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Interactive comment on "Dependence of the cyclization of branched tetraethers (CBT) on soil moisture in the Chinese Loess Plateau and the adjacent areas: implications for palaeorainfall reconstructions" *by* H. Wang et al.

Anonymous Referee #1

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The authors newly analyzed 9 branched glycerol dialkyl glycerol tetraethers (brGDGTs) for 97 surface soil samples collected from 33 sites in the Chinese Loess Plateau (CLP) and its adjacent arid/semi-arid area. They investigated the relationships of environmental variables such as soil pH, soil water content (SWC), mean annual precipitation (MAP), mean annual air temperature (MAAT) and mean annual ground surface temperature (MAGST) with the cyclization of branched tetraethers (CBT) index. They concluded that CBT is not sensitive to soil pH but mainly controlled by soil moisture, and thus by the MAP for the alkaline soils (pH >7) in arid/semi-arid regions. Consequently, they conclude that the CBT can potentially be used as a paleorainfall proxy in the CLP and applied it to three loess-paleosol sequences published before.

Recently, a new set of brGDGT isomers, so-called 6-methyl brGDGTs, were identified by De Long et al. (OG, 78-82, 2013) and it appears that they are co-eluting with the 5-methyl brGDGTs using the method commonly used thus far. It also turned out that this co-elution has an impact on the calculation of the established paleoclimate proxies, such as the CBT (De Jone et al., Geochimica et Cosmochimica Acta 141, 97–112, 2014). The separate quantification of the 6-methyl brGDGTs allows the definition of new indices. They showed that the CBT', which is newly defined based on the 6-methyl brGDGTs, substantially improved the soil pH prediction, especially for the arid/semi-arid regions, in comparison to the previous CBT, which is based on the 5-methyl brGDGTs. Accordingly, the separate quantification of the 6- and 5-methyl brGDGTs is essential for accurately quantifying brGDGTs in environmental samples. In this context, one of my main concerns is that this study did not consider separating the 6-methyl brGDGTs from the 5-methyl brGDGTs. The weak positive relationship between CBT and soil pH, and flattening-off of CBT at higher pH values (>7 pH) might be at least in part caused by the inaccurate identification and subsequent quantification of the 5-methyl brGDGTs. Considering that the new technical development in the field of branched GDGT research and the arid/semi-arid study area where the previous indices based on the 5-methyl brGDGTs showed particularly difficulties to reconstruct CBT-based soil pH, I feel that it is necessary to cross check the results presented in this study, separating the 5-methyl brGDGTs from the 6-methyl brGDGTs using an improved chromatography. Subsequently, the newly proposed index based on the 6-methyl brGDGTs should be also tested. This will allow the authors to reconstruct more accurate changes in paleo-precipitations in the CLP using the proxies derived from brGDGTs. I provide some more detailed comments below.

Other comments: It might be the journal editing style, but, in general, it would be more helpful to provide page numbers and to do line numbering continuously.

Page 2: In the introduction, the most recent brGDGTs and MBT-CBT calibration papers by De Long et al. (OG, 78-82, 2013 and Geochimica et Cosmochimica Acta 141, 97–112, 2014) should be introduced.

Page 2, Line 7: introduce the CBT index fully, like the cyclization of branched tetraethers (CBT) index.

Page 3, Line 17: n-alkanes using italic for “n”.

Page 3, Line 19: correct “mental ratios” to “ metal ratios”.

Page 3, Line 24: it would be better to use “ advances” instead of “ advantages”.

Page 4, Line 6: add distributed between globally and soils.

Page 5, Line 5: provide the exact number of soils (n=97) considered in this study. It is also not clear whether the data from soils were newly obtained or the authors revisited the previously published data.

Page 5, Line 15: MAAT was already defined before.

Page 7, line 12: the formula of CBT is not correctly presented.

Page 8, Line 3: correct (2010).

Page 9, Line4: the correlation of CBT with SWC is r2=0.46. I am not sure whether we can say this is a strong correlation. I would say rather “weak to moderate negative correlation”.

Page 9, Line13: mm is missing, MAP >800 mm.

Page 9, Line11-14: the authors argue that the positive correlation between MAP and CBT for the data set with MAP >800 mm might be due to the negative co-variation between CBT and pH. And thus the MAP does not the direct cause of the positive relationship of the CBT with the MAP. This argument is a little bit difficult to follow since the negative relationship between MAP and pH holds for the entire dataset, including the data with <800 mm according to Fig. 5b.

Page 9, Line 14-19: This part of the discussion is also difficult to follow.

Page 10, Line 16: Fig. 6 should be indicated.

Page 10, Lines 22-24: There is a weaker, but still relatively high correlation between CBT and MAGST. More importantly the MAGST is relatively strongly correlated with MAP (r^2=0.62). This means that the influence of MAGST on CBT might not be ignored. That is, we cannot be sure that the CBT variation is solely controlled by the MAP, in my view.

Table 1: It would be recommended to report the concentration of each individual branched GDGT compound as a separated Appendix table.

Fig. 3: it seems that the data published by Yang et al. (2014a) are missing in this figure. I would be helpful to summarize all the Chinese soil data published so far.

Fig. 4: In total 97 soils were analyzed but they are only from 33 sites. So in my view it would be better to show the scatter within the sites too. The mean values of CBT vs. SWC or MAD for each site can be plotted with standard deviations of each parameter for each site. In the panel a, n= 96, while in the panel b, n=97. Why is there this difference?

Fig. 5: see the comment on Fig. 4. In the panel, it would be also logical to add the new soil data from this study.

Fig. 6: the scatter plot between CBT and MAGST should be added here.

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