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Biogeosciences Discussions

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.

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We thank the referee for his positive 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.

A. Baird (Referee 4) (Received and published: 28 July 2008)

1. The description of the research sites is terse. It is difficult for the reader to compare the sites with those used by other research groups, making it difficult to put the flux rates presented by the authors into a wider context. For example, it would have been useful to have known more about the degree of decomposition of the peat/litter in the upper few decimetres. It would also have been useful to have known more about the

plant species at each station. The authors note that station 1 at Cors Caron and Blaen Fign contained a greater cover of Sphagnum than station 2, which in each case contained a greater cover of vascular plants. Without giving more detail, this information is of little use to the reader. A range of different microhabitats on ombrotrophic bogs contain a high cover of Sphagnum (e.g. hollows dominated by Sphagnum cuspidatum Ehrh. ex Hoffm., lawns dominated by Sphagnum magellanicum Brid. and low hummocks dominated by Sphagnum capillifolium (Ehrh.) Hedw.). The litter laid down by these different species of Sphagnum may differ in its properties as a medium through which oxygen diffuses and as a mechanical retainer of biogenic gas bubbles. In addition, given the large differences observed between measured flux rates and estimated rates of pore-water diffusion, it would be interesting to know the details of the vascular plants (species and abundance) that were responsible for the relatively high rates of methane emissions from the bog surfaces enclosed by the chambers at station 2 at each site. I would like to have seen the pore-water data presented by the authors put into the context of data presented in other recent studies. A short paragraph should suffice.

Response: The degree of decomposition in acrotelm peat was similar for Cors Caron, Blaen Fign and Gors Lwyd: the peat contained an abundance of fibrous plant remains and showed little humification. In contrast, peat typically was heavily humified within a few centimeters of the moss surface (in hollows and lawns) at Crymlyn Bog. Details about dominant plant species in the vicinity of sampling stations at the four peatlands have been added to Table 1. The latitude and longitude coordinates for each peatland have been moved to the text on page 2612 to make space for the vegetation data. Detailed surveys of *Sphagnum* were not conducted at the sites at the time of sampling and consequently, the term [*Sphagnum* spp.] is used to denote the presence or general abundance of this bryophyte at the stations relative to vascular plant species. Similarly we do not have detailed information about the relative coverage of the various vascular plants within the flux collars, only that the amount in ground collar 2 was much greater than in collar 1 at Crymlyn Bog and Blaen Fign. The pore water CH_4 concentration data

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are discussed and compared at length in the manuscript. The concentration ranges and depth trends are typical of freshwater wetlands and thus representative pore water CH_4 diffusion rates in many peatlands.

2. On page 2621, line 23, the authors note that "Chamber measurements that exhibited erratic pulses (i.e. ebullition) were excluded from the flux analysis because it could not be determined exclusively whether the events were natural or induced during sample collection." The authors seem to have taken great care to avoid being near their chambers during sample collection (via a 4-m Tygon tube) so it is not immediately clear why they think the ebullition events were possibly caused by disturbance. I think it would be useful if they could provide more detail on why they excluded the ebullition events, what proportion of their dataset these events comprised, and how their results and conclusion may have changed if ebullition had been accounted for. In this respect it is interesting to note the findings from the study of Tokida et al. (2007a). Tokida et al. (2007a) measured methane efflux using two chambers placed on a temperate bog dominated by Sphagnum spp. but also containing vascular plants such as Eriophorum vaginatum L. and Rhynchospora alba (L.) Vahl.. High-frequency measurements of efflux were taken using the chambers every 1.5 - 2 hours over four days when atmospheric pressure varied but showed a general fall from 1017 - 1000 hPa. Over this period, ebullition contributed 50-64 percent of the total methane efflux. However, during individual events, ebullition losses exceeded the other losses combined by one to two orders of magnitude.

Response: The details about exclusion of flux data showing evidence of ebullition are provided in the response to Comment 14 by Reviewer 3. To reiterate, data were omitted for only 1 out of 78 chamber deployments for Blaen Fign, Cors Caron and Crymlyn Bog but for 10 of 24 measurements at Gors Lwyd. The latter peatland, in contrast to the other three sites, has an unstable partially floating mat. Flux events that contain evidence of ebullition typically have higher short-term flux rates than periods dominated by either plant-mediated transport or pore water diffusion of methane. The reported

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steady state surface flux rates already are much higher than internal pore water CH_4 diffusion rates and including those ebullition events would have made that contrast even more extreme. With or without the ebullition fluxes, our conclusion remains the same: pore water diffusion of CH_4 under most conditions contributes little to CH_4 emissions to the atmosphere.

3. Flora is used quite often to denote, it seems, [plant species]. This can lead to some odd expressions like "vascular flora" (are not all flowering plants vascular?).

Response: The term [flora]; was used to denote generically all [plants] rather than just those that flower. We use [vascular flora] to make the distinction between Sphagnum and plants that might be capable of mediating CH_4 transport through aerenchyma. We agree with Reviewer 4 that more formal wording would improve the clarity of the text. We have changed the term [flora] to [plant] throughout the manuscript.

4. Page 2610, line 20, "eliminate a key zone". The English here is a little awkward; I recommend rewording the sentence.

Response: The sentence has been rewritten: [Water table level is a particularly critical parameter because it controls the thickness of the unsaturated zone, which when enlarged enhances the capacity for methanotrophy, but conversely diminishes CH_4 production at shallow depths in vicinity of the rhizosphere where methanogens benefit from higher temperatures and an abundant supply of labile substrates from root exudation.];

5. Page 2612, line 2, "of complete attenuation of". The English here is a little awkward; I recommend rewording the sentence.

Response: The sentence has been rewritten: [Complete attenuation of CH_4 transport via pore water diffusion was evident when the abundance of dissolved CH_4 equalled 0 μmol l^{-1} within the saturated zone.]

6. Page 2622, line 7. "impacted". Better word such as affected?]

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Response: The word [impacted] has been changed to [affected].

7. Page 2623, line 18. Should "less depleting" be "less depleted"?]

Response: Yes - correction made.

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