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Origin and Circulation of CH_4 and CO_2 in Peatlands: Implications from C-isotope Composition and Geochemical Modelling

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The methane and carbon dioxide concentrations in an almost 6m deep pore water profile of an ombrotrophic bog are currently being investigated at the Etang de la Gruère locality (Jura Mountains) in Western Switzerland. This long-term study aims at a better understanding of the processes that drive CH_4 and CO_2 production and transport in natural wetlands as well as seasonal changes and depth-relationship. Both, CH_4 and DIC concentrations reveal a steep geochemical gradient with values increasing from ca. 0.1 and 1.0mmol/l, respectively, at 0.53m to 1.6 and 10mmol/l at 5.3m. Declining concentrations in the lowermost part of the profile are probably the result of lateral groundwater flow at the base of the bog. $\delta^{13}C$ values indicate prevailing microbial origin of CH_4 and CO_2 for all depths in the bog. For methane, the $\delta^{13}C$ analysis shows a trend towards heavier isotopes (-67 to -60‰ vs. V-PDB) with depth. The same trend is observed for $\delta^{13}C$ of DIC, although inorganic carbon is much less depleted in the heavy carbon isotope (-16 to ±0‰ vs. V-PDB). The isotope signals of CO_2 and CH_4 bear information on the pathways of methanogenesis (e.g. acetate splitting vs. CO_2 reduction), but are also influenced by physical processes linked to the hydrology of the site. In order to allow for meaningful interpretation of the observed patterns, a geochemical model is being developed which accounts for pore water advection, diffusion, microbial CH_4/CO_2 production, and outgassing by bubble formation. A previous model neglecting bubble formation could well reproduce the observed profiles of DIC and its isotopes (Steinmann et al., 2000). Yet, the concentrations of dissolved CH_4 predicted by the same model are much higher than those observed in the bog. Loss of gas into escaping bubbles most likely represents the missing sink for CH_4.

Steinmann P., Eilrich B., and Burns S. J., *Conf.Abs.: Non-CO2 Greenhouse Gases: Scientific Understanding, Control and Implementation*, 151-152, (2000).