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Biological, Physical and Chemical Data From Gulf of Mexico Gravity and Box Core MRD05-04

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Introduction

This paper presents the benthic foraminiferal census data, magnetic susceptibility measurements, vanadium and organic geochemistry (carbon isotope, sterols, and total organic carbon) data from the MRD05-04 gravity and box cores. The MRD05-04 cores were obtained from the Louisiana continental shelf in an on-going initiative to examine the geographic and temporal extent of hypoxia, low-oxygen bottom-water content, and geochemical transport. The development of low-oxygen bottom water conditions in coastal waters is dependent upon a new source of bio-available nutrients introduced into a well-stratified water column. A number of studies have concluded that the development of the current seasonal hypoxia (dissolved oxygen < 2 mg L^{-1}) in subsurface waters of the northern Gulf of Mexico is related to increased transport of nutrients (primarily nitrogen, but possibly also phosphorous) by the Mississippi River (Rabalais, 2002; Rabalais et al., 1994, 1996, 1999; Rabalais and Turner, 2001; Turner et al., 2005). However, the development of earlier episodes of seasonal low-oxygen subsurface water on the Louisiana shelf may be related to Mississippi River discharge (Osterman et al., 2005)

Age Models

Sediment geochronologies, in terms of both mass accumulation and linear sedimentation rates, were derived from boxcores collected at the same site and time using multiple radioactive tracers, including excess ^{210}Pb ($t_{1/2}$ = 22.3 yr) and ^{137}Cs ($t_{1/2}$ = 30.1yr). A detailed discussion of the dating methods can be found in *Swarzenski et al.* [2006]. A box-core record yielded a robust (r^2 = 96) linear sedimentation rate at this site of 0.31 cm y^{-1} that corresponded to a mass accumulation rate of 0.18 g cm^{-2} y^{-1}. Such rates indicate that the last 100 years are represented by approximately the upper 35 cm. Extrapolating an age-date on sediments much older than 100 years with these techniques is tenuous, as we must assume a constant mass accumulation rate. A comparison of excess ^{210}Pb inventories from cores collected pre- and post Hurricane Katrina (Swarzenski et al., in press) clearly illustrates that this assumption may be compromised by the occurrence of storms and sediment redistribution in the region.

Two AMS ^{14}C dates were obtained on mixed foraminfers from the base of MRD05-04GC (226.5 cm, 1400 +/- 140 yrs BP; 228.5 cm 1630 +/- 45 yrs BP). The ages are in radiocarbon year (BP) using the Libby half-life of 5568 years. Since the core was collected in 38 mwd we applied

the standard surface water reservoir correction of 400 yrs [*Poore et al.*, 2004] to the dates to obtain an average age of 1,100 ^{14}C years BP for the base of the core.

Methods and Data

Gravity and box cores MRD05-04 (Lat: 28.9319°N, Long: 89.8961°W) were collected at 39 and 38 meters water depth (mwd), respectively, on the Louisiana continental shelf aboard the R/V *Pelican* during May 2005. Both gravity and box cores were collected and capped in the field. The gravity core was sectioned at 40 and 120 cm. The cores were refrigerated and transported to the U.S. Geological Survey, Florida Integrated Science Center, in St. Petersburg, FL. Sediments in the plastic core liners were extruded and sampled shortly after collection. Each 1-cm slice was divided into three subsamples and stored either frozen in precombusted glass jars (organics), or refrigerated in pre-weighed plastic cups (trace elements and radionuclides) or plastic bags (foraminifers) for further processing.

Magnetic Susceptibility

Whole-core magnetic susceptibility (MS) was measured on an archive gravity core and box core collected at the same location [MRD05-04GCb (190 cm), and MRD0404BC archive] using the GEOTEK multi-sensor core logger, via the Bartington system with a 5-cm loop diameter. The meter was set to SI (Systeme Internationale) units and automatically zeroed before each core or section was analyzed. Because of unreliable measurements near the ends of core sections, the values from the top and bottom 4-5 cm of each section were discarded. The MS values are reported in Tables 2 and 3.

