High Resolution sampling of dissolved organic matter (DOM) around Mo'orea coupled with macroalgal collections (Coral DOM2 project)

Website: https://www.bco-dmo.org/dataset/720234
Data Type: Other Field Results
Version: 1
Version Date: 2017-12-01

Project
» Collaborative Research: Dissolved organic matter feedbacks in coral reef resilience: The genomic & geochemical basis for microbial modulation of algal phase shifts (Coral DOM2)

Contributors	Affiliation	Role
Carlson, Craig A.	University of California-Santa Barbara (UCSB-MSI)	Principal Investigator
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Abstract
Data was collected here in collaboration with the MCR-LTER group in July 2016. Dissolved organic carbon (DOC) samples were collected for us during an existing field project (Turbinaria tissue collections). The primary goal was to collect water from as many of ~180 Lagoon sites as possible to obtain high-resolution surface DOC dataset. This dataset includes dissolved organic carbon (DOC) measurements around the periphery of Mo'orea Island from July 26 to September 1, 2016. Samples were taken at 1-meter depth.

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Coverage

Spatial Extent: **N**:-17.47 **E**:-149.76 **S**:-17.6 **W**:-149.92
Temporal Extent: 2016-07-26 - 2016-09-01

Methods & Sampling

Procedural overview:

- All samples were collected via boat, using 1L square Polycarbonate bottles (surface grabs).
- Bottles were gravity filtered (combusted 47mm GF/F) into glass vials.
- Samples were returned to the on-shore MCR LTER laboratory, acidified and stored at Room Temperature.
- Samples were shipped to Craig Carlson's Laboratory at UCSB for analysis using the HTCO Method (Carlson, et al. 2010 DSRII).

DOC analysis methodology (from Carlson et al (2010)).

All samples were analyzed via high-temperature combustion on Shimadzu TOC-V analyzers that were slightly modified from the manufacturer's model system. The condensation coil was removed and the head space of

an internal water trap was reduced to minimize system dead space. The combustion tube contained 0.5 cm Pt pillows placed on top of Pt alumina beads to improve peak shape and to reduce alteration of the combustion matrix throughout the analytical run. CO2-free carrier gas was delivered to the TOC-V systems via commercial ultra high purity gas cylinders or a Whatmans gas generator. Three milliliters of sample were drawn into a 5 ml injection syringe, acidified with 2 M HCL (1.5%), and sparged for 1.5 min with CO2-free gas. Three to five replicate 100 ml of sample were injected into the combustion tube heated to 680 1C. A magnesium perchlorate trap was added to the existing water and halide traps to ensure removal of water vapor from the gas line prior to entering a nondispersive infrared detector. The resulting peak area was integrated with Shimadzu chromatographic software.
Extensive conditioning of the combustion tube with repeated injections of low carbon water (LCW) and deep seawater was essential to minimize the machine blanks. The system response was standardized daily with a four-point calibration curve of potassium hydrogen phthalate solution in LCW. Sample and reference swapping and intercalibration exercises were conducted periodically between the UCSB and University of Miami to ensure comparability between sample sets. All samples were systematically referenced against low carbon water, deep Sargasso Sea reference waters (2600 m), and surface Sargasso Sea water every 6-8 analyses (Hansell and Carlson, 1998; Carlson et al., 2004). Daily reference waters were calibrated with DOC Consensus Reference Waters (Hansell, 2005). The standard deviation of the deep and surface references analyzed throughout a run generally had a coefficient of variation ranging between 1-2% over the 3-7 independent analyses (number of references depended on the size of the run), allowing resolution of approximately 1 mmol/kg in the deep waters.

Data 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
- corrected ISO_DateTime to include reported time rather than 00:00:00; removed separate Time column

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Data Files

File
DOM.csv (Comma Separated Values (.csv), 15.12 KB) MD5:98a2840690094bd92e66fd29a0e372a0 Primary data file for dataset ID 720234

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Related Publications

Carlson, C. A., Giovannoni, S. J., Hansell, D. A., Goldberg, S. J., Parsons, R., & Vergin, K. (2004). Interactions among dissolved organic carbon, microbial processes, and community structure in the mesopelagic zone of the northwestern Sargasso Sea. Limnology and Oceanography, 49(4), 1073–1083. doi:10.4319/lo.2004.49.4.1073
Methods

Carlson, C. A., Hansell, D. A., Nelson, N. B., Siegel, D. A., Smethie, W. M., Khatiwala, S., Meyers, M. M., Halewood, E. (2010). Dissolved organic carbon export and subsequent remineralization in the mesopelagic and bathypelagic realms of the North Atlantic basin. Deep Sea Research Part II: Topical Studies in Oceanography, 57(16), 1433–1445. doi:10.1016/j.dsr2.2010.02.013
Methods

Hansell, D. A. (2005). Dissolved Organic Carbon Reference Material Program. Eos, Transactions American Geophysical Union, 86(35), 318. doi:10.1029/2005eo350003
Methods

Hansell, D. A., & Carlson, C. A. (1998). Deep-ocean gradients in the concentration of dissolved organic carbon.

