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Biogeosciences Discussions

Interactive comment on "Carbon isotopic composition of branched tetraether membrane lipids in soils suggest a rapid turnover and a heterotrophic life style of their source organism(s)" *by* J. W. H. Weijers et al.

Anonymous Referee #1

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This work by Weijers et al. reports on 13C signatures of Branched Glycerol Dialkyl Glycerol Tetraethers (GDGT's) in soil samples that were taken at a wide range of field sites. The authors then use these isotopic signatures to infer about the metabolic strategy of GDGT-producing bacteria. At one of the sites the vegetation recently changed from C3 to C4 plants, whereas plots at another site were fumigated for 10 years with 13C-depleted CO2. Both these treatments resulted in an isotopic shift for soil C input, allowing the authors to estimate turnover times of various GDGT's.

This is an interesting and generally well-written paper that falls within the scope of Bio-

geosciences. Whereas the heterotrophic lifestyle of branched GDGT-producing bacteria has been suggested before using 13C data, the real novel aspect lies in the analyses of the soils that included a 13C label.

- Does this article really need the isotopic data on plant leaf wax derived n-alkanes? The focus of the article is clearly on GDGT's and their isotopic signature. The comparison between isotopic values of GDGT's and the n-alkanes does not seem to add much additional insight to the discussion, which already is quite long. Also, this comparison distracts from the main point the authors try to make (see title). With that, isotopic values for the n-alkanes have been reported previously for both field sites with a 13C label (Wiesenberg et al. 2004, 2008).

- Plots from the Swiss FACE site received either 140 or 560 kg N/hec/yr (see for instance Zanetti et al. 1997). Could the authors please indicate which plots were sampled for this paper? This is important information, since later in the discussion, the authors explain the high amounts of crenarchaeol (page 3713, line 8) is explained by high N availability at the Swiss site. For the same reason, the authors should include an estimate of average fertilizer N rates at the corn field site.

- As indicated by the title, the high GDGT turnover rates is one of the main findings of this manuscript. As such, the article would benefit if the authors included the formulas that were used to calculate turnover times of GDGT's in the Material methods section.

- Were soil samples from all sites pre-treated in the same way? Were they dried at the same temperature, were they sieved, and were plant roots removed? If not, could a difference in pre-treatment have contributed to differences between sites?

- As indicated by the authors, the isotopic analyses were not performed on entire GDGT molecules, but rather on the alkyl moieties. Perhaps the authors could briefly discuss whether the exclusion of the glycerol component from the isotopic analyses could have affected their results?

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- At +9500 words, the current version of the manuscript is quite long. By writing in a more concise way, the authors could reduce the length of the text considerably.

Some minor editorial suggestions:

- Throughout the text, the authors refer to “peat and soils” and “soils, including peat”. The first phrase suggests that peats are no soils, the second one suggests they are. Please be consistent.

- P3699, L7. Please replace “decarbonisation of the inorganic carbon” with “removal of the inorganic carbon”.

- P3712, L4. Please replace “carbon sequestration” with “carbon assimilation”. The first term is typically used to indicate carbon storage in soil pools with a slow turnover rate.

- Table 2: the bold letters indicating the structures of the carbon chains are not placed correctly above the corresponding columns. Also, the letter “d” is missing.

- The number of references (over 90) is too high for a research article.

References: Wiesenberg, G. L. B., Schwarzbauer, J., Schmidt, M. W. I., and Schwark, L.: Source and 10 turnover of organic matter in agricultural soils derived from n-alkane/n-carboxylic acid compositions and C-isotope signatures, Org. Geochem., 35, 1371–1393, 2004.

Wiesenberg, G. L. B., Schwarzbauer, J., Schmidt, M. W. I., and Schwark, L.: Plant and soil lipid modification under elevated atmospheric CO2 conditions: II. Stable carbon isotopic values (delta C-13) and turnover, Org. Geochem., 39, 103–117, 2008.

Zanetti, S., Hartwig, U.A., Lüscher, A., Hebeisen, T., Frehner, M., Fisher, B.U., Hendrey, G.R., Blum, H., Nösberger, J.: Stimulation of symbiotic N2 fixation in Trifolium repens L under elevated atmospheric pCO2 in a grassland ecosystem. Plant Physiology, 112, 575-583, 1997.

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