Depth profile data from R/V New Horizons NH1418 in the tropical Pacific from Sept-Oct. 2014

Website: https://www.bco-dmo.org/dataset/829895
Data Type: Cruise Results
Version: 1
Version Date: 2020-11-19

Project
» Biological Controls on the Ocean C:N:P ratios (Biological C:N:P ratios)

Programs
» Dimensions of Biodiversity (Dimensions of Biodiversity)
» Ocean Carbon and Biogeochemistry (OCB)

Contributors	Affiliation	Role
Lomas, Michael W.	Bigelow Laboratory for Ocean Sciences	Principal Investigator
Martiny, Adam	University of California-Irvine (UC Irvine)	Co-Principal Investigator
Copley, Nancy	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Depth profile data including CTD, oxygen, chlorophyll, light, nutrients, microbe abundances, and DNA sample log from R/V New Horizons NH1418 in the tropical Pacific from Sept-Oct. 2014.

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Coverage

Spatial Extent: **N**:19.001 **E**:-149.67 **S**:-3.0001 **W**:-158
Temporal Extent: 2014-09-20 - 2014-10-06

Methods & Sampling

Temperature, salinity, oxygen concentration and saturation, and PAR were measured using a Sea-Bird SBE-911+ CTD platform equipped on the rosette deployment system. Fluorescence was measured via the rosette system using a WetLabs ECO AFL/FL platform.

Samples for NO3-/NO2- and NO2- were gravity filtered through 0.8 µm Nucleopore polycarbonate filters using acid cleaned in-line polycarbonate filter holders, then frozen (-20oC) in HDPE bottles until analysis on an Alpkem Flow Solution IV (Dore et al. 1996).

Soluble reactive phosphorus was measured after preparation via the magnesium-induced coprecipitation method (Karl and Tien 1992; Lomas et al. 2010).

Particulate organic carbon (POC), nitrogen (PON), and phosphorus samples were filtered on precombusted Whatman GF/F filters and frozen until analysis. After thawing, POC/PON filters were allowed to dry overnight at 65◦C before being packed into a 30 mm tin capsule (CE Elantech, Lakewood, New Jersey). Samples were then analyzed for C and N content on a FlashEA 1112 nitrogen and carbon analyzer (Thermo Scientific, Waltham, Massachusetts). POC and PON concentrations were calibrated using known quantities of atropine. Particulate organic phosphorus samples (POP) are analyzed using a ash-hydrolysis method (Lomas et al., 2010)

For chlorophyll, ~ 250–500 mL seawater was filtered onto 25-mm Ahlstrom glass fiber filters (nominal pore size 0.7 µm) under low pressure (15 kpa), and frozen immediately at −80_C. Samples were extracted in 90% acetone in the dark for 14–18 h at −20_C and quantified on a Turner 10-AU fluorometer using the acidification method (Parsons et al. 1984).

For cell counts, samples of whole seawater were collected in 2-mL centrifuge tubes, fixed with freshly made 0.2 -µm-filtered paraformaldehyde (0.5% v/v final concentration) for 1 h at 5_C in the dark, and counted on a FACSJazz or Influx flow cytometer (BD, Franklin Lakes, NJ, U.S.A.) utilizing a 200 mW 488 nm laser, with detectors for forward scatter, side scatter, 530 nm, and 692 nm. Prochlorococcus populations were discriminated based on forward scatter and red fluorescence, and a gate in orange (585 nm) discriminated for Synechococcus. Picoeukaryotic phytoplankton were all the red auto fluorescing cells that did not fit the Cyanobacteria gating scheme with a cell size below 2 – 3 µm.

See https://www.rvdata.us/search/cruise/NH1418 for further details.

For published methodologies please see the Related Publications section.

Data Processing Description

BCO-DMO Processing:
- data submitted in Excel file "NH1418_BCODMO.xlsx" sheet "SHEET1" extracted to csv
- added conventional header with dataset name, PI name, version date
- renamed columns to conform with BCO-DMO naming conventions (removed spaces)

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Data Files

File
NH1418_ctd.csv (Comma Separated Values (.csv), 39.88 KB) MD5:f051bc7f9ee4185ce7c61a92aed5390a Primary data file for dataset ID 829895

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Related Publications

Baer, S. E., Lomas, M. W., Terpis, K. X., Mouginot, C., & Martiny, A. C. (2017). Stoichiometry of Prochlorococcus, Synechococcus, and small eukaryotic populations in the western North Atlantic Ocean. Environmental Microbiology, 19(4), 1568–1583. doi:10.1111/1462-2920.13672
Methods

