Sinking POC and PIC fluxes measured with PIT sediment traps on 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/556068
Version: 17 April 2015
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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

Sinking POC and PIC fluxes measured with PIT sediment traps on the KN207-03 cruise.

Methods & Sampling

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

Vertically sinking particulate carbon fluxes were measured at 50, 150, and 300 meters using surface-tethered cylindrical sediment traps (0.0125 m2 cross-sectional area; materials and construction as described in McDonnell and Buesseler, 2012). A mooring consisting of four traps at each depth, a surface buoy, wave-action mitigation bungee cord, and several floats, was deployed at each process station and allowed to drift for 3-5 days. The quasi-Lagrangian behavior of the mooring during each deployment was confirmed by comparison of positional data obtained from an Argos satellite beacon mounted on the surface buoy with shipboard acoustic Doppler current profiler (ADCP) data from the R/V Knorr, which trailed the mooring at a range of 1-2 miles.

Traps were prepared, deployed, and recovered as described in McDonnell and Buesseler (2012). Traps were then sampled for particulate carbon in accordance with McDonnell and Buesseler (2012), except that the screened brine suspension (350 um pore size, to exclude macrozooplankton) was filtered onto a series of

precombusted, 47 mm GF/F filters (0.7 um nominal pore size). Field and analytical blanks were collected at each station. Filters were immediately frozen in liquid nitrogen and then stored at -80 degrees C.

Filters from three of the four traps at each depth were used for determination of total particulate and particulate inorganic carbon (TPC and PIC, respectively). After thawing, the filters (including blanks) were first dried at 70 degrees C in a drying oven; each filter was then weighed and cut in half with precombusted stainless steel scissors. Each half was then weighed separately. One half was reserved for PIC analysis and the other reserved for determination of TPC.

For TPC, sets of filter halves were transferred to 12 mm by 20 cm precombusted quartz tubes containing copper oxide (100 mg) and elemental silver wires. The tubes were then attached to a vacuum line, evacuated, flame-sealed, and combusted at 850 degrees C for 10 h. The evolved carbon dioxide was then isolated through a series of cold traps and quantified manometrically. PIC was determined from the other set of filter halves by coulometric analysis of acidified samples using a Model CM5014 UIC Coulometric Analyzer with Carbonate Acidification Module, as described in Honjo et al. (1995). Particulate organic carbon (POC) was determined for each trap by difference of the blank-corrected TPC and PIC measurements.

POC measurements were not obtained for the first of the four stations on this cruise due to an equipment failure.

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.

McDonnell, A. M. P., and K. O. Buesseler (2012), A new method for the estimation of sinking particle fluxes from measurements of the particle size distribution, average sinking velocity, and carbon content, *Limnol Oceanogr-Meth*, *10*, 329-346, doi:10.4319/Lom.2012.10.329.

Honjo, S., J. Dymond, R. Collier, and S. J. Manganini (1995), Export production of particles to the interior of the equatorial Pacific Ocean during the 1992 EqPac experiment, *DSR*, *42*(2–3), 831-870, doi:10.1016/0967-0645(95)00034-N.

Data Processing Description

BCO-DMO processing notes:
- Modified parameter names to conform with BCO-DMO naming conventions.
- Modified format of date/time to fit ISO8601 format.
- Replaced blanks (missing data) with 'nd'.

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Data Files

File	
KN207-03_sed_trap_flux.csv	(Comma Separated Values (.csv), 1.67 KB) MD5:391d55e9b36922dc6ab832e308ca3708
Primary data file for dataset ID 556068	

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Parameters

Parameter	Description	Units
lat	Latitude.	decimal degrees
lon	Longitude.	decimal degrees
ISO_DateTime_Start_UTC	Start date and time (UTC), formatted to ISO 8601 standard.	YYYY-mm-ddTHH:MM:SS.xxZ
ISO_DateTime_End_UTC	End date and time (UTC), formatted to ISO 8601 standard.	YYYY-mm-ddTHH:MM:SS.xxZ
deploy_duration	Deployment duration.	days
depth	Depth.	meters
PIC_flux	Particulate inorganic carbon (PIC) flux.	milligrams C per square meter per day (mg C m-2 d-1)
PIC_flux_stdev	Standard deviation of PIC.	milligrams C per square meter per day (mg C m-2 d-1)
POC_flux	Particulate organic carbon (POC) flux.	milligrams C per square meter per day (mg C m-2 d-1)
POC_flux_stdev	Standard deviation of POC flux.	milligrams C per square meter per day (mg C m-2 d-1)
POC_to_PIC_ratio	Rain ratio of POC to PIC.	dimensionless (ratio)

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Instruments

Dataset-specific Instrument Name	Model CM5014 UIC Coulometric Analyzer
Generic Instrument Name	CO2 Coulometer
Dataset-specific Description	PIC was determined from the other set of filter halves by coulometric analysis of acidified samples using a Model CM5014 UIC Coulometric Analyzer with Carbonate Acidification Module, as described in Honjo et al. (1995).
Generic Instrument Description	A CO2 coulometer semi-automatically controls the sample handling and extraction of CO2 from seawater samples. Samples are acidified and the CO2 gas is bubbled into a titration cell where CO2 is converted to hydroxyethylcarbonic acid which is then automatically titrated with a coulometrically-generated base to a colorimetric endpoint.

Dataset-specific Instrument Name	PIT sediment trap
Generic Instrument Name	Sediment Trap - Particle Interceptor
Dataset-specific Description	Vertically sinking particulate carbon fluxes were measured at 50, 150, and 300 meters using surface-tethered cylindrical sediment traps (0.0125 m2 cross-sectional area; materials and construction as described in McDonnell and Buesseler, 2012).
Generic Instrument Description	A Particle Interceptor Trap is a prototype sediment trap designed in the mid 1990s to segregate 'swimmers' from sinking particulate material sampled from the water column. The prototype trap used 'segregation plates' to deflect and segregate 'swimmers' while a series of funnels collected sinking particles in a chamber (see Dennis A. Hansell and Jan A. Newton. September 1994. Design and Evaluation of a "Swimmer"-Segregating Particle Interceptor Trap, Limnology and Oceanography, Vol. 39, No. 6, pp. 1487-1495).

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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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