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Linking diversity and processes to biogeochemical depth gradients in acidic fens

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Peatlands are known to be significant sources of the green house gas methane. However, minerotrophic acidic fens can receive sulfate and Fe(II) from groundwater flow. Thus, considerable amounts of Fe(III) (up to 18 g kg^{-1} soil) and small amounts of sulfate (up to 300 μM) are available as alternative electron acceptor for the oxidation of organic matter in fens located in northern Bavaria. Biogeochemical parameters measured in the fen soil solution during 5 years documented that the upper 5 to 10 cm were exposed to drying and oxygenation prior to sampling. Periodic oxygenation reached a maximum depth of 25 cm in the water saturated fen and was concomitant with relative high concentrations of nitrate and sulfate. The fen soil was permanently anoxic below 30 cm depth with average concentrations of sulfate below 40 μM and maximum concentrations of methane. Anoxic incubation experiments with peat samples from oxidized surface layer demonstrated high Fe(III)-reducing but negligible sulfate-reducing or methanogenic activities. Numbers of Fe(III)-reducing bacteria cultured at pH 5.5 approximated 10^5 to 10^6 cells g (fresh weight soil)$^{-1}$ and did not decrease with soil depth. Detection of sulfate reducers with Terminal-Restriction Fragment Length Polymorphism (T-RFLP) analysis of amplified dissimilatory (bi)sulfite reductase genes (*dsrAB*) separated three subgroups along the depth profile. Cloning of *dsrAB* PCR products yielded a total of 84 distinct *dsrAB* restriction patterns (genotypes). Most of the genotypes were unique. Differences in the sulfate-reducing community structures suggested that sulfate reducers present in the upper fen soil have to tolerate O_2 and even drying, whereas sulfate reducers present in deep anoxic zones may act as synthrophic fermentors in cooperation with H_2-utilizing methanogens. Reduced sulfur seemed to be only temporarily fixed as inorganic sulfur, because it was subjected to aerobic oxidation in upper soil layers. Thus, drying or oxygenation of the

top soil favoured Fe(III)- or sulfate-reducing activities due to a renewal of the electron acceptor pools. Enhanced dyring events caused by climate change might accelerate not only carbon mineralization processes but also further inhibit methanogenesis.