Skeletal Mineralogy Carbonate Chemistry measurements from the Sapodilla Caye, Belize starting in 2010 (OA - Ocean Acidification and Warming Impact on Calcification project)

Website: https://www.bco-dmo.org/dataset/3538
Version: 13 September 2011
Version Date: 2011-09-13

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
Ries, Justin B.	University of North Carolina at Chapel Hill (UNC-Chapel Hill)	Principal Investigator, Contact
Gegg, Stephen R.	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

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Dataset Description

Skeletal Mineralogy - Carbonate chemistry data

Methods & Sampling

(tbd)

Data Processing Description

BCO-DMO Processing Notes
- Generated from original .xlsx file "Data_Ries_OCE1031995_5Jul2011_Skeletal_mineralogy.xls", Sheet: "Carbonate Parameters" contributed by Justin Ries
- Parameter names edited to conform to BCO-DMO naming convention found at Choosing Parameter Name

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Data Files

File
SkelMineral_CarbonateChem.csv(Comma Separated Values (.csv), 2.81 KB) MD5:9b9cff9ae28cda73bbd31e4f376e5d83 Primary data file for dataset ID 3538

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Parameters

Parameter	Description	Units
Tank	Tank Descriptor	text
MEASURED_pCO2	MEASURED pCO2	(tbd)
MEASURED_pCO2_SD	MEASURED pCO2 SD	(tbd)
MEASURED_Sal	MEASURED Sal	(tbd)
MEASURED_Sal_SD	MEASURED Sal SD	(tbd)
MEASURED_Temp	MEASURED Temp	(tbd)
MEASURED_Temp_SD	MEASURED Temp SD	(tbd)
MEASURED_Alk	MEASURED Alk	(tbd)
MEASURED_Alk_SD	MEASURED Alk SD	(tbd)
MEASURED_pH	MEASURED pH	(tbd)
MEASURED_pH_SD	MEASURED pH SD	(tbd)
CALCULATED_DIC	CALCULATED DIC	(tbd)
CALCULATED_DIC_SD	CALCULATED DIC SD	(tbd)
CALCULATED_pCO2	CALCULATED pCO2	(tbd)
CALCULATED_pCO2_SD	CALCULATED pCO2 SD	(tbd)

CALCULATED_Omega_arag	CALCULATED Ωarag	(tbd)
CALCULATED_Omega_arag_SD	CALCULATED ?arag SD	(tbd)
CALCULATED_t_test	CALCULATED t test	(tbd)
CALCULATED_P_value	CALCULATED P_value	(tbd)

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Deployments

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

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

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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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