Geophysical Research Abstracts
Vol. 14, EGU2012-2057, 2012
EGU General Assembly 2012

Distribution of archaeal and bacterial glycerol dialkyl glycerol tetraethers in tropical sediments from Guadeloupe (French West Indies): implications for application of the MBT/CBT and TEX86 proxies

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Glycerol dialkyl glycerol tetraethers (GDGTs) are lipids of high molecular weight present in membranes of Archaea and some bacteria. Archaeal membranes are composed predominantly of isoprenoid GDGTs, with acyclic or ring-containg biphytanyl chains. The amount of isoprenoid GDGTs with cyclopentyl moieties was shown to increase with water temperature and variations in surface water temperature can be determined via the TEX86 proxy. Recently, another type of GDGTs, with branched instead of isoprenoid alkyl chains, has been discovered in peat and was observed to occur ubiquitously in soils and in aquatic environments. Branched GDGTs were suggested to be produced in soils by still unknown bacteria. The degree of methylation of branched GDGTs, expressed in the MBT, was shown to depend on air temperature and to a lesser extent on soil pH, whereas the relative abundance of cyclopentyl rings of branched GDGTs, expressed in the CBT, was related to soil pH. The MBT/CBT proxies are increasingly used as paleoclimate proxies. The aim of this study was to investigate the distribution of GDGTs in tropical sediments from Guadeloupe (French West Indies). Surficial sediment samples were collected in four coastal water ponds: two located in Grande-Terre and two in a smaller island named La Désirade, 10 km east from Grande-Terre. GDGTs either present as core lipids (CLs; presumed of fossil origin) or derived from intact polar lipids (IPLs; markers for living cells) were analysed. A large part of archaeal GDGTs was present as IPLs (40-50% of total extractable archaeal GDGTs) in all sites. The proportion of IPL GDGTs of bacterial origin with respect to the total pool (CLs +IPLs) was 25-30% in the sediments from La Désirade and $\sim$ 50% in the upper sediment layers from Grande-Terre. Interestingly, the distribution of archaeal and bacterial GDGTs differed between the four sites, as shown by the higher values of the TEX86 and MBT in sediments from La Désirade (TEX86$\sim$0.80; MBT$\sim$0.65-0.70) than in those from Grande-Terre (TEX86$\sim$0.40; MBT$\sim$0.30-0.40). Temperature estimates derived from GDGTs present in La Désirade sediments (25-30°C) were consistent with temperature recorded in the area (annual air temperature 26°C), whereas temperature estimates derived from Grande-Terre sediments (5-10°C) were much lower than expected values. The variability in archaeal GDGT distribution between the four water ponds might be due to different archaeal communities between Grande-Terre and La Désirade: crenarchaeaol, derived from Crenarchaeota, was much less abundant than other archaeal GDGTs in Grande-Terre sediments, which was not the case in La Désirade. Bacterial GDGTs seem to be essentially derived from surrounding soils in La Désirade. In contrast, in Grande-Terre, a substantial proportion of bacterial GDGTs might be produced in the water pond in addition to being produced in surrounding soils, as revealed by the high relative abundance of bacterial IPLs vs. CLs downcore. Our results suggest that caution should be exercised when interpreting MBT/CBT-derived temperatures in aquatic environments, as they might be largely biased by in situ microbial production.