Clathromorphum compactum and C. nereostratum calcification experiment data involving multiple temperatures and pCO2 levels (CorallineAlgaePaleo-pH)

Website: https://www.bco-dmo.org/dataset/871633
Data Type: experimental
Version: 1
Version Date: 2022-04-04

Project
» Collaborative Research: Development and application of a method using coralline algae to reconstruct past changes in pH and impacts on calcification (CorallineAlgaePaleo-pH)

Contributors	Affiliation	Role
Ries, Justin B.	Northeastern University	Principal Investigator, Contact
Rasher, Douglas B.	Bigelow Laboratory for Ocean Sciences	Co-Principal Investigator
Williams, Branwen	University of California-San Diego Scripps (UCSD-SIO)	Co-Principal Investigator
Westfield, Isaac	Northeastern University	Scientist
Newman, Sawyer	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Experimental calcification results from crustose coralline algae experiment involving multiple temperatures and pCO2 levels. Clathromorphum compactum and C. nereostratum were used for this experiment.

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Coverage

Temporal Extent: 2015-10-08 - 2016-02-09

Methods & Sampling

Methodology:

Sampling and analytical procedures:

C. compactum and *C. nereostratum* cultured for 4 months under 12 pCO2/T treatments in 42 liter aquaria.

Seawater samples were obtained every ~14 days using 250 mL ground-glass-stoppered borosilicate glass bottles for measurement of total alkalinity (TA) and dissolved inorganic carbon (DIC) and other carbonate parameters.

Temp, salinity, pH were measured three times weekly.

For buoyant weight, specimens were suspended beneath a balance in an aquarium at 4 cm depth in seawater of constant temperature and salinity.

Specimens were dosed with calcein before the experiment and the vertical growth was determined by measuring the vertical growth from the resulting calcein line to the surface.

Data Processing Description

Researcher processing notes:

- R Project and Microsoft Excel were used for all calculations and figure creation.
- CO2Sys used to calculate all carbonate parameters.

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Data Files

File
final_data_file_westfield_updated_04-14-2022-1.csv (Comma Separated Values (.csv), 62.65 KB) MD5:e6bdcf9f31599dbcab0e7257b52aa4f7 Primary data file for dataset ID 871633

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Related Publications

Westfield, I., Gunnell, J., Rasher, D. B., Williams, B., & Ries, J. B. (2022). Cessation of Hardground Accretion by the Cold-Water Coralline Algae Clathromorphum Compactum and Clathromorphum Nereostratum Predicted Within Two Centuries. Geochemistry, Geophysics, Geosystems, 23(5). Portico. https://doi.org/10.1029/2021gc009942 https://doi.org/10.1029/2021GC009942
Results

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Related Datasets

References

Westfield, I., Ries, J. B., Williams, B., Rasher, D. B. (2022) **Experimental tank parameters throughout the life of Clathromorphum compactum and C. nereostratum calcification experiment from from 2015-2016 (CorallineAlgaePaleo-pH project).** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-04-04 doi:10.26008/1912/bco-dmo.872498.1 [view at BCO-DMO]
Relationship Description: The tank condition measurements summarized (averaged) within this dataset are detailed in the dataset "Measured experimental tank parameters" (872498).

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Parameters

Parameter	Description	Units
Sample_ID	Individual IDs for each specimen	unitless
Species	Species name of specimen	unitless
Start_Date	Date of the start of experiment for that specimen; YYYY-MM-DD	unitless
Finish_Date	Date of the end of the experiment for that specimen; YYYY-MM-DD	unitless
Days_Elapsed	Total number of days in experiment for that specimen	days
Mean_pCO2_uatm	Mean pCO2 of experimental tank	ppm
Mean_Temp_c	Mean temperature of experimental tank	Celsius
Mean_pH	Mean pH of experimental tank	unitless
Tank	Tank number within a temperature/pCO2 combination	unitless
Initial_Buoyant_Weight_g	Initial buoyant weight of specimen	grams
Final_Buoyant_Weight_g	Final buoyant weight of specimen	grams
Surface_Area_cm2	Final surface area of specimen	cm2
Vertical_Extension_cm	Vertical growth of that specimen	cm2
Calcification_Rate_mg_per_cm2_year	Mass of calcification per surface area projected for a year	mg/cm2/year

