Internal carbonic anhydrase activity in three species of coral collected from the Florida Keys in August 2013

Website: https://www.bco-dmo.org/dataset/794342
Data Type: Other Field Results
Version: 1
Version Date: 2020-02-26

Project
» Ocean Acidification: Coral Inorganic Carbon Processing in Response to Ocean Acidification (OA_coral_Ci_acquisition)

Programs
» Science, Engineering and Education for Sustainability NSF-Wide Investment (SEES): Ocean Acidification (formerly CRI-OA) (SEES-OA)
» Ocean Carbon and Biogeochemistry (OCB)

Contributors	Affiliation	Role
Hopkinson, Brian M.	University of Georgia (UGA)	Principal Investigator
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Abstract
Internal carbonic anhydrase activity in three species of coral collected from the Florida Keys in August 2013.

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Coverage

Spatial Extent: **N**:25.1193 **E**:-80.3008 **S**:25.1017 **W**:-80.4391
Temporal Extent: 2013-08 - 2013-08

Methods & Sampling

Fragments of Orbicella faveolata, Porites astreoides were collected from Little Grecian reef (25.1193 N 80.3008 W) and Siderastrea radians was collected from Florida Bay (25.1017 N, 80.4391 W) in Key Largo, FL, USA, in August of 2013 as permitted by the Florida Keys National Marine Sanctuary (FKNMS-2011-093, FKNMS-2014-015). Exposed skeleton was covered with modeling clay, and the colonies were maintained in closed circulation tanks filled with reef seawater, allowing at least 2 days of recovery after collection prior to experimentation. The tank was exposed to a natural light regime, with shading added at midday to keep solar irradiance below 600 umol photons m−2 s−1.

Data Processing Description

Coral external carbonic anhydrase (CA) activity was measured on each fragment using an 18O-exchange technique described in (Tansik et al. 2015). Coral tissue was then removed using an air-brush filled with artificial seawater. The coral-algal slurry was homogenized and then centrifuged to remove symbiotic algae. A portion of the purified homogenate was then assessed for total CA activity using an 18O-exchange approach. Internal CA activity was determined by subtracting external CA activity from total CA activity. All 18O-exchange data was processed using MATLAB code, which is publicly available at https://github.com/bmhopkinson/18O_processing. Methodological details are described in Hopkinson et al. (2015).

Note:
Brian Hopkinson's github repo has been forked by BCO-DMO to ensure a copy of the code is available. This can be accessed at https://github.com/BCODMO/18O_processing. A .zip file of the code is also attached to this dataset as a Supplemental File.

BCO-DMO Processing:
- modified columnn names;
- added columns for: Latitude, Longitude, Collection_Date;
- forked original github repo and downloaded a .zip file of the code.

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Data Files

File
coral_iCA_activity.csv (Comma Separated Values (.csv), 1.21 KB) MD5:8f168bb3568005b41ff7520b22b806a1 Primary data file for dataset ID 794342

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Supplemental Files

File
18O processing repo filename: 18O_processing-master.zip (ZIP Archive (ZIP), 67.46 KB) MD5:4b74426c332fba1e35acdc0d481fa6d9 MATLAB code for processing 18O-exchange data; associated with dataset 794342. PI: Brian Hopkinson. Also available from BCO-DMO github at https://github.com/BCODMO/18O_processing

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Related Publications

Hopkinson, B. M., Tansik, A. L., & Fitt, W. K. (2015). Internal carbonic anhydrase activity in the tissue of scleractinian corals is sufficient to support proposed roles in photosynthesis and calcification. Journal of Experimental Biology, 218(13), 2039–2048. doi:10.1242/jeb.118182
Results

Tansik, A. L., Fitt, W. K., & Hopkinson, B. M. (2015). External carbonic anhydrase in three Caribbean corals: quantification of activity and role in CO2 uptake. Coral Reefs, 34(3), 703–713. doi:10.1007/s00338-015-1289-8
Methods

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Parameters

Parameter	Description	Units
Species	Species name	unitless
Sample	Sample ID	unitless
kif	Internal carbonic anhydrase (CA) activity	/s
Latitude	Latitude of sample collection	decimal degrees
Longitude	Longitude of sample collection	decimal degrees
Collection_Date	Year and month of sample collection; format: yyyy-mm	unitless

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Instruments

Dataset-specific Instrument Name	Pfeiffer QMS220M2
Generic Instrument Name	Mass Spectrometer
Dataset-specific Description	18O-exchange was measured using a Pfeiffer QMS220M2 mass spectrometer.
Generic Instrument Description	General term for instruments used to measure the mass-to-charge ratio of ions; generally used to find the composition of a sample by generating a mass spectrum representing the masses of sample components.

