Plant Effects on Carbon Composition and Recalcitrance in Peat from a Boreal Bog: Implications for Methane Emissions

N.B. WALDO,1 M.M. TFAILY,2 R.K. CHU,2 C.R. ANDERTON,2 J.J. MORAN,2 AND R.B. NEUMANN3

1201 More Hall, University of Washington, Seattle WA 98195 (nbwaldo@uw.edu)
2 Pacific Northwest National Laboratory
Richland, WA 99352
3201 More Hall, University of Washington, Seattle WA 98195 (*correspondence: rbneum@uw.edu)

To advance understanding of climate-methane (CH4) feedbacks, this greenhouse study molecularly characterized peat carbon both with and without plants, and isotopically tracked the flow of carbon from plants into emitted CH4. We grew Carex aquatilis in rootboxes filled with peat collected from a boreal bog in Alaska and exposed them to headspace 13CO2, which the plants fixed. Some of this 13C was exuded by the roots and used by soil microbes. We tracked the isotope ratio of emitted CH4 and destructively harvested root and soil samples to determine isotopic enrichment of roots and root exudates. Using the measured enrichments of roots, soil, and CH4, we constructed a model to estimate what portion of emitted CH4 was derived from labelled root exudates. The model showed that less than 10% of the emitted CH4 was from labelled root exudates. Combining this result with our finding that planted boxes produce far greater amounts of CH4 than unplanted control boxes, we concluded that root exudates did not only directly fuel methanogenesis but rather plants changed the soil environment such that it facilitated more CH4 production. Supporting the notion that root exudates change the soil chemistry, Fourier transform ion cyclotron resonance MS analysis of soil carbon indicated that sugars and proteins make up a larger share of compounds present in the soil surrounding roots, while hydrocarbons comprised a relatively smaller share than in the bulk soil.