

# Dilution 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/561605>

**Version:** 30 June 2015

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## Project

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

Contributors	Affiliation	Role
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## Dataset Description

Data from dilution 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 Carboy experiments (380 and 1200 ppm CO<sub>2</sub>) after equilibration at T24h.

Dilutions performed by mixing raw and filtered seawater to final concentrations of 100%, 75%, 50%, 25% and 0% in 2L bottles. One 100% bottle also supplemented with 10µmol NO<sub>3</sub>.

All bottles incubated for 24h at surface temperature and light and bubbled at 380 and 1200 ppm CO<sub>2</sub>.

Bottles sampled at T0 and T24h for Chl a, PIC, BSi, Birefringent Cell and Coccolith counts, and dissolved nutrients.

## Data Processing Description

### BCO-DMO Processing Notes

- Generated from original files "GB1 Dilution data.xlsx" and "GB2 Dilution 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\_Diln1, GB2\_Diln1, etc.)
- "nd" (no data) inserted into blank cells
- blank rows removed
- 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
<b>Dilution_Experiments.csv</b> (Comma Separated Values (.csv), 29.44 KB) MD5:40a9ed8a2fad57e270d9add0b6b5279a
Primary data file for dataset ID 561605

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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
Sample_No	Sample number	dimensionless
Event_No	Event number	dimensionless
Bottle_No	Bottle number	dimensionless
Treatment	Treatment	text
Dilution	Dilution	text
Time	Sample time	hours
Corr_ChI_a	Corr Chl a	ug/l
Corr_Pheo	Corr Pheo	ug/l
ChI_a_plus_Pheo	Chl a + Pheo	ug/l
PIC	PIC	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
eb_lith4	birefringent counts of coccoliths	number/ml
eb_cell_plus_agg	birefringent counts of cells + aggregates	number/ml

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## Instruments

<b>Dataset-specific Instrument Name</b>	
<b>Generic Instrument Name</b>	CTD Sea-Bird SBE 911plus
<b>Generic Instrument Description</b>	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

<b>Dataset-specific Instrument Name</b>	
<b>Generic Instrument Name</b>	Niskin bottle
<b>Generic Instrument Description</b>	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

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

### RR1202

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/473230">https://www.bco-dmo.org/deployment/473230</a>
<b>Platform</b>	R/V Roger Revelle
<b>Start Date</b>	2012-02-18
<b>End Date</b>	2012-03-23
<b>Description</b>	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 km<sup>2</sup>, 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 pCO<sub>2</sub>, 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**

<b>Funding Source</b>	<b>Award</b>
<a href="#">NSF Division of Ocean Sciences (NSF OCE)</a>	<a href="#">OCE-0961660</a>

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