

CarBoy experiment data from R/V Melville, R/V Roger Revelle cruises MV1101, RR1202 in the Southern Ocean (30-60S); 2011-2012 (Great Calcite Belt project)

Website: <https://www.bco-dmo.org/dataset/561302>

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Project

» [The Great Southern Coccolithophore Belt](#) (Great Calcite Belt)

Contributors	Affiliation	Role
Balch, William M.	Bigelow Laboratory for Ocean Sciences	Principal Investigator, Contact
Gegg, Stephen R.	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

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Dataset Description

Data from carboy experiments conducted aboard the vessels during the two Great Southern Coccolithophore Cruises - MV1101 and RR1202.

[CarBoy and Dilution Experiments Location Map](#)

Methods & Sampling

Water collected from a single CTD cast at 4 Stations, approximately 5m depth.

8 x 20l Carboys filled with raw seawater

4 x 20l Carboys filled with 0.2µm filtered seawater

4 treatments incubated at surface temperature/light levels (on deck with surface seawater circulated through incubators) at 380, 500, 750, and 1200 ppm CO₂ (premixed Air/CO₂ continuously bubbled in each carboy). Each treatment consists of 2 whole water and 1 fsw carboy.

Carboys sampled at T0, 24h, 48h, and 72 hours for Chlorophyll a (Chl a), Particulate Inorganic Carbon (PIC), Biogenic Silica (BSi), Birefringent Cell and Coccolith counts, Dissolved nutrients (NO₃, PO₄, SiO₄, NO₂, NH₄), Dissolved Inorganic Carbon (DIC), and Total Alkalinity (TA).

Data Processing Description

BCO-DMO Processing Notes

- Generated from original files "GB1 carboy data.xlsx" and "GB2 carboy data.xlsx" contributed by Bruce

Bowler

- Parameter names edited to conform to BCO-DMO naming convention found at [Choosing Parameter Name](#)
- CruiseId, CTD Station, Cast, Date, Lat and Lon inserted from CTD station data
- Experiment Id inserted into data (GB1_CB1, GB2_CB1, etc.)
- "nd" (no data) inserted into blank cells
- blank rows removed
- POC and PON inserted into GB1 data for compatibility with GB2 data (all GB1 data set to "nd")
- parameters: eb lith1:ml, eb lith2:ml, eb lith3:ml, eb tot lith:ml, eb lith area:ml, eb cell+agg area:ml removed per instruction from Bruce Bowler

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Data Files

File
CarBoy_Experiments.csv (Comma Separated Values (.csv), 64.86 KB) MD5:1c5a43be5fa42cd9d7e554489918184e Primary data file for dataset ID 561302

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Parameters

Parameter	Description	Units
CruiseId	Official UNOLS cruise id	text
Experiment	Car Boy Experiment Id	text
CTD_Station	Station number	dimensionless
CTD_Cast	Cast number	dimensionless
Date	Date (UTC)	YYYYMMDD
Latitude	Station latitude (South is negative)	decimal degrees
Longitude	Station longitude (West is negative)	decimal degrees
Time_Point	Sample time point	text
Sample_No	Sample number	dimensionless
Relative_Time	Sample relative time	hours
Carboy_No	CarBoy Number	dimensionless
Treatment	Treatment	text
Corr_ChI_a	Corr Chl a	ug/l
Corr_Pheo	Corr Pheo	ug/l
Chl_a_plus_Pheo	Chl a + Pheo	ug/l
PIC	PIC	umol/l
POC	POC	umol/l
PON	PON	umol/l
Bsi	Bsi	umol/l
Nuts_No	Sample numbers submitted to the nutrient analyst onboard	dimensionless
NO3	NO3	umol/l
PO4	PO4	umol/l
SIL	SIL	umol/l
NO2	NO2	umol/l
NH4	NH4	umol/l
DIN_to_DIP	DIN/DIP	ratio
Corr_TA	Corr TA	micro equivalents per kilogram
Corr_DIC	Corr DIC	micromoles per kilogram
Comments	Comments	text
eb_lith4	birefringent counts of coccoliths	number/ml
eb_cell_plus_agg	birefringent counts of cells + aggregates	number/ml

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	CTD Sea-Bird SBE 911plus
Generic Instrument Description	The Sea-Bird SBE 911 plus is a type of CTD instrument package for continuous measurement of conductivity, temperature and pressure. The SBE 911 plus includes the SBE 9plus Underwater Unit and the SBE 11plus Deck Unit (for real-time readout using conductive wire) for deployment from a vessel. The combination of the SBE 9 plus and SBE 11 plus is called a SBE 911 plus. The SBE 9 plus uses Sea-Bird's standard modular temperature and conductivity sensors (SBE 3 plus and SBE 4). The SBE 9 plus CTD can be configured with up to eight auxiliary sensors to measure other parameters including dissolved oxygen, pH, turbidity, fluorescence, light (PAR), light transmission, etc.). more information from Sea-Bird Electronics

Dataset-specific Instrument Name	
Generic Instrument Name	Niskin bottle
Generic Instrument Description	A Niskin bottle (a next generation water sampler based on the Nansen bottle) is a cylindrical, non-metallic water collection device with stoppers at both ends. The bottles can be attached individually on a hydrowire or deployed in 12, 24, or 36 bottle Rosette systems mounted on a frame and combined with a CTD. Niskin bottles are used to collect discrete water samples for a range of measurements including pigments, nutrients, plankton, etc.

