BACTERIAL GMGTS IN EAST AFRICAN LAKES: SOURCES AND THEIR POTENTIAL AS PALEOTEMPERATURE INDICATORS

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Glycerol monoalkyl glycerol tetraethers (GMGTs) are a group of membrane spanning lipids produced by species of archaea and bacteria which are found in a variety of natural settings. They are structurally similar to the better studied glycerol dialkyl glycerol tetraethers (GDGTs) but differ by having a covalent carbon-carbon bond that forms a bridge between the two alkyl chains. Recent research involving marine sediments (Sollich et al., 2017) and peat (Naafs et al., 2018) suggests that this feature is an adaptation to high temperatures. Presently, there is very little evidence of which organisms produce GMGTs, especially in moderate-temperature environments such as lakes and oceans.

Here we report on the structural complexity, abundance and distribution of bacterial branched GMGTs (brGMGTs) in a set of East African lake surface sediments covering a temperature gradient from 2.4–26.8 °C. The recovered brGMGTs have *m/z* of 1020, 1034, and 1048 and greater structural complexity than those previously reported from a global peat data set (Naafs et al., 2018), with up to three possible isomers appearing in the mass chromatograms of *m/z* 1020 and 1034 brGMGTs (Fig. 1). As was demonstrated in peats (Naafs et al., 2018), we find a correlation between the %brGMGT (relative to brGDGTs) and mean annual air temperature (MAAT), with a higher %brGMGT in warmer lakes. This correlation shows significant scatter, particularly at higher temperatures (>20°C). We also observe an influence of temperature on the relative abundances of individual brGMGT isomers. Based on this, we define a new index using the temperature dependent brGMGTs (brGMGTI) which shows a strong linear correlation (r^2=0.94) with MAAT.

To further investigate the sources of brGMGTs in lakes, we will study the presence and diversity of brGMGTs in suspended particulate matter from the water column of Lake Chala, a permanently stratified African crater lake near Mt. Kilimanjaro, over a 17 month period. In order to link seasonal trends in brGMGTs to potential climatic drivers, their presence in sediment trap material collected over a period of four and a half years will also be studied. This should provide insight into the season and depth of brGMGT production and therefore lead to a better understanding of the nature of the temperature signal derived from brGMGTs in lake sediments. In light of the stability of brGMGTs relative to brGDGTs, our new calibrations have potential for reconstructing tropical climate from ancient lake sediments where brGDGTs are not present.

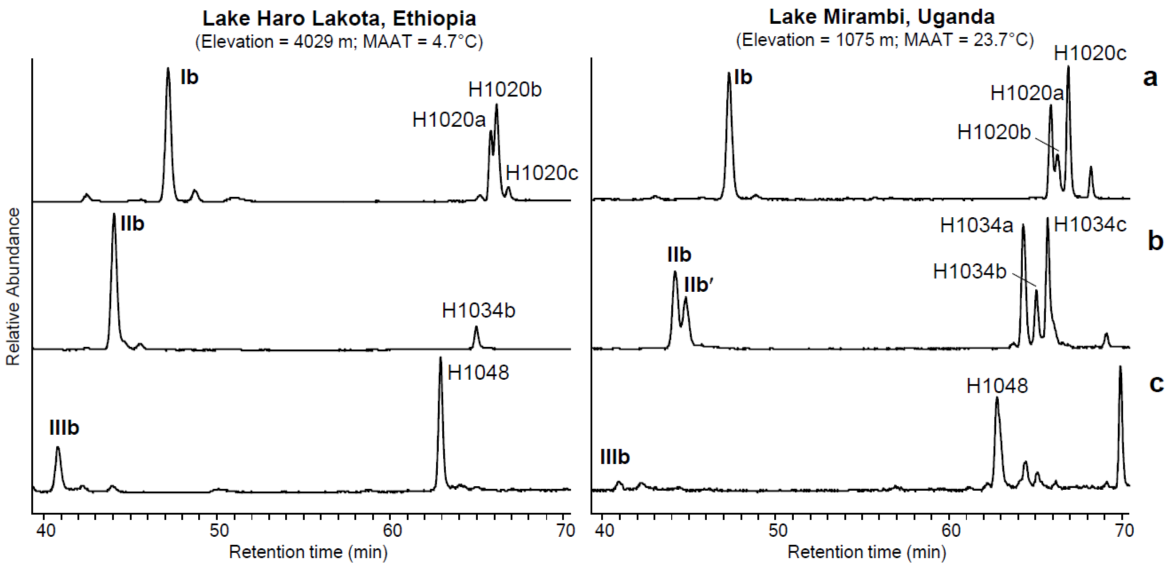

Figure 1. Mass chromatograms for (a) *m/z* 1020, (b) *m/z* 1034, and (c) *m/z* 1048 of the polar fraction of the extracts of the surface sediments from Lake Haro Lakota, Ethiopia (elevation = 4029 m: MAAT =4.7°C) and Lake Mirambi, Uganda (Elevation = 1075m: MAAT = 23.7°C). The distributions of the brGMGTs are representative for those found in cold and warm lakes, respectively.

References

Naafs B., McCormick D., Inglis G., Pancost R. D. and the T-GRES peat database collaborators (2018) Archaeal and bacterial H-GDGTs are abundant in peat and their relative abundance is positively correlated with temperature. *Geochimica et Cosmochimica Acta* **227**, 156-170.

Sollich M., Yoshinaga M. Y., Häusler S., Price R. E., Hinrichs K. U. and Bühring S. I. (2017) Heat stress dictates microbial lipid composition along a thermal gradient in marine sediments. *Frontiers in Microbiology* **8**, 1550.