Nature, 395(6699), 263–266. doi:10.1038/26200
Methods

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Parameters

Parameter	Description	Units
CRUISE	cruise name	unitless
STATION	MCR site number	unitless
TYPE	B for bottle - surface bottle grabs	unitless
ISO_DateTime_Local	Local date and time (UTC-10) in the format yyyy-mm-ddThh:mm:ss	unitless
Latitude	Latitude; north is positive	decimal degrees
Longitude	Longitude; east is positive	decimal degrees
Depth	Sampling depth	meters
SAMPLE_ID	Unique Identified Code for each sample collected	unitless
DOC_FINAL_uM	Dissolved organic carbon concentration by HTCO. Glass fiber filtrate type GF/F (Whatman). Methodological reference is Carlson et al. 2010 DSRII	Micromol Carbon
DOC_SD	standard deviation for DOC	Micromol Carbon
FLAG	quality flag for DOC [1= acceptable; 4= questionable]	unitless

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Instruments

Dataset-specific Instrument Name	Shimadzu TOC-V analyzers, modified
Generic Instrument Name	Total Organic Carbon Analyzer
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

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Deployments

MCR16-1

Website	https://www.bco-dmo.org/deployment/720231
Platform	Richard B Gump Research Station - Moorea LTER
Start Date	2016-07-26
End Date	2016-09-01
Description	Various boats, including the following, were used to sample from the research station

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Project Information

Collaborative Research: Dissolved organic matter feedbacks in coral reef resilience: The genomic & geochemical basis for microbial modulation of algal phase shifts (Coral DOM2)

Coverage: Pacific Coral Reefs

NSF award abstract:
Coral reef degradation, whether driven by overfishing, nutrient pollution, declining water quality, or other anthropogenic factors, is associated with a phase shift towards a reefs dominated by fleshy algae. In many cases managing and ameliorating these stressors does not lead to a return to coral dominance, and reefs languish in an algal-dominated state for years. Nearly a decade of research has demonstrated that trajectories toward increasing algal dominance are restructuring microbial community composition and metabolism; the investigators hypothesize that microbial processes facilitate the maintenance of algal dominance by metabolizing organic compounds released by algae thereby stressing corals through hypoxia and disease. The resilience of reefs to these phase shifts is a critical question in coral reef ecology, and managing reefs undergoing these community shifts requires developing an understanding of the role of microbial interactions in facilitating algal overgrowth and altering reef ecosystem function. The research proposed here will investigate the organics produced by algae, the microbes that metabolize the organics, and the impacts of these processes on coral health and growth. This research has implications for managing reef resilience to algal phase shifts by testing the differential resistance of coral-associated microbial communities to algae and defining thresholds of algal species cover which alter ecosystem biogeochemistry. This project provides mentoring across multiple career levels, linking underrepresented undergraduates, two graduate students, a postdoctoral researcher, and a beginning and established investigators.

This project will integrate dissolved organic matter (DOM) geochemistry, microbial genomics and ecosystem process measurements at ecologically-relevant spatial and temporal scales to test hypothetical mechanisms by which microbially-mediated feedbacks may facilitate the spread of fleshy algae on Pacific reef ecosystems. A key product of this research will be understanding how the composition of corals and algae on reefs interact

synergistically with complex microbial communities to influence reef ecosystem resilience to algal phase shifts. Emerging molecular and biogeochemical methods will be use to investigate mechanisms of microbial-DOM interactions at multiple spatial and temporal scales. This project will leverage the background environmental data, laboratory facilities and field logistical resources of the Mo'orea Coral Reef Long Term Ecological Research Project in French Polynesia and contribute to the mission of that program of investigating coral reef resilience in the face of global change. The investigators will quantify bulk diel patterns of DOM production and characterize the composition of chromophoric components and both free and acid-hydrolyzable neutral monosaccharides and amino acids from varying benthic algae sources. The team will also characterize planktonic and coral-associated microbial community changes in taxonomic composition and gene expression caused by algal DOM amendments in on-site controlled environmental chambers using phylogenetics and metatranscriptomics, including tracking algal exudate utilization by specific microbial lineages. Field-deployed 100 liter tent mesocosms will be used to examine in situ diel patterns of coupled DOM production and consumption, microbial community genomics and ecosystem metabolism over representative benthic communities comprising combinations of algal and coral species. Together these experimental results will guide interpretation of field surveys of centimeter-scale spatial dynamics of planktonic and coral-associated microbial genomics and metabolism at zones of coral-algal interaction, including boundary layer dynamics of oxygen, bacteria and DOM using planar optodes, high-throughput flow cytometry and fluorescence spectroscopy.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1538567
NSF Division of Ocean Sciences (NSF OCE)	OCE-1538393
NSF Division of Ocean Sciences (NSF OCE)	OCE-1538428

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