

Dataset Expocode	BMBE20130716
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Dataset	Funding Info: NOAA Climate Program Office; NOAA Ocean Acidification Program Initial Submission (yyyymmdd): 20160713 Revised Submission (yyyymmdd): 20160713
Campaign/Cruise	Expocode: BMBE20130716 Campaign/Cruise Name: BarX20130716 Campaign/Cruise Info: AOML_SOOP_CO2 Platform Type: CO2 Instrument Type: Equilibrator-IR or CRDS or GC Survey Type: SOOP Line Vessel Name: Barcelona Express Vessel Owner: Anglo Eastern Ship Management Vessel Code: BMBE
Coverage	Start Date (yyyymmdd): 20130716 End Date (yyyymmdd): 20130820 Westernmost Longitude: 80.1 W Easternmost Longitude: 14.8 E Northernmost Latitude: 44.3 N Southernmost Latitude: 26.1 N Port of Call: Cagliari, Italy Port of Call: Leghorn, Italy Port of Call: Genoa, Italy Port of Call: Barcelona, Spain Port of Call: Valencia, Spain Port of Call: Port Everglades, FL, USA
Variable	Name: xCO2_EQU_ppm Unit: ppm Description: Mole fraction of CO2 in the equilibrator headspace (dry) at equilibrator temperature (ppm)
Variable	Name: xCO2_ATM_ppm Unit: ppm Description: Mole fraction of CO2 measured in dry outside air (ppm)
Variable	Name: xCO2_ATM_interpolated_ppm

Unit: ppm
Description: Mole fraction of CO₂ in outside air associated with each water analysis. These values are interpolated between the bracketing averaged good xCO₂_ATM analyses (ppm)

Variable **Name:** PRES_EQU_hPa
Unit: hPa
Description: Barometric pressure in the equilibrator headspace (hPa)

Variable **Name:** PRES_ATM@SSP_hPa
Unit: hPa
Description: Barometric pressure measured outside, corrected to sea level (hPa)

Variable **Name:** TEMP_EQU_C
Unit: Degree C
Description: Water temperature in equilibrator (°C)

Variable **Name:** SST_C
Unit: Degree C
Description: Sea surface temperature (°C)

Variable **Name:** SAL_permil
Unit: ppt
Description: Sea surface salinity on Practical Salinity Scale (o/oo)

Variable **Name:** fCO₂_SW@SST_uatm
Unit: µatm
Description: Fugacity of CO₂ in sea water at SST and 100% humidity (µatm)

Variable **Name:** fCO₂_ATM_interpolated_uatm
Unit: µatm
Description: Fugacity of CO₂ in air corresponding to the interpolated xCO₂ at SST and 100% humidity (µatm)

Variable **Name:** dfCO₂_uatm
Unit: µatm
Description: Sea water fCO₂ minus interpolated air fCO₂ (µatm)

Variable **Name:** WOCE_QC_FLAG
Unit: None
Description: Quality control flag for fCO₂ values (2=good, 3=questionable)

Variable **Name:** QC_SUBFLAG
Unit: None
Description: Quality control subflag for fCO₂ values, provides explanation when QC flag=3

Sea Surface Temperature **Location:** In ship's engine room at a side port off the piping carrying cooling water for the engines. Between the sea chest and the side port there is ~5 meters of pipe (~0.25 diameter). During the transit, the seawater warms an estimated 0.2-0.5 deg C. The reported SST is the value measured at the side port.
Manufacturer: Seabird
Model: SBE 38
Accuracy: 0.001 (°C if units not given)
Precision: 0.0003 (°C if units not given)
Calibration: Factory calibration
Comments: Manufacturer's Resolution is taken as Precision.

Sea Surface Salinity **Location:** In the ship's engine room next to CO₂ system.

Manufacturer: Seabird
Model: SBE 45
Accuracy: ± 0.005 o/oo
Precision: 0.0002 o/oo
Calibration: Factory calibration
Comments: Manufacturer's Resolution is taken as Precision.

Atmospheric Pressure

Location: On deck above bridge at ~20 m above sea surface.
Normalized to Sea Level: yes
Manufacturer: Druck
Model: RPT350
Accuracy: ± 0.08 hPa (hPa if units not given)
Precision: 0.01 hPa (hPa if units not given)
Calibration: Factory calibration
Comments: Manufacturer's Resolution is taken as Precision.