Faunal Analysis

Previous work (Osterman, 2003) determined that in the benthic foraminiferal assemblages found in the Gulf of Mexico, the relative abundance of three low-oxygen tolerant species was highest in the Louisiana hypoxic zone. Therefore in this research only the cumulative percentage of these three species (% *Pseudononion atlanticum* + % *Epistominella vitrea* + % *Buliminella morgani* = PEB index of hypoxia) was used to reconstruct the past record of low-oxygen bottom-water events in MRD05-04GC (Osterman et al., in press).

Each 1-cm sediment sample for faunal analyses was soaked in a 5% Calgon solution, agitated for 1-2 hours to aid disaggregation, then washed over a stainless steel 63 μm sieve. The remaining sample was oven dried at ≤ 50°C, then dry sieved at 125 μm. The samples were not dried prior to the wet-sieving process; the calculated dry weights were obtained by measuring the moisture content of a small subsample of each sample. Processed samples contained few to abundant benthic foraminifera (1.02 to 729 foraminifers/g). When required, a representative subsample of approximately 300 specimens was obtained for faunal analysis using a microsplitter. Benthic foraminifers were picked from the >125 μm faunal split spread across a 45 square hole-punched tray. Individual foraminifers were identified and counted as one of four categories (*P. atlanticum*, *E. vitrea*, *B. morgani*, and others). After counting each specimen was dropped though a hole in the punched tray onto a stationary 60-square micropaleontological slide placed in a cardboard cutout. All faunal slides will be curated at the Natural History Museum, Smithsonian Institution at the conclusion of the study. Identification of benthic foraminiferal species were based on the use of classic and modern literature, including the taxonomy of Phleger and Parker (1951), Loeblich and Tappan (1988, 1994), Parker (1954), Bandy (1954), Anderson (1961), Murray (1971, 2000), Bock et al., (1971), Poag (1981), and Morkhoven et al. (1986). Tables 4 and 5 display sample interval, percentage of sample examined, benthic foraminiferal counts, relative percentage of the PEB species (Osterman, 2003), and confidence interval data (Patterson and Fishbein, 1989) for gravity and box cores MRD05-04. Table 5 also notes 15 samples containing low foraminifer numbers that are excluded from data presented in Osterman et al., in press.

Organic Geochemical Analyses

Sediment samples for molecular analysis were placed in pre-combusted 100 ml glass jars with aluminum foil-lined lids. Two 1-cm intervals for each data point were combined and homogenized for adequate sample size. In the UGSS laboratory, sediment samples were extracted with a methylene chloride and methanol (2:1 vol) solvent mixture. Lipid fractions were further isolated utilizing silica gel chromatography (5g, 70-230 mesh). After elution of the less polar lipid fractions (i.e., alkanes, Polycyclic Aromatic Hydrocarbons (PAHs)), two fractions were eluted and combined using 20% ethyl acetate (F6) and 15% ethyl acetate (F5) in hexane. The sterol fractions were then converted to trimethylsilyl ether (TMS-ethers) derivatives using bis (trimethylsilysl) trifluoroacetamide and acetonitrile. Gas chromatography-mass spectrometry (GC-MS) analyses

were performed for compound identification with an Agilent 6890 GC equipped with a Hewlett-Packard 5973 mass selective detector. The GC oven was temperature programmed from 80˚C to 280˚C with an initial 2.0-minute hold and a ramp of 8°C/min and a final temperature hold of 15 minutes. The GC column used was an HP5-MS 30-m column with a 0.25 mm I.D. (J&W Scientific, Inc.) using ultra-pure helium as the carrier gas. The column was inserted directly into the ion source of the mass spectrometer through an interface heated at 230˚C. Sterol concentrations (dry weight) were calculated based on an internal standard method and normalized to organic carbon.

Isotopic Analyses

Sediment samples for isotopic carbon analyses were dried at 60˚C for 24 hours. Dried sediment was finely ground and homogenized to a fine powder with a mortar and pestle. Weighed aliquots (~50 mg) of dried sediment were transferred to Costech silver capsules, and vapor acidified with concentrated hydrochloric acid for 24 hours according to a modification of the method of Yamamuro and Kayanne (1995), dried at 60°C for 24 hours, crimp-sealed and stored in a desiccator until analyzed. Samples were analyzed for carbon isotopic composition on a Micromass (now GVI) Optima continuous-flow mass spectrometer. Carbon isotope compositions are expressed in per mil (‰) relative to Vienna Pee Dee belemnite (VPDB) standard. The analytical precision for standards is about ±0.15‰ for $\delta^{13}C$ and precision for samples is 0.6%.

