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

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To advance understanding of climate-methane (CH_4) feedbacks, this greenhouse study molecularly characterized peat carbon both with and without plants, and isotopically tracked the flow of carbon from plants into emitted CH_4. We grew *Carex aquatilis* in rootboxes filled with peat collected from a boreal bog in Alaska and exposed them to headspace $^{13}CO_2$, which the plants fixed. Some of this ^{13}C was exuded by the roots and used by soil microbes. We tracked the isotope ratio of emitted CH_4 and destructively harvested root and soil samples to determine isotopic enrichment of roots and root exudates. Using the measured enrichments of roots, soil, and CH_4, we constructed a model to estimate what portion of emitted CH_4 was derived from labelled root exudates. The model showed that less than 10% of the emitted CH_4 was from labelled root exudates. Combining this result with our finding that planted boxes produce far greater amounts of CH_4 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 CH_4 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.