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Temperature sensitivity of freshwater branched glycerol dialkyl glycerol tetraethers in different seasons: a mesocosm approach

FATEMEH AJALLOOEIAN[1] AND CINDY DE JONGE[2]

[1]ETH Zurich

[2]Biogeosciences, Geology

Presenting Author: fatemeh.ajallooeian@erdw.ethz.ch

Branched Glycerol Dialkyl Glycerol Tetraethers (brGDGTs) are ubiquitous bacterial membrane spanning lipids, containing 4-6 methyl branches that can form cyclopentane moieties following internal cyclization. BrGDGTs have been encountered in soils, marine, lake sediments, and the water column. On a global scale, the degree of methylation of 5- methyl brGDGTs (calculated as $MBT'_{5M}E$ ratio) correlates with temperature in soils and lakes.

Although the MBT'_{5ME} proxy has been applied successfully in several paleoclimate studies, the mechanisms that cause the dependency on temperature are still not fully elucidated. Specifically, it is not clear whether the composition of the brGDGT membrane lipid changes in direct response to changes in temperature, and/or if temperature causes the composition of the bacterial community to change. Although some bacterial taxa have been proposed as producers of brGDGT lipids, the main producers of these biomarker lipids in the environment are not well known.

To investigate the response of brGDGTs and their bacterial producers to changing temperatures, our experiment uses lake/river freshwater mesocosms that are subjected to three different growth temperatures (10°C, 17.5°C, 25°C), sampled at several timepoints (24h, 1, 2, 3 and 5 weeks). Here, oxic surface water was collected seasonally from Lake Rot and Sihl River both situated in central Switzerland. With these experiments, we aim to understand i) which brGDGTs are produced at different temperatures and ii) how this production depends on the composition of the bacterial community. The current abstract focuses on the lipid concentration and distribution variability. Inorganic parameters measured as drivers of brGDGTs distribution include alkalinity, concentration of cation and anions, pH and conductivity.

We present results of three seasons: spring, summer and autumn 2021. Although in-situ MBT'_{5ME} show higher values in the warmer season, MBT'_{5ME} values do not always increase with temperature (25 °C> 17.5°C> 10°C) in the mesocosms, disputing the mechanism of the MBT'_{5ME} proxy as a direct response to temperature. Still, changes in the brGDGT distribution are observed between different growing temperatures. Apart from temperature, inorganic indices such as conductivity display a significant correlation with MBT'_{5ME}. Insights into the temperature-dependent production of brGDGTs will improve the accuracy of current paleoclimate proxies.