Cetinić, I., Poulton, N., & Slade, W. H. (2016). Characterizing the phytoplankton soup: pump and plumbing effects on the particle assemblage in underway optical seawater systems. Optics Express, 24(18), 20703. doi:10.1364/oe.24.020703 https://doi.org/10.1364/OE.24.020703
Methods

Dore, J., Houlihan, T., Hebel, D., Tien, G., Tupas, L., and Karl, D. (1996) Freezing as a method of sample preservation for the analysis of dissolved inorganic nutrients in seawater. Marine Chemistry 53, 173-185. ftp://soest.hawaii.edu/dkarl/misc/dave/Reprints/1996MarChem53-173-185.pdf
Methods

Garcia, C.A., Hagstrom, G.I., Larkin, A.A., Ustick, L.J., Levin, S.A., Lomas, M.W., & Martiny AC. (2020). Linking regional shifts in microbial genome adaptation with surface ocean biogeochemistry. Philosophical Transactions of the Royal Society B, 375, 20190254. doi: 10.1098/rstb.2019.0254
Results

Karl, D. M., & Tien, G. (1992). MAGIC: A sensitive and precise method for measuring dissolved phosphorus in aquatic environments. Limnology and Oceanography, 37(1), 105–116. doi:10.4319/lo.1992.37.1.0105
Methods

Kent, A. G., Baer, S. E., Mouginot, C., Huang, J. S., Larkin, A. A., Lomas, M. W., & Martiny, A. C. (2018). Parallel phylogeography of Prochlorococcus and Synechococcus. The ISME Journal, 13(2), 430–441. doi:10.1038/s41396-018-0287-6
Results

Lomas, M. W., Bonachela, J. A., Levin, S. A., & Martiny, A. C. (2014). Impact of ocean phytoplankton diversity on phosphate uptake. Proceedings of the National Academy of Sciences, 111(49), 17540–17545. doi:10.1073/pnas.1420760111
Methods

Lomas, M. W., Burke, A. L., Lomas, D. A., Bell, D. W., Shen, C., Dyhrman, S. T., & Ammerman, J. W. (2010). Sargasso Sea phosphorus biogeochemistry: an important role for dissolved organic phosphorus (DOP). Biogeosciences, 7(2), 695–710. doi:10.5194/bg-7-695-2010
Methods

Martiny, A. C., Ustick, L., A. Garcia, C., & Lomas, M. W. (2020). Genomic adaptation of marine phytoplankton populations regulates phosphate uptake. Limnology and Oceanography, 65(S1). doi:10.1002/lno.11252
Methods

Parsons, T. R., Y. Maita, and C. M. Lalli. "A Manual of Chemical and Biological Methods of Seawater Analysis", Pergamon Press (1984). ISBN: 9780080302874
Methods

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Parameters

Parameter	Description	Units
Cruise	Cruise ID	unitless
ISO_DateTime_UTC	Date/Time (UTC) ISO formatted yyyy-mm-ddTHH:MMZ	unitless
yrday_utc	UTC day and decimal time: 326.5 for the 326th day of the year or November 22 at 1200 hours (noon)	unitless
Station	Station ID number	unitless
Cast	Cast number	unitless
Latitude	Sampling Site Latitude (North is positive)	decimal degrees
Longitude	Sampling Site Longitude (West is negative)	decimal degrees
Depth	Water sample depth	meters
Temperature	Temperature	degrees Celsius
Salinity	Salinity	Practical Salinity Units (PSU)
Oxygen_Concentration	Oxygen concentration	micromol/kilogram (umol/kg)
Oxygen_Saturation	Oxygen saturation	percent
Density	Water density	kilograms/meter^2 (kg/m^2)
Chla	Chlorophyll a concentration	micrograms/liter (ug/L)
CTD_PAR	Photosynthetically active radiation; measured off a CTD platform	micromol/meter^2/second (umol/m^2/s)
CTD_Fluorescence	Fluorescence; measured off a CTD platform	milligrams/meter^3 (mg/m^3)
Nitrate_Nitrite	Nitrate + Nitrite	microMolar (uM)
Nitrite	Nitrite	microMolar (uM)
SRP	Soluble reactive phosphate	microMolar (uM)
POC	Particulate organic carbon	microMolar (uM)
PON	Particulate organic nitrogen	microMolar (uM)
POP	Particulate organic phosphorus	microMolar (uM)
Prochlorococcus	Prochlorococcus concentration	cells/milliliter
Synechococcus	Synechococcus concentration	cells/milliliter
Picoeukaryotes	Picoeukaryote concentration	cells/milliliter
Nanoeukaryotes	Nanoeukaryote concentration	cells/milliliter
Prochlorococcus_POC_cell	Prochlorococcus particulate organic carbon per cell	femtograms/cell (fg/cell)
Synechococcus_POC_cell	Synechococcus particulate organic carbon per cell	femtograms/cell (fg/cell)
Picoeukaryotes_POC_cell	Picoeukaryote particulate organic carbon per cell	femtograms/cell (fg/cell)
Nanoeukaryotes_POC_cell	Nanoeukaryote particulate organic carbon per cell	femtograms/cell (fg/cell)
DNA_Cast	Cast number for DNA samples	unitless
DNA_ISO_DateTime_UTC	Time of DNA cast	unitless
DNA_Depth	Depth of DNA sample collection	meters
DNA_Niskin_Bottle	DNA sample bottle	unitless
DNA_Sample	DNA sample ID	unitless

