

DISTRIBUTION OF TETRAETHER MEMBRANE LIPIDS IN EUROPEAN LAKE SEDIMENTS

Cornelia Iulia BLAGA¹, Gert-Jan REICHART¹ and Jaap S. SINNINGHE DAMSTÉ^{1,2}

1. Utrecht University, Faculty of Geosciences, Department of Molecular Palaeontology, Budapestlaan 4, 3584 CD Utrecht, The Netherlands

2. Royal Netherlands Institute for Sea Research (NIOZ), P.O. Box 59, 1790 AB Den Burg, The Netherlands

One of the most important tools for the reconstruction of past climatic changes is the analysis of geological records that result from sediment deposition in lakes and oceans. These sediments contain fossils derived from the climate dependant lifeforms that thrived in the water system at the time of the deposition. In the frame of a multiproxy study, we aim to develop novel proxies for lake surface temperatures. The TetraEther indeX of lipids with 86 carbon atoms, or TEX₈₆, is one of the relatively new palaeotemperature proxies developed and successfully applied in the marine environments (Schouten *et al.* 2002) and also shows potential for application in lakes (Powers *et al.* 2004). This proxy is based on the distribution of pelagic crenarchaeotal membrane lipids found as chemical fossils in sediments. In the current study we tested this proxy in a large series of European lakes in order to further extend its use into lacustrine environments.

For the assessment of glycerol dialkyl glycerol tetraether (GDGT) distributions in sediments, the top 5 cm sediment from a series of 43 lakes, situated along a transect from south Italy to the northern part of Scandinavia was collected and analysed. After analysis of the polar fraction of the organic matter extracted from the sediment with HPLC-MS the relative distribution of GDGTs was determined. Our results show that both archaea-derived isoprenoid and bacteria-derived branched GDGTs were present in all lake sediments and both relative distribution and concentration varied between the different lakes (Fig.1). Branched GDGTs, produced by an unknown group of anaerobic soil bacteria, dominate especially in the northern lakes. Crenarchaeotal GDGTs (including crenarchaeol VI) were found in varying concentrations, being more dominant in the lakes from the Alps and in some of the lakes from the more southern part of the transect. In some lakes, usually of a smaller size, a relatively high amount of GDGT-0 (I) compared with a very low amount of crenarchaeol is observed. As methanogenic Euryarchaeota are known to biosynthesise this compound, they may be responsible for the presence of GDGT-0 in these lakes rather than crenarchaeota.

The large input of soil-derived branched GDGTs (Fig.1) indicates a related input of terrestrial isoprenoid GDGTs in most lakes (cf. Weijers *et al.* 2006). This input affects the distribution of in-situ produced crenarchaeotal GDGTs and prevents application of the TEX₈₆

proxy. Furthermore, it was observed that in the lakes where in-situ production of crenarchaeota is sufficient, the crenarchaeol regio-isomer, which plays an important role in determining TEX₈₆ values (Schouten *et al.* 2002), has an anomalously low concentration. This biases the TEX₈₆ and thus leads to an altered reconstructed lake surface temperature. We are currently working on improving the temperature calibration for lake-GDGT distributions.

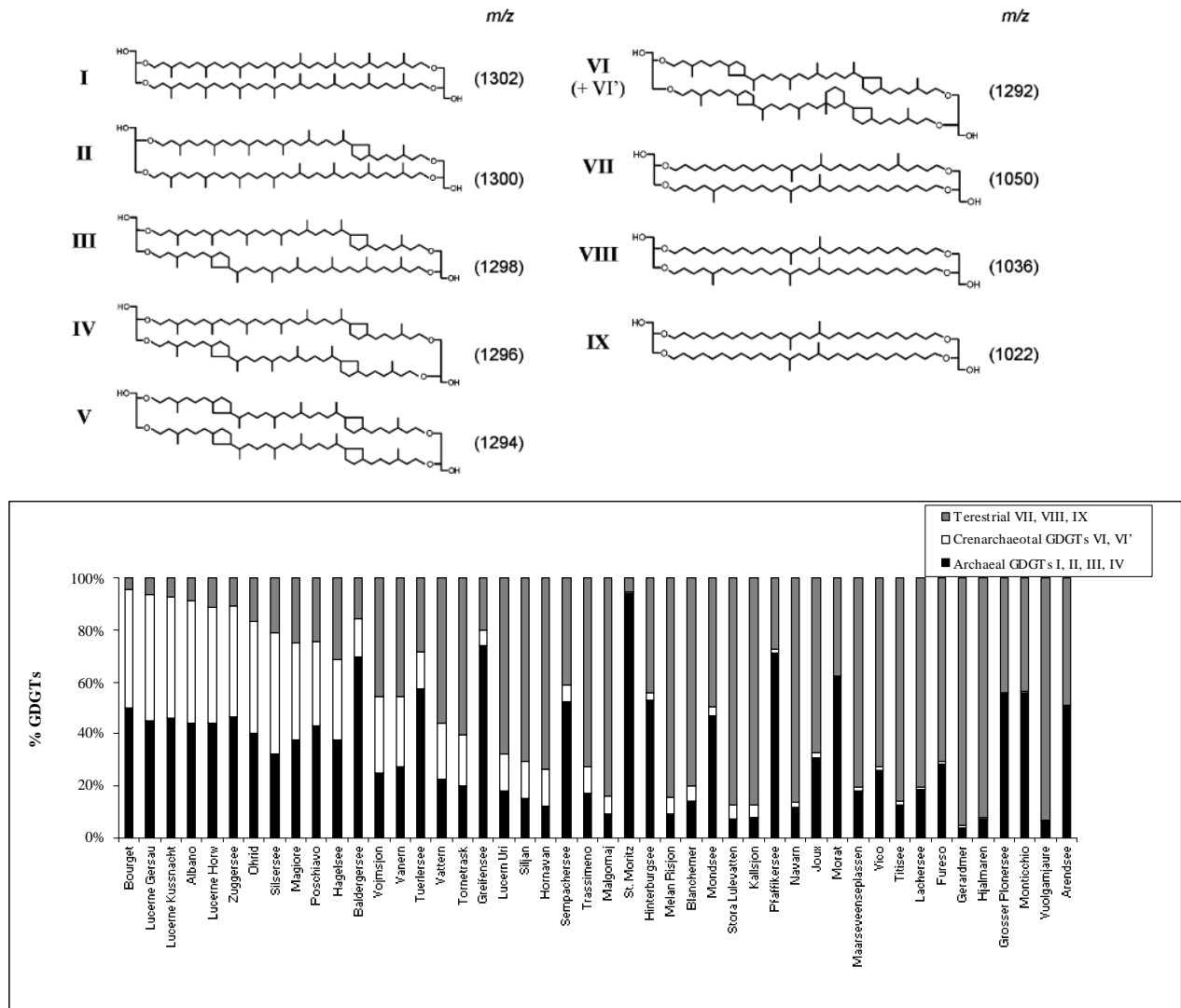


Figure 1. Molecular structures of the glycerol dialkyl glycerol tetraethers (GDGTs) and their relative distribution in different lakes.

REFERENCES

- Schouten, S., Hopmans, E.C., Schefuß, E., Sinninghe Damsté, J.S., 2002. Distributional variations in marine crenarchaeotal membrane lipids: a new tool for reconstructing ancient sea water temperatures? *Earth and Planetary Science Letters* **204**, 265–274.
- Powers L.A., Werne J.P., Johnson T.C., Hopmans E.C., Sinninghe Damsté J.S., Schouten S. 2004. Crenarchaeotal membrane lipids in lake sediments; a new paleotemperature proxy for continental paleoclimate reconstruction? *Geology* **32**, 613-616
- Weijers J.W.H., S. Schouten, O. Spaargaren and J.S. Sinninghe Damsté 2006. Occurrence and distribution of tetraether membrane lipids in soils: Implications for the use of the TEX₈₆ proxy and the BIT index. *Organic Geochemistry* **37**, 1680-1693