Microbial enzyme activities: polysaccharide hydrolase activities in bulk seawater samples from the RV\Polarstern cruise ARKXXVII/3 in the Central Arctic Ocean and Laptev Sea, Aug-Sept. 2012

Website: https://www.bco-dmo.org/dataset/742235
Data Type: Cruise Results, experimental
Version: 1
Version Date: 2018-07-24

Project
» Latitudinal and depth-related contrasts in enzymatic capabilities of pelagic microbial communities: Predictable patterns in the ocean? (Patterns of activities)

Contributors	Affiliation	Role
Arnosti, Carol	University of North Carolina at Chapel Hill (UNC-Chapel Hill)	Principal Investigator
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Abstract
This dataset includes polysaccharide hydrolysis rates measured in bulk (not filter-fractionated) seawater. Links to archived CTD data are also provided.

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Coverage

Spatial Extent: **N**:88.809 **E**:130.5795 **S**:79.6502 **W**:31.21
Temporal Extent: 2012-08-09 - 2012-09-22

Dataset Description

This dataset includes polysaccharide hydrolysis rates measured in bulk (not filter-fractionated) seawater. Links to archived CTD data are also provided.

Methods & Sampling

Water was collected via Niskin bottles mounted on a rosette, equipped with a CTD.

The potential of the seawater microbial community to hydrolyze six high-molecular-weight polysaccharides (arabinogalactan, chondroitin sulfate, fucoidan, laminarin, pullulan, and xylan) was investigated in surface and bottom water. For each substrate, three 15 mL falcon tubes were filled with seawater and one 15 mL falcon tube was filled with autoclaved seawater to serve as a killed control. Substrate was added at 3.5 uM monomer-

equivalent concentrations. Two 15 mL falcon tubes – one with seawater and one with autoclaved seawater – with no added substrate served as blank controls. Incubations were stored in the dark at 0 C. Subsamples of the incubations were collected at time zero, and at 120h, 240 h, 360 h, and 600 h. At each timepoint, 2 mL of seawater was collected from the 15 mL falcon tube using a sterile syringe, filtered through a 0.2 um pore size syringe filter, and stored frozen until processing.

The hydrolysis of high molecular weight substrate to lower molecular weight hydrolysis products was measured using gel permeation chromatography with fluorescence detection, after the method of Arnosti [1996, 2003]. In short, the subsample was injected onto a series of columns consisting of a 21 cm column of G50 and a 19 cm column of G75 Sephadex gel. The fluorescence of the column effluent was measured at excitation and emission wavelengths of 490 and 530 nm, respectively. Hydrolysis rates were calculated from the change in molecular weight distribution of the substrate over time, as described in detail in Arnosti [2003].

Data Processing Description

BCO-DMO Processing Notes:
- added conventional header with dataset name, PI name, version date
- reduced decimal precision of rate columns from 9 to 6 places

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Data Files

File
ARK27-3_bulk_FLA_joined.csv (Comma Separated Values (.csv), 81.18 KB) MD5:18694b95ab578798167ab5358c396abd Primary data file for dataset ID 742235

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Related Publications

Arnosti, C. (1996). A new method for measuring polysaccharide hydrolysis rates in marine environments. Organic Geochemistry, 25(1-2), 105–115. doi:10.1016/s0146-6380(96)00112-x https://doi.org/10.1016/S0146-6380(96)00112-X
Methods

Arnosti, C. (2003). Fluorescent derivatization of polysaccharides and carbohydrate-containing biopolymers for measurement of enzyme activities in complex media. Journal of Chromatography B, 793(1), 181–191. doi:10.1016/s1570-0232(03)00375-1 https://doi.org/10.1016/S1570-0232(03)00375-1
Methods

Balmonte, J. P., Teske, A., & Arnosti, C. (2018). Structure and function of high Arctic pelagic, particle-associated and benthic bacterial communities. Environmental Microbiology, 20(8), 2941–2954. Portico. https://doi.org/10.1111/1462-2920.14304
Results

