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Characterizing ecosystem-driven chemical composition differences in natural and drained Finnish bogs using Pyrolysis-GC/MS

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Aerobic decomposition increases in drained peatlands; releasing stored organic matter (OM) and shifting greenhouse gas fluxes from sink to source. This study explored how drainage influenced peat OM chemical composition by investigating paired sites from a Sphagnum-dominated ombrotrophic Finnish bog undergoing contrasting hydrological management (natural and drained). Peat OM was investigated in replicate cores using analytical pyrolysis, compared with observed vegetation, elemental analysis (O:C, N:C), stable isotopes (δ13C, δ15N), and fraction radiocarbon. Principal component analysis of quantified pyrolysis products separated four primary components: vascular plants vs Sphagnum, aerobic degradation of fresh plant biomass, anaerobic processes in water-saturated depths, and pine vs Eriophorum. The largest influence of drainage on peat chemistry was via aerobic decomposition (decreased abundance of Sphagnum phenols and simple polysaccharides; accumulation of macromolecular polysaccharides) ($p<0.05$, 0-2 cm). Drainage-induced shifts in vegetation (from Sphagnum to Pinus sylvestris ($p<0.01$, 0-2 cm) were reflected by increased abundance in lignin, N-compounds, and lipids, and decreased abundance in phenols and polysaccharides. Anaerobic processes also differentiated the natural and drained sites and primarily affected polysaccharides ($p<0.05$, 0-2, 8-10 cm). Vegetation shifts and aerobic decomposition similarly affected many of the same compounds upon drainage-demonstrating the simultaneous influence of different processes on the same OM. Pre-drainage intercore variation illustrated the importance of replicate cores in disentangling anthropogenic changes from natural biodiversity. These findings suggest that even short-term and moderate alterations in peatland hydrology strongly influence the chemical composition of peat OM, and that its chemistry serves as an effective indicator to assess decomposition status.

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