Biogeosciences Discuss.,
doi:10.5194/bg-2016-162-RC1, 2016

Biogeosciences Discussions

Interactive comment on "Microtopography matters for CH_4 formation in a peat soil: a combined inhibitor and ^{13}C study" *by* Johannes Krohn et al.

Anonymous Referee #1

Received and published: 18 June 2016

Krohn et al. address the effect of peatland microtopography on methane and carbon dioxide production. They use incubations with an inhibitor and isotope measurements of the produced gases to assess the pathway of methanogenesis in depth profiles. Peatland microtopography is well known to regulate greenhouse gas emissions, but less is known about the belowground processes producing the gases. Particularly addressing the CH4 production pathways between hummocks and hollows has potential to provide valuable new information.

Unfortunately, mostly due to the selected inhibition method and other shortcomings, the data presented here do not allow any conclusions on this question. Some of the isotope data point to a difference in pathways between hollows and hummocks (Fig. 4), but this difference could actually represent the depth variation of the pathways. No information is given on water table position in the hummocks, but because hummocks

are elevated, the sampled depths in hummocks will be higher in respect to the water level than in hollows. Therefore it is problematic to compare the depth of 15 cm in hollows (water-logged, optimal depth for CH4 production) to depth 15 cm in hummocks (most likely above water level, aerobic and not the optimal depth for CH4 production). It seems in the hummocks the depth of 50 cm is closer to the depth of highest CH4 production (Fig. 1a) and thus more appopriate for comparison with 15 cm of hollows.

The conclusions that are well-supported by the data concern differences in CH4 and CO2 production and pathway of methanogenesis with depth in the peat profile. However, decrease of production and increased contribution of hydrogenotrophic methanogenesis with peat depth are well-described already by several studies. Methane production with peat depth and between microforms has even been reported in the same peatland (Saarnio et al. 1997 cited in the manuscript).

There are several concerns about the inhibition method used. it is difficult to consider the addition of 1 mM BES as a justified approach to study the contribution of methanogenetic pathways. The use of this low concentration to inhibit acetoclastic methanogenesis is based on a single study on digestor sludge (Zinder et al. 1984), where the authors warn that the results should not be generalized to other systems or to longer incubations times (as in this study). Very variable and contradicting BES concentrations have been shown to inhibit all methanogenesis. The authors conclude that the method was not specific for acetoclastic methanogenesis, but this could already have been anticipated based on literature, and it could have been obvious from the preliminary tests with different concentrations (l. 128-129). BES was also added in a small volume (2 ml) to solid peat, not a slurry - did it spread throughout the peat? Considering this issue, the level of inhibition is actually very surprising. An additional problem is that the controls appear to have not been done in triplicate like the treatment (l. 132-33, no error bars in Fig. 2). There is also a more commonly used inhibitor for acetoclastic methanogenesis (methyl fluoride) available.

It is difficult to see how the data on N, S, and Fe (Fig. 5, Fig. 6) contribute to the main

hypotheses. Were the correlations with CH4 production expected to vary between hummock and hollow? Moreover, the data on Fe and S Fig. 6 are not mentioned at all in the methods or the results.

It is true that there is quite little information on microform effects on CH4 and CO2 production (lines 55-56), but the studies that have already addressed this question should be mentioned here or in the discussion (for example Bubier et al. 1993, Saarnio et al. 1997 cited in the manuscript).

Minor comments:

1. lines 71-72 What do you mean with 'competitive effects between methanotrophs and methanogens for electron donors'? Aerobic methanotrophs and anaerobic methanogens do not compete for the same electron donors.

2. l. 75 Methyl-coenzyme M is required for methanogenesis, not responsible for methanogenesis.

3. l. 230 Do you mean CO2 emission rather than production?

4. l. 236-240 This reasoning is difficult to follow. How does possible higher occurrence of aerobic and facultative microbes in hummocks than in hollows lead to similar CO2 production rates under anoxic conditions?

5. l. 256-258 What support is there for the statement that single plant species directly contribute to methane production? Please rephrase and also consider that in addition to the plant community, peat quality can differ between hollows and hummocks due to different exposure of organic matter to aerobic decomposition.

6. l. 271 Please rephase - there is no data on higher active biomass of methanogens in hollows than in hummocks.

7. l. 320 The low CH4 production may simply indicate very low numbers of methanogens and low substrate availability in the highly decomposed deep peat layers

that do not receive new carbon inputs.

8. l. 307-308 Do you mean that if AOM is taking place, the C source would be strongly depleted CH4?

9. The language of the manuscript allows understanding the content without problems, but I would still recommend having it checked.

Interactive comment on Biogeosciences Discuss., doi:10.5194/bg-2016-162, 2016.