EGU21-9922
https://doi.org/10.5194/egusphere-egu21-9922
EGU General Assembly 2021

Changes in peatland hydrology alter organic matter chemical composition in ombrotrophic Finnish mires: a comparative Py-GCMS depth profile study

Kristy Klein[1,2], Miriam Groβ-Schmölders[2], Christine Alewell[2], and Jens Leifeld[1]
[1]Agroscope, Climate and Agriculture, Zürich, Switzerland (kristy.klein@agroscope.admin.ch)
[2]Environmental Geosciences, University of Basel, Bernoullistrasse 32, CH-4056 Basel

From a carbon sequestration perspective, peatland restoration projects could be considered successful when net primary productivity exceeds decomposition, resulting in net peat growth in the ecosystem. To demonstrate the effectiveness of peatland restoration projects with a carbon storage aim, analytical techniques are needed that can distinguish between natural/restored ecosystems undergoing (or transitioning to) net peat growth and degraded ecosystems experiencing increased rates of aerobic decomposition (carbon loss). Molecular analysis techniques able to relate changes in organic matter (OM) chemical composition to changes in degradation status occurring on the mechanistic level are especially needed.

This study combined a molecular biomarker and chemical compound class approach to conduct a depth-based molecular comparison of natural (ON) and drained (OD) ombrotrophic peatland sites in Lakkasuo Finland. To explore how changes in hydrology impacted peat OM chemical composition, the relative abundance of various molecular biomarkers (Sphagnum marker p-isopropenylphenol, lignin vascular plant markers) and chemical compound classes (phenolics, polysaccharides, aromatics, N-containing compounds, lipids) was determined with depth from three replicate cores per site using pyrolysis gas chromatography tandem mass spectrometry (Py-GCMS). Py-GCMS results were compared with onsite vegetative assemblages and bulk elemental analysis conducted on the same cores. ON and OD were matched by age using radiocarbon dating at three depths per core.

For OD relative to ON, significant reductions in average relative percent abundance were observed for p-isopropenylphenol, phenolics and polysaccharides, and corresponding increases in abundance were observed for lignin, aromatics, N-containing compounds, and lipid sterols. Differences in compound classes between sites were greatest in the drainage-affected upper acrotelm, and diminished with depth. Samples consistently below the depth of the water table (>20 cm) followed similar trends in both ON and OD, suggesting that deeper horizons remained unaffected by the onsite drainage activities. An increasing trend in the relative abundance of lignin-derived compounds was observed with depth - particularly in ON. As the plant macrofossil assessment did not suggest previous dominance of vascular plants, this trend was considered evidence for preservation of lignin in anaerobic conditions in organic soils. Overall, these findings

indicate that differences in chemical composition between the two sites can be directly correlated to OM transformation occurring on a mechanistic level, and that observed shifts in chemical composition reflect the effect of altered hydrology in peatland ecosystems.