Atmospheric CO2

Measured/Frequency: Yes, 5 readings in a group every ~4.5 hours
Intake Location: On mast above the bridge at ~20 meters above the sea surface
Drying Method: Gas stream passes through a thermoelectric condenser (~5 °C) and then through a Perma Pure (Nafion) dryer before reaching the analyzer (90% dry).
Atmospheric CO2 Accuracy: ± 0.5 μ atm in fCO₂_ATM
Atmospheric CO2 Precision: ± 0.01 μ atm in fCO₂_ATM

Aqueous CO2 Equilibrator Design

System Manufacturer:
Intake Depth: 5 meters
Intake Location: Bow
Equilibration Type: Spray head above dynamic pool, with thermal jacket
Equilibrator Volume (L): 0.95 L (0.4 L water, 0.55 L headspace)
Headspace Gas Flow Rate (ml/min): 70 - 150 ml/min
Equilibrator Water Flow Rate (L/min): 1.5 - 2.0 L/min
Equilibrator Vented: Yes
Equilibration Comments: Primary equilibrator is vented through a secondary equilibrator.
Drying Method: Gas stream passes through a thermoelectric condenser (~5 °C) and then through a Perma Pure (Nafion) dryer before reaching the analyzer (90% dry).

Aqueous CO2 Sensor Details

Measurement Method: IR
Method details: details of CO₂ sensing (not required)
Manufacturer: LI-COR
Model: 840A
Measured CO2 Values: xCO₂(dry)
Measurement Frequency: Every 140 seconds, except during calibration
Aqueous CO2 Accuracy: ± 2 μ atm in fCO₂_SW
Aqueous CO2 Precision: ± 0.01 μ atm in fCO₂_SW
Sensor Calibrations:
Calibration of Calibration Gases: The analyzer is calibrated every ~4.5 hours using ESRL standards that are directly traceable to the WMO scale. Ultra-High Purity air (0.0 ppm CO₂) and the high standard (when both present) are used to zero and span the LI-COR analyzer.
Number Non-Zero Gas Standards: 4
Calibration Gases:

Std 1: CA05585, 280.18 ppm, owned by ESRL, used every ~5.0 hours.
Std 2: CA06368, 328.12 ppm, owned by ESRL, used every ~5.0 hours.
Std 3: CA03910, 372.81 ppm, owned by ESRL, used every ~5.0 hours.
Std 4: CC71588, 531.98 ppm, owned by ESRL, used every ~5.0 hours.

Comparison to Other CO2 Analyses:

Comments: Instrument is located below a walkway in the engine room.

Method Reference:

Pierrot, D., C. Neil, K. Sullivan, R. Castle, R. Wanninkhof, H. Lueger, T. Johannessen, A. Olsen, R. A. Feely, and C. E. Cosca (2009), Recommendations for autonomous underway pCO₂ measuring systems and data reduction routines, Deep-Sea Res II, 56, 512-522.

**Equilibrator
Temperature Sensor**

Location: Inserted into equilibrator ~5 cm below water level

Manufacturer: Hart

Model: 1521

Accuracy: 0.025 (°C if units not given)

Precision: 0.001 (°C if units not given)

Calibration: Factory calibration

Comments: Manufacturer's Resolution is taken as Precision.

**Equilibrator
Pressure Sensor**

Location: Inside LICOR connected to ambient air. The differential pressure reading from A Setra 239, which is attached to the equilibrator headspace, is added to the pressure reading from the LICOR analyzer.

Manufacturer: Licor

Model: 840-P

Accuracy: 15 (hPa if units not given)

Precision: 1 (hPa if units not given)

Calibration: Factory calibration

Comments: Manufacturer's Resolution is taken as Precision.

**Additional
Information**

Suggested QC flag from Data Provider: NA

Additional Comments: Water flow stopped after YDay 225. atm P lost after YDay 206. It was estimated after YDay 206 (and between YDay 200.8-201.6) using offset with licor Pressure determined before YDay 206. atmP = licorP - 4.585 (+/- 0.174) mbar Otherwise, no real issues to report for this cruise. Original Data Location: http://www.aoml.noaa.gov/ocd/ocdweb/barcelona/barcelona_introduction.html

Citation for this Dataset:

Other References for this Dataset: