

Dataset Expocode **BMBE20130528**

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Dataset **Funding Info:** NOAA Climate Program Office; NOAA Ocean Acidification Program
Initial Submission (yyyymmdd): 20160713
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Campaign/Cruise **Expocode:** BMBE20130528
Campaign/Cruise Name: BarX20130528
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):** 20130528
End Date (yyyymmdd): 20130701
Westernmost Longitude: 80 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
Port of Call: Veracruz, Mexico
Port of Call: Altamira, Mexico
Port of Call: Houston, TX, USA
Port of Call: New Orleans, LA, USA

Variable **Name:** xCO2_EQU_ppm
Unit: ppm
Description: Mole fraction of CO2 in the equilibrator headspace (dry) at equilibrator temperature (ppm)

Variable	<p>Name: xCO2_ATM_ppm Unit: ppm Description: Mole fraction of CO2 measured in dry outside air (ppm)</p>
Variable	<p>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)</p>
Variable	<p>Name: PRES_EQU_hPa Unit: hPa Description: Barometric pressure in the equilibrator headspace (hPa)</p>
Variable	<p>Name: PRES_ATM@SSP_hPa Unit: hPa Description: Barometric pressure measured outside, corrected to sea level (hPa)</p>
Variable	<p>Name: TEMP_EQU_C Unit: Degree C Description: Water temperature in equilibrator (°C)</p>
Variable	<p>Name: SST_C Unit: Degree C Description: Sea surface temperature (°C)</p>
Variable	<p>Name: SAL_permil Unit: ppt Description: Sea surface salinity on Practical Salinity Scale (o/oo)</p>
Variable	<p>Name: fCO2_SW@SST_uatm Unit: µatm Description: Fugacity of CO2 in sea water at SST and 100% humidity (µatm)</p>
Variable	<p>Name: fCO2_ATM_interpolated_uatm Unit: µatm Description: Fugacity of CO2 in air corresponding to the interpolated xCO2 at SST and 100% humidity (µatm)</p>
Variable	<p>Name: dfCO2_uatm Unit: µatm Description: Sea water fCO2 minus interpolated air fCO2 (µatm)</p>
Variable	<p>Name: WOCE_QC_FLAG Unit: None Description: Quality control flag for fCO2 values (2=good, 3=questionable)</p>
Variable	<p>Name: QC_SUBFLAG Unit: None Description: Quality control subflag for fCO2 values, provides explanation when QC flag=3</p>
Sea Surface Temperature	<p>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)</p>

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 µatm in fCO2_ATM
Atmospheric CO2 Precision: ± 0.01 µatm 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 µatm in fCO2_SW
Aqueous CO2 Precision: ± 0.01 µatm 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: Seawater was turned off before Year Day 149. EQU gas flow through the analyzer stopped due to water in the nafion tubes after Year Day 156. After that, only ATM measurements are valid. Original Data Location: http://www.aoml.noaa.gov/oce/oceweb/barcelona/barcelona_introduction.html

Citation for this Dataset:

Other References for this Dataset: