

Cruise: GU2102
Ship: R/V Gordon Gunter
Expo Code: 33GG20210514
Dates: May 14th – May 27th, 2021
Chief Scientist: Jerome Prezioso
Equipment: CTD Rosette & Ship's Flow Thru (FT)
Total number of stations: 48
Location: U.S. Mid-Atlantic and New England coastal region

The samples were run for Chris Melrose of the NEFSC as part of our coastal ocean acidification monitoring project.

Sample Collection

The discrete samples were collected from Niskin bottles attached to a 24-bottle configured rosette and the TSG flow thru system onboard the R/V Gordon Gunter by the survey tech. The date and time listed in the data file are UTC when each sample bottle was collected.

DIC:

48 locations, 136 samples each 500-ml, 15 duplicate samples.
 Sample_ID#: 90101, etc.; Station, cast number and Niskin bottle number
 PI: Dr. Rik Wanninkhof
 Analyzed by: Charles Featherstone, Dr. Denis Pierrot and Dr. Leticia Barbero

pH:

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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	06/07/2021	2063.31	2064.57	1.26	27.1	8

AOML 5	06/08/2021	2063.31	2063.33	0.02	12.0	8
AOML 5	06/14/2021	2063.31	2063.03	0.28	13.8	7
AOML 5	06/17/2021	2063.31	2063.33	0.02	17.0	7
AOML 6	06/07/2021	2063.31	2062.51	0.80	27.4	10
AOML 6	06/08/2021	2063.31	2064.33	1.02	24.8	8
AOML 6	06/14/2021	2063.31	2064.41	1.10	14.8	10
AOML 6	06/17/2021	2063.31	2063.65	0.34	14.6	9

Analysis date: 06/07/2021

Coulometer used: DICE–CM5011- AOML 5

Blanks: 27.1 counts/min

CRM # 203 was used and with an assigned value of (includes both DIC and salinity):

Batch 169, c: 2063.31 $\mu\text{mol/kg}$, S: 33.518

CRM values measured: AOML 5: offset 0.1.26 $\mu\text{mol/kg}$ (2064.57 $\mu\text{mol/kg}$).

Average run time, minimum run time, maximum run time: 8, 7 and 10 min.

Analysis date: 06/08/2021

Coulometer used: DICE–CM5011- AOML 5

Blanks: 12.0 counts/min

CRM # 1132 was used and with an assigned value of (includes both DIC and salinity):

Batch 169, c: 2063.31 $\mu\text{mol/kg}$, S: 33.518

CRM values measured: AOML 5: offset 0.02 $\mu\text{mol/kg}$ (2063.33 $\mu\text{mol/kg}$).

Average run time, minimum run time, maximum run time: 8, 7 and 10 min.

Analysis date: 06/14/2021

Coulometer used: DICE–CM5011- AOML 5

Blanks: 13.8 counts/min

CRM # 572 was used and with an assigned value of (includes both DIC and salinity):

Batch 169, c: 2063.31 $\mu\text{mol/kg}$, S: 33.518

CRM values measured: AOML 5: offset 0.28 $\mu\text{mol/kg}$ (2063.03 $\mu\text{mol/kg}$).

Average run time, minimum run time, maximum run time: 7, 7 and 9 min.

Analysis date: 06/17/2021

Coulometer used: DICE–CM5017O- AOML 5

Blanks: 17.0 counts/min

CRM # 1191 was used and with an assigned value of (includes both DIC and salinity):

Batch 169, c: 2063.31 $\mu\text{mol/kg}$, S: 33.518

CRM values measured: AOML 5: offset 0.02 $\mu\text{mol/kg}$ (2063.33 $\mu\text{mol/kg}$).

Average run time, minimum run time, maximum run time: 7, 7 and 10 min.

Analysis date: 06/07/2021

Coulometer used: DICE–CM5017O- AOML 6

Blanks: 27.4 counts/min

CRM # 514 was used and with an assigned value of (includes both DIC and salinity):

Batch 169, c: 2063.31 $\mu\text{mol/kg}$, S: 33.518

CRM values measured: AOML 6: offset 0.80 $\mu\text{mol/kg}$ (2062.51 $\mu\text{mol/kg}$).

Average run time, minimum run time, maximum run time: 10, 8 and 12 min.