Elemental Analysis

Sediment sub-samples were dried, powdered, homogenized, and digested in a mixture of HCl, HNO_3, $HClO_4$, and HF acids. The concentration of vanadium (V) was analyzed by ICP-MS (Nameroff et al., 2002) and instrument calibration was performed using digested standard rock reference material, multi-element solution standards, and internal standards. The V concentration in standard reference samples and duplicates indicates an analytical precision of <10%.

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Table 1. Radiocarbon dates MRD05-04GC					
LAB ID	SAMPLE ID	MATERIAL	^{13}C	^{14}C AGE	DATED ON
WW5842	MRD-05-04 226-227cm (0.2 mg)	mixed foraminifers	0	1400 ± 140	10/03/06
WW5843	MRD-05-04 228-229cm	mixed foraminifers	0	1630 ± 45	10/03/06

Table 2. Magnetic Susceptibility MRD05-04BC	
Depth (cm)	MS value (SI)
1	1
3	2
5	5
7	8
9	12
11	14
13	16
15	17
17	17
19	18
21	20
23	20
25	21
27	21
29	21
31	20
33	19
35	18
37	16
39	12
41	5

Table 3. Magnetic Susceptibility MRD05-04GC			
Depth (cm)	MS value (SI)	Depth (cm)	MS value (SI)
4	2	102	6
6	2	104	6
8	4	106	6
10	4	108	6
12	6	110	5
14	6	112	2
16	7	114	0
18	8	116	1
20	7	126	3
22	8	128	4
24	7	130	4
26	7	132	5
28	7	134	5
30	7	136	6
32	7	138	7
34	6	140	7
44	6	142	7
46	6	144	8
48	6	146	8
50	6	148	8
52	6	150	8
54	7	152	9
56	7	154	9
58	8	156	8
60	7	158	10
62	7	160	9
64	7	162	8
66	7	164	8
68	7	166	8
70	8	168	8
72	7	170	8
74	7	172	8
76	6	174	9
78	5	176	8
80	5	178	9
82	4	180	10
84	5	182	9
86	5	184	9
88	5	186	8
90	5	188	8
92	5	190	5
94	5		
96	6		
98	6		
100	7		

Table 4. Benthic foraminiferal data MRD05-04BC									
sample depth midpoint (cm)	**Split of sample examined**	**Number of *P. atlanticum***	**Number *of E. vitrea***	**Number of *B. morgani***	**Number of other foraminifers**	**total Number of foraminifers (N)**	**% of PEB species**	**Age based on ^{210}Pb**	**Confidence Interval of PEB**
0.5	25.00	141	123	41	42	347	87.90	2004	3.43
1.5	50.00	116	54	12	113	295	61.69	2001	5.55
2.3	6.25	117	117	45	36	315	88.57	1998	3.51
3.5	1.56	100	146	68	56	370	84.86	1995	3.65
4.5	2.34	105	96	52	48	301	84.05	1992	4.14
5.5	1.56	186	140	48	67	441	84.81	1989	3.35
6.5	6.25	130	105	30	42	307	86.32	1986	3.84
7.5	3.13	124	139	62	56	381	85.30	1983	3.56
8.5	3.13	174	93	37	42	346	87.86	1980	3.44
9.5	3.13	209	88	48	52	397	86.90	1977	3.32
10.5	3.13	167	133	61	49	410	88.05	1974	3.14
11.2	1.56	159	90	60	53	362	85.36	1972	3.64
12.5	3.13	149	103	47	73	372	80.38	1968	4.04
13.5	3.13	145	67	27	60	299	79.93	1965	4.54
14.5	1.56	157	89	39	113	398	71.61	1962	4.43
15.5	4.69	195	67	25	99	386	74.35	1959	4.36
16.5	6.67	90	31	13	306	440	30.45	1956	4.30
17.5	7.78	52	8	5	323	388	16.75	1954	3.72
18.5	14.44	57	5	2	283	347	18.44	1951	4.08
19.5	11.11	44	17	5	290	356	18.54	1948	4.04
20.5	6.67	36	25	9	280	350	20.00	1945	4.19
21.5	6.11	41	10	1	300	352	14.77	1942	3.71
22.5	3.61	31	14	12	298	355	16.06	1939	3.82
23.5	7.22	45	15	2	314	376	16.49	1936	3.75
24.5	2.22	45	41	9	232	327	29.05	1933	4.92
25.5	5.00	23	9	2	320	354	9.60	1930	3.07
26.5	5.00	37	11	1	412	461	10.63	1927	2.81
27.5	5.00	42	13	3	286	344	16.86	1924	3.96
28.5	2.78	38	10	0	305	353	13.60	1921	3.58
29.5	2.78	31	8	1	299	339	11.80	1918	3.43
30.5	2.78	56	15	2	270	343	21.28	1915	4.33
31.5	3.33	44	29	2	271	346	21.68	1912	4.34
32.5	6.11	30	7	2	364	403	9.68	1909	2.89
33.5	5.56	26	5	3	301	335	10.15	1906	3.23
34.5	3.89	36	9	1	313	359	12.81	1904	3.46
35.5	5.56	20	7	2	315	344	8.43	1901	2.94
36.5	2.78	28	5	5	278	316	12.03	1898	3.59
37.5	5.00	24	5	2	352	383	8.09	1895	2.73
38.5	6.39	34	16	2	271	323	16.10	1892	4.01
39.5	4.44	34	6	5	299	344	13.08	1889	3.56
40.5	3.89	24	8	2	313	347	9.80	1886	3.13

