Bacterial production data from R/V Knorr cruise KN207-03 in the North Atlantic (transect from Ponta Delgada, Azores to Reykjavik, Iceland) in 2012 (NA-VICE project)

Website: https://www.bco-dmo.org/dataset/555950
Version: 16 April 2015
Version Date: 2015-04-16

Project
» Lipid lubrication of oceanic carbon and sulfur biogeochemistry via a host-virus chemical arms race (NA-VICE)

Program
» Ocean Carbon and Biogeochemistry (OCB)

Contributors	Affiliation	Role
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Dataset Description

Water column bacterial production (BP) rates measured using the 3H-leucine incorporation microcentrifuge method.

Methods & Sampling

Refer to Collins et al., *Global Biogeochem. Cycles* (2015), in review. Excerpted from methods section:

Water column bacterial production (BP) rates were measured using the 3H-leucine incorporation microcentrifuge method of Simon and Azam (1989), as modified by Kirchman (2001). Incubations were conducted following each CTD cast using water samples from six depths; the first and sixth samples were always from the immediate surface layer (3-5 m) and 150 m. Triplicate 1 mL samples from each chosen depth or net trap were incubated with 3H-leucine (PerkinElmer, Inc., Waltham, MA; 146.5 Ci mmol-1, diluted to achieve 20 nM final concentration) for 4-12 hours at the temperature of the mixed layer. At the conclusion of the cruise, samples were processed and analyzed in a laboratory ashore according to Kirchman (2001) using Ultima Gold Low-Level Tritium cocktail (PerkinElmer, Inc.). Decay per minute counts in killed control samples were subtracted from the mean of each set of triplicates and divided by the incubation time to obtain a blank-corrected leucine incorporation rate in units of pmol leucine L-1 h-1.

References:
Collins, J. R., B. R. Edwards, K. Thamatrakoln, J. E. Ossolinksi, G. R. DiTullio, K. D. Bidle, S. C. Doney, and B. A. S.

Van Mooy (2015), The multiple fates of sinking particles in the North Atlantic Ocean, *Global Biogeochem. Cycles,* in review.

Simon, M., and F. Azam (1989), Protein-content and protein-synthesis rates of planktonic marine bacteria, *Mar. Ecol. Prog. Ser.*, *51*(3), 201-213, doi:10.3354/Meps051201.

Kirchman, D. (2001), Measuring bacterial biomass production and growth rates from leucine incorporation in natural aquatic environments, in *Methods in Microbiology*, edited by J. H. Paul, pp. 227-237, Academic Press, doi:10.1016/S0580-9517(01)30047-8.

Data Processing Description

The "signal_to_noise" column gives the ratio for each measurement, i.e., the ratio of the incorporation rate in the live samples to the killed control at that depth.

BCO-DMO processing notes:
- Replaced 'NaN' with 'nd' to indicate 'no data'.
- Modified parameter names to conform with BCO-DMO naming conventions.
- Modified format of date/time to fit ISO8601 format.

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Data Files

File
KN207-03_bact_prod.csv (Comma Separated Values (.csv), 47.93 KB) MD5:d600b44d08339f16cc5cf35aefcf761a Primary data file for dataset ID 555950

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Parameters

Parameter	Description	Units
station_ctd	CTD station number.	dimensionless
incub_duration	Incubation duration.	minutes
ISO_DateTime_UTC	Date and time (from CTD timestamp) formatted to ISO 8601 standard. T represents the start of the time string and Z indicates UTC.	YYYY-mm-ddTHH:MM:SS.xxZ
lat_CTD	Latitude of CTD station.	decimal degrees
lon_CTD	Longitude of CTD station.	decimal degrees
depth	Sample depth.	meters (m)

