

Cruise: Inaugural Cruise-Atlantic Transit

Ship: Celebrity Cruise Ship Flora

Expo Code: FLRA20190515

Dates: May 15th – June 4th, 2019

Chief Scientist: Dr. Denis Pierrot

Equipment: TSG Flow Through

Total number of stations: 34

Location: North Atlantic transit from Europe to the Canary Islands and onto St. Martin.

Samples were collected for Dr. Leticia Barbero for the Ocean Acidification Program during the Ships of Opportunity Project (SOOP) transit of the Celebrity cruise ship Flora by Kevin Sullivan.

Sample Collection

The discrete samples were collected from the flow thru system onboard the cruise ship Celebrity Flora by Kevin Sullivan. The date and time listed in the data file are UTC when each sample bottle was collected.

DIC:

34 locations, 39 samples each 500-ml, 5 duplicate samples.

Sample ID#: 820000, etc.; Bottle number was used for sample ID

PI: Dr. Rik Wanninkhof

Analyzed by: Charles Featherstone and Patrick Mears

pH:

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Talk:

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Sample Analysis

DIC:

Instrument ID	Date	Certified CRM ($\mu\text{mol/kg}$)	CRM Value ($\mu\text{mol/kg}$)	CRM Offset ($\mu\text{mol/kg}$)	Blank (Counts)	Avg. Sample Analysis Time
AOML 5	09/11/2019	2042.41	2045.74	3.33	12.0	10.0

AOML 6	09/11/2019	2042.41	2045.04	2.63	14.2	9.0
AOML 6	09/12/2019	2042.41	2045.74	3.33	12.0	9.0

Analysis date: 09/11/2019

Coulometer used: DICE-CM5011-AOML 5

Blanks: 12.0 counts/min

CRM # 507 was used and with an assigned value of (includes both DIC and salinity):

Batch 173, c: 2042.41 $\mu\text{mol/kg}$, S: 33.414

CRM values measured: AOML 5: offset 3.33 $\mu\text{mol/kg}$ (2045.74 $\mu\text{mol/kg}$).

Average run time, minimum run time, maximum run time: 10.0, 9.0 and 12.0 min.

Analysis date: 09/11/2019

Coulometer used: DICE-CM5011-AOML 6

Blanks: 14.2 counts/min

CRM # 1128 was used and with an assigned value of (includes both DIC and salinity):

Batch 173, c: 2042.41 $\mu\text{mol/kg}$, S: 33.414

CRM values measured: AOML 6: offset 2.63 $\mu\text{mol/kg}$ (2045.04 $\mu\text{mol/kg}$).

Average run time, minimum run time, maximum run time: 9.0, 7.0 and 13.0 min.

Analysis date: 09/12/2019

Coulometer used: DICE-CM5011-AOML 6

Blanks: 12.0 counts/min

CRM # 1001 was used and with an assigned value of (includes both DIC and salinity):

Batch 173, c: 2042.41 $\mu\text{mol/kg}$, S: 33.414

CRM values measured: AOML 6: offset 3.33 $\mu\text{mol/kg}$ (2045.74 $\mu\text{mol/kg}$).

Average run time, minimum run time, maximum run time: 9.0, 8.0 and 11.0 min.

Reproducibility: (# samples and average difference): 5 duplicate samples were collected with an average difference 0.90 $\mu\text{mol/kg}$ (0.28 – 2.97) and an average STDEV of 0.64 (0.20 – 2.10).

Sample ID	Bottle #	DIC	Average	Difference	STDEV
820000	82	2118.75			
830000	83	2118.47	2118.61	0.28	0.20
870000	87	2127.87			
880000	88	2128.74	2128.30	0.86	0.61
990000	99	2121.93			
1000000	100	2122.60	2122.27	0.67	0.47
1790000	179	2116.54			

1800000	180	2113.57	2115.05	2.97	2.10
1870000	187	2075.52			
1880000	188	2073.51	2074.51	2.01	1.42
Average				0.90	0.64

CRM, salinity and HgCl₂ correction applied: Salinity correction was applied using TSG salinity.

Remarks

The volume correction was applied due to added HgCl₂ (Measured DIC*1.00037).
The first CRM of each cell was used for a CRM correction.

The DIC instruments were stable: the gas loop and CRM values did not change significantly throughout the life span of each cell.

pH:

Analysis date: 09/11/2019 and 09/12/2019
Spectrophotometer used: HP Agilent 8453

09/11/2019

CRM 189, Batch 173, salinity = 33.414, temperature = 19.974⁰C, pH value = 7.8748

09/12/2019

CRM 632, Batch 173, salinity = 33.414, temperature = 19.998⁰C. pH value = 7.8734

Reproducibility: (# samples and average difference): 5 duplicate samples were collected with an average difference 0.0019 μmol/kg (0.0002 – 0.0057) and an average STDEV of 0.0013 (0.0001 – 0.0041).

Sample ID	Sample Btl #	Salinity	Temp	pH	Average	Difference	STDEV
820000	82	34.926	20.014	7.9821			
830000	83	34.997	20.021	7.9878	7.9849	0.0057	0.0041
870000	87	34.825	20.018	8.0572			
880000	88	34.727	20.018	8.0571	8.0572	0.0002	0.0001
990000	99	34.266	20.013	8.1089			
1000000	100	34.075	20.010	8.1069	8.1079	0.0021	0.0015

1790000	179	31.626	20.013	8.1414			
1800000	180	31.674	20.020	8.1422	8.1418	0.0008	0.0006
1870000	187	30.768	20.020	8.1726			
1880000	188	30.845	20.023	8.1733	8.1730	0.0007	0.0005
Average						0.0019	0.0013

Remarks

The equations of Liu et al, 2011 formulated using the purified m-cresol purple indicator was used to determine pH of the samples. pH samples were analyzed at 20°C at Full Scale (pH 0-14).

Temperature for each sample was measured before analysis using a Hart Scientific Fluke 1523 reference thermometer.

Approximately 80 mL of sample was extracted from each DIC sample bottle by automatic syringe before DIC analysis to determine the pH.

pH was reported at 25°C and at temperature at time of analysis.

Talk:

The results posted are duplicate analyses from the same sample bottles used for DIC and pH.

Analysis dates: 00/19/2019

Titration system used: Open cell

CRM batch: 174, S = 33.408, certified TA = 2212.23 µmol/kg

2 CRM samples were run on each cell, before and after the seawater samples. The TA for the water samples was corrected using the daily averaged ratios between the certified and measured values of the 2 CRMs run on each cell. The following table shows the CRM measurements for each cell.

Cell System	Date	Time	Bottle #	TA	ΔCRM
1	09/19/2019	08:52:35	762	2206.40	
1	09/19/2019	17:06:50	762	2206.51	0.11
2	09/19/2019	08:46:37	454	2206.97	
2	09/19/2019	17:00:42	454	2204.48	2.49

Reproducibility: (# samples and average difference): 5 duplicate samples were collected with an average difference 1.50 $\mu\text{mol/kg}$ (3.54 – 0.08) and an average STDEV of 1.06 (0.06 – 2.50).

System	Sample ID	Bottle #	TA	Average	Difference	STDEV
1	820000	82	2358.18			
1	830000	83	2361.72	2359.95	3.54	2.50
1	870000	87	2419.46			
1	880000	88	2419.54	2419.50	0.08	0.06
1	990000	99	2443.27			
1	1000000	100	2442.88	2443.07	0.39	0.28
2	1790000	179	2459.48			
2	1800000	180	2457.51	2458.49	1.98	1.40
2	1870000	187	2427.98			
2	1880000	188	2426.44	2427.21	1.53	1.09
Average					1.50	1.06

Remarks

The two systems behaved well during the analyses.

Comments

The latitude, longitude, date, and time reported with the DIC, pH and TALK measurements were taken from the sample field log. The field log values are provided for reference; no post-cruise assurance of accuracy has been done to this data.

Salinities used for calculations were taken from the underway TSG-pCO₂ system.

The Sample ID is the sample bottle number for each of the discrete samples with 00 for cast number and 00 for niskin number.

Station number was assigned in the order samples were collected (1 thru 34).

No discrete oxygen or nutrient samples were collected.

Corresponding UW pCO₂ data can be found at the following website

<http://www.aoml.noaa.gov/ocd/ocdweb/occ.html>