

pH measurements from the Sapodilla Caye, Belize for Calcifying Fluid study at UNC Ries laboratory starting 2010 (OA - Ocean Acidification and Warming Impact on Calcification project)

Website: <https://www.bco-dmo.org/dataset/3542>

Version: 20 September 2011

Version Date: 2011-09-20

Project

» [Investigation of the Effects of CaCO₃ Saturation State and Temperature on the Calcification Rate and Skeletal Properties of Benthic Marine Calcifiers](#) (OA - Ocean Acidification and Warming Impact on Calcification)

Program

» [Ocean Carbon and Biogeochemistry](#) (OCB)

| Contributors | Affiliation | Role |
|----------------------------------|---|---------------------------------|
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Dataset Description

Carbonate system parameters of seawater and the calcifying fluid of the coral *Astrangia poculata* determined via pH microelectrode

Original contributed as Table 2 in a .doc document

Methods & Sampling

(tbd)

Data Processing Description

BCO-DMO Processing Notes

- Generated from original .doc file "Data_Ries_OCE1031995_5Jul2011_Calcifying_fluid_pH_measurements.doc" contributed by Justin Ries
- Original table in .doc document converted to text and uploaded to Excel
- Parameter names extensively edited to conform to BCO-DMO naming convention found at [Choosing Parameter Name](#)
- Columns added for Seawater type and Fluid type

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Data Files

| File |
|--|
| Calfluid_pH_measurements.csv (Comma Separated Values (.csv), 1.87 KB) MD5:ba6790c3fad3303638c9c303ce8ed240 |
| Primary data file for dataset ID 3542 |

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Parameters

| Parameter | Description | Units |
|------------|--|-----------------|
| Seawater | Seawater type - Non-acidified or acidified seawater | text |
| Event | Event/Activity | text |
| Fluid | Fluid type - SW = seawater; CF = calcifying fluid | text |
| Sal | Sal = salinity | psu |
| T | T = temperature | degrees celsius |
| pH | pH | sea water scale |
| TA | TA = total alkalinity | micromol/kg-SW |
| DIC | DIC = dissolved inorganic carbon | micromol/kg-SW |
| pCO2 | pCO ₂ = partial pressure of CO ₂ of air in equilibrium with fluid ppm; pCO ₂ of SW and CF are assumed to be equivalent on the premise that SW is the ultimate source of CF | ppm |
| HCO3_minus | [HCO ₃ ⁻] = bicarbonate ion concentration of fluid | micromol/kg-SW |
| CO32_minus | [CO ₃ ²⁻] = carbonate ion concentration of fluid | micromol/kg-SW |
| CO2_aq | [CO ₂] _{aq} = CO ₂ concentration of fluid | micromol/kg-SW |
| OmegaA | Ω _A = saturation state of fluid with respect to aragonite | (tbd) |

| | | |
|---------------------|--|----------------|
| Hplus | $[H^+] =$ proton concentration of fluid | micromol/kg-SW |
| Hplus_minus_removed | $[H^+]$ -removed = $[H^+]$ -removed from calcifying fluid; calculated from difference between total alkalinity of SW and CF after H^+ -removal assuming composition of CF before H^+ -removal is equivalent to that of external SW | micromol/kg-SW |
| Hplus_E_to_Hplus_I | $[H^+^E]/[H^+]_I =$ ratio of external seawater $[H^+]$ to calcifying fluid $[H^+]_I$ | ratio |

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Deployments

lab_Ries_Sapodilla_Caye

| | |
|--------------------|---|
| Website | https://www.bco-dmo.org/deployment/58722 |
| Platform | Ries |
| Report | http://www.unc.edu/~jries/field_sites.html |
| Start Date | 2010-09-01 |
| End Date | 2099-01-01 |
| Description | The Ries Lab - Sapodilla Caye, Belize |

lab_Ries UNC Chapel Hill

| | |
|--------------------|---|
| Website | https://www.bco-dmo.org/deployment/58723 |
| Platform | Ries |
| Report | http://www.unc.edu/~jries/index.html |
| Start Date | 2010-09-01 |
| End Date | 2099-01-01 |
| Description | The Ries Lab |

