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# *Interactive comment on* "Provenance of tetraether membrane lipids in a large temperate lake (Loch Lomond, UK): implications for GDGT-based palaeothermometry" *by* L. K. Buckles et al.

**Anonymous Referee #1**

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1. General comments

By studying the GDGT distributions in Loch Lomond, a temperate lake with large catchment area, Buckles et al. demonstrated that along with allochthonous input of branched GDGT from adjacent soil and streams there was also evident in situ production in the lake water and sediment. The application of GDGT based proxies in such circumstance was then considered to be problematic. Intensive work of sampling and lipid analysis can be recognized in this study. The discussion paper is well written. Sufficient data were provided and then comprehensively discussed. I believe this paper fits well into the scope of Biogeoscience and will be interesting to the organic geochemistry and geobiology community.



However, I do have a little concern for the distribution pattern of brGDGT in soil, river and lake samples (section 4.1). Indeed this lipid distribution difference among sample groups and together with their changing proportion of IPL vs. CL could indicate in situ production in water column and sediment of both rive and lake. But, as shown in Fig. 4 there is clearly a source-to-sink profile of steady decrease in MBT' and increase in DC from soil to lake. If this pattern only represents a distinct biological source in each setting, then why does it follow such a gradual change from soil to lake? Is it only a coincidence? The increasing degree of methylation and cyclization in brGDGT from soil to river and then lake seems like a response of the same organism community to certain environmental gradient. What could it be, redox condition, pH or other parameters?

2. Specific comments

p4194, line 5, Is there any concern about the sampling efficiency of using GFF filter? As discussed in a previous study (Ingalls et al. 2012 AEM), considering the small diameter of archaeal cells, the application of GFF filter, 0.7$\mu$m pore size, might underestimate the abundance of isoprenoidal GDGTs.

p4196, line 24, what solvent was used here to load the TLE onto your column? p4197, line 2, it was refluxed at what temperature? P4199, line 19-21, is this the reason why the statistical analysis was only performed with core lipids (CL)? As shown in Table A1, 'sample group comparison (CL)'.

p4206, line 15-17, the higher proportion of cyclization in the lower north basin is hard to distinguish in Fig. 5, why not to compare them with directly their DC values?

p4206, line 20-21, higher CBT in lower north basin? This is opposite of the higher proportion of cyclized brGDGTs (line 15-17). Higher CBT means less cyclized brGDGTs.

p4208-4209, ok, in situ riverine production seems reasonable, but how is the hydrodynamics of these rivers? River Endrick and Falloch are main inflows of Loch Lomond.

The brGDGT IPL abundance in river SPM is even one magnitude higher than lake SPM (Table 2), while crenarchaeol IPL in both settings are similar. It is hard to imagine, if planktonic microbe in river water contributed this high brGDGT concentration under a dynamic condition, then their turnover time must be really short.

p4218, line 17-19, since there is no access to Buckles et al. 2014 (submitted), I don't understand how a decrease in %IPL was attributed to preferential degradation on in situ produced brGDGT. I think, here with preferential degradation the author means not only cleavage of polar head group but also degradation of the core lipid. If the sedimentary brGDGT producer dwells in surface or shallow subsurface sediment, hydrolysis only on the labile polar head groups of in situ produced IPL, which then contribute to the CL pool will also cause a decrease in %IPL in deeper sediment.

p4218, line 20-21, in Takano et al., 2010 I don't see selective uptake on GDGT produced in sediment. So Takano's recycling hypothesis can not explain why in a general case sedimentary input has no strong impact to the preserved water column signal.

3. Technical corrections

p4198, line 20, the nomenclatures used in all following equations should refer to Fig. A1 p4199, line 11, please provide source and access information of the R program, such as a link of website? p4201, line 15, CL: 1.08 not 1.07, see Table 2. p4206, line 2, the averages of 0.42 in CL TEX86 is lower than that of IPL, not 'relatively high'. p4207, line 26, not similar DC, clearly the lake sediments give generally higher DC compared to soil. p4208, line 26-28, as shown in Table A1 all statistical analysis was did only with CL, but here the author is discussing difference in IPL or CL. p4209, line 11, there is only one literature of Zell et al. 2013 in the reference list.

In all figures, the panel labels are in capital letters, but not in the main text. Please make it consistent. p4214, line 1, Tables 2 and 4 p4215, line 16, should it be 'bias towards annual air temperatures'? not 'summer'. p4215, line 17, Shanahan et al., 2013 is not in the reference list. p4218, line 13, Weijers et al., 2011 (GCA) is not in the



reference list. p4219, line 6, 'isoprenoidal' or 'isoprenoid' ? check and keep consistent for the entire manuscript.

Table 3, concentration unite 'ngg-1 dry wt.' as used in the other tables.

Fig. 1, the green circle between P7 and P8 is not labeled, and S8 can not be found in the figure. The labels of compass are too small. There is no display of river Falloch and Endrick. Why the lower north and south basin area is shaded?

Fig. A1, delete the prime on the mass to charge ratio of crenarchaeol regioisomer, m/z 1292'

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Interactive comment on Biogeosciences Discuss., 11, 4187, 2014.