

Extracellular enzymatic activity in the water column:

A comparison among polar, temperate, and subtropical environments

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BACKGROUND & MAJOR QUESTIONS

- Extracellular enzymes catalyze the first step in the remineralization of high molecular weight DOC
- Polysaccharides comprise the largest identifiable fraction of identifiable DOC¹, and are particularly important in the Arctic²
- Different microbial communities (e.g. sediment vs. seawater communities³ or communities along an estuarine gradient⁴) have access to different spectra of polysaccharides
- Specific polysaccharides may be rapidly remineralized by some microbial communities, yet meet operational definition of semi-labile DOC by other communities*
- The Arctic Ocean exports an estimated 13.6 Tg DOC yr⁻¹, of which 3.5 Tg is semi-labile DOC⁵.
- Warming and the decrease in sea ice coverage in the next decades may make the Arctic resemble more closely warmer bodies of water

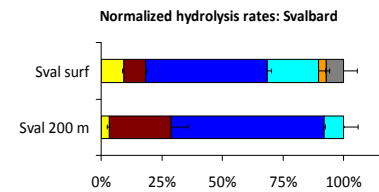
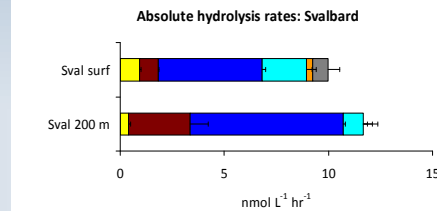
Will climate change result in a change in the function of the microbial loop with respect to DOC processing in the Arctic Ocean?

METHODS

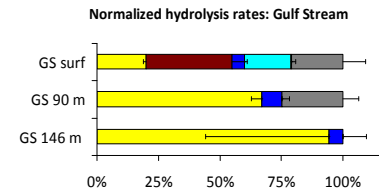
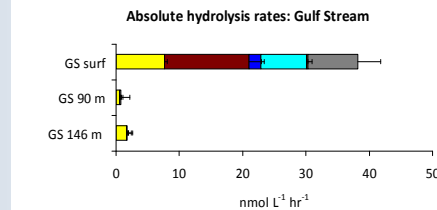
- Polysaccharide hydrolysis rates determined with fluorescently-labeled (fl-) polysaccharides per ref. 6; fl-substrates were added to a concentration of 3.5 $\mu\text{mol L}^{-1}$.
- Incubated at *in situ* temperatures
- Sampled hydrolysis rates at multiple timepoints: 2-26 days (different timepoints at different sites)
 - Reported rate is maximum rate compared to all timepoints for given substrate and water sample
- Stations
 - Svalbard fjord – 218 m water depth, unstratified (Sval)
 - Gulf Stream – 149 m water depth (GS)
 - Gulf of Mexico, off Louisiana – 925 m water depth (GOM)

Differences in polysaccharide 'preferences' by latitude and by depth

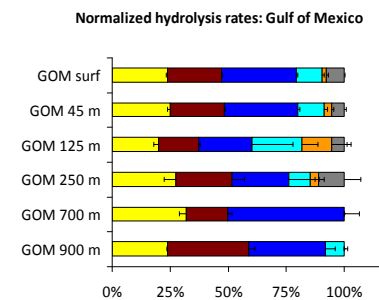
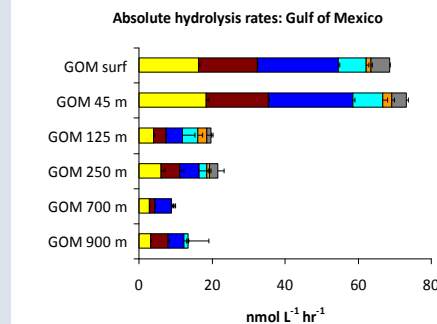
Svalbard fjord (Sval)



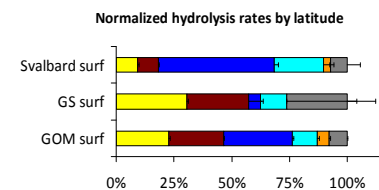
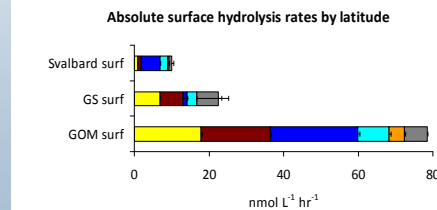
Mid-Atlantic Bight – Gulf Stream (GS)



Gulf of Mexico (GOM)



Surface water at 3 sites compared



Polysaccharide substrates



Sampling sites



CONCLUSIONS & IMPLICATIONS

- Faster polysaccharide hydrolysis rates in warmer waters – due in part to kinetics (slower rates at colder temperatures)
- Microbial loop has access to apparently broader spectrum of polysaccharides in temperate/subtropical surface water
- Warming of Arctic may expand the spectrum of DOC available to the microbial loop in the Arctic.

Warming of the Arctic could lead to an increased spectrum of DOC available to microbial heterotrophs, and thereby to increased heterotrophic activity and decreased DOC export to the deep ocean.

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