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## Influence of environmental parameters on bacterial lipids in soils from the French Alps: implications for paleo-reconstructions

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Microorganisms can modify the composition of their lipid membrane in response to variations in environmental parameters. This is the case for bacterial lipids such as glycerol dialkyl tetraethers (GDGT) and 3-hydroxy fatty acids (3-OH FAs), both used for temperature and pH reconstructions in terrestrial paleoenvironmental studies. However, a major concern with these proxies is that their structure may be influenced by other environmental parameters than temperature or pH. The present study aimed at identifying and quantifying the influence of environmental parameters such as soil moisture, vegetation types and soil types on bacterial GDGTs and 3-OH FAs. These lipids were analyzed in 49 soil samples collected between 200 m and 3,000 m altitude in the French Alps. The soils cover a wide range of temperature (0 °C to 15 °C) and pH (3 to 8) and are representative of the diversity of soils and vegetation encountered along the investigated altitudinal transects. Using this new well-documented and unique dataset, the GDGT-pH correlation was confirmed, but the one between 3-OH FAs and pH was lower than in previous studies. For the temperature, correlations were lower than in previous studies for the GDGTs and absent for the 3-OH FAs. These observations could be explained thanks to different statistical analyses. Redundancy analysis (RDA) showed that pH is the main driver of the variability of 3-OH FAs and GDGTs, explaining 20.5 % and 56 % of the distribution of these bacterial lipids, respectively, followed by the altitude (8 % influence on the distribution of 3-OH FAs, and 11 % on GDGTs) and granulometry (5 % impact on 3-OH FAs and 7.5 % on GDGTs). Taken together, these results highlight the major influence of the vegetation cover and soil types on the distribution of bacterial lipids. Indeed, we quantified and explained for the first time the impact of the different environmental factors (temperature, vegetation, soil type...) on the distribution of bacterial lipids. This novel comprehension of the impacts of environmental parameters will allow to refine the use of proxies based on these compounds. These results pave the way for new types of applications of GDGTs and 3-OH FAs as environmental proxies in paleosoils, peat or lacustrine sediments.