CTD cast data from R/V Melville cruise MV1101 in the Southern Ocean (30-60S) in 2011 (Great Calcite Belt project)

Website: https://www.bco-dmo.org/dataset/473895
Version: 08 January 2014
Version Date: 2014-01-08

Project
» The Great Southern Coccolithophore Belt (Great Calcite Belt)

Contributors	Affiliation	Role
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Dataset Description

CTD Down Casts - MV1101

Methods & Sampling

* Sea-Bird SBE 9 Data File:
* FileName = C:\CTD\MV1101-Balch\00501.hex
* Software Version Seasave V 7.20g
* Temperature SN = 4209
* Conductivity SN = 2572
* Number of Bytes Per Scan = 44
* Number of Voltage Words = 5
* Number of Scans Averaged by the Deck Unit = 1
* Append System Time to Every Scan
* System UpLoad Time = Jan 14 2011 03:28:37
* NMEA Latitude = 52 22.17 S
* NMEA Longitude = 056 33.43 W
* NMEA UTC (Time) = Jan 14 2011 03:28:46
* Store Lat/Lon Data = Append to Every Scan
** SHIP: RV-Melville RV-Melville
** CRUISE: MV1101 MV-1101
** STATION: 005
** CAST: 01
** event 0140320
# nquan = 36
# nvalues = 2026
# units = specified
# name 0 = bat: Beam Attenuation, Chelsea/Seatech/WET Labs CStar [1/m]
# name 1 = xmiss: Beam Transmission, Chelsea/Seatech/WET Labs CStar [%]

name 2 = bpos: Bottle Position in Carousel
name 3 = nbf: Bottles Fired
name 4 = c0S/m: Conductivity [S/m]
name 5 = c1S/m: Conductivity, 2 [S/m]
name 6 = sigma-é00: Density [sigma-theta, Kg/m^3]
name 7 = sigma-é11: Density, 2 [sigma-theta, Kg/m^3]
name 8 = depSM: Depth [salt water, m]
name 9 = flSP: Fluorescence, Seapoint
name 10 = latitude: Latitude [deg]
name 11 = longitude: Longitude [deg]
name 12 = oxsolML/L: Oxygen Saturation, Garcia & Gordon [ml/l]
name 13 = oxsatML/L: Oxygen Saturation, Weiss [ml/l]
name 14 = sbeox0ML/L: Oxygen, SBE 43 [ml/l]
name 15 = par: PAR/Irradiance, Biospherical/Licor
name 16 = potemp090C: Potential Temperature [ITS-90, deg C]
name 17 = potemp068C: Potential Temperature [ITS-68, deg C]
name 18 = potemp190C: Potential Temperature, 2 [ITS-90, deg C]
name 19 = potemp168C: Potential Temperature, 2 [ITS-68, deg C]
name 20 = pta090C: Potential Temperature Anomaly [ITS-90, deg C], a0 = 0, a1 = 0
name 21 = ptempC: Pressure Temperature [deg C]
name 22 = prDM: Pressure, Digiquartz [db]
name 23 = sal00: Salinity, Practical [PSU]
name 24 = sal11: Salinity, Practical, 2 [PSU]
name 25 = spar: SPAR/Surface Irradiance
name 26 = t090C: Temperature [ITS-90, deg C]
name 27 = t068C: Temperature [ITS-68, deg C]
name 28 = t190C: Temperature, 2 [ITS-90, deg C]
name 29 = t168C: Temperature, 2 [ITS-68, deg C]
name 30 = density00: Density [density, Kg/m^3]
name 31 = density11: Density, 2 [density, Kg/m^3]
name 32 = depSM: Depth [salt water, m], lat = -52.3695
name 33 = sal00: Salinity, Practical [PSU]
name 34 = sal11: Salinity, Practical, 2 [PSU]
name 35 = flag: flag
span 0 = 0.5406, 0.8628
span 1 = 80.5968, 87.3564
span 2 = 0, 1
span 3 = 0, 1
span 4 = 3.161311, 3.520603
span 5 = 3.161369, 3.520693
span 6 = 26.5513, 27.3583
span 7 = 26.5513, 27.3582
span 8 = 0.496, 1001.658
span 9 = 4.2555e-02, 1.7800e+00