DPM_live_samples_mean	Mean DPM (disintegrations per minute), live samples.	dpm (disintegrations per minute)
DPM_live_samples_stdev	Standard deviation DPM (disintegrations per minute), live samples.	dpm (disintegrations per minute)
DPM_of_killed_control	DPM (disintegrations per minute) of killed control.	dpm (disintegrations per minute)
trit_leu_uptake_live_mean_dpm	Mean tritium-labeled leucine (3H-Leu) uptake, live samples.	dpm per liter per hour (dpm/L/hr)
trit_leu_uptake_live_stdev_dpm	Standard deviation of tritium-labeled leucine (3H-Leu) uptake, live samples.	dpm per liter per hour (dpm/L/hr)
trit_leu_uptake_killed_dpm	Tritium-labeled leucine (3H-Leu) uptake, killed control.	dpm per liter per hour (dpm/L/hr)
trit_leu_uptake_dpm	Tritium-labeled leucine (3H-Leu) uptake.	dpm per liter per hour (dpm/L/hr)
trit_leu_uptake_stdev_dpm	Standard deviation of tritium-labeled leucine (3H-Leu) uptake.	dpm per liter per hour (dpm/L/hr)
trit_leu_uptake_live_mean_pmol	Mean tritium-labeled leucine (3H-Leu) uptake, live samples.	picomoles per liter per hour (pmol/L/hr)
trit_leu_uptake_live_stdev_pmol	Standard deviation tritium-labeled leucine (3H-Leu) uptake, live samples.	picomoles per liter per hour (pmol/L/hr)
trit_leu_uptake_killed_pmol	Tritium-labeled leucine (3H-Leu) uptake, killed control.	picomoles per liter per hour (pmol/L/hr)
trit_leu_uptake_pmol	The final, blank-corrected, replicate-averaged rates of leucine incorporation for each CTD station and depth.	picomoles 3H-leucine per liter per hour (pmol 3H-leu/L/hr)
trit_leu_uptake_stdev_pmol	Standard deviation of the final, blank-corrected, replicate-averaged rates of leucine incorporation for each CTD station and depth.	picomoles 3H-leucine per liter per hour (pmol 3H-leu/L/hr)
signal_to_noise	The "signal to noise" ratio for each measurement, i.e., the ratio of the incorporation rate in the live samples to the killed control at that depth.	dimensionless (ratio)
incub_temp	Incubation temperature.	degrees Celsius (C)

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Deployments

KN207-03

Website	https://www.bco-dmo.org/deployment/58868
Platform	R/V Knorr
Start Date	2012-06-15
End Date	2012-07-14
Description	Description from the WHOI Cruise Synopsis: The 30 day "NA-VICE" (North Atlantic Virus Infection of Coccolithophores Expedition) cruise in June-July 2012 aboard the R/V Knorr followed a transect from Ponta Delgada, Azores to Reykjavik, Iceland. The goal for this cruise was to transect the region of the NEA spring bloom and to extensively sample the bloom when it is encountered. The cruise track was modeled after a recent study in this area that documented intense coccolithophore (and other haptophyte) blooms across Rockall Hatton Plateau to the Iceland Basin (55-63°N latitude) and coincided with elevated POC and TEP. The science plan calls for sampling of 12 water depths at 20 station locations. In addition, three stations were occupied for several days to allow opportunities for extended experiments and sinking particulate carbon collection and flux determination. Given that the timing of the bloom is difficult to predict exactly, the precise cruise track was determined by remote sensing data (satellite and autonomous glider from Rutgers) analyzed by the PIs a few days before and during the cruise. The cruise was supported by NSF award OCE-1061883. Additional cruise information and original data are available from the NSF R2R data catalog.

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Project Information

Lipid lubrication of oceanic carbon and sulfur biogeochemistry via a host-virus chemical arms race (NA-VICE)

Coverage: North Atlantic; Azores to Iceland

This project is also called "**NA-VICE**" (North Atlantic Virus Infection of Coccolithophores Expedition).

Project description from NSF award abstract:
Despite the critical importance of viruses in shaping marine microbial ecosystems, very little is known about the molecular mechanisms mediating phytoplankton-virus interactions. As a consequence, we currently lack biomarkers to quantify active viral infection in the oceans, significantly hindering our understanding of its ecological and biogeochemical impacts.