Table 5. Benthic foraminiferal data MRD05-04GC

sample depth midpoint (cm)	Split of sample examined	Number of *P. atlanticum*	Number of *E. vitrea*	Number of *B. morgani*	Number of other foraminifers	total Number of foraminifers (N)	% of PEB species	Confidence Interval of PEB
0.5	25.00	160	31	6	160	357	55.18	5.16
1.5	25.00	73	32	2	215	322	33.23	5.14
2.5	25.00	58	23	0	222	303	26.73	4.98
3.5	50.00	74	28	4	313	419	25.30	4.16
4.5	25.00	54	17	3	320	394	18.78	3.86
5.5	25.00	73	14	4	327	418	21.77	3.96
6.5	25.00	100	33	5	308	446	30.94	4.29
7.5	25.00	68	35	3	241	347	30.55	4.85
8.5	12.50	70	31	2	212	315	32.70	5.18
9.5	25.00	80	26	2	279	387	27.91	4.47
10.5	18.75	75	15	1	288	379	24.01	4.30
11.5	25.00	39	6	0	267	312	14.42	3.90
12.5	16.67	71	17	3	296	387	23.51	4.23
13.5	16.67	68	9	1	277	355	21.97	4.31
14.5	25.00	41	16	1	244	302	19.21	4.44
15.5	25.00	49	0	1	303	353	14.16	3.64
16.5	25.00	41	2	1	363	407	10.81	3.02
17.5	12.50	31	6	0	270	307	12.05	3.64
18.5	12.50	44	10	8	299	361	17.17	3.89
19.5	6.25	29	5	1	264	299	11.71	3.64
20.5	6.25	21	11	4	264	300	12.00	3.68
21.5	12.50	41	9	2	272	324	16.05	4.00
22.5	12.50	30	5	0	320	355	9.86	3.10
23.5	50.00	26	4	2	381	413	7.75	2.58
24.5	25.00	9	2	3	271	285	4.91	2.51
25.5	75.00	12	1	0	293	306	4.25	2.26
26.5	66.67	33	5	2	309	349	11.46	3.34
27.5	50.00	25	13	1	314	353	11.05	3.27
28.5	50.00	23	1	0	271	295	8.14	3.12
29.5	50.00	26	13	0	357	396	9.85	2.93
30.5	25.00	20	16	0	268	304	11.84	3.63
31.5	56.25	38	8	0	298	344	13.37	3.60
32.5	50.00	34	8	6	300	348	13.79	3.62
33.5	100.00	40	9	0	382	431	11.37	3.00
34.5	50.00	19	5	3	323	350	7.71	2.80
35.5	66.67	29	7	0	266	302	11.92	3.65
36.5	100.00	7	2	0	139	148	6.08	3.85
37.5	37.50	35	2	0	291	328	11.28	3.42
38.5	43.75	27	6	5	322	360	10.56	3.17
39.5	100.00	20	2	1	218	241	9.54	3.71
40.5	100.00	10	4	0	253	267	5.24	2.67
41.5	100.00	11	6	0	202	219	7.76	3.54
42.5	100.00	9	4	0	314	327	3.98	2.12
43.5	100.00	24	10	1	229	264	13.26	4.09
44.5	100.00	17	6	1	293	317	7.57	2.91
45.5	100.00	10	4	4	181	199	9.05	3.99
46.5	100.00	18	1	0	210	229	8.30	3.57
47.5	100.00	6	1	0	172	179	3.91	2.84
48.5	100.00	15	7	1	393	416	5.53	2.20
49.5	100.00	15	8	2	269	294	8.50	3.19
50.5	100.00	21	6	1	281	309	9.06	3.20
51.5	100.00	22	9	1	164	196	16.33	5.17
52.5	100.00	45	19	2	238	304	21.71	4.63
53.5	100.00	10	5	0	95	110	13.64	6.41
54.5	100.00	21	11	1	87	120	27.50	7.99
55.5	100.00	57	36	4	108	205	47.32	6.83
56.5	100.00	91	77	1	185	354	47.74	5.20
57.5	100.00	65	61	2	116	244	52.46	6.27
58.5	100.00	67	81	4	86	238	63.87	6.10
59.5	100.00	66	113	7	187	373	49.87	5.07
60.5	62.50	16	80	2	268	366	26.78	4.54

