

Impact de l'eutrophisation sur l'utilisation de lipides membranaires (alkyl tetraéthers de glycerol) comme marqueurs d'environnement dans les lacs d'Ile-de-France

Arnaud Huguet¹, François Mainié¹, Alice Breban¹, Gérard Lacroix², Christelle Anquetil¹,
Sylvie Derenne¹

¹ METIS, CNRS/UPMC/EPHE UMR 7619, Paris, France

² IEES, CNRS/UPMC UMR 7618, Paris, France

Contact: arnaud.huguet@upmc.fr

Résumé:

The Ile-de-France region, which includes the city of Paris, is the most populated area in France, with ca. 12 million inhabitants. The peri-urban aquatic ecosystems of this region are impacted by a large variety of environmental stressors, and especially high anthropogenic pressures (agricultural, industrial and urban pollutants), leading to the increased eutrophication of these water systems. The Ile-de-France lakes are therefore highly vulnerable ecosystems. Glycerol dialkyl glycerol tetraethers (GDGTs) are membrane lipids which include the isoprenoid GDGTs (iso GDGTs) produced by archaea and the branched GDGTs (br GDGTs) produced by some unknown bacteria. These compounds are increasingly used as temperature proxies in lakes, even though they were only rarely investigated in highly polluted ones. In this study, the two pools of GDGTs, either present as core lipids (CLs) or derived from intact polar lipids (IPLs), were analysed in 33 lakes from the Ile-de-France region, representing the diversity of the regional landscape and characterised by different levels of eutrophication. The origin and applicability of these compounds as temperature proxies was examined in these lakes.

The distribution and abundance of iso and br GDGTs were first compared in all lacustrine sediments and surrounding soils. Both br and iso GDGTs were systematically more abundant in sediments than in soils. In addition, GDGT distributions differed between the two types of ecosystems. Taken together, the results suggest that (i) GDGTs are mainly produced *in situ* in lakes, in the water column and sediments and that (ii) the predominant microbial communities producing br GDGT and iso GDGTs are not the same in lakes and surrounding soils.

The lakes were also distinguished by their eutrophication level. Concentrations in iso GDGTs were significantly higher in hypertrophic lakes than in oligotrophic lakes. This suggests for the first time that the eutrophication level may have an impact on the production of archaeal membrane lipids. In contrast, no significant difference in br GDGT concentration was observed between hypertrophic and oligotrophic lakes. In addition, the eutrophication was shown not to affect the iso and br GDGT distributions,

Methanogenic archaea were predominant in most of the lakes, preventing the application of the archaeal GDGT-based proxy to estimate water surface temperature. In contrast, br GDGT proxies (MBT'/CBT) could be used to reconstruct air temperature. Temperature estimates based on lacustrine calibrations were consistent with, respectively, mean annual air temperature (11 °C) and mean summer air temperature (19 °C) recorded in the Ile-de-France region whatever the eutrophication level of the lakes. This suggests that br GDGT-derived proxies can be used even in highly anthropogenic aquatic ecosystems.