Measuring and modelling of pore water gases in various regeneration stages of a Jura cutover bogs

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Significant areas of temperate bogs have been damaged by peat harvesting but may regenerate. These secondary mires, if well managed, may act as strong C sinks, regulate hydrology, maintain biodiversity, and buffer regional climate (Chapman et al. 2003). The aim of this study was to characterise the contribution of the in-depth methane and CO_2 to the greenhouse gas emissions from different regeneration stages of some temperate cutover Sphagnum-bogs. This study was conducted within the frame of the 5FPRTD project RECIPE (reconciling commercial exploitation of peat with biodiversity in peatland ecosystems).

We sampled the in-depth pore water at different regeneration stages (recent, middle and advanced) with help of cylindrical peepers inserted in the upper 50 cm of the peat and left to equilibrate for a period of two weeks (Steinmann & Shotyk 1997). The peepers were inserted where cores were taken for microbial characterisation. In spring 2004, we measured CH_4 and CO_2 gases, cations, anions (including acetate) and gas production in the laboratory (basal respirations). In parallel, we developed a numerical model for methane and CO_2 production and the relevant transport processes in thick peatland profiles. Furthermore, we compared the model-extrapolated gas production data with the basal respiration. For the production we assume a depth-dependent microbial reaction rate, whereas the processes under consideration are diffusion, advection, and bubble-formation.

Discrepancies between the results and a model, in which the processes under consideration are diffusion, advection, and bubble-formation, highlight the influence of heterogeneities in the peat structure and new forming vegetation. Comparisons of these model-extrapolated microbial "reactions" with microbial respirations show that although our model is giving a good overall approximation of the microbial respirations, it is unable to differentiate between the various regeneration stages. Moreover, these comparisons emphasise the importance of processes occurring at the surface of restoring peatlands down to a depth of 25 cm. The model results show an increase in concentration for both gases with depth (about 10-fold for dissolved inorganic carbon and more than 20-fold for methane). Other gases such as nitrogen are rapidly, almost completely within the first meter, removed from the pore water. The simulation further indicates that gas loss by bubble formation is by far more efficient than by diffusion.

References

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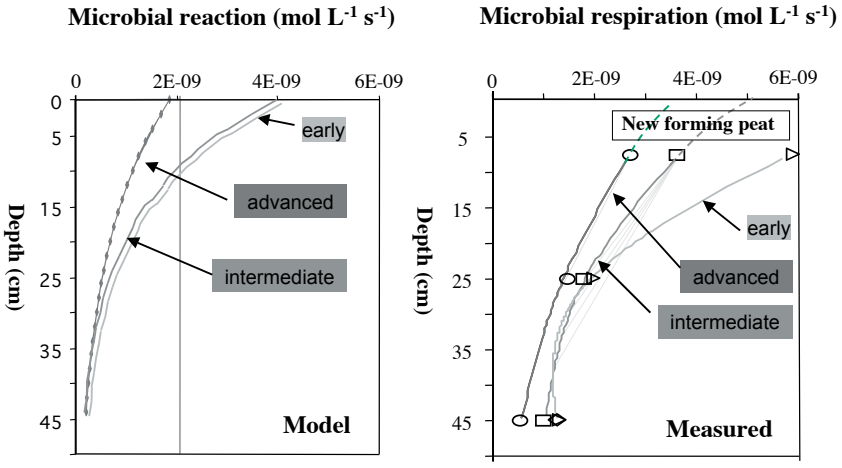

Figure 1 Comparison of model-extrapolated microbial "reactions" (from selected replicates, spring 2004) with basal microbial respirations.