Hydrolysis rates from bulk water sample incubations from R/V Endeavor cruise EN556 in 2015

Website: https://www.bco-dmo.org/dataset/719712
Data Type: experimental
Version: 2
Version Date: 2023-03-14

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

Contributors	Affiliation	Role
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Abstract
This dataset includes polysaccharide hydrolysis rates to measure microbial enzyme activities and bacterial productivity.

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Coverage

Spatial Extent: **N**:40.7072 **E**:-68.4005 **S**:37.6018 **W**:-71.028
Temporal Extent: 2015-04-27 - 2015-05-01

Dataset Description

This dataset includes polysaccharide hydrolysis rates to measure microbial enzyme activities and bacterial productivity.

See Niskin Bottle and Cast List EN556 to link specific casts and bottles to each experiment: https://www.bco-dmo.org/dataset/717427.

Methods & Sampling

Seawater was transferred to 20 liter (L) carboys that were rinsed three times with water from the sampling depth and then filled with seawater from a single Niskin bottle, using silicone tubing that had been acid washed

and then rinsed with distilled water prior to use. From each carboy, water was dispensed into smaller glass containers that were cleaned and pre-rinsed three times with water from the carboy prior to dispensing. This water was used to measure cell counts, bacterial productivity, and the activities of polysaccharide hydrolases, peptidases, and glucosidases. A separate glass Duran bottle was filled with seawater from the carboy and sterilized in an autoclave for 20-30 minutes to serve as a killed control for microbial activity measurements.

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 50 milliliter (mL) falcon tubes were filled with seawater and one 50 mL falcon tube was filled with autoclaved seawater to serve as a killed control. Substrate was added at 3.5 micromolar (µM) monomer-equivalent concentrations, except for fucoidan, which was added at 5 µM concentrations (a higher concentration was necessary for sufficient fluorescence signal). Two 50 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 as close to *in situ* temperature as possible. Subsamples of the incubations were collected at time zero, and at a sequence of subsequent time points. At each time point, 2 mL of seawater was collected from the 50 mL falcon tube using a sterile syringe, filtered through a 0.2 micrometer (µm) 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-centimeter (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 nanometers (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:
version 1: (version date 2017-11-01)
- added conventional header with dataset name, PI name, version date;
- modified parameter names to conform with BCO-DMO naming conventions;
- removed 'cast00' and 'stn0' from data records for the cast and station columns.
version 2: (version date 2023-03-14)
- replaced previous dataset with new version received on 2023-02-03; this version contains data from additional stations that were omitted from version 1;
- added date, latitude, and longitude from the related Niskin bottle dataset (717427).

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Data Files

File	
en556_bulk_polysaccharide_hydrolysis_rates.csv	(Comma Separated Values (.csv), 96.20 KB) MD5:dce062a000c0b461dd917c771e5add15
Primary data file for dataset ID 717427 (version 2) version date: 2023-03-14	

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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

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Related Datasets

IsRelatedTo

Arnosti, C. (2017) **Notes on Niskin bottle sampling and use: depth of sample, operator, observations, type of experiments run on the sample, from RV/Endeavor EN556 and EN584, 2015 and 2016 (Patterns of activities project).** Biological and Chemical Oceanography Data Management Office (BCO-DMO). Version Date 2017-10-20 http://lod.bco-dmo.org/id/dataset/717427 [view at BCO-DMO]

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Parameters

Parameter	Description	Units
cruise_id	cruise identifier	unitless
station	station number	unitless
cast	cast number	unitless
date	date of cast	unitless
lat	latitude of cast	decimal degrees North
lon	longitude of cast	decimal degrees East
depth_no	depth description: sequence of depths sampled with 1 is surface and higher numbers at greater depths	unitless
depth_m	actual depth at which water collected	meters (m)
substrate	substrates for measurement of enzymatic activities: a-glu = alpha glucosidase: 4-methylumbelliferyl-a-D-glucopyranoside; b-glu = beta glucosidase: 4-methylumbelliferyl-beta-D-glucopyranoside; L = leucine aminopeptidase (L-leucine-7-amido-4 MCA); AAF = chymotrypsin activity: ala-ala-phe-MCA; AAPF = chymotrypsin activity: N-succinyl-ala-ala-pro-phe-MCA; QAR = trypsin activity: Boc-gln-ala-arg-MCA; FSR = trypsin activity: N-t-boc-phe-ser-arg-MCA	unitless

timepoint	sampling time point (0; 1; 2; etc.) post-incubation	unitless
time_elapsed_hr	hours elapsed to reach a specific timepoint	hours
rep1_rate	replicate 1 of enzymatic hydrolysis rate	nanomoles monosaccharide/liter/hour
rep2_rate	replicate 2 of enzymatic hydrolysis rate	nanomoles monosaccharide/liter/hour
rep3_rate	replicate 3 of enzymatic hydrolysis rate	nanomoles monosaccharide/liter/hour
average	average of the 3 hydrolysis rates	nanomoles monosaccharide/liter/hour
std_dev	standard deviation of the 3 hydrolysis rates	nanomoles monosaccharide/liter/hour

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Instruments

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	30 liter Niskin bottles
Generic Instrument Name	Niskin bottle
Dataset-specific Description	Used to collect water for large volume mesocosm experiments
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

EN556

Website	https://www.bco-dmo.org/deployment/717216
Platform	R/V Endeavor
Start Date	2015-04-27
End Date	2015-05-02
Description	Project: Latitudinal and Depth-Related Contrasts in Enzymatic Capabilities of Pelagic Microbial Communities. Cruise track obtained from rvdata.us control-point navigation (http://www.rvdata.us/catalog/EN556)

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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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