span 10 = -52.36906, -52.36666
span 11 = -56.55682, -56.55292
span 12 = 6.66126, 7.44779
span 13 = 6.66889, 7.46949
span 14 = 4.51487, 6.90205
span 15 = -8.735e-06, 1.8879e+00
span 16 = 2.9826, 7.8618
span 17 = 2.9833, 7.8637
span 18 = 2.9834, 7.8625
span 19 = 2.9841, 7.8644
span 20 = 2.9826, 7.8618
span 21 = 7.59, 7.68
span 22 = 0.500, 1013.000
span 23 = 34.0335, 34.3382
span 24 = 34.0449, 34.3381
span 25 = 2.2363e+00, 2.2363e+00
span 26 = 3.0516, 7.8619
span 27 = 3.0524, 7.8638
span 28 = 3.0524, 7.8625

```
# span 29 =     3.0531,     7.8644
# span 30 =  1026.5539,  1032.0471
# span 31 =  1026.5539,  1032.0469
# span 32 =      0.496,   1001.658
# span 33 =    34.0335,    34.3382
# span 34 =    34.0449,    34.3381
# span 35 = 0.0000e+00, 0.0000e+00
# interval = decibars: 0.5
# start_time = Jan 14 2011 03:28:37 [System UTC, first data scan.]
# bad_flag = -9.990e-29
# <Sensors count="15" >
#   <sensor Channel="1" >
#     <!-- Frequency 0, Temperature -->
#     <TemperatureSensor SensorID="55" >
#       <SerialNumber>4209</SerialNumber>
#       <CalibrationDate>05-Oct-2010 </CalibrationDate>
#       <UseG_J>1</UseG_J>
#       <A>4.37678235e-003</A>
#       <B>6.44438270e-004</B>
#       <C>2.17656588e-005</C>
#       <D>1.69467919e-006</D>
#       <F0_Old>1000.000</F0_Old>
#       <G>4.37657769e-003</G>
#       <H>6.44225069e-004</H>
#       <I>2.17331621e-005</I>
#       <J>1.69320881e-006</J>
#       <F0>1000.000</F0>
#       <Slope>1.00000000</Slope>
#       <Offset>0.0000</Offset>
#     </TemperatureSensor>
#   </sensor>
#   <sensor Channel="2" >
#     <!-- Frequency 1, Conductivity -->
#     <ConductivitySensor SensorID="3" >
#       <SerialNumber>2572</SerialNumber>
#       <CalibrationDate>21-Sep-10 </CalibrationDate>
#       <UseG_J>1</UseG_J>
#       <!-- Cell const and series R are applicable only for wide range sensors. -->
#       <SeriesR>0.0000</SeriesR>
#       <CellConst>2000.0000</CellConst>
#       <ConductivityType>0</ConductivityType>
#       <Coefficients equation="0" >
#         <A>0.00000000e+000</A>
#         <B>0.00000000e+000</B>
#         <C>0.00000000e+000</C>
#         <D>0.00000000e+000</D>
#         <M>0.0</M>
#         <CPcor>-9.57000000e-008</CPcor>
#       </Coefficients>
#       <Coefficients equation="1" >
#         <G>-1.01992844e+001</G>
#         <H>1.57134377e+000</H>
#         <I>3.74440094e-004</I>
#         <J>5.17863092e-005</J>
#         <CPcor>-9.57000000e-008</CPcor>
#         <CTcor>3.2500e-006</CTcor>
#         <!-- WBOTC not applicable unless ConductivityType = 1. -->
#         <WBOTC>0.00000000e+000</WBOTC>
#       </Coefficients>
#       <Slope>1.00000000</Slope>
#       <Offset>0.00000</Offset>
#     </ConductivitySensor>
#   </sensor>
```

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#   <sensor Channel="3" >