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Project Information

Investigation of the Effects of CaCO₃ Saturation State and Temperature on the Calcification Rate and Skeletal Properties of Benthic Marine Calcifiers (OA - Ocean Acidification and Warming Impact on Calcification)

Website: <http://www.unc.edu/~jries/index.html>

Coverage: Chapel Hill, North Carolina (lab) and Mesoamerican Barrier Reef System - Sapodilla Caye, Belize (16.2 N 88.5 W)

Description from NSF award abstract:

Anthropogenic elevation of atmospheric pCO₂ is increasing the acidity of the oceans, thereby reducing the

saturation state of seawater with respect to calcium carbonate (CaCO₃). Of mounting concern is the potential impact of these changes on the ability of calcifying organisms to form their shells and skeletons. Recent studies, including pilot work conducted by investigator Ries and his colleagues on a suite of benthic marine calcifiers spanning broad taxonomic, mineralogical, and ecological ranges, have revealed that marine organisms exhibit a wide range of calcification responses to CO₂-induced ocean acidification, including positive, negative, parabolic, threshold, and neutral responses. Marine calcifiers build their shells and skeletons from various forms (polymorphs) of CaCO₃, most commonly aragonite, high-Mg calcite, and low-Mg calcite. These polymorphs differ greatly in their solubility in seawater and, therefore, in their potential response to CO₂-induced ocean acidification. X-ray diffraction analysis of shells secreted by the organisms investigated in the pilot study reveals that the proportion of calcite (the less soluble form of CaCO₃) to aragonite (the more soluble form) within their shells increases under elevated pCO₂, while the Mg:Ca ratio of their calcite declines. These observations suggested that some marine calcifiers may partially adapt to a declining CaCO₃ saturation state by accreting a greater proportion of the less-soluble form of CaCO₃ (low-Mg calcite) at the expense of the more soluble forms (aragonite, high-Mg calcite). However, it is likely that such mineralogical and compositional changes in the shells and skeletons of marine organisms would alter their structural and biomechanical properties.

The project seeks to build upon the results of a pilot study by rearing a suite of benthic marine calcifiers under past (280 ppm), present (385 ppm), and predicted future (540, 840 ppm) pCO₂ and under three distinct temperatures to investigate changes in: (1) their rates of calcification and linear extension; (2) the relative abundance and micron-scale distribution of the various CaCO₃ polymorphs within their shells/skeletons; (3) the ultrastructure and crystal morphology of their shells/skeletons; and (4) their biomechanical properties. The research also builds upon the pilot experiments by utilizing a more thoroughly replicated study design, by more precisely constraining the chemical parameters of the experimental seawater treatments, by investigating calcification responses under 3 different temperature regimes, and by employing a "pre-industrial" pCO₂ level (280 ppm). The results of the proposed research should advance our understanding of how benthic marine calcifiers shall respond to future CO₂-induced changes in seawater temperature and CaCO₃ saturation state. By investigating the response of organisms over the range of atmospheric pCO₂ that has occurred since late Paleozoic time, this research should inform our understanding of the putative links between atmospheric pCO₂, mass extinction events, and secular variation in the polymorph mineralogy of marine calcifiers throughout geologic time. Finally, comparison of the observed biological responses to variable pCO₂-T scenarios with that already established for abiogenic carbonates will advance our understanding of the very mechanisms by which marine calcifiers build their shells and skeletons.

Results of this research project will inform the decisions of policy makers and legislators working to mitigate the impacts of CO₂-induced warming and ocean acidification by establishing pCO₂-T tolerances for a range of marine calcifiers.

Note (02 Oct 2014): Funding for this project has transferred from award OCE-1031995 to OCE-1357665, coincident with Principal Investigator's affiliation change from University of North Carolina at Chapel Hill to Northeastern University.

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Program Information

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 Division of Ocean Sciences (NSF OCE) | OCE-1031995 |
| NSF Division of Ocean Sciences (NSF OCE) | OCE-1357665 |

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