Soil branched GDGTs measured along an Icelandic temperature gradient change only when the bacterial community changes

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Branched glycerol dialkyl glycerol tetraethers (brGDGTs) are bacterial membrane lipids that are abundant in soils. Their distribution in globally distributed soils correlates with the prevailing mean annual air temperature and soil pH [1,2]. To explain this correlation, the original paradigm was that the introduction of different brGDGT lipids in the cell membrane ensured an optimal membrane fluidity and permeability in different pH and temperature conditions. An alternative mechanism is that the observed co-variation with temperature and pH is tracing a shift in microbial composition.

To study the unique effect of temperature on these lipids, we have sampled along five permanent research transects in a long-term (>70 years) geothermally warmed grassland soil, where soil temperature was measured in-situ. This geothermal warming only influences the soil through heat radiation, and does not influence the soil pH or other chemical characteristics. At each sample site (n=30) the fatty acid and brGDGT lipid distribution and the composition of the bacterial community, based on the diversity of the 16S rRNA, was determined. Here we present evidence that the brGDGT fingerprint is mainly controlled by the composition of the microbial community, rather than being a biochemical response of an unchanged community. The Icelandic bacterial community remains unchanged during moderate warming. At higher temperatures (mean soil temperature > 15 °C) the community shifts, and only then a shift in brGDGTs lipids and brGDGT precursors is observed. The lipid pattern of the warm soils agrees with predicted distributions, which supports the application of the palaeoproxy.

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