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Contrasting mechanisms of peat formation between blanket and raised bogs

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Worrall et al. (2016, 2017, 2018) have determined the processes of organic matter transfer, transition and peat formation through and into a blanket bog at Moor House, UK (N54:41:18, W2:22:45 – altitude 580 m asl; MAT 5.8 deg C; rainfall 2012 mm/yr). These examinations indicated a transition from plant material to superficial and deeper peat that became thermodynamically limited around 40 cm depth with a continuous increase in the degree of unsaturation of the organic matter. However, it is not clear whether the same processes observed at Moor House are ultimately a universal pattern of peat formation and organic matter transitions or are site–specific. Therefore, to test theories developed at Moor House, peat formation and organic matter transitions were examined at a continental raised bog (Pürgschachen Moor, Austria, N47:34:53, E14:20:48 – altitude 632 m asl; MAT 7.3 deg C; rainfall 1248 mm/yr).

To test our developed theories the following were sampled: vegetation (Sphagnum, cotton grass and pine); dissolved organic carbon (DOC); and peat samples between 0 and 100 cm depth. Samples were dried, ground, and analysed by elemental analysis (for CHN and O), bomb calorimetry, and thermogravimetric analysis.

Results show that the pattern of a continuously rising degree of unsaturation from superficial to deeper peat does not prevail at the raised bog. At Pürgschachen Moor, the degree of unsaturation does not change between vegetation and superficial and deeper peat. Furthermore, thermodynamic limitation at the raised bog occurs in the top 10 cm of the peat profile. However, DOC at both sites show signs of strong alteration compared to peat samples. DOC export is an important pathway at Moor House (blanket bog) but not at Pürgschachen Moor (raised bog) in Austria. Therefore, we deduce that the immobile DOC and the lack of pore water movement lead to a closed system and a rapid preservation of the peat in the raised bog. In contrast, mobile DOC and the fluvial export promotes a relatively open pore water system that drives further chemical reaction in the organic matter.

Our research indicates that, depending on relief and rainfall, there are distinctly different pathways of peat formation in blanket bogs compared to raised bogs. Furthermore, this provides direct chemical evidence of why high and static water tables preserve organic matter in raised bogs leading to higher relative carbon sequestration rates.

References:

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