

This study performs a lab experiment on peat cores to quantify the effect of peat pore structure on the production and transport of CH<sub>4</sub> and CO<sub>2</sub>. The study is unique because few studies on peat have addressed these processes at these scales. The experimental setup and data analysis are sound and well explained. The study could not provide a definitive linkage between pore structure, gas transport and gas production, but this does not detract from the study's overall value. I have one concern about the study and list several minor corrections that I recommend the authors should address:

It appears that the shrinkage of the peat has affected your analysis of air-filled porosity near the edge of your samples. Although you explain this in the text, the plot in Figure 3f can be misleading. Could you either indicate on Figure 3f where the edge effects begin or subset the data that does not include the edges and replot Figure 3f.

### **Minor corrections**

Line 5: remove "the"

Line 12: consider rewriting "air-filled porosity was" as it does not read smoothly

Line 31: add Wright et. al 2018 as a reference for peat pore structure affecting methane emissions in the field

Methane ebullition from subtropical peat: Testing an ebullition model reveals the importance of pore structure, W Wright, JA Ramirez, X Comas - Geophysical Research Letters, 2018

Line 39: instead write "Despite the progress in"

Figure 2: line 2 should be CH<sub>4</sub>. Throughout all plots, axis labels should be formatted as CO<sub>2</sub> and CH<sub>4</sub>. Remove brackets from axis labels.

Line 108: complete subscript for V<sub>mol</sub> and t<sub>cycle</sub>, and add symbol for 20 °C

Line 112: complete subscript for C<sub>min</sub> and C<sub>max</sub>

Line 117: remove bold

Line 119: complete subscript for R<sub>ref</sub> and CH<sub>4</sub>

Line 175: typographical error: effectst

Figure 3: add to caption that the air-filled pore space is displayed in black and peat in white, and also add a scale bar

Figure S1: consider adding a legend to easily understand the colors. Marker sizes are difficult to distinguish so make the figure larger on a 2 x 2 layout. Line 3 in caption typographical error: "[he"

Line 207: is this the correct units:  $\mu\text{mol hh}^{-1}$  ?

Figure 4: add subscripts and superscripts to y-axis labels. Not sure what you mean by “Letters in panel(b) indicate significant differences between the injection rounds” because no letters appear in the panels. For the methane flux plots, consider adjusting the min and max values of the y-axis for complete visualization of the data (i.e negative fluxes).

Line 213: make sure subscripts and superscripts are applied throughout the remainder of the manuscript (e.g.  $\text{CH}_4$ ). Is this correct  $\mu\text{mol hh}^{-1}$ , if not, please also correct throughout the manuscript.

Line 224: please report the temperature values throughout the duration of the experiment.

Line 226: typographical error: trying

Figure 5: add subscripts to y-axis labels

Figure 6: add subscripts to y-axis labels. Explain in the caption the meaning of the letters (e.g. ab) within the plots.

Line 243: replace til with until

Line 256: remove bold

Line 259: typographical error: ( $^{13}\text{CO}_2$

Line 262: first sentence reads awkwardly and needs rewriting

Figure 7: subscripts are needed throughout labels and there is no reference to plot d in caption

Line 281: not clear what “time 5” means and replace slowly with slower

Line 291: figure 9 does not exist

Line 292: Fig. Snn?

Line 295: Table Snn?

Line 300: remove “a”

Line 303: “small number of essential...” should be “small number of pores are essential...”?

Figure 8: time on the y-axis label needs units. In the caption provide explanation for asterisks and n.s.