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Instruments

Dataset-specific Instrument Name	VINDTA 3C (Marianda Corporation, Kiel, Germany)
Generic Instrument Name	MARIANDA VINDTA 3C total inorganic carbon and titration alkalinity analyser
Dataset-specific Description	Measures total alkalinity and DIC using closed-cell potentiometric Gran titration and coulometry (UIC 5400), with both methods calibrated using certified Dickson DIC/TA standards.
Generic Instrument Description	The Versatile INstrument for the Determination of Total inorganic carbon and titration Alkalinity (VINDTA) 3C is a laboratory alkalinity titration system combined with an extraction unit for coulometric titration, which simultaneously determines the alkalinity and dissolved inorganic carbon content of a sample. The sample transport is performed with peristaltic pumps and acid is added to the sample using a membrane pump. No pressurizing system is required and only one gas supply (nitrogen or dry and CO2-free air) is necessary. The system uses a Metrohm Titrino 719S, an ORION-Ross pH electrode and a Metrohm reference electrode. The burette, the pipette and the analysis cell have a water jacket around them. Precision is typically +/- 1 umol/kg for TA and/or DIC in open ocean water.

Dataset-specific Instrument Name	Nimbus NBL 423e Precision Balance (±0.0002 precision, ±0.002 accuracy; AE Adam®; Oxford, Connecticut, USA)
Generic Instrument Name	scale or balance
Dataset-specific Description	Used for all mass measurements.
Generic Instrument Description	Devices that determine the mass or weight of a sample.

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Project Information

Collaborative Research: Development and application of a method using coralline algae to reconstruct past changes in pH and impacts on calcification (CorallineAlgaePaleo-pH)

Coverage: Marine Science Center, Northeastern University; and Keck Science Department, Claremont Colleges

Description from NSF award abstract:
The impacts of recent and future human-caused increases in atmospheric CO2 on the acidity (pH) of shallow cold-water marine environments (a process known as "ocean acidification"), and on the organisms that inhabit them, are poorly understood. This is due, in part, to the difficulty in reconstructing past changes in ocean chemistry in these remote environments. This research seeks to develop and apply a technique to reconstruct past seawater pH from boron isotope signatures in long-lived crustose coralline alga that are widespread throughout shallow, cold-water marine environments. In addition, the research will evaluate the impact of changing seawater pH on the growth rate of these ecologically important organisms, which are thought to be particularly vulnerable to ocean acidification because of the high magnesium content of their skeleton. Overall, this project will advance understanding of ocean acidification in shallow, cold-water environments, and provide key information to evaluate the impact that changes in ocean pH have had on organisms inhabiting these environments. The outcomes of this work will provide important information to policy makers and legislators seeking to mitigate the negative effects of rising atmospheric CO2 on these fragile, high-latitude marine ecosystems.

Funding supports a graduate student, numerous undergraduate researchers, and a new collaboration between two early career faculty members. Outreach includes mentoring high school students from groups underrepresented in the sciences through the Scripps College Academy and production of an educational film

on the biological impacts of ocean acidification. The research team will strengthen international ties through collaboration with Canadian and UK scientists, while helping maintain US-based scientists at the forefront of this important sub-field of ocean acidification research.

The work plan includes three main parts: (1) developing the first laboratory-derived and field-verified calibration of the delta11B-proxy of paleoseawater pH for coralline algae, (2) generating the first high-resolution, multi-centennial dataset of high-latitude seawater pH before (ca. 1365 to 1760 AD; i.e., "baseline") and after (ca. 1760 AD to present; i.e., "anthropogenic signal") the Industrial Revolution, and (3) evaluating the impact of anthropogenic ocean acidification on the linear extension, density, and ultrastructure of skeletons produced by an ecologically important, habitat-forming coralline red alga. The associated objectives are: (1) to provide a new tool for reconstructing paleo-seawater pH, (2) to generate historical records of ocean acidification that would elucidate the rate and magnitude of high-latitude ocean acidification that could be used to verify predictive models, and (3) to establish empirical relationships between ocean acidification and coralline algal calcification that would inform predictions of future impacts of ocean acidification on high-latitude marine calcifiers.

Additional information may be found on the following lab websites:
Ries Lab - http://nuweb2.neu.edu/rieslab/
Williams Marine Environmental Change (MEC) Lab - https://branwenwilliams.com/

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Funding

Funding Source	Award
NSF Arctic Sciences (NSF ARC)	PLR-1316141
NSF Division of Ocean Sciences (NSF OCE)	OCE-1459706
NSF Division of Ocean Sciences (NSF OCE)	OCE-1459827

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