Table 5 cont. Benthic foraminiferal data MRD05-04GC

sample depth midpoint (cm)	Split of sample examined	Number of *P. atlanticum*	Number of *E. vitrea*	Number of *B. morgani*	Number of other foraminifers	total Number of foraminifers (N)	% of PEB species	Confidence Interval of PEB
61.5	50.00	11	48	2	289	350	17.43	3.97
61.5	100.00	11	2	0	102	115	11.30	5.79
63.5	100.00	7	2	0	70	79	11.39	7.01
64.5	100.00	13	2	0	64	79	18.99	8.65
65.5	100.00	7	2	0	129	138	6.52	4.12
66.5	100.00	14	4	0	327	345	5.22	2.35
67.5	75.00	16	0	0	316	332	4.82	2.30
68.5	100.00	20	1	0	293	314	6.69	2.76
69.5	100.00	11	0	0	250	261	4.21	2.44
70.5	100.00	11	0	0	274	285	3.86	2.24
71.5	100.00	7	2	0	182	191	4.71	3.01
72.5	100.00	6	5	1	107	119	10.08	5.41
73.5	100.00	9	13	0	103	125	17.60	6.68
74.5	100.00	13	14	2	67	96	30.21	9.19
75.5	100.00	17	8	0	188	213	11.74	4.32
76.5	100.00	24	9	1	420	454	7.49	2.42
77.5	50.00	22	24	1	280	327	14.37	3.80
78.5	25.00	17	25	4	297	343	13.41	3.61
79.5	37.50	23	40	5	274	342	19.88	4.23
80.5	12.50	20	22	10	268	320	16.25	4.04
81.5	25.00	26	21	9	295	351	15.95	3.83
82.5	50.00	20	15	2	334	371	9.97	3.05
83.5	50.00	14	4	5	289	312	7.37	2.90
84.5	50.00	20	8	0	386	414	6.76	2.42
85.5	50.00	15	7	0	310	332	6.63	2.68
86.5	50.00	21	16	3	257	297	13.47	3.88
87.5	75.00	21	8	0	329	358	8.10	2.83
88.5	75.00	17	25	5	275	322	14.60	3.86
89.5	100.00	7	7	1	136	151	9.93	4.77
90.5	100.00	15	6	0	188	209	10.05	4.08
91.5	100.00	5	6	1	142	154	7.79	4.23
92.5	100.00	11	2	0	145	158	8.23	4.28
93.5	100.00	10	0	1	129	140	7.86	4.46
94.5	100.00	17	2	1	177	197	10.15	4.22
95.5	100.00	9	8	1	89	107	16.82	7.09
96.5	100.00	9	7	0	70	86	18.60	8.22
97.5	100.00	9	2	0	43	54	20.37	10.74
98.5	100.00	6	1	1	60	68	11.76	7.66
99.5	100.00	4	0	0	15	19	21.05	18.33
100.5	100.00	11	2	0	33	46	28.26	13.01
101.5	100.00	5	0	0	11	16	31.25	22.71
102.5	100.00	9	0	0	36	45	20.00	11.69
103.5	100.00	7	2	0	74	83	10.84	6.69
104.5	100.00	31	7	0	55	93	40.86	9.99
105.5	100.00	15	2	1	56	74	24.32	9.78
106.5	100.00	16	1	0	61	78	21.79	9.16
107.5	100.00	24	6	1	63	94	32.98	9.50
108.5	100.00	11	2	0	15	28	46.43	18.47
109.5	100.00	15	5	0	62	82	24.39	9.29
110.5	100.00	36	3	0	103	142	27.46	7.34
111.5	100.00	35	4	0	195	234	16.67	4.78
112.5	100.00	13	7	0	329	349	5.73	2.44
113.5	100.00	17	0	2	300	319	5.96	2.60
114.5	50.00	6	6	1	311	324	4.01	2.14
115.5	66.67	10	6	0	303	319	5.02	2.40
116.5	50.00	17	4	0	286	307	6.84	2.82
117.5	50.00	7	1	1	330	339	2.65	1.71
118.5	50.00	18	5	2	303	328	7.62	2.87
119.5	37.50	26	6	0	426	458	6.99	2.33
120.5	100.00	27	6	2	472	507	6.90	2.21

