

# ***Interactive comment on* “Substrate potential of Eemian to Holocene permafrost organic matter for future microbial greenhouse gas production” by Janina G. Stapel et al.**

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The authors have produced an interesting study investigating the material present within a permafrost core, and describing both the possibility that it has been degraded over time, and the potential for future degradation as climate warms. This is important work, preparing the ground for estimates of CO<sub>2</sub> release from thawing permafrost.

Major comments

Methods section – there is no explicit mention of the technique used to measure acetates, or it's not mentioned clearly. Since this is the main purpose of the paper it

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should be obvious what has been done to measure the acetate compounds.

A lot of the molecular concentrations are reported as per gram sediment, but this leads to depth profiles that mostly correlate with OC content. Reporting molecular concentrations per gram carbon may lead to more interesting comparisons along and between cores.

Permafrost soils and Yedoma can have very different biomarker compositions. For example, GDGTs are being used as microbial biomarkers, but Sparkes et al., Biogeosciences, 2015 showed that GDGT concentrations are low in Yedoma sediments. Bacteriohopanepolyols may be better tracers of microbial activity in this region (see for example Bischoff et al., Biogeosciences, 2016). When linking timescales to substrate potential, the different sediment types within each core need to be shown in figures and discussed as well, since there could be a combination of climatic and sedimentological controls on OM quality and substrate potential.

P9 Line 1 – it is asserted that the permafrost deposits are dominated by terrestrial OM. Since GDGTs were measured, the BIT index could be used to confirm this.

P1 Line 23 – The GDGTs seem to correlate with TOC in the core sections referenced here. Relative increases in these molecules may support increased bacterial productivity, but if the biomarkers are changing with TOC then it may just represent variations in preservation. Once more, other markers for microbial activity would add value to the study.

#### Minor comments

P5 Line 24 - Was an internal GDGT standard used? The synthetic C46 GDGT standard is commonly used to provide accurate quantification of GDGTs, correcting for biases in response factor.

P5 Line 24 – The GDGT biomarker molecules being measured are not defined.

P 9 Line 15 – Absence of a particular biomarker does not necessarily mean that it has

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decomposed, it may never have been present.

P10 Line 10-15. This section is hard to understand, rephrasing may help

Typos

P2 Line 10 – preserved

P2 Line 11 – gases

P3 Line 32 – no comma needed after intervals

P4 Line 30, and elsewhere – grinding rather than grounding; gorund rather than grounded

P6 Line 21 – sentence does not make sense, especially “whereas”

P6 Line 23 – is should be are

P8 Line 4 – commas required after ‘are’ and ‘sediment’

P9 Line 23 – “nonene” rather than “nonen”?

P9 Line 27 – ‘have’ does not make sense

P11 Line 20 – freeze-locked

P12 Line 11 – comma required after ‘transportation’

Figure 3 caption – Eglinton not Eglington

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