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Project Information

Ocean Acidification: Coral Inorganic Carbon Processing in Response to Ocean Acidification (OA_coral_Ci_acquisition)

Coverage: Florida Keys, Laboratory in Athens Georgia

NSF Award Abstract:
A significant portion of the carbon dioxide generated by human activity and released into the atmosphere dissolves into ocean waters, leading to ocean acidification. Acidification can impair the ability of many calcifying organisms, including reef-building corals, to form their calcium carbonate shells or skeletons but the mechanism of these effects is not well understood. This project will improve understanding of inorganic carbon processing in corals thereby providing insight into the effects of ocean acidification on calcification and photosynthesis in corals. Microelectrodes and membrane inlet mass spectrometry (MIMS) will be applied to measure the concentration and reaction rates of inorganic carbon and other chemical species involved in calcification and photosynthesis in three species of Caribbean corals. A major goal is to validate the use of MIMS techniques and microelectrodes in corals. Measurements will be used to develop a numerical model of inorganic carbon processing in corals, allowing chemical fluxes and the composition of the calcifying fluid to be constrained. Improved mechanistic understanding of the effects of ocean acidification on corals will permit robust predications about the longer-term effects of ocean acidification on corals and coral reefs. Broader Impacts: This project will improve predictions of the effects of ocean acidification on corals and coral reef ecosystems. Undergraduate and graduate students will be trained on the project and outreach activities include educating K-12 students and the general public about ocean acidification. A teaching module on the effects of ocean acidification on corals will be added to an existing set of ocean acidification lesson plans and a

collaboration with the Driftwood Education Center will be established to make use of the ocean acidification teaching module. The investigators will host an annual mini-symposium called "Symbiofest", which attracts scientists working on corals and other symbioses from around the south-east and beyond.

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Program Information

Science, Engineering and Education for Sustainability NSF-Wide Investment (SEES): Ocean Acidification (formerly CRI-OA) (SEES-OA)

Website: https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503477

Coverage: global

NSF Climate Research Investment (CRI) activities that were initiated in 2010 are now included under Science, Engineering and Education for Sustainability NSF-Wide Investment (SEES). SEES is a portfolio of activities that highlights NSF's unique role in helping society address the challenge(s) of achieving sustainability. Detailed information about the SEES program is available from NSF (https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504707).

In recognition of the need for basic research concerning the nature, extent and impact of ocean acidification on oceanic environments in the past, present and future, the goal of the SEES: OA program is to understand (a) the chemistry and physical chemistry of ocean acidification; (b) how ocean acidification interacts with processes at the organismal level; and (c) how the earth system history informs our understanding of the effects of ocean acidification on the present day and future ocean.

Solicitations issued under this program:
NSF 10-530, FY 2010-FY2011
NSF 12-500, FY 2012
NSF 12-600, FY 2013
NSF 13-586, FY 2014
NSF 13-586 was the final solicitation that will be released for this program.

PI Meetings:
1st U.S. Ocean Acidification PI Meeting(March 22-24, 2011, Woods Hole, MA)
2nd U.S. Ocean Acidification PI Meeting(Sept. 18-20, 2013, Washington, DC)
3rd U.S. Ocean Acidification PI Meeting (June 9-11, 2015, Woods Hole, MA – Tentative)

NSF media releases for the Ocean Acidification Program:

Press Release 10-186 NSF Awards Grants to Study Effects of Ocean Acidification

Discovery Blue Mussels "Hang On" Along Rocky Shores: For How Long?

Discovery nsf.gov - National Science Foundation (NSF) Discoveries - Trouble in Paradise: Ocean Acidification This Way Comes - US National Science Foundation (NSF)

Press Release 12-179 nsf.gov - National Science Foundation (NSF) News - Ocean Acidification: Finding New Answers Through National Science Foundation Research Grants - US National Science Foundation (NSF)

Press Release 13-102 World Oceans Month Brings Mixed News for Oysters

Press Release 13-108 nsf.gov - National Science Foundation (NSF) News - Natural Underwater Springs Show How Coral Reefs Respond to Ocean Acidification - US National Science Foundation (NSF)

Press Release 13-148 Ocean acidification: Making new discoveries through National Science Foundation research grants

Press Release 13-148 - Video nsf.gov - News - Video - NSF Ocean Sciences Division Director David Conover

answers questions about ocean acidification. - US National Science Foundation (NSF)

Press Release 14-010 nsf.gov - National Science Foundation (NSF) News - Palau's coral reefs surprisingly resistant to ocean acidification - US National Science Foundation (NSF)

Press Release 14-116 nsf.gov - National Science Foundation (NSF) News - Ocean Acidification: NSF awards $11.4 million in new grants to study effects on marine ecosystems - US National Science Foundation (NSF)

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 Emerging Frontiers Division (NSF EF)	EF-1315944

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