Border indicates samples not included in analysis

Table 5 cont. Benthic foraminiferal data MRD05-04GC

sample depth midpoint (cm)	Split of sample examined	Number of *P. atlanticum*	Number of *E. vitrea*	Number of *B. morgani*	Number of other foraminifers	total Number of foraminifers (N)	% of PEB species	Confidence Interval of PEB
121.5	42.22	15	12	4	282	313	9.90	3.31
122.5	20.00	12	3	0	298	313	4.79	2.37
123.5	53.33	11	1	0	303	315	3.81	2.11
124.5	53.33	5	0	0	309	314	1.59	1.38
125.5	35.56	17	7	0	290	314	7.64	2.94
126.5	35.56	10	3	1	296	310	4.52	2.31
127.5	40.00	14	3	0	307	324	5.25	2.43
128.5	100.00	10	4	0	332	346	4.05	2.08
129.5	100.00	25	10	1	178	214	16.82	5.01
130.5	100.00	25	23	6	111	165	32.73	7.16
131.5	100.00	31	20	5	111	167	33.53	7.16
132.5	100.00	11	12	2	130	155	16.13	5.79
133.5	100.00	21	16	2	160	199	19.60	5.52
134.5	100.00	14	13	0	168	195	13.85	4.85
135.5	100.00	6	7	0	191	204	6.37	3.35
136.5	20.00	2	2	0	372	376	1.06	1.04
137.5	100.00	9	4	0	234	247	5.26	2.78
138.5	100.00	11	1	0	225	237	5.06	2.79
139.5	100.00	15	1	0	325	341	4.69	2.24
140.5	100.00	0	0	0	103	103	0.00	0.00
141.5	100.00	10	3	0	233	246	5.28	2.80
142.5	100.00	4	0	0	124	128	3.13	3.01
143.5	100.00	13	2	0	234	249	6.02	2.96
144.5	100.00	12	1	0	177	190	6.84	3.59
145.5	100.00	9	1	1	231	242	4.55	2.62
146.5	100.00	5	0	0	144	149	3.36	2.89
147.5	100.00	8	3	0	317	328	3.35	1.95
148.5	100.00	6	2	0	165	173	4.62	3.13
149.5	100.00	0	0	0	81	81	0.00	0.00
150.5	100.00	20	19	3	271	313	13.42	3.78
151.5	100.00	10	1	0	129	140	7.86	4.46
152.5	100.00	0	0	0	9	9	0.00	0.00
153.5	100.00	1	3	1	79	84	5.95	5.06
154.5	100.00	4	1	1	104	110	5.45	4.24
155.5	100.00	6	0	0	53	59	10.17	7.71
156.5	100.00	18	7	2	77	104	25.96	8.43
157.5	100.00	5	2	1	60	68	11.76	7.66
158.5	100.00	13	69	29	228	339	32.74	5.00
159.5	100.00	12	30	2	211	255	17.25	4.64
160.5	50.00	21	15	7	295	338	12.72	3.55
161.5	100.00	7	6	1	217	231	6.06	3.08
162.5	100.00	7	1	1	318	327	2.75	1.77
163.5	100.00	8	0	0	226	234	3.42	2.33
164.5	50.00	17	10	2	384	413	7.02	2.46
165.5	100.00	8	14	4	296	322	8.07	2.98
166.5	100.00	5	4	1	190	200	5.00	3.02
167.5	50.00	8	11	2	283	304	6.91	2.85
168.5	75.00	9	6	2	303	320	5.31	2.46
169.5	50.00	10	7	0	350	367	4.63	2.15
170.5	100.00	19	12	1	359	391	8.18	2.72
171.5	100.00	18	8	2	313	341	8.21	2.91
172.5	75.00	17	8	0	298	323	7.74	2.91
173.5	100.00	14	3	2	221	240	7.92	3.42
174.5	50.00	9	8	0	285	302	5.63	2.60
175.5	25.00	10	9	4	286	309	7.44	2.93
176.5	66.67	5	4	0	302	311	2.89	1.86
177.5	100.00	7	4	1	194	206	5.83	3.20
178.5	50.00	9	16	1	294	320	8.13	2.99
179.5	75.00	15	4	0	351	370	5.14	2.25