#     <!-- Frequency 2, Pressure, Digiquartz with TC -->
#     <PressureSensor SensorID="45" >
#       <SerialNumber>0914</SerialNumber>
#       <CalibrationDate>04-AUG-2010</CalibrationDate>
#       <C1>-4.348786e+004</C1>
#       <C2>1.072445e-001</C2>
#       <C3>5.364520e-003</C3>
#       <D1>3.649793e-002</D1>
#       <D2>0.000000e+000</D2>
#       <T1>3.006798e+001</T1>
#       <T2>-2.820967e-004</T2>
#       <T3>5.568048e-006</T3>
#       <T4>-3.897905e-008</T4>
#       <Slope>1.00000000</Slope>
#       <Offset>0.00000</Offset>
#       <T5>0.000000e+000</T5>
#       <AD590M>1.287890e-002</AD590M>
#       <AD590B>-8.813534e+000</AD590B>
#     </PressureSensor>
#   </sensor>
#   <sensor Channel="4" >
#     <!-- Frequency 3, Temperature, 2 -->
#     <TemperatureSensor SensorID="55" >
#       <SerialNumber>4213</SerialNumber>
#       <CalibrationDate>05-Oct-2010 </CalibrationDate>
#       <UseG_J>1</UseG_J>
#       <A>4.37531885e-003</A>
#       <B>6.48275404e-004</B>
#       <C>2.25444747e-005</C>
#       <D>1.77570523e-006</D>
#       <F0_Old>1000.000</F0_Old>
#       <G>4.37511470e-003</G>
#       <H>6.48061103e-004</H>
#       <I>2.25114734e-005</I>
#       <J>1.77417516e-006</J>
#       <F0>1000.000</F0>
#       <Slope>1.00000000</Slope>
#       <Offset>0.0000</Offset>
#     </TemperatureSensor>
#   </sensor>
#   <sensor Channel="5" >
#     <!-- Frequency 4, Conductivity, 2 -->
#     <ConductivitySensor SensorID="3" >
#       <SerialNumber>2819</SerialNumber>
#       <CalibrationDate>21-Sep-10 </CalibrationDate>
#       <UseG_J>1</UseG_J>
#       <!-- Cell const and series R are applicable only for wide range sensors. -->
#       <SeriesR>0.0000</SeriesR>
#       <CellConst>2000.0000</CellConst>
#       <ConductivityType>0</ConductivityType>
#       <Coefficients equation="0" >
#         <A>0.00000000e+000</A>
#         <B>0.00000000e+000</B>
#         <C>0.00000000e+000</C>
#         <D>0.00000000e+000</D>
#         <M>0.0</M>
#         <CPcor>-9.57000000e-008</CPcor>
#       </Coefficients>
#       <Coefficients equation="1" >
#         <G>-1.03781454e+001</G>
#         <H>1.46070728e+000</H>
#         <I>-2.96284306e-003</I>
```

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#         <J>2.92833553e-004</J>
#         <CPcor>-9.57000000e-008</CPcor>
#         <CTcor>3.2500e-006</CTcor>
#         <!-- WBOTC not applicable unless ConductivityType = 1. -->
#         <WBOTC>0.00000000e+000</WBOTC>
#       </Coefficients>
#       <Slope>1.00000000</Slope>
#       <Offset>0.00000</Offset>
#     </ConductivitySensor>
#   </sensor>
#   <sensor Channel="6" >
#     <!-- A/D voltage 0, Fluorometer, Seapoint -->
#     <FluoroSeapointSensor SensorID="11" >
#       <SerialNumber>SCF3004</SerialNumber>
#       <CalibrationDate></CalibrationDate>
#       <!-- The following is an array index, not the actual gain setting. -->
#       <GainSetting>2</GainSetting>
#       <Offset>0.000</Offset>
#     </FluoroSeapointSensor>
#   </sensor>
#   <sensor Channel="7" >
#     <!-- A/D voltage 1, PAR/Irradiance, Biospherical/Licor -->
#     <PAR_BiosphericalLicorChelseaSensor SensorID="42" >
#       <SerialNumber>4644</SerialNumber>
#       <CalibrationDate>Sept 29, 2009</CalibrationDate>
#       <M>1.00000000</M>
#       <B>0.00000000</B>
#       <CalibrationConstant>2604166666.67000010</CalibrationConstant>
#       <Multiplier>1.00000000</Multiplier>
#       <Offset>-0.54550000</Offset>
#     </PAR_BiosphericalLicorChelseaSensor>
#   </sensor>
#   <sensor Channel="8" >
#     <!