HPLC pigment analyses of CTD-collected samples 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/517634
Data Type: Cruise Results
Version: 1
Version Date: 2014-09-17

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
DiTullio, Giacomo	Grice Marine Laboratory - College of Charleston (GML-CoC)	Principal Investigator
Cooper, Emily	Grice Marine Laboratory - College of Charleston (GML-CoC)	Contact
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Dataset includes HPLC pigment analyses of CTD collected samples from the KN207-03 cruise (Northeast Atlantic Ocean transect from Azores to Iceland).

Table of Contents

Coverage

Spatial Extent: **N**:65.447967 **E**:-26.102033 **S**:42.963 **W**:-35.0733
Temporal Extent: 2012-06-17 - 2012-07-13

Dataset Description

Dataset includes HPLC pigment analyses of CTD collected samples from the KN207-03 cruise (Northeast Atlantic Ocean transect from Azores to Iceland).

Methods & Sampling

Water samples were collected from CTD Niskin bottles. Water samples for HPLC analyses were taken from one Niskin bottle per cast-depth combination included in the dataset. Note that the niskin_sampled column indicates

which Niskin bottle the HPLC sample was taken from. The niskins_fired column indicates all Niskin bottle numbers fired at the specified depth, though the HPLC sample was taken from only one of those bottles.

Chlorophyll and accessory pigment composition was analyzed by high performance liquid chromatography (HPLC; Agilent 1100). Culture aliquots were filtered on Whatmann GF/F filters, flash frozen in liquid nitrogen, and stored at -80°C until analysis. Just prior to analysis, pigments were extracted overnight in acetone at -20°C. The following day extracted pigments were centrifuged and measured using a gradient elution method (DiTullio and Geesey, 2003), a modification of the Zapata et al 2000 method. Chromatographic separation was performed using a Waters C8 symmetry column, photodiode array and fluorescence detectors. The internal standard, β-Apo-8-carotenal-trans standard (Fluka Chemical Corp., USA) was added to extracted pigments as a peak reference. Individual pigment peaks were quantified with Chemstation software (revision B.03.01, Agilent) and our pigment action spectra library calibrated using pigment standards from DHI LABS (Hoersholm, Denmark) and in-house purifications of non-commercially available pigments. Coefficient of variation among replicate HPLC injections is < 3% and our limit of detection is approximately 1 ng L-1.

Data Processing Description

Response factors for pigments were performed using dilutions of calibration standards. Full details of data processing and methods used can be found in:
DiTullio, G. R. & Geesey, M. E. (2002) Photosynthetic pigments in marine algae and bacteria. *In:* BITTON, G. (ed.) *The Encyclopedia of Environmental Microbiology.* New York: John Wiley & Sons Inc.

BCO-DMO Processing Notes:
- Modified parameter names to conform to BCO-DMO conventions;
- Blanks (missing data) replaced with "nd" meaning "no data";
- Separated the original "niskin" column into two columns: "niskin_sampled" and "niskins_fired";
- Converted original longitude values provided as positive degrees West to negative degrees East;
- Added ISO_DateTime_UTC column from original date_gmt and time_gmt fields;
- Transposed data to convert columns containing pigment concentrations into rows.

[table of contents | back to top]

Data Files

File
HPLC.csv (Comma Separated Values (.csv), 814.33 KB) MD5:2f683edce14ed6bb847454d85483ff03 Primary data file for dataset ID 517634

[table of contents | back to top]

Related Publications

DiTullio, G., & Geesey, M. E. (2003). Photosynthetic Pigments in Marine Algae and Bacteria. Encyclopedia of Environmental Microbiology. doi:10.1002/0471263397.env185
Methods

[table of contents | back to top]

Parameters

Parameter	Description	Units
cast	Cast number.	alphanumeric
station	Station name.	text
date_gmt	Date of cast (GMT). in the format mmddyyyy	unitless
time_gmt	Time of cast (GMT). in the format hhmmss	unitless
date_local	Date of cast (local time zone). in the format mmddyyyy	unitless
time_local	Time of cast (local time zone). in the format hhmmss	unitless
lat	Latitude. Positive values = North.	decimal degrees
lon	Longitude. Positive values = East.	decimal degrees
lat_deg	Degrees latitude.	degrees North
lat_min	Minutes latitude.	minutes North
lon_deg	Degrees longitude. Positive = West.	degrees West
lon_min	Minutes longitude. Positive = West.	minutes West
ISO_DateTime_UTC	Date and time of cast formatted to ISO8601 standard.	yyyy-MM-dd'T'HH:mm:ss.SS
depth	Depth of Niskin bottle firing.	meters
amb_bot	Amber bottle identification number.	integer
niskin_sampled	Niskin bottle number from which HPLC sample was taken.	integer
niskins_fired	Niskin bottle numbers fired at depth; HPLC sample was taken from one Niskin bottle.	range of integers
filt_vol	Volume of water filtered.	liters (L)
pigment	Name of the pigment measured: chl_c3 = Chlorophyll c3; chl_ide = Chlorophyllide a; mg_dvp = Magnesium-2;4-divinyl phaeoporphyrin a5 monomethyl ester; chl_c2 = Chlorophyll c2; chl_c1 = Chlorophyll c1; peridinin = Peridinin; but19 = 19-butanoyloxyfucoxanthin; fucox = Fucoxanthin; ph_ide = Pheophorbide a; neox = Neoxanthin; prasinox = Prasinoxanthin; violax = Violaxanthin; hex19 = 19'-hexanoyloxyfucoxanthin; diadinox = Diadinoxanthin; cis_fucox = cis-Fucoxanthin; allox = Alloxanthin; diatox = Diatoxanthin; monad = Monadoxanthin; zeax = Zeaxanthin; lutein = lutein; crocox = Crocoxanthin; chl_b = Chlorophyll b; dv_chl_a = Divinyl Chlorophyll a; chl_a = Chlorophyll a; p_phytin = Phaeophytin a; carotene_a = alpha Carotene; carotene_b = beta Carotene.	text
concentration	Concentration of the pigment as determined by HPLC.	nanograms per liter (ng/L)

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	HPLC
Generic Instrument Name	High-Performance Liquid Chromatograph
Dataset-specific Description	Chlorophyll and accessory pigment composition was analyzed by high performance liquid chromatography (HPLC; Agilent 1100).
Generic Instrument Description	A High-performance liquid chromatograph (HPLC) is a type of liquid chromatography used to separate compounds that are dissolved in solution. HPLC instruments consist of a reservoir of the mobile phase, a pump, an injector, a separation column, and a detector. Compounds are separated by high pressure pumping of the sample mixture onto a column packed with microspheres coated with the stationary phase. The different components in the mixture pass through the column at different rates due to differences in their partitioning behavior between the mobile liquid phase and the stationary phase.

Dataset-specific Instrument Name	Niskin bottle
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.

[table of contents | back to top]

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.

[table of contents | back to top]

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.

[table of contents | back to top]

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.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1061876

[table of contents | back to top]