

EXTENDED HYDROXYARCHAEOL, A NOVEL LIPID BIOMARKER FOR ANAEROBIC METHANOTROPHY IN COLD SEEPS OF THE EASTERN MEDITERRANEAN

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Anaerobic oxidation of methane (AOM) is a widespread microbial process. It occurs at a range of scales from a few cm-thick sedimentary intervals in normal pelagic sediments, to large areas associated with the escape of methane from accumulations at depth. AOM serves as an important sink for methane in marine settings and considerably controls atmospheric concentrations of methane. AOM is performed by a putative consortia of Archaea and sulfate reducing bacteria capable for methane consumption resulted in the incorporation of methane-derived carbon into their cell membranes. The presence of ether core membrane lipids with isoprenoidal units linked to a glycerol moiety is considered to be one of the most characteristic chemotaxonomical markers of Archaea. In addition, substantially ¹³C-depleted lipid biomarkers in methane venting settings and associated authigenic carbonates are strong evidence for the presence of anaerobic methanotrophs performing AOM. However, the metabolic pathways for anaerobic methanotrophy remain unknown issue since no anaerobic methanotrophs are available in pure cultures.

To learn more about microbes capable to utilize methane anaerobically, we studied lipid biomarkers related to AOM from diverse methane venting areas at the seafloor of the Eastern Mediterranean. Here we report a finding of a new lipid biomarker, an extended hydroxyarchaeol (Figure 1), occurred in gas saturated sediments and methane-related carbonates in presently known active fluid venting areas in the whole Eastern Mediterranean: the Eastern and Central areas of the Nile deep-sea fan, the Anaximandra mud volcano province, and the Olimpy area. Figure 1 shows the gas chromatogram of the total lipid fraction from AOM-related micro-carbonates collected in the Central province of the Nile deep-sea fan (Eastern Mediterranean) from the site with free gas emanation into the water column. The identification of the extended hydroxyarchaeol was based on the defragmentation pattern. Its mass spectrum is similar to that of hydroxyarchaeol (Hinrichs et al., 2000). The only difference is that instead of the distinctive fragment at 517 Da, which is related to the C₂₉H₆₅O₃Si₂ moiety (Hinrichs et al., 2000), the introduced extended

hydroxyarchaeol possesses the fragment at 587 Da, which was tentatively assigned to the $C_{34}H_{75}O_3Si_2$ moiety. Specifically, the extended hydroxyarchaeol is 70 Da heavier than the hydroxyarchaeol reported by Hinrichs et al., (2000), and the additional C_5H_{10} fragment is likely belongs to the alkyl chain possessing OH group. The structural elucidation experiment of the compound is still in process.

Previous studies of lipid biomarkers from sediments and authigenic carbonates from known active seepage areas, e.g. in the Black Sea, the Gulf of Cadiz, the Haakom Mostby mud volcano, the Gulf of Mexico, and in the Hydrate Ridge, have not reported the presence of the extended hydroxyarchaeol. This leaves a probable exceptional occurrence of this lipid biomarker to the environments in the Eastern Mediterranean seepages and additionally contributes to our knowledge about AOM-related microbes, their metabolisms and ecological occurrence.

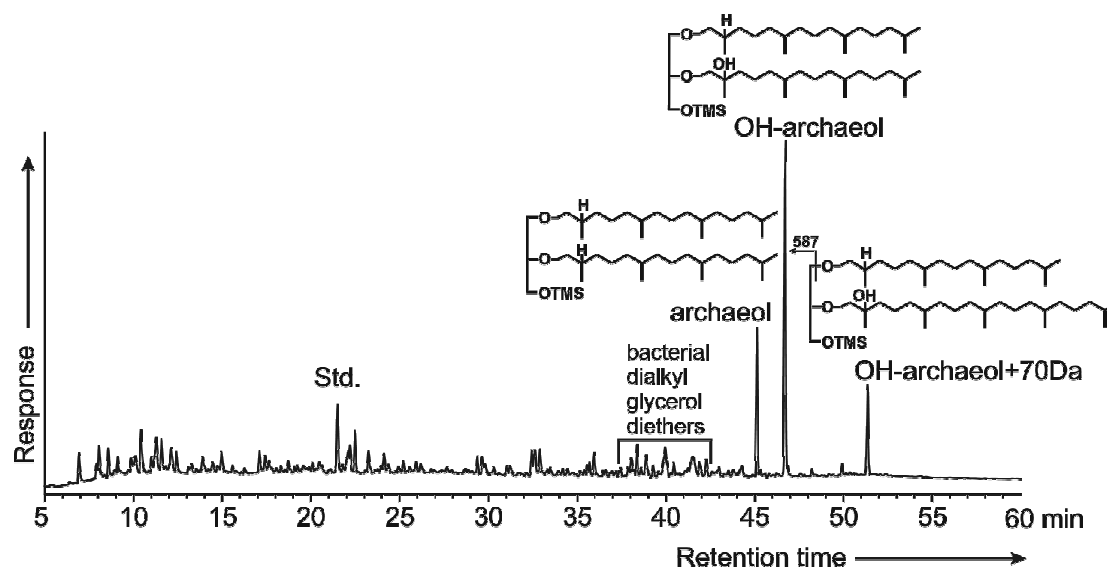


Figure 1. Example of gas chromatogram of total lipid fraction extracted from AOM-related micro-carbonates from the active seepage site in the Nile deep-sea fan, Eastern Mediterranean. All alcohols were analyzed as their trimethylsilyl derivatives. The molecular structure of the hydroxyarchaeol+70Da is tentative.

REFERENCES

- Hinrichs K.-U., Pancost R.D., Summons R.E., Sprott, G.D., Sylva S.P., Sinninghe Damsté J.S., and Hayes, J.M. (2000). Mass spectra of sn-2-hydroxyarchaeol, a polar lipid biomarker for anaerobic methanotrophy. *Geochemistry, Geophysics, Geosystems*, **1**, May 30, paper number: 2000GC000042.