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Instruments

Dataset-specific Instrument Name	FACSJazz: Fluorescence Activated Cell Sorter (BD Biosciences)
Generic Instrument Name	Automated Cell Counter
Dataset-specific Description	Used to count cells
Generic Instrument Description	An instrument that determines the numbers, types or viability of cells present in a sample.

Dataset-specific Instrument Name	FlashEA 112
Generic Instrument Name	CHN Elemental Analyzer
Dataset-specific Description	Used for carbon and nitrogen measurements
Generic Instrument Description	A CHN Elemental Analyzer is used for the determination of carbon, hydrogen, and nitrogen content in organic and other types of materials, including solids, liquids, volatile, and viscous samples.

Dataset-specific Instrument Name	Sea-Bird SBE-911+
Generic Instrument Name	CTD Sea-Bird SBE 911plus
Generic Instrument Description	The Sea-Bird SBE 911 plus is a type of CTD instrument package for continuous measurement of conductivity, temperature and pressure. The SBE 911 plus includes the SBE 9plus Underwater Unit and the SBE 11plus Deck Unit (for real-time readout using conductive wire) for deployment from a vessel. The combination of the SBE 9 plus and SBE 11 plus is called a SBE 911 plus. The SBE 9 plus uses Sea-Bird's standard modular temperature and conductivity sensors (SBE 3 plus and SBE 4). The SBE 9 plus CTD can be configured with up to eight auxiliary sensors to measure other parameters including dissolved oxygen, pH, turbidity, fluorescence, light (PAR), light transmission, etc.). more information from Sea-Bird Electronics

Dataset-specific Instrument Name	Influx Flow Cytometer
Generic Instrument Name	Flow Cytometer
Dataset-specific Description	Used for cell counts
Generic Instrument Description	Flow cytometers (FC or FCM) are automated instruments that quantitate properties of single cells, one cell at a time. They can measure cell size, cell granularity, the amounts of cell components such as total DNA, newly synthesized DNA, gene expression as the amount messenger RNA for a particular gene, amounts of specific surface receptors, amounts of intracellular proteins, or transient signalling events in living cells. (from: http://www.bio.umass.edu/micro/immunology/facs542/facswhat.htm)

Dataset-specific Instrument Name	
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.

Dataset-specific Instrument Name	
Generic Instrument Name	Turner Designs Fluorometer 10-AU
Generic Instrument Description	The Turner Designs 10-AU Field Fluorometer is used to measure Chlorophyll fluorescence. The 10AU Fluorometer can be set up for continuous-flow monitoring or discrete sample analyses. A variety of compounds can be measured using application-specific optical filters available from the manufacturer. (read more from Turner Designs, turnerdesigns.com, Sunnyvale, CA, USA)

Dataset-specific Instrument Name	
Generic Instrument Name	WETLabs ECO-FLNTU
Generic Instrument Description	The ECO FLNTU is a dual-wavelength, single-angle sensor for simultaneously determining both chlorophyll fluorescence and turbidity.

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Deployments

NH1418

Website	https://www.bco-dmo.org/deployment/829909
Platform	R/V New Horizon
Start Date	2014-09-19
End Date	2014-10-07
Description	For project "Biological Controls on the Ocean C:N:P Ratio".