Border indicates samples not included in analysis

Table 5 cont. Benthic foraminiferal data MRD05-04GC								
sample depth midpoint (cm)	**Split of sample examined**	**Number of *P. atlanticum***	**Number of *E. vitrea***	**Number of *B. morgani***	**Number of other foraminifers**	**total Number of foraminifers (N)**	**% of PEB species**	**Confidence Interval of PEB**
181.0	62.50	15	6	0	367	388	5.41	2.25
182.5	100.00	6	2	0	352	360	2.22	1.52
183.5	100.00	22	6	0	391	419	6.68	2.39
184.5	100.00	25	2	0	318	345	7.83	2.83
185.5	100.00	11	0	0	210	221	4.98	2.87
186.5	100.00	55	2	8	186	251	25.90	5.42
187.5	40.00	65	31	37	256	389	34.19	4.71
188.5	100.00	2	0	1	208	211	1.42	1.60
189.5	100.00	7	0	0	245	252	2.78	2.03
190.5	100.00	4	0	0	199	203	1.97	1.91
191.5	100.00	8	0	0	193	201	3.98	2.70
192.5	100.00	3	0	0	185	188	1.60	1.79
193.5	100.00	3	0	0	202	205	1.46	1.64
194.5	100.00	8	0	0	285	293	2.73	1.87
195.5	100.00	8	0	0	82	90	8.89	5.88
196.5	80.00	8	3	1	402	414	2.90	1.62
197.5	48.89	16	3	2	382	403	5.21	2.17
198.5	80.00	17	1	1	374	393	4.83	2.12
199.5	100.00	14	3	2	274	293	6.48	2.82
200.5	100.00	17	8	1	278	304	8.55	3.14
201.5	100.00	7	3	2	186	198	6.06	3.32
202.5	100.00	6	1	0	199	206	3.40	2.47
203.5	100.00	13	7	3	291	314	7.32	2.88
204.5	100.00	6	3	0	192	201	4.48	2.86
205.5	60.00	18	7	0	382	407	6.14	2.33
206.5	60.00	12	2	0	362	376	3.72	1.91
207.5	80.00	27	2	1	380	410	7.32	2.52
208.5	100.00	12	4	2	313	331	5.44	2.44
209.5	100.00	6	0	1	353	360	1.94	1.43
210.5	100.00	6	0	0	117	123	4.88	3.81
211.5	100.00	1	0	0	59	60	1.67	3.24
212.5	100.00	5	0	0	81	86	5.81	4.95
213.5	100.00	3	0	0	73	76	3.95	4.38
214.5	100.00	1	0	0	88	89	1.12	2.19
215.5	100.00	1	0	0	40	41	2.44	4.72
216.5	100.00	2	0	0	55	57	3.51	4.78
217.5	100.00	1	0	0	9	10	10.00	18.59
218.5	100.00	6	1	2	248	257	3.50	2.25
219.5	100.00	4	2	0	67	73	8.22	6.30
220.5	100.00	14	5	0	335	354	5.37	2.35
221.5	100.00	7	6	0	274	287	4.53	2.41
222.5	100.00	12	3	0	250	265	5.66	2.78
223.5	100.00	10	0	0	363	373	2.68	1.64
224.5	100.00	7	0	0	203	210	3.33	2.43
225.5	100.00	7	1	0	330	338	2.37	1.62
226.5	20.00	14	6	2	407	429	5.13	2.09
227.5	22.22	15	0	0	358	373	4.02	1.99
228.5	12.22	9	3	2	327	341	4.11	2.11