The coccolithophore *Emiliania huxleyi* (Prymnesiophyceae, Haptophyte) is a cosmopolitan unicellular photoautotroph whose calcite skeletons account for about a third of the total marine CaCO3 production. *E. huxleyi* forms massive annual spring blooms in the North Atlantic that are infected and terminated by lytic, giant double-stranded DNA containing coccolithoviruses. Findings that lytic viral infection of *E. huxleyi* recruits the hosts programmed cell death (PCD) machinery demonstrate that viruses employ a sophisticated, co-evolutionary “arms race” in mediating host-virus interactions. The investigators recently demonstrated that viral glycosphingolipids (vGSLs), derived from unexpected cluster of sphingolipid biosynthetic genes, a pathway never before described in a viral genome, play a crucial functional role in facilitating infection of *E. huxleyi*. The observations of vGSLs in the North Atlantic and Norwegian fjords further suggest that they may be novel, diagnostic biomarkers for viral infection of coccolithophore populations. At the same time, the discovery of vGSLs and a distinct, protective 802 lipid argues that a host-virus, co-evolutionary chemical arms race plays a pivotal role in regulating viral infection and in lubricating upper ocean biogeochemical fluxes of carbon and sulfur.

The focus of this collaborative research project is to elucidate the molecular, ecological, and biogeochemical links between vGSLs (and other polar lipids) and the global cycles of carbon and sulfur.

The team of investigators proposes a multi-pronged approach combing a suite of lab-based, mechanistic studies using several haptophyte-virus model systems along with observational studies and manipulative field-based experiments the Northeast Atlantic. Using these diagnostic markers, they will document active viral infection of natural coccolithophore populations and couple it with a suite of oceanographic measurements in order to quantify how viral infection (via vGSLs) influences cell fate, the dissolved organic carbon (DOC) pool, vertical export of particular organic (POC) and inorganic carbon (PIC; as calcium carbonate, CaCO3) (along with associated alkenone lipid biomarkers and genetic signatures of viruses and their hosts) and the upper ocean sulfur cycle (via the cycling of dimethylsulfide [DMS] and other biogenic sulfur compounds). Furthermore, given they are unique to viruses, the investigators propose that vGSLs can be used to trace the flow of virally-derived carbon and provide quantitative insights into a “viral shunt” that diverts fixed carbon from higher trophic levels and the deep sea.

The overarching hypothesis for this study is that vGSLs are cornerstone molecules in the upper ocean, which facilitate viral infection on massive scales and thereby mechanistically "lubricate" the biogeochemical fluxes of C and S in the ocean.

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Program Information

Ocean Carbon and Biogeochemistry (OCB)

Website: http://us-ocb.org/

Coverage: Global

The Ocean Carbon and Biogeochemistry (OCB) program focuses on the ocean's role as a component of the global Earth system, bringing together research in geochemistry, ocean physics, and ecology that inform on and advance our understanding of ocean biogeochemistry. The overall program goals are to promote, plan, and coordinate collaborative, multidisciplinary research opportunities within the U.S. research community and with international partners. Important OCB-related activities currently include: the Ocean Carbon and Climate Change (OCCC) and the North American Carbon Program (NACP); U.S. contributions to IMBER, SOLAS, CARBOOCEAN; and numerous U.S. single-investigator and medium-size research projects funded by U.S. federal agencies including NASA, NOAA, and NSF.

The scientific mission of OCB is to study the evolving role of the ocean in the global carbon cycle, in the face of environmental variability and change through studies of marine biogeochemical cycles and associated ecosystems.

The overarching OCB science themes include improved understanding and prediction of: 1) oceanic uptake and release of atmospheric CO2 and other greenhouse gases and 2) environmental sensitivities of biogeochemical cycles, marine ecosystems, and interactions between the two.

The OCB Research Priorities (updated January 2012) include: ocean acidification; terrestrial/coastal carbon fluxes and exchanges; climate sensitivities of and change in ecosystem structure and associated impacts on biogeochemical cycles; mesopelagic ecological and biogeochemical interactions; benthic-pelagic feedbacks on biogeochemical cycles; ocean carbon uptake and storage; and expanding low-oxygen conditions in the coastal and open oceans.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1059884

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