Average measured temperature, salinity, TA, DIC, and pH; Average calculated pCO2, pH, carbonate ion concentration, bicarbonate ion concentration, dissolved CO2, and aragonite saturation state.

Website: https://www.bco-dmo.org/dataset/722024
Data Type: experimental
Version: 1
Version Date: 2017-12-28

Project
» A combined boron isotope, pH microelectrode and pH-sensitive dye approach to constraining acid/base chemistry in the calcifying fluids of corals (CoralCalcifyFluid_pH)

Contributors	Affiliation	Role
Ries, Justin B.	Northeastern University	Principal Investigator
Switzer, Megan	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	Data Manager

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Dataset Description

Seawater chemistry for experiments investigating impact of ocean acidification on coral (*Siderastrea siderea*) calcification and morphometry.

See also related datasets for *Siderastrea siderea* calcification rates and corallite morphometry:
Calcification rates
Corallite morphometry

Data are published in:

Horvath, K.M., Ries, J.B., Castillo, K.D., Westfield, I.T., Armstrong, P., Courtney, T., 2016, Next-century ocean acidification and warming both reduce calcification rate, but only acidification alters skeletal morphology of reef-building coral *Siderastrea siderea*. Scientific Reports 6: 29613. doi: 10.1038/srep29613

Please see manuscript for complete methodology.

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Data Files

File
722024.csv (Comma Separated Values (.csv), 1.54 KB) MD5:502c1b54d82addeb51342af8bcbbae89 Primary data file for dataset ID 722024

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Parameters

Parameter	Description	Units
Experiment	Each experiment was conducted under different temperature and pCO2 conditions. A= 31.9 degrees C and pCO2= 424 ppm-v; B= 28.1 degrees C and 246 ppm-v, C= 31.8 degrees C and 940 ppm-v; D= 28.0 degrees C and 888 ppm-v.	A,B,C,D
Temp_m	Average measured temperature of the experimental seawater	degrees Celsius
Temp_m_SE	Standard error for average measured temperature of the experimental seawater	degrees Celsius
Temp_m_range_min	Range minimum for average measured temperature of the experimental seawater	degrees Celsius
Temp_m_range_max	Range maximum for average measured temperature of the experimental seawater	degrees Celsius
Temp_m_n	Number of measurements for average measured temperature of the experimental seawater	number
Sal_m	Average measured salinity of the experimental seawater	psu
Sal_m_SE	Standard error for average measured salinity of the experimental seawater	psu
Sal_m_range_min	Range minimum for average measured salinity of the experimental seawater	psu
Sal_m_range_max	Range maximum for average measured salinity of the experimental seawater	psu
Sal_m_n	Number of measurements for average measured salinity of the experimental seawater	number
pH_m	Average measured pH of the experimental seawater	pH scale
pH_m_SE	Standard error for average measured pH of the experimental seawater	pH scale
pH_m_range_min	Range minimum for average measured pH of the experimental seawater	pH scale
pH_m_range_max	Range maximum for average measured pH of the experimental seawater	pH scale
pH_m_n	Number of measurements for average measured pH of the experimental seawater	number
TA_m	Average measured total alkalinity (TA) of the experimental seawater	uM
TA_m_SE	Standard error for average measured total alkalinity (TA) of the experimental seawater experimental seawater	uM
TA_m_range_min	Range minimum for average measured total alkalinity (TA) of the experimental seawater experimental seawater	uM
TA_m_range_max	Range maximum for average measured total alkalinity (TA) of the experimental seawater experimental seawater	uM
TA_m_n	Number of measurements for average measured total alkalinity (TA) of the experimental seawater experimental seawater	number
DIC_m	Average measured dissolved inorganic carbon (DIC) of the experimental seawater	uM

DIC_m_SE	Standard error for average measured dissolved inorganic carbon (DIC) of the experimental seawater	uM
DIC_m_range_min	Range minimum for average measured dissolved inorganic carbon (DIC) of the experimental seawater	uM
DIC_m_range_max	Range maximum for average measured dissolved inorganic carbon (DIC) of the experimental seawater	uM
DIC_m_n	Number of measurements for average measured dissolved inorganic carbon (DIC) of the experimental seawater	number
pCO2_c	Average calculated pCO2 of the mixed gases in equilibrium with the experimental seawater	ppm-v
pCO2_c_SE	Standard error for average calculated pCO2 of the mixed gases in equilibrium with the experimental seawater	ppm-v
pCO2_c_range_min	Range minimum for average calculated pCO2 of the mixed gases in equilibrium with the experimental seawater	number
pCO2_c_range_max	Range maximum for average calculated pCO2 of the mixed gases in equilibrium with the experimental seawater	number
pCO2_c_n	Number of measurements for average calculated pCO2 of the mixed gases in equilibrium with the experimental seawater	number
pH_c	Average calculated pH of the experimental seawater	pH scale
pH_c_SE	Standard error for average calculated pH of the experimental seawater	pH scale
pH_c_range_min	Range minimum for average calculated pH of the experimental seawater	pH scale
pH_c_range_max	Range maximum for average calculated pH of the experimental seawater	pH scale
pH_c_n	Number of measurements for average calculated pH of the experimental seawater	pH scale
CO3_c	Average calculated carbonate ion concentration of the experimental seawater	uM
CO3_c_SE	Standard error for average calculated carbonate ion concentration of the experimental seawater	uM
CO3_c_range_min	Range minimum for average calculated carbonate ion concentration of the experimental seawater	uM
CO3_c_range_max	Range maximum for average calculated carnonate ion concentration of the experimental seawater	uM
CO3_c_n	Number of measurements for average calculated carbonate ion concentration of the experimental seawater	number
HCO3_c	Average calculated bicarbonate ion concentration of the experimental seawater	uM
HCO3_c_SE	Standard error for average calculated bicarbonate ion concentration of the experimental seawater	uM
HCO3_c_range_min	Range minimum for average calculated bicarbonate ion concentration of the experimental seawater	uM
HCO3_c_range_max	Range maximum for average calculated bicarbonate ion concentration of the experimental seawater	uM
HCO3_c_n	Number of measurements for average calculated bicarbonate ion concentration of the experimental seawater	uM
CO2sw_c	Average calculated dissolved CO2 of the experimental seawater	uM

