Effect of temperature and polymorph mineral solubility on average modeled dissolution rates.

Website: https://www.bco-dmo.org/dataset/723865
Data Type: experimental
Version: 1
Version Date: 2018-01-17

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)

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Table of Contents

Dataset Description

Effect of temperature and polymorph mineral solubility (high-Mg calcite > aragonite > low-Mg calcite) on average modelled dissolution rate over $\Omega_A = 0.2 - 5.0$ (using Ω_A increments of 0.2) at 10.1 °C (± 0.02) and 25.0 °C (± 0.02). Results ranked by magnitude of temperature effect on average dissolution rate. Ω_A = saturation state of seawater with respect to aragonite.

See also related datasets for seawater chemistry, calcification rates, and dissolution rates.
Seawater chemistry
Calcification rates
Dissolution rates

These data are published in:

Ries, J.B., Ghazaleh, M.N., Connolly, B., Westfield, I., Castillo, K.D., 2016, Impacts of ocean acidification and warming on the dissolution kinetics of whole-shell biogenic carbonates. Geochimica et Cosmochimica Acta 192: 318–337. doi: 10.1016/j.gca.2016.07.001

Please see manuscript for complete methodology.

[table of contents | back to top]

Data Files

File
723865.csv (Comma Separated Values (.csv), 676 bytes) MD5:ba89878e26fbcc0cc85e37c1b9228c1f Primary data file for dataset ID 723865

[table of contents | back to top]

Parameters

Parameter	Description	Units
Specimen	Specimen	name
Scientific_name	Scientific name	name
diss_rate_10C	Average dissolution rate (weight % change per day) at 10 degrees Celsius	percent per day
diss_rate_25C	Average dissolution rate (weight % change per day) at 25 degrees Celsius	percent per day
difference	Difference between the average dissolution rate at 10 degrees Celsius and the average dissolution rate at 25 degrees Celsius	percent per day
Mineralogy	Relative polymorph composition of sample?	A - aragonite; LMC - low-Mg calcite (<4 mol% $MgCO_3$); HMC - high-Mg calcite (>4 mol% $MgCO_3$)

[table of contents | back to top]

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 CO_2 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 CO_2-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 CO_2 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.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1437371
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[table of contents | back to top]