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Tetraether membrane lipid distributions in lake particulate matter and sediments: A study of 47 European lakes along a North-South transect

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The distributions of glycerol dialkyl glycerol tetraethers (GDGTs) in particulate matter and the top 5 cm sediment from a series of 47 lakes, situated along a transect from southern Italy to the northern part of Scandinavia, were analyzed to study the biological sources and potential palaeoenvironmental applications of GDGTs in lacustrine sediments. Both archaea-derived isoprenoid and bacteria-derived branched GDGTs, produced by yet unknown soil bacteria, were identified in all lake sediments. GDGT distributions varied substantially. Crenarchaeotal GDGTs (including the characteristic GDGT crenarchaeol) were found in varying relative concentrations, being more dominant in lakes from the Alps and some of the lakes from the more southern part of the latitudinal transect. In some lakes, high amounts of the GDGT with no cyclopentane moieties relative to crenarchaeol were observed. As methanogenic Euryarchaeota are known to biosynthesise this GDGT predominantly, these archaea, rather than Crenarchaeota, may be their dominant biological source. In most of the lakes a substantial contribution of soil bacteria-derived branched GDGTs ($>$40 % of total GDGTs) indicated a substantial contribution from soil erosion. Branched GDGTs dominate especially in the northern lakes, possibly related to high soil erosion rates. Soil input affects the distribution of isoprenoidal GDGTs and prevents the reliable application of the TEX_{86} temperature proxy for lake water temperature based on in-situ

produced crenarchaeotal GDGTs in many of the lakes. In 9 out of the 47 lakes studied the TEX_{86} temperature proxy could be reliably used. When we compared the TEX_{86} correlation with annual and winter lake surface temperature, respectively, it appears that the relationship between TEX_{86} and winter temperature is slightly stronger. This could be an indication for the season in which these organisms have peak abundance.