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Discussions

Interactive comment on "Short-term variability in the sedimentary BIT index of Lake Challa, East Africa over the past 2200 years: validating the precipitation proxy" *by* L. K. Buckles et al.

Anonymous Referee #1

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- Summary: Application of the BIT index as a paleo-precipitation proxy at Lake Challa, East Africa has sparked a highly interesting and complex debate over the past several years. The proxy seems to say something important about hydroclimate on long timescales, but how it works remains a mystery. In this manuscript, Buckles et al. present a new analysis of branched GDGTs in sediment trap and sediment core data in order to clarify how this proxy works. The dataset and the analysis are a highly valuable contribution, and the paper is generally well-written (although the 'Results' section needs to be revised for a more general, non-organic geochemistry audience; see my comments below). However, my main issue is that the conclusions are strongly biased towards supporting the BIT index as a robust and consistent paleo-precipitation

proxy in this setting, when the authors' own data show that it is, in fact, not. I strongly recommend that the authors remove the highly speculative conclusions toward the end of the paper (more information below) and focus, instead, on what their dataset does in fact show. The data are extremely informative and they add more pieces to the puzzle, but they do not come close to 'proving' that the BIT index "is a reliable precipitation proxy, at least in the Lake Challa system and on (multi-)decadal and longer time scales" (Conclusion, pg 1199). The authors should provide a more honest discussion of what we still need to learn in order to understand how the BIT index reflects hydroclimate at Lake Challa.

- A note on the writing style:

The topic of this paper (assessing the validity of the BIT index as a paleo-precipitation proxy in Lake Challa) is highly relevant to the broader paleoclimate community. However, the Results section (and parts of the Discussion prior to section 4.4) is written in such a way that it would be much better suited to an organic geochemistry journal. The authors should revise the paper to be more accessible to a non-organic geochemistry audience. For example, rather than focus on the technical details of every measurement they performed, the authors should give the results alongside a discussion of why these measurements were made in the first place. What is the importance of looking at core lipids and intact polar lipids? Why would someone do this? What new information does this provide? Why are there multiple indices for brGDGTs, and why bother comparing BIT to, e.g., MBT? These may be obvious to an organic geochemist, but it is totally unfamiliar territory to most Climate of the Past readers.

- Detailed comments: Generally, I find the arguments presented in this section to be rather biased towards "support[ing] use of the BIT index as hydroclimatic proxy in this system (Verschuren et al., 2009)." It should not be assumed a-priori that the interpretation presented in Verschuren et al., 2009 is correct and should be supported, somehow, by the modern data. In fact, the data presented here show that BIT is an unreliable and inconsistent hydroclimate proxy in this system. It does seem to respond to

ecological changes in the lacustrine system following the early-2008 erosion event, via suppression of Crenarchaeol production. However, this rainfall event was less intense (if Challa and Taveta are comparable) than a heavy rainfall event in early 2007, but that early 2007 event was not detected by BIT. Therefore, BIT does not in fact respond in a consistent manner to extreme rainfall events.

If, in fact, the BIT index does respond to rainfall events that follow severe drought (as the authors postulate for the early-2008 event), then it is an indicator of erosion extremes, not precipitation extremes or seasonal (monsoonal) precipitation. The proxy of course could be detecting high-amplitude variability. It is very possible that in the 25,000 year record, the BIT index is not recording regular monsoonal rainfall but rather extreme flooding events that also follow extreme droughts. The BIT signals get smoothed out and even shifted in time relative to the varve record, as is shown in Figure 3G.

Finally, the authors' conclusions that the BIT index may be reliable on decadal timescales even if it is not reliable on interannual timescales seems highly over- speculative. Conveniently, we do not have decades' worth of modern data to disprove this. But in fact, even in this multi-year dataset, the authors have only one single event on which this interpretation is based.

These findings are important for continuing to develop the interpretation of the Lake Challa BIT record. The authors should recognize that the interpretation of this proxy in this setting will continue to develop through time with new data, and it may even be revised quite thoroughly. Such is the purpose of collecting modern data to inform a proxy.

The BIT index at Lake Challa does seem to say something about precipitation and erosion on long timescales. However, at this stage it is unclear what this proxy is telling us, and why it seems to work. This paper is an important first step, and additional modern observations will continue to clarify and develop the interpretation of this proxy and its application in other settings. However, I feel that a more laudable approach

would be for the authors to explain what they have found and to honestly assess what is still not well-understood. They do not need to 'solve' the BIT proxy in this paper in order for the 25,000 year record to still be useful. In fact I feel the over-speculation weakens the overall findings of the paper, which in themselves are very interesting and a highly worthy contribution to the paleoclimate community.

- Line-by-line comments:

Pg 1180: Make it clear that Crenarchaeol = GDGT V

Pg 1183 Lines 5-10: Please include a figure with the age model. In the supplementary material please provide the 14C AMS dates and their 1- and 2-sigma uncertainties.

Pg 1185, Equation 3: Define DC?

Pg 1186, Line 5: Why these 'general guidelines?' How were these cut-offs chosen? 0.5 is very low to be considered "strongly correlated", especially since these are r-values ad not rËȨ2.

Pg 1186, What is SD? standard deviation? Please define

Pg 1187: Does r=0.67 for [brGDGT] with both crenarchaeol and its regioisomer? Please confirm

Pg 1189 line ∼20: Do the gravity core samples have any actual age control points at the top? Otherwise, it is a strong assumption to say you know their timing down to the month.

Figure 6: Confused. I do not see GDGT-0 on this figure. I am only now realizing that GDGT-0 is the same as GDGT-I in the Appendix. This is very confusing. Can you please make this terminology very clear, repeating it throughout the paper so that the reader can follow.

Figure 6: Why no error bars on CH07?

Pg 1193 line 12: Why would it be true that brGDGTs/crenarchaeol are correlated, and hence brGDGT producers are heterotrophic bacteria? This connection is not clear, please explain.

Figure 2a: Because of the missing Challa precipitation data it is difficult to compare the magnitude of the precipitation that resulted in the erosion event with the other precipitation in the records. Please plot Taveta rainfall for the other events as well on

Fig 2a, so that the comparison may be made.

Pg 1194, line 19: The onset of the principal rainy season cannot be the only reason for erosion, because the other years' principal rainy seasons did not see similar erosion events.

Pg 1197: "Since stronger austral-winter winds are associated with a weak southeasterly monsoon compromising the main rain season during March–May " Please provide citation for this mechanism

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