa-loss.nl/