CO2sw_c_SE	Standard error for average dissolved CO2 of the experimental seawater	uM
CO2sw_c_range_min	Range minimum for average dissolved CO2 of the experimental seawater	uM
CO2sw_c_range_max	Range maximum for average dissolved CO2 of the experimental seawater	uM
CO2sw_c_n	Number of measurements for average dissolved CO2 in exerimental seawater	number
Arag_sat_c	Average calculated aragonite saturation state of the experimental seawater	omega
Arag_sat_c_SE	Standard error for average calculated aragonite saturation state of the experimental seawater	omega
Arag_sat_c_range_min	Range minumum for average calculated aragonite saturation state of the experimental seawater	omega
Arag_sat_c_range_max	Range maximum for average calculated aragonite saturation state of the experimental seawater	omaga
Arag_sat_c_n	Number of measurements for average calculated aragonite saturation state of the experimental seawater	number

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Instruments

Dataset-specific Instrument Name	MARIANDA corporation VINDTA 3C
Generic Instrument Name	MARIANDA VINDTA 3C total inorganic carbon and titration alkalinity analyser
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.

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Project Information

A combined boron isotope, pH microelectrode and pH-sensitive dye approach to constraining acid/base chemistry in the calcifying fluids of corals (CoralCalcifyFluid_pH)

Website: http://nuweb2.neu.edu/rieslab/

Coverage: Marine Science Center, Northeastern University

Description from NSF award abstract:
The anthropogenic elevation of atmospheric CO2 is causing the oceans to become more acidic, which may make it more challenging for corals to build their skeletons and, ultimately, entire reef structures. How corals respond to future ocean acidification will largely depend on how the pH of the internal fluid from which they

produce their skeletons-their so-called calcifying fluid-is impacted by the surrounding seawater. It is therefore essential that current methods are refined to accurately measure the pH of corals' calcifying fluids in order to understand and, ideally, predict their responses to CO2-induced ocean acidification. In this project, a three-pronged approach to measure calcifying fluid pH within three species of reef-forming corals will be used to assess how their calcifying fluid pH responds to experimentally induced ocean acidification. This research will improve our understanding of corals' responses to ocean acidification and thus has the potential to inform the decisions of policy makers and legislators seeking to mitigate the deleterious effects of rising atmospheric CO2 on marine ecosystems. The work will support the development of three early career scientists, a postdoctoral fellow, graduate students, and undergraduate researcher assistants-several of whom are from underrepresented groups in the earth and ocean sciences. Results will be widely disseminated through publications, conference presentations, the PIs' websites, an educational film, coursework, and outreach activities at area schools, museums, and science centers.

Corals and other types of marine calcifiers are thought to begin the mineralization of their calcium carbonate skeletons by actively elevating pH of their calcifying fluid, thereby converting bicarbonate ions (comprising ~90% of seawater dissolved inorganic carbon) to carbonate ions, the form of carbon used in calcification. This project will compare the combined boron isotope, pH microelectrode, and pH-sensitive dye approach to measure the calcifying fluid pH of three species of scleractinian corals, and to assess how their calcifying fluid pH (a primary factor controlling their calcification) responds to experimentally induced ocean acidification. As a result this multi-pronged approach to measuring calcifying fluid pH of the same coral species under equivalent culturing conditions will permit the first systematic cross-examination of the validity of these independent approaches. The combined approach will also yield values of calcifying fluid pH with uncertainties that can be quantified via inter-comparison and statistical treatment of these independent measurements. Importantly, this multi-pronged approach will be used on three coral species that due to differences in the carbonate chemistry of their native waters possess differing capacities for proton regulation at their site of calcification; a deep, cold-water coral (strong proton-pumper); a shallow, temperate coral (moderate proton-pumper); and a shallow, tropical coral (weak proton-pumper). Target outcomes of this research include (1) cross-examination of the validity of three independent approaches to estimating coral calcifying fluid pH, (2) quantification of uncertainty associated with the three approaches to estimating coral calcifying fluid pH, (3) advancement of our mechanistic understanding of coral calcification, (4) exploration of the mechanism by which ocean acidification impacts coral calcification, (5) elucidation why corals exhibit such varied responses to ocean acidification, (6) identification of coral types most vulnerable to ocean acidification, (7) exploration of so-called "vital effects" that limit the use of corals in paleoceanographic reconstructions, and (8) quantitative constraint of existing models of coral biomineralization.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1357665
NSF Division of Ocean Sciences (NSF OCE)	OCE-1437371
NSF Division of Ocean Sciences (NSF OCE)	OCE-1459706

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