# CTD and bottle data from R/V Roger Revelle RR1202 in the Southern Ocean (30-60S) in 2012 (Great Calcite Belt project)

**Website**: https://www.bco-dmo.org/dataset/474156
**Version**: 08 Jaunuary 2014
**Version Date**: 2014-01-08

**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

CTD Bottle Data - RR1202

### Methods & Sampling

* Sea-Bird SBE 9 Data File:
* FileName = C:\CTD\RR1202\RR1202-00101.hex
* Software Version Seasave V 7.21d
* Temperature SN = 4941
* Conductivity SN = 1879
* Number of Bytes Per Scan = 40
* Number of Voltage Words = 5
* Number of Scans Averaged by the Deck Unit = 1
* System UpLoad Time = Feb 20 2012 06:06:55
* NMEA Latitude = 35 30.41 S
* NMEA Longitude = 037 27.50 E
* NMEA UTC (Time) = Feb 20 2012 06:06:49
* Store Lat/Lon Data = Append to Every Scan
** RR1202 RR1202
** Great Belt 2 Great Belt 2
** Latitude 35o 30.418S
** Longitude 037o 27.521E
** Event # 20120510602
** Great Belt II first CTD cast!!
* System UTC = Feb 20 2012 06:06:55
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# start_time = Feb 20 2012 06:06:49 [NMEA time, header]
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# <sensor Channel="1" >

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#       <D>1.67064322e-006</D>
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#       <C2>1.989810e-001</C2>
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#     <FluoroSeapointSensor SensorID="11" >
#       <SerialNumber>SCF 3003</SerialNumber>
#       <CalibrationDate></CalibrationDate>
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#       <Offset>0.000</Offset>
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#       <CalibrationDate>14 Dec 2009</CalibrationDate>
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#       <B>0.00000000</B>
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#   </sensor>
#   <sensor Channel="8" >
#     <!-- A/D voltage 2, Transmissometer, Chelsea/Seatech -->
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#       <M>19.3070</M>
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#   <sensor Channel="11" >
#     <!-- A/D voltage 5, Free -->
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#     <!-- A/D voltage 6, Oxygen, SBE 43 -->
#     <OxygenSensor SensorID="38" >
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#       <CalibrationDate>23-Nov-11</CalibrationDate>
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#       <CalibrationCoefficients equation="0" >
#         <!-- Coefficients for Owens-Millard equation. -->
#         <Boc>0.0000</Boc>
#         <Soc>0.0000e+000</Soc>
#         <offset>0.0000</offset>
#         <Pcor>0.00e+000</Pcor>
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#         <!-- Coefficients for Sea-Bird equation - SBE calibration in 2007 and later. -->
#         <Soc>5.0382e-001</Soc>
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#         <offset>-0.5242</offset>
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#   </sensor>
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#   </sensor>
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#     <!-- SPAR voltage, Unavailable -->
#   </sensor>
#   <sensor Channel="15" >
#     <!-- SPAR voltage, SPAR/Surface Irradiance -->
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#       <CalibrationDate></CalibrationDate>
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#     </SPAR_Sensor>
#   </sensor>
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# datcnv_ox_hysteresis_correction = yes
# datcnv_bottle_scan_range_source = scans marked with bottle confirm bit, 0, 2
# datcnv_scans_per_bottle = 49
# bottlesum_date = Jun 20 2012 07:58:19, 7.21k
# bottlesum_in = C:\ctd\processing\process\rr1202-00101.ros C:\ctd\processing\process\rr1202-00101.CON


**Data Processing Description**

**BCO-DMO Processing Notes**
- Awk written to reformat original .btl files contributed by Bruce Bowler
- AWK: CTDbtl_2_BCODMO_RR1202.awk
- Header data for CTD data generated from .btl file headers
- space delimited reformatted to tab delimited
- all records with "#" or "*" ignored
- blank lines ignored
- BCO-DMO header o/p from routine

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## Data Files

| File |
| --- |
| **CTD_BottleData_RR1202.csv**(Comma Separated Values (.csv), 353.70 KB)<br>MD5:ceaca9bf48e2914b3445290a7161b43a<br><br>Primary data file for dataset ID 474156 |