Analysis date: 06/08/2021

Coulometer used: DICE–CM50170- AOML 6

Blanks: 24.8 counts/min

CRM # 818 was used and with an assigned value of (includes both DIC and salinity):

Batch 169, c: 2063.31 $\mu\text{mol/kg}$, S: 33.518

CRM values measured: AOML 6: offset 1.02 $\mu\text{mol/kg}$ (2064.33 $\mu\text{mol/kg}$).

Average run time, minimum run time, maximum run time: 8, 7 and 10 min.

Analysis date: 06/14/2021

Coulometer used: DICE–CM50170- AOML 6

Blanks: 14.8 counts/min

CRM # 257 was used and with an assigned value of (includes both DIC and salinity):

Batch 169, c: 2063.31 $\mu\text{mol/kg}$, S: 33.518

CRM values measured: AOML 6: offset 1.10 $\mu\text{mol/kg}$ (2064.41 $\mu\text{mol/kg}$).

Average run time, minimum run time, maximum run time: 10, 7 and 14 min.

Analysis date: 06/17/2021

Coulometer used: DICE–CM50170- AOML 6

Blanks: 14.6 counts/min

CRM # 884 was used and with an assigned value of (includes both DIC and salinity):

Batch 169, c: 2063.31 $\mu\text{mol/kg}$, S: 33.518

CRM values measured: AOML 6: offset 0.34 $\mu\text{mol/kg}$ (2063.65 $\mu\text{mol/kg}$).

Average run time, minimum run time, maximum run time: 9, 8 and 11 min.

Reproducibility: (# samples and average difference): 15 duplicate samples were collected with an average difference 1.16 $\mu\text{mol/kg}$ (0.005-3.56) and an average STDEV of 0.82 (0.003-2.52).

Instrument	Sample ID	Bottle #	DIC ($\mu\text{mol/kg}$)	Average	STDEV	Difference
AOML6	10104	2	2037.8			
AOML6	10104	3	2034.2	2036.0	2.52	3.56
AOML5	120201	12	2183.4			
AOML5	120201	13	2184.5	2183.9	0.77	1.08
AOML6	150409	22	2042.3			
AOML6	150409	23	2040.8	2041.6	1.03	1.46
AOML5	280512	32	1949.4			
AOML5	280512	33	1950.4	1949.9	0.67	0.94

AOML5	410806	46	2202.1			
AOML5	410806	47	2199.9	2201.0	1.53	2.16
AOML6	510903	51	2052.2			
AOML6	510903	52	2051.5	2051.9	0.48	0.68
AOML5	561012	61	2045.5			
AOML5	561012	62	2044.4	2044.9	0.79	1.12
AOML5	581206	69	2054.2			
AOML5	581206	70	2052.8	2053.5	0.99	1.41
AOML6	631401	78	2090.4			
AOML6	631401	79	2090.1	2090.2	0.20	0.29
AOML6	651505	84	2167.2			
AOML6	651505	85	2167.2	2167.2	0.003	0.005
AOML6	671612	90	2018.2			
AOML6	671612	91	2017.5	2017.9	0.48	0.68
AOML5	801901	103	2101.5			
AOML5	801901	104	2100.1	2100.8	0.93	1.31
AOML5	922012	113	1999.7			
AOML5	922012	114	2001.5	2000.6	1.30	1.84
AOML6	1002203	121	2083.0			
AOML6	1002203	122	2083.6	2083.3	0.41	0.57
AOML6	1022401	130	2050.7			
AOML6	1022401	131	2051.0	2050.8	0.24	0.33
Average					0.82	1.16

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: 06/07/2021, 06/08/2021, 06/14/2021 and 06/17/2021

Spectrophotometer used: HP Agilent 8453

No CRMs run.

Reproducibility: pH at 20⁰C (# samples, average difference, average STDEV): 15 duplicate samples were collected with an average difference 0.0043 (0.0003 – 0.0330) and an average STDEV of 0.0031 (0.0002 – 0.0233).

Instrument	Sample ID	Bottle #	pH @20deg C	Average	STDEV	Difference
HP Agilent 8453	10104	2	7.88415	7.88582	0.0024	0.0033
HP Agilent 8453	10104	3	7.88749			
HP Agilent 8453	120201	12	7.79090	7.77442	0.0233	0.0330
HP Agilent 8453	120201	13	7.75794			
HP Agilent 8453	150409	22	7.92042	7.91791	0.0036	0.0050
HP Agilent 8453	150409	23	7.91540			
HP Agilent 8453	280512	32	8.01751	8.01811	0.0009	0.0012
HP Agilent 8453	280512	33	8.01871			
HP Agilent 8453	410806	46	7.74001	7.74063	0.0009	0.0012
HP Agilent 8453	410806	47	7.74124			
HP Agilent 8453	510903	51	7.89041	7.89197	0.0022	0.0031
HP Agilent 8453	510903	52	7.89352			
HP Agilent 8453	561012	61	8.04512	8.04489	0.0003	0.0005
HP Agilent 8453	561012	62	8.04466			
HP Agilent 8453	581206	69	7.87995	7.87687	0.0044	0.0062
HP Agilent 8453	581206	70	7.87379			
HP Agilent 8453	631401	78	7.81387	7.81240	0.0021	0.0029
HP Agilent 8453	631401	79	7.81093			
HP Agilent 8453	651505	84	7.79463	7.79343	0.0017	0.0024
HP Agilent 8453	651505	85	7.79223			

HP Agilent 8453	671612	90	7.88731	7.88747	0.0002	0.0003
HP Agilent 8453	671612	91	7.88763			
HP Agilent 8453	801901	103	7.75720	7.75566	0.0022	0.0031
HP Agilent 8453	801901	104	7.75413			
HP Agilent 8453	922012	113	7.96911	7.96957	0.0007	0.0009
HP Agilent 8453	922012	114	7.97003			
HP Agilent 8453	1002203	121	7.78928	7.78909	0.0003	0.0004
HP Agilent 8453	1002203	122	7.78889			
HP Agilent 8453	1022401	130	7.81514	7.81529	0.0002	0.0003
HP Agilent 8453	1022401	131	7.81545			

Average					0.0031	0.0043
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Reproducibility: pH at 25⁰C (# samples, average difference, average STDEV): 15 duplicate samples were collected with an average difference 0.0042 (0.0003 – 0.0323) and an average STDEV of 0.0030 (0.0002 – 0.0229).

Instrument	Sample ID	Bottle #	pH @25deg C	Average	STDEV	Difference
HP Agilent 8453	10104	2	7.81126	7.81290	0.0023	0.0033
HP Agilent 8453	10104	3	7.81455			
HP Agilent 8453	120201	12	7.71929	7.70313	0.0229	0.0323
HP Agilent 8453	120201	13	7.68698			
HP Agilent 8453	150409	22	7.84695	7.84448	0.0035	0.0050
HP Agilent 8453	150409	23	7.84200			
HP Agilent 8453	280512	32	7.94294	7.94353	0.0008	0.0012
HP Agilent 8453	280512	33	7.94413			
HP Agilent 8453	410806	46	7.66939	7.66999	0.0009	0.0012
HP Agilent 8453	410806	47	7.67059			
HP Agilent 8453	510903	51	7.81737	7.81890	0.0022	0.0031
HP Agilent 8453	510903	52	7.82043			
HP Agilent 8453	561012	61	7.97007	7.96984	0.0003	0.0005

HP Agilent 8453	561012	62	7.96962			
HP Agilent 8453	581206	69	7.80707	7.80404	0.0043	0.0061
HP Agilent 8453	581206	70	7.80101			
HP Agilent 8453	631401	78	7.74207	7.74062	0.0020	0.0029
HP Agilent 8453	631401	79	7.73918			
HP Agilent 8453	651505	84	7.72296	7.72179	0.0017	0.0023
HP Agilent 8453	651505	85	7.72061			
HP Agilent 8453	671612	90	7.81442	7.81458	0.0002	0.0003
HP Agilent 8453	671612	91	7.81473			
HP Agilent 8453	801901	103	7.68655	7.68504	0.0021	0.0030
HP Agilent 8453	801901	104	7.68354			
HP Agilent 8453	922012	113	7.89502	7.89548	0.0006	0.0009
HP Agilent 8453	922012	114	7.89594			
HP Agilent 8453	1002203	121	7.71800	7.71781	0.0003	0.0004
HP Agilent 8453	1002203	122	7.71762			
HP Agilent 8453	1022401	130	7.74341	7.74356	0.0002	0.0003
HP Agilent 8453	1022401	131	7.74372			
Average					0.0030	0.0042

Temperatures measured during pH analysis.

Sample ID	Sample BTL #	Salinity	Analysis Temp. (°C)
10100	5	32.260	20.31
10102	1	32.490	20.31
10104	2	32.450	20.337
10104	3	32.450	20.366
10112	4	32.260	20.39
40400	6	32.651	20.358
60600	7	32.696	20.372
70700	8	32.528	20.364
90900	9	32.779	20.594

101000	10	32.582	20.623
111100	11	32.802	20.649
120200	16	32.990	20.242
120201	12	35.060	20.636
120201	13	35.060	20.246
120204	14	35.320	20.245
120212	15	32.990	20.231
130300	20	32.950	20.625
130303	17	35.390	20.365
130306	18	35.710	20.354
130312	19	32.950	20.577
141200	26	32.719	20.648
150400	25	32.970	20.241
150403	21	33.230	20.646
150409	22	33.010	20.247
150409	23	33.010	20.24
150412	24	32.970	20.237
161300	27	32.621	20.245
181500	28	33.113	20.25
191600	29	33.194	20.257
280500	34	31.280	20.242
280503	30	32.530	20.245
280509	31	31.320	20.243
280512	32	31.280	20.241
280512	33	31.280	20.24
373300	35	32.131	20.248
380600	39	32.330	20.264
380601	36	32.820	20.248
380607	37	32.780	20.265
380612	38	32.330	20.263
393500	40	32.693	20.249
400700	44	32.590	20.266
400701	41	35.600	20.257
400704	42	35.470	20.268
400712	43	32.590	20.267
410800	49	34.840	20.267
410803	45	35.080	20.266
410806	46	35.260	20.282
410806	47	35.260	20.279
410812	48	34.840	20.26
433900	50	32.505	20.271

510900	55	32.900	20.27
510903	51	32.920	20.275
510903	52	32.920	20.282
510906	53	32.920	20.257
510912	54	32.900	20.266
524700	56	32.865	20.206
534800	57	32.919	20.21
545000	58	32.833	20.216
561000	63	34.460	20.229
561001	59	35.050	20.215
561006	60	35.310	20.206
561012	61	34.460	20.212
561012	62	34.460	20.235
571100	67	33.090	20.34
571101	64	35.260	20.263
571105	65	35.530	20.291
571112	66	33.090	20.305
581200	72	32.770	20.329
581203	68	32.790	20.356
581206	69	32.800	20.369
581206	70	32.800	20.375
581212	71	32.770	20.369
611300	76	32.890	20.221
611312	75	32.890	20.222
611303	73	32.900	20.376
611306	74	32.890	20.388
625700	77	32.963	20.224
631400	82	32.990	20.245
631401	78	33.110	20.203
631401	79	33.110	20.204
631405	80	33.090	20.224
631412	81	32.990	20.224
651500	87	32.250	20.373
651501	83	35.190	20.269
651505	84	34.980	20.3
651505	85	34.980	20.323
651512	86	32.250	20.339
671600	92	31.790	20.377
671603	88	35.130	20.379
671606	89	34.790	20.346
671612	90	31.790	20.358

671612	91	31.790	20.378
696700	93	31.068	20.344
711700	97	31.420	20.344
711701	94	32.780	20.299
711704	96	32.450	20.314
711712	95	31.420	20.293
751800	101	32.190	20.301
751803	98	34.300	20.351
751806	99	33.520	20.304
751812	100	32.190	20.299
787500	102	32.362	23.479
801900	107	32.090	20.222
801901	103	32.830	23.827
801901	104	32.830	20.138
801904	105	32.510	20.159
801912	106	32.090	20.179
848100	108	31.347	20.269
878400	109	32.638	20.27
898600	110	32.404	20.257
922000	115	32.430	20.255
922001	111	34.170	20.256
922004	112	33.340	20.269
922012	113	32.430	20.262
922012	114	32.430	20.256
962100	119	31.610	20.269
962103	116	32.820	20.266
962106	117	32.320	20.266
962112	118	31.610	20.266
989500	120	31.603	23.631
1002200	125	31.690	20.232
1002203	121	32.670	20.111
1002203	122	32.670	20.154
1002206	123	32.400	20.166
1002212	124	31.690	20.196
1012300	129	31.620	20.253
1012303	126	32.660	20.284
1012306	127	32.570	20.238
1012312	128	31.620	20.259
1022400	134	31.700	20.257
1022401	130	32.330	20.271
1022401	131	32.330	20.248

1022409	132	31.730	20.241
1022412	133	31.700	20.26
10510100	135	31.796	20.271
10610200	136	31.594	20.272

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 20⁰C at Full Scale (pH 0-14).

Samples were run on an automated system where the temperature was kept constant.

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

pH values are reported at 20⁰C and 25⁰C.

Talk:

Analysis date: 06/09/2021, 06/11/2021, 06/15/2021 and 06/18/2021

Titration system used: Open cell

CRM Batch 169, Salinity = 33.518, cert. TA = 2207.03 μmol/kg.

System 1:

On 06/09/2021 CRM #514 was run before analysis and CRM #203 was run at the end of analysis.

On 06/15/2021 CRM #572 was run before analysis and CRM #257 was run at the end of analysis.

On 06/18/2021 CRM #1132 was run before analysis and CRM #1191 was run at the end of analysis.

System 2:

On 06/09/2021 CRM #514 was run before analysis and CRM #203 was run at the end of analysis.

On 06/11/2021 CRM #818 was run before and after analysis.

On 06/15/2021 CRM #572 was run before analysis and CRM #257 was run at the end of analysis.

On 06/18/2021 CRM #1132 was run before analysis and CRM #884 was run at the end of analysis.

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

Cell System	Date	Time	Bottle #	TA	\u0394CRM
1	06/09/2021	09:46:51	514	2193.41	
1	06/09/2021	19:08:56	203	2242.16	48.75
1	06/15/2021	09:38:41	572	2208.05	
1	06/15/2021	18:12:15	257	2213.79	5.74
1	06/18/2021	10:31:12	1132	2198.26	
1	06/18/2021	17:01:12	1191	2215.14	16.88
2	06/09/2021	10:35:00	514	2196.58	
2	06/09/2021	18:41:54	203	2227.01	30.43
2	06/11/2021	09:00:05	818	2202.41	
2	06/11/2021	14:45:41	818	2205.02	2.61
2	06/18/2021	09:28:08	572	2203.22	
2	06/18/2021	17:52:27	257	2207.41	4.19
2	06/09/2021	10:24:40	1132	2199.57	
2	06/09/2021	16:55:54	884	2235.93	36.36

Reproducibility: (# samples and average difference): 15 duplicate samples were collected with an average difference $\mu\text{mol/kg}$ 2.76 (0.19 – 7.55) and an average STDEV of 1.95 (0.14 – 5.34).

Station	Sample ID	TA ($\mu\text{mol/kg}$)	Average	Difference	STDEV
1	10104	2180.5			
1	10104	2175.1	2177.8	5.36	3.79
12	120201	2304.2			
12	120201	2296.7	2300.4	7.55	5.34
15	150409	2199.6			
15	150409	2199.8	2199.7	0.19	0.14
28	280512	2141.5			
28	280512	2141.1	2141.3	0.46	0.33

41	410806	2318.8				
41	410806	2321.7	2320.2	2.88	2.04	
51	510903	2217.1				
51	510903	2216.4	2216.8	0.67	0.47	
56	561012	2298.5				
56	561012	2299.4	2299.0	0.92	0.65	
58	581206	2216.8				
58	581206	2223.3	2220.1	6.53	4.61	
63	631401	2228.6				
63	631401	2230.8	2229.7	2.20	1.55	
65	651505	2308.0				
65	651505	2304.6	2306.3	3.34	2.36	
67	671612	2173.9				
67	671612	2173.3	2173.6	0.63	0.45	
80	801901	2223.4				
80	801901	2217.7	2220.6	5.71	4.04	
92	922012	2210.4				
92	922012	2209.5	2210.0	0.95	0.67	
100	1002203	2214.9				
100	1002203	2212.5	2213.7	2.48	1.75	
102	1022401	2190.9				
102	1022401	2189.4	2190.1	1.51	1.07	
Average				2.76	1.95	

Remarks

The CRM measurement for each day was used to correct the data for that day only. Both systems worked well.

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.

The Sample ID is the sample station, cast number and Niskin bottle number for the discrete samples.

Final data – the sample ID number of the flow through (FT) samples is the sample station, cast number and 0 for Niskin bottle number (example 260400).

CTD surface sample temperature and salinity was used for the FT samples associated with a CTD cast. All other flow through samples used temperature and salinity from the TSG processed underway pCO₂ system.

Corresponding UW pCO₂ data can be found at the following website
<http://www.aoml.noaa.gov/ocd/ocdweb/occ.html>