Author Reply to Anonymous Referee #1

This is a well-written and timely contribution, focusing on the distribution of branched GDGTs in Lake Chala, Kenya. The data support the conclusions, and move forward our understanding these biomarkers as potential environmental proxies.
Main points: 1. brGDGTs produced primarily in situ in the water column of Lake Chala a. distinct distribution from soils b. also appears to be production in sediments, as they are distinct from water and soil brGDGTs 2. brGDGT distribution changes with depth and season, but not exactly as expected if driven by environmental parameters 3. Likely this is due to production by various different bacterial groups producing at different times, rather than a single group changing lipids 4. brGDGTs do not correlate well with Acidobacteria rRNA, suggesting other groups are more dominant producers.
The research discussed here is an important step towards determining source organisms of brGDGTs and the extent to which their distribution actually reflect temperature, pH, or other parameters.

Reply: We thank the referee for the appreciation of our work.

I'd like to see some discussion of how this system is unique, and whether they think that would bias the results. For example, Chala is a crater lake with very little terrestrial input. What about a system with very different morphology that does get a lot of terrestrial input? This sort of reflection would be easy to add to the implications section, and would figure strongly in how broadly the results from Chala are likely to apply.

Reply: The input of soil material into a lake will indeed depend on the morphology of the catchment. In addition, local climate may be an important factor, as e.g. precipitation events are needed for soil mobilization and transport to the lake. However, it still remains impossible to determine the exact contribution of soil-derived brGDGTs to the signal that is stored the sediments of a lake: In contrast to rivers and the coastal marine environment, where in situ brGDGT production can be recognized based on the relative abundance of 6-methyl brGDGTs (De Jonge et al., 2014) or the weighed number of rings in the tetramethylated brGDGT (Sinninghe Damsté, 2016), there are currently no indices that systematically indicate the aquatic production in lakes. Pending the development of such index, so far the source of brGDGTs is mostly inferred from comparisons of brGDGT distributions between lake sediments and catchment soils, but the offsets appear inconsistent among lake systems. For example, MBT'_{5me} is lower in the surface sediments of Basin Pond (Maine, USA) than in surrounding soils (Miller et al., 2018), whereas it is the other way around in Loe Pool (UK; Guo et al., 2020). Given the clear indications for in situ production in Lake Chala, but good relation with brGDGT distributions and modeled temperature in the East African Lakes calibration set (Russell et al., 2018), it seems that the brGDGT-based temperature calibration already takes the additional production into account, as we also suggest in our manuscript. A next step would be to derive a lake-specific transfer function based on a global dataset rather than East African lakes only. In the revised version of our manuscript we will describe the implications of our findings in Lake Chala and put them in a broader perspective.

I did notice a few typos scattered throughout (e.g. line 199 should read "...liquid chromatograph. . ."; line 648 should read ". . .related to temperature. . ."), but one more detailed read by the authors should find these.

Reply: We thank the referee for catching these. We will carefully re-read our manuscript, and make corrections where appropriate in a revised version of our manuscript.

References:

De Jonge et al., 2014 GCA 125, 476-491

Guo et al., 2020 Biogeosciences 17, 3183-3202

Miller et al., 2018 Climate of the Past 14, 1653-1667

Russell et al., 2018 Org. Geochem 117, 56-69

Sinninghe Damsté, 2016 GCA 186, 13-21