Summary of pCO2, temperature, calcification rate, d18 sw, d13C sw; d18Oe, d13Ce, d18Oe-sw, and d13Ce-sw for individual echinoid specimens.

Website: https://www.bco-dmo.org/dataset/721315
Version: 1
Version Date: 2017-12-17

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
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Dataset Description

Experimental results for echinoid calcification under different temperature and pCO2 concentrations. This dataset includes measurements of stable isotopes Oxygen-18 and Carbon-13 in the echinoid spines and in the seawater.

See also related datasets for experimental seawater chemistry and calcification.
Echinoid seawater chemistry
Echinoid calcification

Data are published in:

Courtney, T., Ries, J. B., 2015, Impact of atmospheric pCO_2, seawater temperature, and calcification rate on the $\delta^{18}O$ and $\delta^{13}C$ composition of echinoid calcite (*Echinometra viridis*). Chemical Geology 411: 228-239. DOI: j.chemgeo.2015.06.030

Please see manuscript for complete methodology.

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Data Files

File
721315.csv (Comma Separated Values (.csv), 1.39 KB) MD5:4473633165f1018f8ae30f40f363ce67 Primary data file for dataset ID 721315

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Parameters

Parameter	Description	Units
pCO2	CO2 concentration (experimental conditions)	ppm-v
Temp	Temperature (experimental conditions)	degrees Celsius
Calcification_Rate	Calcification rate	percent
d18Osw	Delta O-18 seawater	per mil VPDB
d13Csw	Delta C13 seawater	per mil VPDB
d18Oe	Delta O-18 echinoidal calcite	per mil VPDB
d13Ce	Delta C-13 echinoidal calcite	per mil VPDB
d18Oe_sw	Difference between delta O13 in echinoidal calcite and delta O18 in seawater (d13Oe - d13Osw)	per mil VPDB
d13Ce_sw	Difference between delta C13 in echinoidal calcite and delta C13 in seawater (d13Ce - d13Osw)	per mil VPDB

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Instruments

Dataset-specific Instrument Name	ThermoFinnigan GasBench II with an in-line Finnigan MAT 253 isotope ratio mass spectrometer
Generic Instrument Name	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

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
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