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Parameters

Parameter	Description	Units
station_no	refers to station number for cruise	unitless
depth_no	sequence of depths sampled (1 is surface; higher numbers at greater depths)	unitless
depth_m	actual depth at which water collected	meters
cast_no	cast number (refers to cast of CTD/Niskin bottles on cruise)	unitless
ISO_DateTime_UTC	date and time in ISO format (yyyy-mm-ddTHH:MM:SS	unitless
Latitude	latitude; north is positive	decimal degreed
Longitude	longitude; east is postivie	decimal degreed
substrate	substrates for measurement of enzymatic activities. ara:arabinogalactan; chn:chondroitin sulfate; fuc:fucoidan; lam:laminarin ; pul:pullulan; xyl:xylan	unitless
timepoint	sampling point post-incubation	unitless
time_elapsed_hr	incubation time	hours
rep1_rate	replicate 1 hydrolysis rate	nanomoles/liter/hour (nmol L-1 h-1)
rep2_rate	replicate 2 hydrolysis rate	nanomoles/liter/hour (nmol L-1 h-1)
rep3_rate	replicate 3 hydrolysis rate	nanomoles/liter/hour (nmol L-1 h-1)
average	average of hydrolysis rates	nanomoles/liter/hour (nmol L-1 h-1)
std_dev	std deviation of hydrolysis rates	nanomoles/liter/hour (nmol L-1 h-1)
comments	url of CTD data in Pangaea database	unitless

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	CTD - profiler
Generic Instrument Description	The Conductivity, Temperature, Depth (CTD) unit is an integrated instrument package designed to measure the conductivity, temperature, and pressure (depth) of the water column. The instrument is lowered via cable through the water column. It permits scientists to observe the physical properties in real-time via a conducting cable, which is typically connected to a CTD to a deck unit and computer on a ship. The CTD is often configured with additional optional sensors including fluorometers, transmissometers and/or radiometers. It is often combined with a Rosette of water sampling bottles (e.g. Niskin, GO-FLO) for collecting discrete water samples during the cast. This term applies to profiling CTDs. For fixed CTDs, see https://www.bco-dmo.org/instrument/869934.

Dataset-specific Instrument Name	
Generic Instrument Name	Fluorometer
Generic Instrument Description	A fluorometer or fluorimeter is a device used to measure parameters of fluorescence: its intensity and wavelength distribution of emission spectrum after excitation by a certain spectrum of light. The instrument is designed to measure the amount of stimulated electromagnetic radiation produced by pulses of electromagnetic radiation emitted into a water sample or in situ.

Dataset-specific Instrument Name	
Generic Instrument Name	Gel Permeation Chromatograph
Generic Instrument Description	Instruments that separate components in aqueous or organic solution based on molecular size generally for molecular weight determination. Gel permeation chromatography (GPC) is a type of size exclusion chromatography (SEC), that separates analytes on the basis of size.

Dataset-specific Instrument Name	
Generic Instrument Name	Niskin bottle
Generic Instrument Description	A Niskin bottle (a next generation water sampler based on the Nansen bottle) is a cylindrical, non-metallic water collection device with stoppers at both ends. The bottles can be attached individually on a hydrowire or deployed in 12, 24, or 36 bottle Rosette systems mounted on a frame and combined with a CTD. Niskin bottles are used to collect discrete water samples for a range of measurements including pigments, nutrients, plankton, etc.

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Deployments

ARK-XXVII-3

Website	https://www.bco-dmo.org/deployment/741293
Platform	R/V Polarstern
Start Date	2012-08-02
End Date	2012-10-08
Description	Project: Latitudinal and depth-related contrasts in enzymatic capabilities of pelagic microbial communities: Predictable patterns in the ocean? For other files related to this cruise, see https://www.pangaea.de/?q=ARK+XXVII%2F3.

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Project Information

Latitudinal and depth-related contrasts in enzymatic capabilities of pelagic microbial communities: Predictable patterns in the ocean? (Patterns of activities)

Coverage: Atlantic Ocean, Arctic Ocean, Pacific Ocean, Greenland

NSF Award Abstract:
Heterotrophic microbial communities are key players in the marine carbon cycle, transforming and respiring organic carbon, regenerating nutrients, and acting as the final filter in sediments through which organic matter passes before long-term burial. Microbially-driven carbon cycling in the ocean profoundly affects the global carbon cycle, but key factors determining rates and locations of organic matter remineralization are unclear. In this study, researchers from the University of North Carolina at Chapel Hill will investigate the ability of pelagic microbial communities to initiate the remineralization of polysaccharides and proteins, which together constitute a major pool of organic matter in the ocean. Results from this study will be predictive on a large scale regarding the nature of the microbial response to organic matter input, and will provide a mechanistic framework for interpreting organic matter reactivity in the ocean.

Broader Impacts: This study will provide scientific training for undergraduate and graduate students from underrepresented groups. The project will also involve German colleagues, thus strengthening international scientific collaboration.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1332881

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