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Project Information

Biological Controls on the Ocean C:N:P ratios (Biological C:N:P ratios)

Coverage: western North Atlantic; 60N to 20N along 66W longitude; 20N to 15S in the tropical Pacific

One of the fundamental patterns of ocean biogeochemistry is the Redfield ratio, linking the stoichiometry of surface plankton with the chemistry of the deep ocean. There is no obvious mechanism for the globally consistent C:N:P ratio of 106:16:1 (Redfield ratio), especially as there is substantial elemental variation among plankton communities in different ocean regions. Thus, knowing how biodiversity regulates the elemental composition of the ocean is important for understanding the ocean and climate as a whole -- now and in the future.

The conceptual hypotheses for this study are as follows: 1. The C:N:P ratio of a cell is constrained by its broad taxonomic group, which determines, for example, whether it has an outer shell, its size, functional metabolism, membrane lipid composition. 2. Within a taxon, there is high genetic diversity. Some of this genetic diversity is potentially laterally transferred, or can be lost within taxa, and confers various functional abilities (organic phosphate assimilation, nitrate assimilation, photoheterotrophy, etc.). Functional diversity provides the cell with further flexibility, such as the ability to respond to varying nutrient supply rates/ratios, and affects a cell's C:N:P ratio within the range specified by the taxon. 3. Given these taxonomic and genetic constraints, a cell is physiologically plastic and modifies how it allocates cellular resources in response to nutrient supply rates/ratios in the environment. 4. The microbial diversity (taxonomic, genetic, and functional) of the surface ocean varies over time and space, driven by many factors in addition to nutrients. The sum of this mixture composes the ecosystem C:N:P, the ratio that Redfield described.

Based on this framework, the CoPIs will make field observations of taxon-specific stoichiometry and growth rates, genomic analyses, and conduct laboratory chemostat experiments to improve understanding of how ocean taxonomic, genetic, and functional biodiversity control the stoichiometry of the surface ocean plankton. Their analyses of these data would lead to a mechanistic understanding of variations in the Redfield ratio, both spatially and temporally.

This study will greatly expand knowledge of the genomic diversity among ocean microbes and how this diversity affects biogeochemistry. The stoichiometry of the ocean's microbes is a parameter that nearly every chemical or biological oceanographer uses, from converting measurements made in one element to another, to estimating regional and global nitrogen budgets. The research also has important implications for the global carbon budget and any changes that might result from climate change.

To understand mechanistically temporal and spatial variability of the plankton C:N:P ratio, biodiversity must be studied not only at the traditional taxonomic level, but at the genetic and functional levels which dictate organism response to their environment. Data will be integrated into a combined ocean ecological, evolutionary, and biogeochemical model, with flexible stoichiometry, including cellular biochemical allocations. Seeding a coupled physical-biological model of the oceans with multiple competing genotypes enables the exploration of ecological and evolutionary patterns of resource acquisition and C:N:P ratios. Developing a more mechanistic examination of the course of ecology and evolution, in which laboratory and field data define tradeoffs between different growth and nutrient acquisition strategies, would estabblish the framework of adaptive dynamics for determining "evolutionarily convergence". Finally, model outcomes will be evaluated against field data.

The field work planned for this project includes several cruises: BV46 (September/October 2011), BV48

(September 2012), a June 2013 cruise from Bermuda to the Labrador Sea, and a cruise from Hawaii to Tahiti (May 2014). Additionally, samples will be be acquired during cruises of opportunity.

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Program Information

Dimensions of Biodiversity (Dimensions of Biodiversity)

Website: http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503446

Coverage: global

(adapted from the NSF Synopsis of Program)
Dimensions of Biodiversity is a program solicitation from the NSF Directorate for Biological Sciences. FY 2010 was year one of the program. [MORE from NSF]

The NSF Dimensions of Biodiversity program seeks to characterize biodiversity on Earth by using integrative, innovative approaches to fill rapidly the most substantial gaps in our understanding. The program will take a broad view of biodiversity, and in its initial phase will focus on the integration of genetic, taxonomic, and functional dimensions of biodiversity. Project investigators are encouraged to integrate these three dimensions to understand the interactions and feedbacks among them. While this focus complements several core NSF programs, it differs by requiring that multiple dimensions of biodiversity be addressed simultaneously, to understand the roles of biodiversity in critical ecological and evolutionary processes.

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-1046001
NSF Division of Ocean Sciences (NSF OCE)	OCE-1046368
NSF Division of Ocean Sciences (NSF OCE)	OCE-1046297
NSF Division of Ocean Sciences (NSF OCE)	OCE-1045966

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