-- A/D voltage 2, Transmissometer, Chelsea/Seatech/WET Lab CStar -->
#     <TransChelseaSeatechWetlabCStarSensor SensorID="59" >
#       <SerialNumber>CST1119DR</SerialNumber>
#       <CalibrationDate>1 May 2008</CalibrationDate>
#       <M>18.9700</M>
#       <B>-1.1570</B>
#       <PathLength>0.250</PathLength>
#     </TransChelseaSeatechWetlabCStarSensor>
#   </sensor>
#   <sensor Channel="9" >
#     <!-- A/D voltage 3, Free -->
#   </sensor>
#   <sensor Channel="10" >
#     <!-- A/D voltage 4, Altimeter -->
#     <AltimeterSensor SensorID="0" >
#       <SerialNumber>1183</SerialNumber>
#       <CalibrationDate></CalibrationDate>
#       <ScaleFactor>15.000</ScaleFactor>
#       <Offset>0.000</Offset>
#     </AltimeterSensor>
#   </sensor>
#   <sensor Channel="11" >
#     <!-- A/D voltage 5, Free -->
#   </sensor>
#   <sensor Channel="12" >
#     <!-- A/D voltage 6, Oxygen, SBE 43 -->
#     <OxygenSensor SensorID="38" >
#       <SerialNumber>1138</SerialNumber>
#       <CalibrationDate>24-Mar-10p</CalibrationDate>
#       <Use2007Equation>1</Use2007Equation>
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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>
<Tcor>0.0000</Tcor>
<Tau>0.0</Tau>
</CalibrationCoefficients>
<CalibrationCoefficients equation="1" >
<!-- Coefficients for Sea-Bird equation - SBE calibration in 2007 and later. -->
<Soc>4.7960e-001</Soc>
<offset>-0.5235</offset>
<A>-3.0266e-003</A>
<B> 1.0957e-004</B>
<C>-1.9445e-006</C>
<D0> 2.5826e+000</D0>
<D1> 1.92630e-004</D1>
<D2>-4.64800e-002</D2>
<E> 3.6000e-002</E>
<Tau20> 2.0900</Tau20>
<H1>-3.3000e-002</H1>
<H2> 5.0000e+003</H2>
<H3> 1.4500e+003</H3>
</CalibrationCoefficients>
</OxygenSensor>
</sensor>
<sensor Channel="13" >
<!-- A/D voltage 7, Free -->
</sensor>
<sensor Channel="14" >
<!-- SPAR voltage, Unavailable -->
</sensor>
<sensor Channel="15" >
<!-- SPAR voltage, SPAR/Surface Irradiance -->
<SPAR_Sensor SensorID="51" >
<SerialNumber>6369</SerialNumber>
<CalibrationDate></CalibrationDate>
<ConversionFactor>1831.50000000</ConversionFactor>
<RatioMultiplier>1.00000000</RatioMultiplier>
</SPAR_Sensor>
</sensor>
</Sensors>
datcnv_date = Mar 23 2011 13:42:15, 7.21c [datcnv_vars = 30]
datcnv_in = c:\mv1101\ctd\00501.hex c:\mv1101\ctd\00101.xmlcon
datcnv_skipover = 0
datcnv_ox_hysteresis_correction = yes
datcnv_ox_tau_correction = yes
wildedit_date = Mar 23 2011 14:03:53, 7.21c
wildedit_in = c:\mv1101\ctd\00501.cnv
wildedit_pass1_nstd = 2.0
wildedit_pass2_nstd = 20.0
wildedit_pass2_mindelta = 0.000e+000
wildedit_npoint = 100
wildedit_vars = bat xmiss bpos c0S/m c1S/m sigma-é00 sigma-é11 depSM flSP latitude longitude oxsolML/L oxsatML/L sbeox0ML/L par potemp090C potemp068C potemp190C potemp168C pta090C ptempC prDM sal00 sal11 spar t090C t068C t190C t168C
wildedit_excl_bad_scans = yes
loopedit_date = Mar 23 2011 14:14:05, 7.21c
