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Unraveling the mystery of δ15N depth profiles in peatlands: The embossing influence of microorganisms

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Our approach is to easily get reliable information about the state of peatlands to support the rescue of these unique environments.

During the last centuries major parts of European peatlands were degraded along with drainage and land use changes. Highly specialized peatland communities and essential ecosystem functions (e.g. flood prevention, groundwater purification and CO_2 sink) were dramatically impaired. Moreover, climate change threatens peatlands in the near future. With increasing pressure to peatland ecosystems more and more effort is put into peatland restoration. However, restoration programs lack reliable and affordable indicators of rehabilitation success. Here, we aim to improve our knowledge of stable isotope depth patterns as indicators for the actual state of peatlands and to develop indicators of restoration success with a special focus on stable nitrogen isotopes.

Evaluation of the state of peatlands and the success of restoration projects calls for cost-efficient and reliable methods that indicate the current state of a peatland. Changes in the natural abundance of stable isotopes (15N, 13C) during degradation and restoration provide a promising opportunity (KRÜGER ET AL. 2015). We investigated five peatlands in central Sweden, Southern Finland and Southern Germany. At all locations, cores were taken from drained and natural sites in parallel to identify trends that could indicate changes due to drainage and rewetting. At all observed locations there was a distinct peak (so called "turning point") in the δ15N values in the center of the drained horizon. In parallel, the δ13C values increase towards heavier values with depth at all investigated locations (KRÜGER ET AL 2015). We hypothesize that these trends are linked to a switch in the dominance of the microbial community from bacterial to fungal dominated communities. In accordance with other studies, our results suggest that fungi dominate the metabolism in the upper, aerobic part of the peat column but are highly disadvantaged with the onset of particular anaerobic conditions in deeper layers. The peak in δ15N values marks this "turning point", where generally aerobic conditions switch to more anaerobic conditions in the deeper part of the horizon affected by drainage. Below this "turning point" and with increasing anaerobic conditions, bacterial decomposition strongly predominates over fungal activity, which causes a change in isotope patterns, caused by a switch in substrates used and metabolic pathways during decomposition.

We aim to verify this connection to use the easily available stable isotope signatures as indicator to obtain information of the peatland status regarding the horizons affected by drainage, the intensity and spread of the drainage effect, the water table height during drainage and the potential onset of renaturation success above formerly drained horizons. In conclusion, our approach provides potential for supporting a monitoring of restoration success and thus contributes to preserve and rehabilitate these unique ecosystems for future generations.

Krüger, J. P., Leifeld, J., Glatzel, S., Szidat, S., & Alewell, C. (2015). Biogeochemical indicators of peatland degradation - A case study of a temperate bog in northern Germany. Biogeosciences, 12(10), 2861–2871.