

Annual linear extension, skeletal density, and calcification rate data from coral cores collected across Bermuda in 2016

Website: <https://www.bco-dmo.org/dataset/821212>

Data Type: Other Field Results

Version: 1

Version Date: 2020-08-24

Project

» [Environmental drivers of coral and reef-scale calcification in the North Atlantic](#) (Coral Calc)

Contributors	Affiliation	Role
Andersson, Andreas	University of California-San Diego (UCSD-SIO)	Principal Investigator
Courtney, Travis	University of California-San Diego (UCSD-SIO)	Co-Principal Investigator, Contact
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract

Annual linear extension, skeletal density, and calcification rate data are reported for coral cores collected from across Bermuda in 2016.

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Coverage

Spatial Extent: N:32.4505 E:-64.6653 S:32.3406 W:-64.843

Temporal Extent: 2016-08 - 2016-08

Dataset Description

Annual linear extension, skeletal density, and calcification rate data are reported for coral cores collected from across Bermuda in 2016.

Acquisition Description

Coral cores were collected in August 2016 using a 2-inch diameter wet concrete diamond drill bit powered by an underwater pneumatic drill. The colonies were sealed with a cement plug and underwater epoxy to

promote recovery of the coral following core extraction. Each core was scanned via a GE Lightspeed VCT at San Diego Imagery alongside density reference materials provided by Dr. Karl Castillo (University of North Carolina at Chapel Hill) in three separate scans. Three scans were necessary to fit all of the cored material in the center region of the scanning table to avoid any potential heel effects near the boundaries of the scanned region. The density standards were scanned in each of the three scans to correct for any intra-scan variability in CT imagery. Approximately 3 mm thick slabs were extracted from the center of each of the cores and standards using standardized window widths and window levels and exported as images via the software Horos for subsequent growth rate analysis in CoralXDS. Annual growth rates and luminance values along the major growth axis were quantified using the half-range mode of the software CoralXDS. The density of the reference materials were strongly correlated with the scanned luminance intensity for each scan and these relationships were used to calculate annual skeletal densities from the annual coral skeletal luminance intensities using the statistical software R. Annual calcification rates were determined as the product of annual linear extension rate and skeletal density using the statistical software R.

All cores were collected under the Government of Bermuda Department of Environment and Natural Resources license number 2015-05-26-46.

Please see Courtney et al. (in review) for further details.

Processing Description

Coral core CT data were processed using Horos, CoralXDS, and R to construct time series data from the raw CT imagery as per the procedures described above.

BCO-DMO Processing:

- added columns for site latitude and longitude.

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Related Publications

Courtney TA, Kindeberg, Andersson AJ. Coral calcification responses to the North Atlantic Oscillation and bleaching in Bermuda. In review.

Results

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Parameters

Parameter	Description	Units
year	Year of growth measurement	unitless
ext	Annual linear extension	centimeters per year (cm/y)
dens	Annual skeletal density	grams per cubic centimeter (g/cm ³)
calc	Annual calcification rate	grams per square centimeter per year (g/cm ² /yr)
coral	Core ID label	unitless
site	Site of core extraction	unitless
species	Genus and species of coral	unitless
site_lat	Site latitude	decimal degrees North
site_lon	Site longitude	decimal degrees East

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Instruments

Dataset-specific Instrument Name	GE LightSpeed VCT CT System
Generic Instrument Name	Computerized Tomography (CT) Scanner
Dataset-specific Description	The cores were analyzed via the CT system at San Diego Imaging and all DICOM files were exported for subsequent analyses in Horos, CoralXDS, and R.
Generic Instrument Description	A CT scan makes use of computer-processed combinations of many X-ray measurements taken from different angles to produce cross-sectional (tomographic) images (virtual "slices") of specific areas of a scanned object.

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Deployments

Bermuda_Reefs_2016

Website	https://www.bco-dmo.org/deployment/821222
Platform	BIOS_Small_Boat
Start Date	2016-08-01
End Date	2016-08-31
Description	Coral reefs sampled in June 2016 as part of the project "Environmental drivers of coral and reef-scale calcification in the North Atlantic": Hog Reef, Bermuda (lat: 32.4505 lon: -64.8363); Three Hill Shoals, Bermuda (lat: 32.4244 lon: -64.7369); Halfway Flat, Bermuda (lat: 32.3763 lon: -64.843); Whalebone Bay, Bermuda (lat: 32.3667 lon: -64.715); Gurnet Rock, Bermuda (lat: 32.3406 lon: -64.6653).

Project Information

Environmental drivers of coral and reef-scale calcification in the North Atlantic (Coral Calc)

Coverage: Bermuda

Millions of people around the world are dependent on the ecosystem services provided by coral reefs, which include the provision of nutrition, fishing, tourism, and protection from storms and waves. The foundation for these services is based on the basic principle that coral reefs maintain positive calcium carbonate accretion, which is facilitated by the production of calcium carbonate by corals and other marine calcifiers. For the past several decades, coral reef calcium carbonate production has declined in many reef systems throughout the world primarily due to coral bleaching, coral disease, and poor water quality. Current projections suggest that this production will continue to decline in response to future ocean warming and acidification. However, our knowledge of how environmental parameters control coral and reef-scale calcification rates in situ is not complete and limits our understanding of the underlying mechanisms for past and future changes in coral and reef-scale calcium carbonate production. Thus, the research proposed here seeks to quantify how coral calcification rates determined from image analysis of coral cores collected in Bermuda have varied as a function of environmental parameters across space and time. This analysis is made possible by the existence of time-series datasets of physical and chemical parameters offshore in the Sargasso Sea and inshore where the coral cores were collected. The combination of data will offer new insights to the environmental controls of coral and reef-scale calcification. Furthermore, we will engage in educational field and classroom activities with Ocean Discovery Institute (ODI) in San Diego. ODI's mission is to engage, educate, and inspire youth from diverse backgrounds through scientific explorations of the ocean and nature, and specifically work with students from underserved communities. The research to be conducted here seeks to understand the relative importance of different environmental drivers of coral and reef-scale calcification on seasonal to interannual timescales. To accomplish this, we will characterize the skeletal density, extension, and calcification rates of 42 coral cores extracted from three different species (*Diploria labyrinthiformis*, *Pseudodiploria strigosa* and *Orbicella franksi*) at five different sites from the Bermuda coral reef platform using computed tomography (CT) scanning techniques. Seasonal measurements of coral skeletal parameters will be analyzed in conjunction with a unique decadal time series of monthly resolved in situ seawater physical-biogeochemical parameters. We will also conduct stable isotope and trace metal geochemical analyses (^{18}O , ^{13}C , Sr/Ca , Cd/Ca) of the coral skeleton to evaluate and construct additional proxy records of environmental conditions for the duration of the coral cores. This combination of coral growth, environmental, and geochemical datasets provides an unprecedented opportunity to evaluate the relative importance of different environmental drivers on coral and reef-scale calcification rates between three dominant coral species along inshore-offshore gradients and over seasonal and interannual timescales. To our knowledge, no such other datasets currently exist and the proposed research has strong potential to contribute to scientific advancement in several areas. The coral calcification record coupled with the geochemical proxies and the monthly in situ seawater biogeochemistry data will help to elucidate causal links between coral calcification and its environmental drivers, including interannual variability linked to the North Atlantic Oscillation. In addition, evaluation and validation of the trace metals and isotopic proxies in the context of the well-constrained environmental data have the potential to greatly assist the coral paleoceanography community in generating more robust reconstructions of past environmental conditions.

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1829778

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