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Deployments

MV1101

Website	https://www.bco-dmo.org/deployment/473222
Platform	R/V Melville
Start Date	2011-01-11
End Date	2011-02-16
Description	Original data are available from the NSF R2R data catalog

RR1202

Website	https://www.bco-dmo.org/deployment/473230
Platform	R/V Roger Revelle
Start Date	2012-02-18
End Date	2012-03-23
Description	Original data are available from the NSF R2R data catalog

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Project Information

The Great Southern Coccolithophore Belt (Great Calcite Belt)

Website: <http://greatbeltresearchcruise.com/gbr11/>

Coverage: Southern Ocean. 60W to 120E; 30S to 60S;

Collaborative Research: The Great Southern Coccolithophore Belt

Intellectual merit: Recent advances in satellite remote sensing enable estimation of suspended calcium carbonate (particulate inorganic carbon or 'PIC') from space. This radiative approach is operationally specific to marine coccolithophores (Haptophyceae) and sensitive enough to quantify PIC concentrations in oligotrophic gyres. Global images of suspended PIC taken over the seven years of the MODIS Aqua mission show a 'Great Belt' of PIC near the sub-Antarctic front of the Southern Ocean that circles the globe. This feature occurs every year during austral summer and appears to be within the high-nutrient, low chlorophyll region of the Southern Ocean. The area of the Great Belt is ~88 million km², 26% of the global ocean. Evidence from several cruises into the Great Belt region of the Atlantic, Indian and Pacific sectors has verified elevated concentrations of coccolithophores; previous work in the Atlantic sector verified high optical scattering from PIC. The few ship observations we have are entirely consistent with the satellite views. In this project, the investigators will systematically study the coccolithophores of the Great Belt guided by the following science goals: (a) identify the coccolithophore species within this belt; (b) measure the abundance of coccolithophores and associated PIC; (c) measure coccolithophore calcification rates; (d) elucidate factors that may limit coccolithophore latitudinal range (e.g. stratification, temperature, macronutrients, trace metals, grazing); (e) demonstrate whether the variability in PIC relates to shallow export flux; (f) define how variability in PIC production relates to the pCO₂, total alkalinity and dissolved inorganic carbon budgets; and (g) examine the impact of short-term ocean acidification on coccolithophore growth and calcite dissolution.

The research will involve cruises along the 50 S parallel to sample the Great Belt, during the austral summer. The investigators will use a combination of underway surface sampling (primarily optical and hydrographic) and vertical station profiles (using CTD/rosette and large volume submersible pumps) to address hypotheses related to the above goals. The cruise track will elucidate both zonal and meridional variability in the Great Belt. Controlled carboy incubation experiments will examine the impact of ocean acidification at various future scenarios on coccolithophore growth and dissolution. Dilution experiments will address grazing-related mortality and dissolution questions. Controlled metal-addition incubations will focus on potential iron, zinc and cobalt limitation of the coccolithophores or competition from diatoms related to silica availability. The proposed field observations and metal-addition experiments will provide important information on the current status of the Great Belt in the context of global biogeochemistry. The ocean acidification experiments to be undertaken are more forward-looking in terms of the fate of the Southern Ocean coccolithophores in a future acidified ocean.

Broader impacts: The globally significant size of the Great Belt indicates that it likely plays a major role in global biogeochemistry and climate change feedbacks. Thus, the investigators expect this work to have broad, transformative impacts in biological and chemical oceanography. Ocean acidification from the burning of fossil fuels is predicted to lower the pH of the surface ocean by 0.3 units in the next century and up to 0.7 units - a 5-fold increase in the proton concentration by the year 2300. A major goal of this study is to examine the effects of ocean acidification on coccolithophores in a region of low calcite saturation (i.e., one of the first regions expected to become sub-saturating for calcite). The results of these experiments will therefore be highly relevant to our basic understanding of the marine carbon cycle. Related to career development and Criterion II activities, the project includes field experience on two cruises for NSF REU undergraduates from Maine universities or colleges, providing funds for them to attend a scientific meeting. Participation of undergraduate students from Maine colleges builds capacity in our rural coastal state and helps thwart the serious issue of 'brain drain', in which the best students are leaving Maine to seek opportunity in wealthier, more populated states. A teacher will also participate on the cruises (via the NSF-sponsored ARMADA program). This teacher will develop learning modules for students about such topics as coccolithophores, calcification, export production, metal-plankton interactions, ocean acidification and climate change.

PUBLICATIONS PRODUCED AS A RESULT OF THIS RESEARCH

Balch, WM; Drapeau, DT; Bowler, BC; Lyczkowski, E; Booth, ES; Alley, D. "The contribution of coccolithophores to the optical and inorganic carbon budgets during the Southern Ocean Gas Exchange Experiment: New evidence in support of the "Great Calcite Belt" hypothesis," *JOURNAL OF GEOPHYSICAL*

RESEARCH-OCEANS, v.116, 2011. View record at Web of Science

Poulton, AJ; Young, JR; Bates, NR; Balch, WM. "Biometry of detached *Emiliana huxleyi* coccoliths along the Patagonian Shelf," *MARINE ECOLOGY-PROGRESS SERIES*, v.443, 2011, p. 1. View record at Web of Science

BOOKS/ONE TIME PROCEEDING

Brown, Michael S, W. Balch, S. Craig, B. Bowler, D. Drapeau, J. Grant. "Optical closure within a Patagonian Shelf coccolithophore bloom", 06/01/2011-05/31/2012, 2012, "ACCESS'12. Atlantic Canada Coastal & Estuarine Science Society. Dalhousie University, Halifax, Nova Scotia. 10-13 May, 2012."

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-0961660

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