loopedit_in = c:\mv1101\ctd\00501.cnv
loopedit_minVelocity = 0.250
loopedit_surfaceSoak: minDepth = 5.0, maxDepth = 20, useDeckPress = 1
loopedit_excl_bad_scans = yes

Derive_date = Mar 23 2011 14:28:14, 7.21c [derive_vars = 5]
Derive_in = c:\mv1101\ctd\00501.cnv c:\mv1101\ctd\00101.xmlcon
binavg_date = Mar 23 2011 14:40:41, 7.21c
binavg_in = c:\mv1101\ctd\00501.cnv
binavg_bintype = decibars
binavg_binsize = 0.5
binavg_excl_bad_scans = yes
binavg_skipover = 0
binavg_surface_bin = no, min = 0.000, max = 0.000, value = 0.000
split_date = Mar 23 2011 14:49:54, 7.21c
split_in = c:\mv1101\ctd\00501.cnv
split_excl_bad_scans = yes
file_type = ascii
END

Data Processing Description

BCO-DMO Processing Notes
- Awk written to reformat original .cnv files contributed by Bruce Bowler
- AWK: CTDcnv_2_BCODMO_MV1101.awk
- Header data for CTD data generated from .cnv 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_DownCasts_MV1101.csv(Comma Separated Values (.csv), 63.69 MB) MD5:6029013aae187c9eccd4ebe1220be90e Primary data file for dataset ID 473895

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Parameters

Parameter	Description	Units
DataFile	CTD .cnv Data File	text
Date	Date (UTC)	YYYYMMDD
Time	Time (UTC)	HHMMSS
Event	Event	dimensionless
Station	Station Number	dimensionless
Cast	Cast Number	dimensionless
Lat	Station Latitude Position (South is negative)	decimal degrees
Lon	Station Longitude Position (West is negative)	decimal degrees
bat	Beam Attenuation Chelsea/Seatech/WET Labs CStar	1/m
xmiss	Beam Transmission Chelsea/Seatech/WET Labs CStar	percentage

bpos	Bottle Position in Carousel	dimensionless
nbf	Bottles Fired	dimensionless
c0S_m	Conductivity	S/m
c1S_m	Conductivity 2	S/m
sigma_e00	Density sigma-theta	Kg/m^3
sigma_e11	Density 2 sigma-theta	Kg/m^3
depSM	Depth salt water	m
flSP	Fluorescence Seapoint	volts
latitude	Latitude	decimal degrees
longitude	Longitude	decimal degrees
oxsolML_L	Oxygen Saturation Garcia & Gordon	ml/l
oxsatML_L	Oxygen Saturation Weiss	ml/l
sbeox0ML_L	Oxygen SBE 43	ml/l
par	PAR/Irradiance Biospherical/Licor	uEinsteins/m2/s
potemp090C	Potential Temperature ITS-90	deg C
potemp068C	Potential Temperature ITS-68	deg C
potemp190C	Potential Temperature 2 ITS-90	deg C
potemp168C	Potential Temperature 2 ITS-68	deg C
pta090C	Potential Temperature Anomaly ITS-90 a0=0 a1=0	deg C
ptempC	Pressure Temperature	deg C
prDM	Pressure Digiquartz	db
sal00	Salinity Practical	PSU
sal11	Salinity Practical 2	PSU
spar	SPAR/Surface Irradiance	uEinsteins/m2/s
t090C	Temperature ITS-90	deg C
t068C	Temperature ITS-68	deg C
t190C	Temperature 2 ITS-90	deg C
t168C	Temperature 2 ITS-68	deg C
density00	Density density	Kg/m^3
density11	Density 2 density	Kg/m^3
depSM_a	Depth salt water	m
sal00_a	Salinity Practical	PSU
sal11_a	Salinity Practical 2	PSU
flag	flag	dimensionless
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

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

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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

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