

STRUCTURAL CHARACTERIZATION AND ENVIRONMENTAL SIGNIFICANCE OF BUTANETRIOL DIALKYL GLYCEROL TETRAETHERS

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Archaeal lipids are typically composed of two biphytanes linked to one or two glycerol backbones via ether linkages. This architecture derives from their biosynthesis involving the reaction between *sn*-glycerol-1-phosphate (G1P) and geranylgeranyl pyrophosphate. The biphytanes can display diverse structures while glycerol is considered as the universal backbone for membrane lipid synthesis (Kates, 1977). However, the discovery of a novel class of archaeal lipids, in which butanetriol substitutes one glycerol unit to form the backbone (Knappy et al., 2014; Zhu et al., 2014), challenges this assumption. These lipids were assigned as isoprenoidal butanetriol glycerol tetraethers (iso-BDGTs; Fig. 1) based on MS/MS experiments and analysis of the backbone after ether cleavage. Based on the analysis of estuarine sediments, Meador et al. (2015) postulated a circumstantial link between BDGTs and *Bathymarchaeota*. Yet, recently, *Methanomassiliicoccus luminyensis*, the only isolate of the seventh order of methanogens, was observed to abundantly produce BDGTs (Becker et al., 2016) while they were absent from a large set of other archaeal cultures. The existence of BDGTs opens numerous questions, notably why and how some microorganisms produce such unusual membrane lipids. The detection of BDGTs in *Methanomassiliicoccus luminyensis* suggests that BDGTs in sedimentary samples could serve as biomarker for methanogenesis although their potential sources in the environment remain highly uncertain.

In this study, we combined the analysis of a pure culture of *Methanomassiliicoccus luminyensis* and of marine sediments to investigate the conditions of production and potential function(s) of BDGTs in the environment. Three sediment cores from the Gulf of Lions (GeoB17306, GeoB17307, GeoB17308; Heuer et al., 2013) exhibiting high rates of methanogenesis, were analysed for their archaeal lipid content. In addition, incubations with ¹⁴C-bicarbonate or ¹⁴C-acetate were performed on (i) a pure culture of *Methanomassiliicoccus luminyensis* and on (ii) one core from the Gulf of Lions (GeoB17306). By following the incorporation of ¹⁴C in BDGTs we aim at determining the carbon metabolism of *Methanomassiliicoccus luminyensis* and compare it with the benthic communities producing BDGTs in the Gulf of Lions. In addition, NMR experiment will be performed to precisely characterize the structure of the major BDGT (BDGT-0; Fig. 1). Indeed, differences in the stereoconfiguration may impact the reactivity and stability of this compound in cells as well as in the sediment.

In the Gulf of Lions, the three cores (275 to 446 cm long) were collected along a transect from the Rhône delta to the shelf. This transect covers contrasted geochemical environments from a highly productive zone close to the Rhône delta to more oligotrophic conditions further offshore. BDGTs were detected at all sites and depths, and represented up to 2% of the total archaeal core lipids and up to 12% of the intact polar lipids suggesting that they are predominantly produced in the sediment.

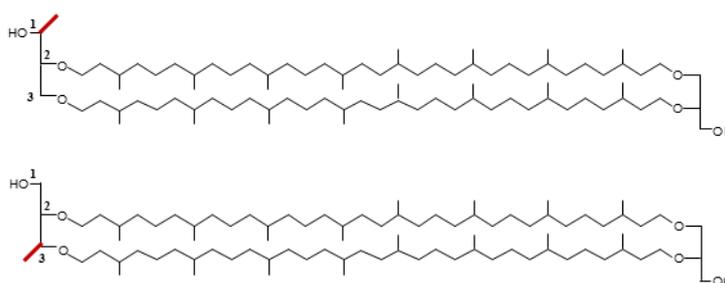


Figure 1 Potential core structure of the major butanetriol dialkyl glycerol tetraether. The additional methyl location remains uncertain and is represented in red in the two potential structures. Carbon numeration follows the Fischer projection of glycerol.

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