

## ***Interactive comment on “Methanotrophy potential versus methane supply by pore water diffusion in peatlands” by E. R. C. Hornibrook et al.***

**E. R. C. Hornibrook et al.**

Received and published: 2 July 2009

We thank the referee for their review and constructive suggestions for improvement of our manuscript. Revisions made to the manuscript in response to reviewer’s comments are described below. We provide explanations for instances where we do not concur with recommended changes.

Anonymous Referee #2 (Received and published: 4 August 2008) 1. Page 2609, lines 5-7, 16-27: In acidic peat there also are methane oxidizers others than Types I and II (they do not have soluble methane monooxygenase, e.g. AEM 64: 922-929, 1998). However, here the text on the diversity could be shortened because methane oxidation is not linked to the diversity of methane oxidizers.

Response: Whether a link between methanotroph diversity and CH<sub>4</sub> oxidation (rates?)

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper



has been established is not essential for inclusion of this short summary of efforts to date to characterize microorganisms responsible for methanotrophy in anoxic soils. The information contained in these dozen or so lines is not excessive and has been retained.

2. There are rather many figures in the manuscript, some could be excluded. These include Fig. 1. There are several figures (Figs 3, 4, 5 and 6) for dissolved methane in pore water profiles. Only one typical profile would be shown, and the rest can be excluded.

Response: The pore water profiles in Figs. 3, 4, 5 and 6 are the central aspect of this manuscript around which much of the analysis and discussion are based. The data are not presented elsewhere in the manuscript in table format and in our opinion, it is important that the data be shown explicitly given some of the issues raised by other reviewers (e.g., the basis for regression analysis of pore water [CH<sub>4</sub>] data, the depth of the 3 cm thick zone in which CH<sub>4</sub> oxidation rates were integrated, etc.). The figures have been retained.

3. The information in the Table 4 can be shown in the legend of the Fig. 7.

Response: The 8 regression equations in Table 4 are presented in a clear manner. Incorporating the equations into the caption of Fig. 7 (which is already a lengthy caption) would diminish the clarity of presentation. Table 4 has not been deleted.

4. Page 2628, lines 24-26: In a short-term this conclusion would be true but if methane oxidation is totally lacking the methane concentration in the peat profile increases causing higher methane release via vascular plants and bubbling. This text should be revised by considering this comment.

Response: We agree that the sentence is ambiguous. We have removed the following text: [however, in the absence of bacterial CH<sub>4</sub> oxidation the flux rate from minerotrophic peatlands would not be significantly greater.]

5. Some comments could be added why the kinetic parameters were larger in the ombrotrophic than minerotrophic peatlands although methane production is expected to be higher in the later peatland types? Is the reason lack of methane and oxygen transport by vascular plants in the ombrotrophic peat? Was the methane concentration higher in the ombrotrophic peat profiles?

Response: It is unclear why the kinetic parameters ( $\mu_m$  and  $K_s$ ) were greater in Cors Caron than Crymlyn Bog. Given that these data are available for only two peatlands we are wary of over-interpreting the results at this stage. Methanotrophs in the ombrotrophic peat may exist in situ under more O<sub>2</sub>-limited conditions than those within the minerotrophic site. Pore water CH<sub>4</sub> concentrations typically were greater in the minerotrophic peatlands (Figs. 3 (Crymlyn Bog) & 4 (Gors Lwyd) versus Figs. 5 (Blaen Ffig) and 6 (Cors Caron), consistent with higher CH<sub>4</sub> production rates measured in vitro for those peatlands (data reported in Hornibrook & Bowes, 2007).

6. It would be interesting if the coverage of various vascular plant species are correlated with the surface methane fluxes. Then their importance in the methane transport is shown here, and some other explanations for the high emissions (like bubbling) can be excluded.

