

LABORATORY INVESTIGATION OF THE RATE OF MICROBIAL DEGRADATION OF INTACT POLAR LIPIDS IN WADDEN SEA SEDIMENTS

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There are many attempts to study the diversity of microbial communities in subsurface environments. These are, for example, cultivation-based approaches or molecular biological studies. Another common way to investigate the composition of microbial communities is by analysing lipid biomarkers such as intact polar lipids (IPLs). Recent studies, however, have shown that biological and geochemical approaches do not always yield complementary results for the same sample set. For example, Schippers et al. (2005) inferred from quantitative PCR analysis that bacteria prevail in deep subsurface sediments from the Peru margin, whereas Biddle et al. (2006) found that the IPLs derived from archaea are dominant in these sediments. When using IPLs as biomarkers for living cells the question arises of how turnover rates for these lipids are influenced by their composition and by specific environmental settings.

White et al. (1979) reported that phospholipids are only stable in intact cells and are rapidly decomposed after cell lysis. Therefore, intact phospholipids are considered indicators for viable microorganisms. However, previous studies have shown that degradation rates of polar lipids are correlated with the content of organic matter, lipid structure and oxygen concentration in sediments. The effect of inhibited degradation was highest under anoxic conditions in organic-matter-rich sediments. Particularly lipids with ether-bound side chains appeared to be more resistant towards degradation than those with ester-bound side chains (Harvey et al., 1986).

The aim of our study was to measure degradation rates of phospholipids in sediment samples obtained from an intertidal flat of the North German Wadden Sea. During a period of 14 days the residual concentrations of the added intact polar lipids in the sediment samples were measured daily. For that purpose, the samples were spiked with three not naturally occurring phospholipids, i.e. octadecylmonomethyl diether phosphatidyl choline (PC ether lipid), diphytanyl diester phosphatidyl glycerol (PG-diphytanyl) and deuterated distearyl phosphatidyl choline D70 (PC-distearyl-D70). Intact phospholipids (IPLs) were identified using HPLC-ESI-MS and quantified with a coupled evaporative light scattering detector (ELSD). During the first four days the amounts of intact phospholipids decreased rapidly (Fig. 1). But in the following ten days degradation nearly stagnated. The final measurement

after 100 days revealed, that the added phospholipids had almost completely disappeared. Interestingly, there was no significant difference between the degradation of ether and ester lipids. All three added phospholipids were decomposed at a similar rate.

Our studies corroborate the idea that IPLs are representative biomarkers for living microorganisms because these lipids are relatively rapidly turned over even under anoxic conditions.

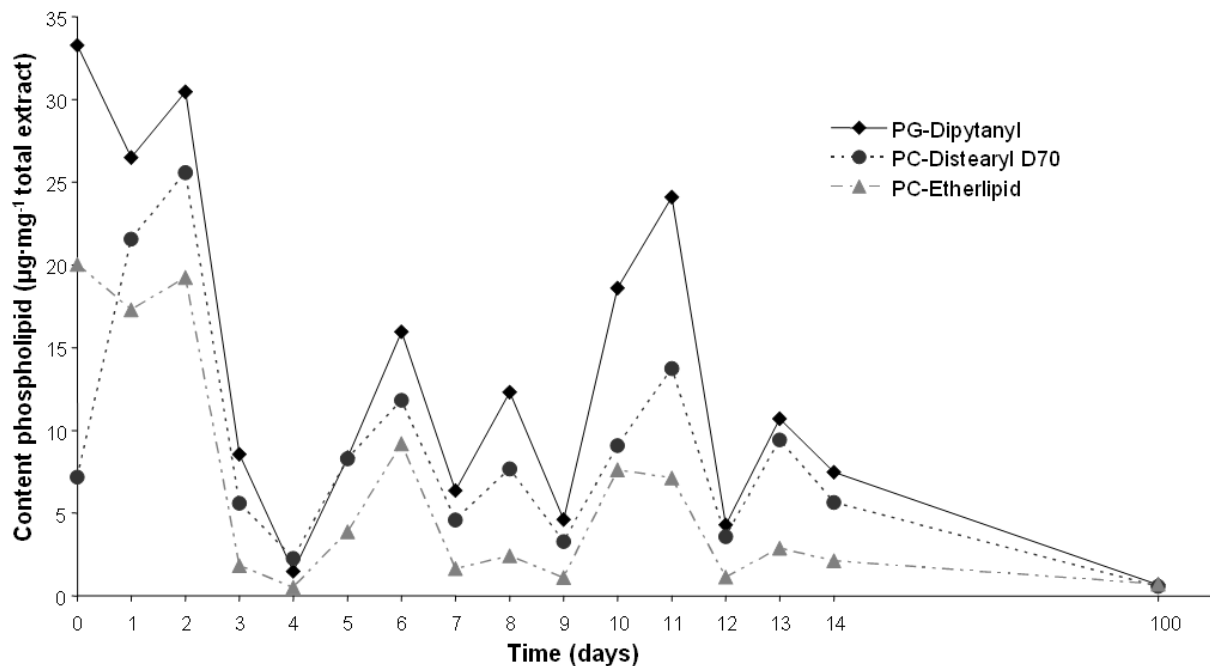


Figure 1. Concentrations of added phospholipid standards, normalized to the content of total extract, as determined by ELSD measurements during a period of 14 days and with the final measurement at day 100.

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