

Dataset Expocode	BHAF20200301
Primary Contact	Name: Sullivan, Kevin Organization: NOAA/Atlantic Oceanographic & Meteorological Laboratory Address: 4301 Rickenbacker Causeway, Miami FL, 33149 Phone: 305-361-4382 Email: Kevin.Sullivan@noaa.gov
Investigator	Name: Wanninkhof, Rik Organization: NOAA/Atlantic Oceanographic & Meteorological Laboratory Address: 4301 Rickenbacker Causeway, Miami FL, 33149 Phone: 305-361-4379 Email: Rik.Wanninkhof@noaa.gov
Investigator	Name: Pierrot, Denis Organization: NOAA/Atlantic Oceanographic & Meteorological Laboratory Address: 4301 Rickenbacker Causeway, Miami FL, 33149 Phone: 305-361-4441 Email: Denis.Pierrot@noaa.gov
Dataset	Funding Info: NOAA Climate Program Office; NOAA Ocean Acidification Program Initial Submission (yyyymmdd): 20200401 Revised Submission (yyyymmdd): 20200401
Campaign/Cruise	Expocode: BHAF20200301 Campaign/Cruise Name: ALoS_20200301 Campaign/Cruise Info: AOML_SOOP_CO2 Platform Type: CO2 Instrument Type: Equilibrator-IR or CRDS or GC Survey Type: SOOP Line Vessel Name: Allure of the Seas Vessel Owner: Royal Caribbean International Vessel Code: BHAF
Coverage	Start Date (yyyymmdd): 20200301 End Date (yyyymmdd): 20200309 Westernmost Longitude: 80.1 W Easternmost Longitude: 17.2 W Northernmost Latitude: 35.9 N Southernmost Latitude: 25.7 N Port of Call: Fort Lauderdale, FL Port of Call: Malaga, Spain
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 Bow Thruster room, about 1m after the intake which is directly through the ship's hull, before the SW pump. Manufacturer: Seabird, Inc. 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; Maintained by University of Miami's MTG group.
Sea Surface Salinity	Location: Near the pCO2 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; Maintained by University of Miami's MTG group.

Atmospheric Pressure

Location: none
Normalized to Sea Level:
Manufacturer: none
Model: none
Accuracy: (hPa if units not given)
Precision: (hPa if units not given)
Calibration:
Comments:

Atmospheric CO2

Measured/Frequency: No
Intake Location: none
Drying Method: none
Atmospheric CO2 Accuracy: $\pm 0.5 \mu\text{atm}$ in fCO₂_ATM
Atmospheric CO2 Precision: $\pm 0.01 \mu\text{atm}$ 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: 6262
Measured CO2 Values: xCO₂(dry)
Measurement Frequency: Every 140 seconds, except during calibration
Aqueous CO2 Accuracy: $\pm 2 \mu\text{atm}$ in fCO₂_SW
Aqueous CO2 Precision: $\pm 0.01 \mu\text{atm}$ in fCO₂_SW
Sensor Calibrations:
Calibration of Calibration Gases: The analyzer is calibrated every 5 hours with field standards that in turn were calibrated with primary standards that are directly traceable to the WMO X2007 scale. The zero gas is ultra-high purity air.
Number Non-Zero Gas Standards: 4
Calibration Gases:

Std 1: CA04890, 282.59 ppm, owned by ESRL, used every ~4.5 hours.
Std 2: CA05386, 357.61 ppm, owned by ESRL, used every ~4.5 hours.
Std 3: CA04523, 401.55 ppm, owned by ESRL, used every ~4.5 hours.
Std 4: CB11260, 503.43 ppm, owned by ESRL, used every ~4.5 hours.
Std 5: LL100000, 0.00 ppm, owned by AOML, used every ~27.5 hours.

Comparison to Other CO2 Analyses:
Comments:

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

Location: Inserted into equilibrator ~5 cm below water level

Temperature Sensor

Manufacturer: Hart

Model: 1523

Accuracy: 0.015 (°C if units not given)

Precision: 0.001 (°C if units not given)

Calibration: Factory calibration

Comments: Resolution is taken as Precision.

Equilibrator

Location: Attached to equilibrator headspace. The differential pressure reading from Setra 239, which is attached to the equilibrator headspace, is added to the pressure reading from the LICOR analyzer, which is measured by an external Setra 270 connected to the exit of the analyzer.

Pressure Sensor

Manufacturer: Setra

Model: 270

Accuracy: 0.15 (hPa if units not given)

Precision: 0.015 (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: The analytical system operated well during this cruise. The seawater flow was more variable or off for extended intervals during the transatlantic crossing, especially at the end of the cruise. Original Data Location: http://www.aoml.noaa.gov/ocd/ocdweb/allure/allure_introduction.html Full unprocessed data files from analytical instrument including flow information and TSG data at time of sampling can be obtained upon request.

Citation for this Dataset:

Other References for this Dataset: