Pathways of anaerobic carbon cycling across an ombrotrophic-minerotrophic peatland gradient

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Limnol. Oceanogr., 52(1), 2007, 96-107 | DOI: 10.4319/lo.2007.52.1.0096

ABSTRACT: Peatland soils represent globally significant stores of carbon, and understanding carbon cycling pathways in these ecosystems has important implications for global climate change. We measured aceticlastic and autotrophic methanogenesis, sulfate reduction, denitrification, and iron reduction in a bog, an intermediate fen, and a rich fen in the Upper Peninsula of Michigan for one growing season. In 3-d anaerobic incubations of slurried peat, denitrification and iron reduction were minor components of anaerobic carbon mineralization. Experiments using ^{14}C-labeled methanogenic substrates showed that methanogenesis in these peatlands was primarily through the aceticlastic pathway, except early in the growing season in more ombrotrophic peatlands, where the autotrophic pathway was dominant or codominant. Overall, methane production was responsible for 3-70% of anaerobic carbon mineralization. Sulfate reduction accounted for 0-26% of anaerobic carbon mineralization, suggesting a rapid turnover of a very small sulfate pool. A large percentage of anaerobic carbon mineralization (from 29% to 85%) was unexplained by any measured process, which could have resulted from fermentation or possibly from the use of organic molecules (e.g., humic acids) as alternative electron acceptors.