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## Parameters

| Parameter | Description | Units |
| --- | --- | --- |
| DataFile | CTD .btl Data File | text |
| Date | Date (UTC) | YYYYMMDD |
| Time | Time (UTC) | HHMMSS |
| Event | Event | dimensionless |
| Station | Station Number | dimensionless |
| Cast | Cast Number | dimensionless |
| Latitude | Station Latitude Position (South is negative) | decimal degrees |
| Longitude | Station Longitude Position (West is negative) | decimal degrees |
| Bottle_Position | Bottle Position | dimensionless |
| Date_Bottle | Date Bottle (UTC) | YYYYMMDD |
| Time_Bottle | Time Bottle (UTC) | HHMMSS |
| Density00_avg | Density density avg | Kg/m^3 |
| sigma_e00_avg | Density sigma-theta avg | Kg/m^3 |
| Density11_avg | Density 2 density avg | Kg/m^3 |
| sigma_e11_avg | Density 2 sigma-theta avg | Kg/m^3 |
| Sal00_avg | Salinity Practical avg | PSU |
| Sal11_avg | Salinity Practical 2 avg | PSU |
| Scan_avg | Scan avg | dimensionless |
| Scan_sdev | Scan sdev | dimensionless |
| PrDM_avg | Pressure Digiquartz avg | db |
| PrDM_sdev | Pressure Digiquartz sdev | db |
| DepSM_avg | Depth salt water avg | m |
| DepSM_sdev | Depth salt water sdev | m |
| T090C_avg | Temperature ITS-90 avg | deg C |
| T090C_sdev | Temperature ITS-90 sdev | deg C |
| C0S_m_avg | Conductivity avg | S/m |
| C0S_m_sdev | Conductivity sdev | S/m |
| T190C_avg | Temperature 2 ITS-90 avg | deg C |
| T190C_sdev | Temperature 2 ITS-90 sdev | deg C |
| C1S_m_avg | Conductivity 2 avg | S/m |
| C1S_m_sdev | Conductivity 2 sdev | S/m |
| Sbeox0V_avg | Oxygen raw SBE 43 avg | Volts |

| | | |
|---|---|---|
| Sbeox0V_sdev | Oxygen raw SBE 43 sdev | Volts |
| Bat_avg | Beam Attenuation Chelsea/Seatech/WET Labs CStar avg | 1/m |
| Bat_sdev | Beam Attenuation Chelsea/Seatech/WET Labs CStar sdev | 1/m |
| FlSP_avg | Fluorescence Seapoint avg | volts |
| FlSP_sdev | Fluorescence Seapoint sdev | volts |
| Par_avg | PAR/Irradiance Biospherical/Licor avg | uEinsteins/m2/s |
| Par_sdev | PAR/Irradiance Biospherical/Licor sdev | uEinsteins/m2/s |
| ISO_DateTime_UTC | Date and time (UTC) formatted to ISO 8601:2004(E) standard. The standard takes on the form: YYYY-MM-DDTHH:MM:SS[.xx]Z where the T indicates the start of the time string and Z indicates UTC (example: 2009-08-30T14:05:00.00Z) | YYYY-MM-DDTHH:MM:SS[.xx]Z |

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### Instruments

| | |
|---|---|
| **Dataset-specific Instrument Name** | CTD SBE 911plus |
| **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** | Fluorometer - Seapoint |
| **Generic Instrument Name** | Fluorometer |
| **Generic Instrument Description** | A fluorometer or fluorimeter is a device used to measure parameters of fluorescence: its intensity and wavelength distribution of emission spectrum after excitation by a certain spectrum of light. The instrument is designed to measure the amount of stimulated electromagnetic radiation produced by pulses of electromagnetic radiation emitted into a water sample or in situ. |

| | |
|---|---|
| **Dataset-specific Instrument Name** | LI-COR Biospherical PAR |
| **Generic Instrument Name** | LI-COR Biospherical PAR Sensor |
| **Generic Instrument Description** | The LI-COR Biospherical PAR Sensor is used to measure Photosynthetically Available Radiation (PAR) in the water column. This instrument designation is used when specific make and model are not known. |

| | |
|---|---|
| **Dataset-specific Instrument Name** | Niskin bottle |
| **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. |

| | |
|---|---|
| **Dataset-specific Instrument Name** | SBE-43 DO |
| **Generic Instrument Name** | Sea-Bird SBE 43 Dissolved Oxygen Sensor |
| **Generic Instrument Description** | The Sea-Bird SBE 43 dissolved oxygen sensor is a redesign of the Clark polarographic membrane type of dissolved oxygen sensors. more information from Sea-Bird Electronics |

| | |
|---|---|
| **Dataset-specific Instrument Name** | WL CSTAR Trans |
| **Generic Instrument Name** | WET Labs {Sea-Bird WETLabs} C-Star transmissometer |
| **Generic Instrument Description** | The C-Star transmissometer has a novel monolithic housing with a highly intgrated opto-electronic design to provide a low cost, compact solution for underwater measurements of beam transmittance. The C-Star is capable of free space measurements or flow-through sampling when used with a pump and optical flow tubes. The sensor can be used in profiling, moored, or underway applications. Available with a 6000 m depth rating. More information on Sea-Bird website: https://www.seabird.com/c-star-transmissometer/product?id=60762467717 |

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## Deployments

**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 coccolithopore 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; Lyczskowski, 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 Emiliania 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 coccolithhophore 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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