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Sources of variability in peat composition and the role of peat age

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During peat formation decaying plant material undergoes partial decomposition that continuously transform its organic matter. As part of this transformation, aromatic moieties such as plant-borne polyphenols are considered to accumulate relative to more labile compounds such as carbohydrates. Here, 13C CPMAS-NMR data from 71 peat samples from sites across Europe (61°48' N – 46°49' N) are analyzed for their variability. Sites differ in their degree of peat disturbance and range from natural to long-term drained and thus strongly degraded. Application of a molecular mixing model to the NMR data indicated that, on average, peat consists by 27, 22, 21, 18, and 11 % of carbohydrates, aliphatics, aromatics, proteins, and char, respectively. Compositional variability was most pronounced for aromatics and carbohydrates. So far, half of the samples was age-dated using 14C. Calibrated 14C ages in the data set range from recent to c. 10000 years BP. Relationships between peat composition and age were non-linear and highly significant. Aromatic moieties accumulated with increasing peat age whereas O-containing moieties relatively declined, in line with a decrease in molar O/C ratios. The relative accumulation of aromatics was 250 % during 10000 years whereas O-containing moieties declined relatively by 65 %. About half of this selective accumulation and degradation occurred during the first 2000 years of peat accumulation, thereby reflecting higher microbial transformation rates during initial phases of built-up. Char content increased with peat age, possibly indicating selective preservation of char during peat formation. C/N ratios correlated significantly but bi-modal with age.
The analysis shows that peat age is a reliable proxy for organic matter transformation in peatlands. Because rates and degree of transformation are derived from multiple sites, the found relationships seem to reveal a general pattern, at least for the studied boreal and temperate systems.