Large volume incubation: DOC, bacterial cell concentration and production from RV/Endeavor EN556, June 2015 (Patterns of activities project)

Website: https://www.bco-dmo.org/dataset/717562
Data Type: experimental
Version: 1
Version Date: 2017-10-27

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
Bacterial protein production, cell counts, and DOC were measured in mesocosm incubations after half the mesocosms were amended with Thalasiosira. See Niskin Bottle and Cast List EN556 to link specific casts and bottles to each experiment: https://www.bco-dmo.org/dataset/717427.

Table of Contents

Coverage

Spatial Extent: **N**:40.0702 **E**:-68.4037 **S**:37.6041 **W**:-71.0052
Temporal Extent: 2015-04-27 - 2015-05-02

Dataset Description

Bacterial protein production, cell counts, and DOC were measured in mesocosm incubations after half the mesocosms were amended with Thalasiosira.

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

Acquisition Description

For mesocosm (large volume) incubation experiments (referred to as “LV” incubations), a 30L Niskin bottle

rosette was used to collect the water. From each depth, 20L seawater from single Niskin bottles was dispensed using cleaned silicon tubing into a single carboy. Prior to filling, carboys were rinsed 3x with water from the same Niskin bottle used to fill the carboy. Six carboys were filled at each depth. Triplicate 20L carboys were amended with ca. 500 mg (exact mass was recorded for each addition) of HMW Thalassiosira; unamended triplicate carboys were used for controls. All mesocosms were incubated in the dark at near in-situ temperatures. Mesocosms were sub-sampled at the start of incubation, and then after 2.5 d, 8d, 15d, 28d, and 69d for the following assays: bacterial production using 3H-Leucine, dissolved organic carbon (DOC), nutrients, bacterial cell counts, peptidase, and glucosidase activity measurements. At the 15d timepoint, sub-samples were also taken to measure polysaccharide hydrolase activities.

Samples were analyzed for nutrients and DOC content modified after Grasshoff and Kremling [1999]. Clean and acid washed syringes, tubing, and filter holders were used for each sampling. Duplicate DOC samples were filtered using the same 60 cc syringe through combusted glass fiber filters (Whatman 1825-025) secured within a polycarbonate filter holder into two combusted 20 mL scintillation vials and acidified using 100 µL of 50% phosphoric acid then immediately frozen at -20°C. DOC samples were analyzed by high-temperature catalytic oxidation (HTCO) using a Shimadzu Total Organic Carbon analyzer (TOC-8000A/5050A).

Bacterial protein production was measured from 3H-leucine incorporation by heterotrophic bacteria using the cold trichloroacetic acid (TCA) and microcentrifuge extraction method [as in Kirchman, 2001]. All work was performed aboard ship. In brief, triplicate live samples of 1.5 mL seawater as well as one 100% (w/v) TCA-killed control were incubated with 23 µL of L-[3,4,5-3H(N)]-Leucine (PerkinElmer, NET460250UC) for between 4 and 24 hours in the dark at as close to in situ temperature as possible. Live samples were then killed with 89 µL of 100% (w/v) TCA and centrifuged (10,000 rpm at 4°C for 10 min) to pelletize cell material. The supernatant liquid was removed and 1 mL of 5% (w/v) TCA solution was added, followed by vortex mixing and centrifugation. Supernatant removal, mixing, and centrifugation were repeated using 1 mL of 80% ethanol solution. Finally, the supernatant liquid was removed and each sample was dried overnight. After drying, 1 mL of scintillation cocktail (ScintiSafe 30% Cocktail, Fisher SX23-5) was added and incorporated radioactivity was measured using an LSA scintillation counter (PerkinElmer Tri-Carb 2910TR). Leucine incorporation rate was calculated from the incorporated radioactivity, compared to 1 mL of scintillation cocktail spiked with 23 µL of L-[3,4,5-3H(N)]-Leucine radioactivity, divided by incubation time.

