Unaltered composition of bacteriohopanepolyols (BHPs) after a deep water oil spill, Gulf of Mexico

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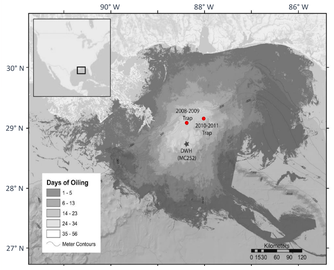
Intro

Aerobic Methane Oxidation (AMO) helps regulate the methane (CH_4) release from the ocean into the atmosphere.



- The Deepwater Horizon (DWH) blowout led to large oil & gas emissions
- Oil & gas discharge stimulated growth of methanotrophs and other hydrocarbon utilizing bacteria *(Valentine et al., 2010; Dubinsky et al., 2013)*

Figure 1: *Map of the Northern Gulf of Mexico from Prouty et al. (2016). Showing (1) in red the sediment trap deployment locations; (2) with a black star the location of the Deep water horizon (DWH) and (3) the days of oiling after the blowout in greyscales.*

Objectives

- identify AMO bacteriohopanepolyol (BHP) biomarkers (e.g. amino-BHPs and methylcarbamate-BHPs) in pre- & post-blowout sinking particulate matter, collected in sediment traps
- examine possible community shifts induced by extreme gas emissions

Result & Discussion

- Bacteriohopanetetrol (BHT) is the most abundant BHP – but BHTs are ubiquitous in marine settings *(Talbot et al., 2008)*
- relative abundances of aminotriol increase after the oil spill, but aminotriol is synthesised by various bacteria *(Talbot et al., 2008)*
- No distinct change of AOM lipids or other BHPs after the oil spill
- Absolute BHP abundances mainly follow the mass flux

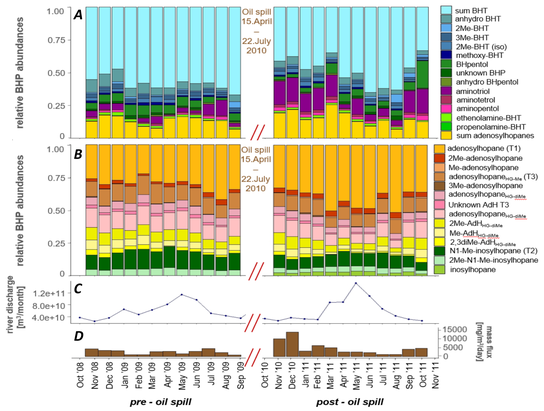
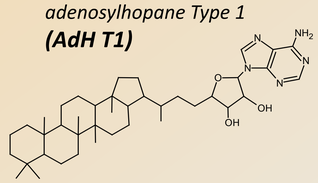


Figure 2: *Relative abundances of (A) all BHPs identified in pre and post oil spill samples – with summed BHT isomers and summed adenosylhopanes (AdHs); (B) relative AdH abundances, showing 14 different identified AdHs; (C) Mississippi-Atchafalaya river discharge – data obtained from USGS – ScienceBase Catalog (on 29th, July 2021)*

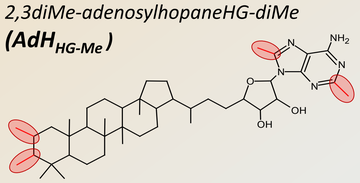
Conclusion

- No clear shift towards lipids indicating an increase in AOM activity
  - i. due to a rapid recovery after the oil spill?
  - ii. Or are these proxies not applicable in marine settings?
- Adenosylhopanes (soil marker) do not correspond to river discharge in our samples east of the Mississippi-Atchafalaya Delta

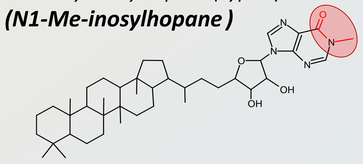
adenosylhopane Type 1
(AdH T1)



2,3diMe-adenosylhopaneHG-diMe
($AdH_{HG\text{-}Me}$)



N1-methyl-inosylhopane (Type 2)
(N1-Me-inosylhopane)



Aerobic Methane Oxidation (AMO) after the Deepwater Horizon oil spill

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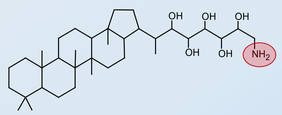
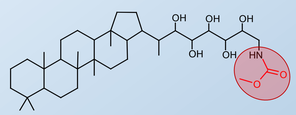
no observed change in the distribution of lipid biomarkers for AMO in the water column of the Gulf of Mexico

aminobacteriohopanepentol
(aminopentol)



methylcarbamate-aminobacteriohopanepentol
(MC-aminopentol)



Adenosylhopanes = soil marker BHPs

often used to interpret soil input into coastal systems *(e.g.: Cooke et al., 2009; Zhu et al., 2011)*

This has been challenged → maybe also be produced in oxygen deficient zones (ODZ) *(Kusch et al., 2021)*

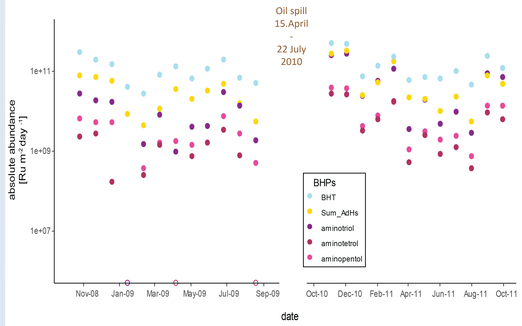


Figure 3: *absolute lipid abundances of BHT; the sum of all identified AdHs; aminotriol; aminotetrol and aminopentol before and after the oil spill. Empty circles display sample points below detection limit.*

Possible biomarker for (marine) aerobic methane oxidation (AMO)

MC-aminopentol = described as possible new proxy for marine AMO *(Rush et al., 2016)*

Aminopentol = often used as proxy for AMO but seems to be impractical in marine settings

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