**Climate
of the Past**

Discussions

Interactive comment on "Microbial Membrane
Tetraether lipid-inferred paleohydrology and
paleotemperature of Lake Chenghai during the
Pleistocene-Holocene transition" *by*
Weiwei Sun et al.

Anonymous Referee #1

Received and published: 16 October 2019

The manuscript "Microbial Membrane Tetraether lipid-inferred paleohydrology and pa-
leotemperature of Lake Chenghai during the Pleistocene-Holocene transition" focuses
on GDGT-based hydrological and temperature reconstruction during the Pleistocene–
Holocene transition in Lake Chenghai (south-west China). Specifically, the authors
calculated isoGDGT based proxies including the relative abundance of crenarchaeol
(%cren) used as proxy for lake water level, TEX86 for lake surface temperature, BIT for
organinc matter input, GDGT-0/Cren as proxy for archaea methanogens and cren'/cren
ratio as proxy for isoGDGT producers. The lipid proxy records, particularly lake surface

temperature is highly relevant, due to the scarcity of terrestrial temperature records
from the Indian Summer Monsoon region, as stated by the authors. I believe that the
BIT, GDGT-0/Cren and cren'/cren records show high potential as the shifts observed
during the YD and H1 events are particularly interesting. However, I see some ma-
jor problems, listed below, which require substantial re-writing in addition to further
analyses. Therefore, I suggest reject with an invitation to re-submit or possibly major
revisions.

1) The assessment of GDGT as paleoclimate and paleohydrology proxy lack of in-depth
discussion on the complex interpretations of the lipids. For instance, the paper does
not address the fact that it is well known that GDGT composition is highly affected by a
variety of environmental factors including air and water temperature, pH, salinity etc.,
which can complicate the interpretation of the proxy used (e.g. Pearson et al., 2008,
Wang et al., 2013) . The paper also attempts to present and discuss the Lake Chenghai
record in the context of the larger Indian Summer Monsoon region (including records
from China and Japan). However, there is a substantial lack of detailed comparison be-
tween the Lake Chenghai record and other records shown in Fig. 5. Specifically, there
is almost no mention of the differences between records and there is little discussion
on the causes of the climatic variation in the studied lake and what might cause the
regional differences observed in the records presented in Fig. 5. Therefore, I suggest
that the authors should provide more discussion on the use of GDGTs as proxy and
how they perform in relation to other records (agree/disagree).

2) The authors mentioned in the method section that both isoprenoid and branched
GDGTs were extracted and analysed. However, they use brGDGTs only to calculate
BIT index but do not use any of the numerous brGDGT based temperature proxy (e.g.
MBT/CBT, MBT'/CBT). Instead only isoGDGT derived TEX86 was adopted for temper-
ature reconstruction. However, TEX86 was only applicable to approximately half of the
core (57 out of 102 samples) due to the high contribution of soil derived isoGDGTs.
As stated by the authors, there is scarcity of terrestrial temperature records from the

studies region, therefore I strongly suggest that brGDGTs-based paleothermometers should be calculated and applied downcore in Lake Chenghai to increase the resolution and the knowledge of air and water temperature changes in the region. Finally, GDGT-based calibrations (in this case TEX86 inferred lake surface temp.) should not be "blindly" applied for downcore climate reconstruction. I strongly suggest that correlation analysis between iso (and eventually brGDGT) based proxies and modern water temperature and air temperature should be performed to test the validity of using GDGT for paleoclimate reconstruction.

3) I suggest that the introduction and the discussion should be throughout modified and potentially revised. In the introduction, there is not enough background on the proxies used (e.g. the producers, the environmental factors affecting TEX86, %cren, cren'/cren and GDGT-0/cren ratios), and there should be more clarification on why it is important to reconstruct lake level changes in the context of modern climate and future predictions. In the discussion, from line 220 to 254 the authors provide a literature review on the proxies used. This section should not be in the discussion, but rather be part of the introduction. Additionally, sections 4.2 and 4.3 are too descriptive and are not well connected between each other. As most of section 4.1 should be in the introduction I suggest to revise the discussion focusing on the a) interpretation (not description) of the proxies used, b) contextualise the climate and hydrological changes within the region and discuss in detail the causes of the changes and the implications for future scenarios, c) evaluate the proxies used for Lake Chenghai as mentioned in point 1 above.

4) I strongly advise for this manuscript to be revised by either a professional translator or a native English speaker as there are large portions of the text which should be rephrased as they are difficult to follow/read. Additionally, I have noticed grammar and stylistic mistakes which I have tried to amend as much as possible. I have also provided suggestions on how to rephrase some of the sentences.

Below are specific comments. Comments on grammar and rephasing can be found in

the attached PDF.

In the introduction I think you should add a figure with the structure of iso and br GDGTs Lines 61 to 74: in this section you need to explain specifically why it is important to reconstruct lake level changes. What do these changes tell us about the hydrological budget? Line 80: You should be more specific and list the producers. We know for example the phyla that produce isoGDGTs (e.g. Euryarchaeota) Line 85 to 98: This is not enough introduction to TEX86 nor %cren, additionally there is no mention of cren'/cren ratio. I'd suggest you move section from line 220 to 254 here (see point 3 above) Line 129 – 130: you should make clearer that the chronology for this lake has already been published in Sun at el. 2019 Lines 145-146: This is an unusual way for extracting lipids, can you add a reference? Line 169: This is the first time you mention brGDGTs. They should be briefly introduced in the introduction section alongside the BIT. Line 202: You should report r not r2 (as r is the correlation coefficient) Lines 220 to 254: this section is a literature review and contextualises the use and potential drawbacks of GDGTs and the GDGT-based proxy. Therefore, it should be rewritten into the introduction section. Line 257: which modern processes? what do you mean by that exactly? Lines 262 - 286: Here you are simply presenting the results of cren/cren' and GDGT-0/cren ratios with a bit of contextualisation within the literature. This should be better explained within the context of climate and hydrological changes. Line 293: "Deep lake conditions" Such as? Can you list some of the conditions affecting the Thaumarchaeota growth? Line 311/ Fig. 4 : Here you mention diatom record but in Fig. 4 you only plot the grain-size record. Could you add the acidophilous record in fig 4? Line 320: You should add what proxy you are talking about. E.g. "Lake levels inferred from %cren do not show a lowstand during the YD, which is generally recognised as a period of low rainfall due to the weakening of the ISM" Line 320-321: add the start and end dates for the YD period Lines 327-330: You should discuss this more. Is it just due to the sensitivity or do other environmental factor affect the proxies that you are presenting? IsoGDGTs including cren and cren' are affected by air and water temperature, pH etc. which can complicate the

interpretation of the proxy used. Discuss this further. Lines 336-339: So how does this impact your interpretation of the %cren record? Lines 340-343: This needs to be further discussed and more details are needed. For instance, cren'/cren record during H1 event appears to be more variable than what you say with a substantial trough at approx. 15.5 cal ka BP, suggesting a shift in archaea community. This change occurs alongside changes in BIT and GDGT-0/cren and grain size. Expand on this. Section 4.3 from line 344: This section does not discuss the causes of the warming during the early Holocene. You are simply comparing the Lake Chenghai record with other record from the region without offering any explanation on the reason of climate warming. Additionally, you don't highlight any differences between the records (and therefore the region) and what might the causes of the regional climate differences. There is a very brief discussion offered in lines 398-402 but this is not enough.

Please also note the supplement to this comment:
https://www.clim-past-discuss.net/cp-2019-82/cp-2019-82-RC1-supplement.pdf

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