Response: High CH<sub>4</sub> emission rates due to ebullition appear as sudden increases in CH<sub>4</sub> concentration within the closed flux chambers. As discussed in responses to Comment 14 by Reviewer 3 and Comment 2 by Reviewer 4, ebullition fluxes have been removed from the data sets (primarily for Gors Lwyd). The high fluxes that remain must be due to plant-mediated transport because pore water diffusion rates are too low to cause the observed CH<sub>4</sub> emission rates. This aspect of CH<sub>4</sub> export from peatlands has been well studied in the past (e.g., Chanton & Dacey, 1991; Schütz et al., 1991; Morrissey et al., 1993; Bubier, 1995; Sugimoto & Fujita, 1997; King et al., 1998; Joabsson et al., 1999; Segers & Leffelaar, 2001; Kettunen, 2003). Additional information about dominant vegetation types at each peatland have been added to Table 1 (as requested by Reviewers 3 & 4); however, we do not have detailed plant surveys for the

study sites or sufficient coverage of flux measurements to quantify how differences in vegetation coverage contributed to CH<sub>4</sub> flux rates in these four peatland. The issue is likely to be more complex than just differences in plant coverage. For example, potential CH<sub>4</sub> production rates for the four peatlands published in Hornibrook & Bowes (2007) demonstrate that the minerotrophic peatlands (Gors Lwyd and Crymlyn Bog) have the capacity to generate greater quantities of CH<sub>4</sub> than the ombrotrophic peatlands (Cors Caron and Blaen Fyn). In summary, we are confident that ebullition can be discounted as a source of the high CH<sub>4</sub> flux rates because (i) flux chamber data exhibiting steps in CH<sub>4</sub> concentration are not included in the data shown in Table 3, and (ii) d<sup>13</sup>C values of CH<sub>4</sub> pore water and flux reported by Hornibrook & Bowes (2007) for these peatlands indicate that plant-mediated transport is the dominant process exporting CH<sub>4</sub> from peat soils to the atmosphere in all four sites.

#### References

Bubier J. L. (1995) The relationship of vegetation to methane emission and hydro-chemical gradients in northern peatlands. *Journal of Ecology* 83(3), 403-420.

Chanton J. P. and Dacey J. W. H. (1991) Effects of vegetation on methane flux, reservoirs, and carbon isotopic composition. In *Trace Gas Emissions From Plants* (ed. T. Sharkey, E. Holland, and H. Mooney), pp. 65-92. Academic.

Joabsson A., Christensen T. R., and Wallen B. (1999) Vascular plant controls on methane emissions from northern peatforming wetlands. *Trends in Ecology & Evolution* 14(10), 385-388.

Kettunen A. (2003) Connecting methane fluxes to vegetation cover and water table fluctuations at microsite level: A modeling study. *Global Biogeochemical Cycles* 17(2), art. no.-1051.

King J. Y., Reeburgh W. S., and Regli S. K. (1998) Methane emission and transport by arctic sedges in Alaska: Results of a vegetation removal experiment. *Journal of*

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)

Geophysical Research-Atmospheres 103(D22), 29083-29092.

Morrissey L. A., Zobel D. B., and Livingston G. P. (1993) Significance of Stomatal Control on Methane Release from Carex- Dominated Wetlands. *Chemosphere* 26(1-4), 339-355.

Segers R. and Leffelaar P. A. (2001) Modeling methane fluxes in wetlands with gas-transporting plants 3. Plot scale. *Journal of Geophysical Research-Atmospheres* 106(D4), 3541-3558.

Schütz H., Schröder P., and Rennenberg H. (1991) Role of plants in regulating the methane flux to the atmosphere. In *Trace Gas Emissions by Plants* (ed. T. Sharkey, E. Holland, and H. Mooney), pp. 29-63. Academic.

Sugimoto A. and Fujita N. (1997) Characteristics of methane emission from different vegetations on a wetland. *Tellus Series B-Chemical and Physical Meteorology* 49(4), 382-392.

7. Is there evidence that methane released from ombrotrophic peatlands is more  $^{13}\text{C}$ -enriched than methane from minerotrophic peatlands?

Response: Methane emitted from the ombrotrophic peatlands is  $^{13}\text{C}$ -depleted relative to the minerotrophic sites because of a predominance of  $\text{H}_2/\text{CO}_2$  methanogenesis in the acidic mires which yields  $\text{CH}_4$  having negative  $\text{d}^{13}\text{C}$  values relative to  $\text{CH}_4$  produced by acetate fermentation in the more alkaline peat soils. Plant-mediated transport imparts an additional negative shift in  $\text{d}^{13}\text{C}(\text{CH}_4)$  values of  $\sim 12$  to  $20$  permil in all four peatlands (Hornibrook & Bowes, 2007).

---

Interactive comment on *Biogeosciences Discuss.*, 5, 2607, 2008.

**BGD**

5, S3439–S3443, 2009

---

Interactive  
Comment

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