Processing Description

BCO-DMO Processing Notes:
- added conventional header with dataset name, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions
- added columns with lat and lon in decimal degrees
- added cruise_id column
- replaced 'NA' and blank cells with 'nd' (no data)
- removed the text 'cast00-' and 'stn0-' from data records for cast and station, leaving the digits in place.

[table of contents | back to top]

Related Publications

Grasshoff, K., Kremling, K., & Ehrhardt, M. (Eds.). (1999). Methods of Seawater Analysis. doi:10.1002/9783527613984
Methods

Kirchman, D. (2001). Measuring bacterial biomass production and growth rates from leucine incorporation in natural aquatic environments. Marine Microbiology, 227–237. doi:10.1016/s0580-9517(01)30047-8 https://doi.org/10.1016/S0580-9517(01)30047-8
Methods

[table of contents | back to top]

Parameters

Parameter	Description	Units
cruise_id	cruise identifier	unitless
station	station number	unitless
timepoint	sampling time point (0; 1; 2; etc.) post-incubation	unitless
time_elapsed_hr	hours elapsed to reach a specific timepoint	hours
depth_id	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
lat_degdecmin	latitude formatted as degrees.decimal_minutes	degrees and decimal minutes
lon_degdecmin_W	longitude formatted as degrees.decimal_minutes	degrees and decimal minutes
lat_dec	latitude; north is positive	decimal degrees
lon_dec	longitude; north is positive	decimal degrees
cast	cast number	unitless
temp	water temperature as determined by CTD	degrees Celsius
salinity	salinity as determined by CTD	per mil
treatment	Large volume experimental treatments: amended or not with Thalassiosira	unitless
meso_no	Large volume experiment mesocosm number	unitless
DOC_uM	dissolved organic carbon concentration	micromolar
cells_per_mL	prokaryotic cell counts per mL seawater	cells/milliliter
Leu_3H_rep_1	replicate 1 of leucine incorporation rate (bacterial protein production)	pico mol leucine/hour

[table of contents | back to top]

Instruments

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.

Dataset-specific Instrument Name	LSA scintillation counter, PerkinElmer Tri-Carb 2910TR
Generic Instrument Name	Liquid Scintillation Counter
Dataset-specific Description	Used to measure incorporated radioactive 3H-leucine
Generic Instrument Description	Liquid scintillation counting is an analytical technique which is defined by the incorporation of the radiolabeled analyte into uniform distribution with a liquid chemical medium capable of converting the kinetic energy of nuclear emissions into light energy. Although the liquid scintillation counter is a sophisticated laboratory counting system used the quantify the activity of particulate emitting (ß and a) radioactive samples, it can also detect the auger electrons emitted from 51Cr and 125I samples.

Dataset-specific Instrument Name	Shimadzu Total Organic Carbon analyzer (TOC-8000A/5050A)
Generic Instrument Name	Total Organic Carbon Analyzer
Dataset-specific Description	Used to measure dissolved organic carbon concentration in the samples.
Generic Instrument Description	A unit that accurately determines the carbon concentrations of organic compounds typically by detecting and measuring its combustion product (CO2). See description document at: http://bcodata.whoi.edu/LaurentianGreatLakes_Chemistry/bs116.pdf

Dataset-specific Instrument Name	
Generic Instrument Name	Shipboard Incubator
Generic Instrument Description	A device mounted on a ship that holds water samples under conditions of controlled temperature or controlled temperature and illumination.

Dataset-specific Instrument Name	
Generic Instrument Name	Centrifuge
Dataset-specific Description	Used to concentrate cell material.
Generic Instrument Description	A machine with a rapidly rotating container that applies centrifugal force to its contents, typically to separate fluids of different densities (e.g., cream from milk) or liquids from solids.

[table of contents | back to top]

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)

[table of contents | back to top]

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.

[table of contents | back to top]

Funding

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

[table of contents | back to top]