Border indicates samples not included in analysis

Table 6. MRD05-04BC Sterols		
Sample depth mid-point (cm)	**§-sitosterol (µg g^{-1})**	**stigmasterol (µg g^{-1})**
7.5	4.074	3.949
9.5	3.495	2.969
11.5	3.834	3.099
13.5	2.495	1.863
16.5	1.812	1.139
20.5	1.892	0.000
21.5	2.904	1.629
24.5	1.711	0.049

Table 7. MRD05-04GC Sterols		
Sample depth mid-point (cm)	**§-sitosterol (µg g^{-1})**	**stigmasterol (µg g^{-1})**
2.0	1.305	0.570
8.0	1.052	0.311
11.0	4.471	1.340
14.0	0.212	0.351
18.0	1.097	0.079
40.5	2.346	0.000
53.0	14.902	3.115
67.0	12.981	2.615
75.0	2.239	0.576
79.0	1.476	0.402
87.0	2.464	0.259
91.0	1.834	0.023
97.0	1.713	0.594
104.0	4.421	1.146
108.0	9.742	1.110
119.0	5.487	1.246
132.0	2.275	0.550
142.0	2.265	0.758
147.0	1.018	0.105
151.0	1.795	1.241
157.0	2.052	2.388
162.0	0.021	0.060
166.0	4.845	3.985
171.0	0.736	0.314
178.0	0.490	0.146
187.5	0.576	0.065
193.0	1.101	0.028

Table 8. Isotope data MRD05-04BC							
Sample depth mid-point (cm)	Avg %C acid	Avg % N acid	Ž ^{13}C	Ž ^{15}N	C:N ratio	Raw %S	Ž ^{34} S
2.5	1.21	0.13	-22.15	4.85	10.86	0.36	-10.65
3.5	1.18	0.12	-22.04	4.74	11.47	0.46	-12.65
4.5	1.16	0.12	-21.95	4.08	11.28	0.33	-20.35
5.5	1.15	0.12	-21.90	4.73	11.18	0.68	-16.95
6.5	1.14	0.12	-21.77	4.40	11.08	0.64	-19.55
7.5	1.07	0.11	-21.86	4.17	11.35	0.64	-20.75
8.5	1.05	0.11	-21.77	4.63	11.14	0.67	-21.54
9.5	1.08	0.11	-21.85	4.30	11.46	0.64	-22.71
10.5	1.03	0.16	-21.80	3.36	7.47	0.75	-17.79
11.2	1.02	0.11	-21.54	4.31	10.82	0.65	-22.19
12.5	0.91	0.10	-21.61	4.24	10.62	0.62	-21.43
13.5	0.95	0.10	-21.46	3.56	11.08	0.59	-20.07
14.5	0.85	0.09	-21.48	3.42	11.02	0.53	-22.71
15.5	0.90	0.10	-21.47	3.62	10.50	0.57	-15.49
16.5	0.84	0.09	-21.70	3.81	10.89	0.41	-20.14
17.5	0.85	0.09	-22.03	3.52	11.02	0.42	-18.30
18.5	0.74	0.08	-22.05	3.46	10.79	0.37	-20.34
19.5	0.79	0.08	-21.99	3.35	11.52	0.30	-15.90
21.5	0.76	0.09	-22.39	3.72	9.85	0.32	-22.96
23.5	0.81	0.29	-22.11	1.46	3.26	0.33	-20.36
25.5	0.72	0.23	-22.26	1.87	3.65	0.31	-18.10
29.5	0.78	0.17	-22.36	1.53	5.35	0.29	-19.62
33.5	0.77	0.17	-22.65	1.65	5.28	0.30	-20.06
37.5	0.78	0.16	-23.22	1.21	5.69	0.24	-20.86

Table 9. MRD05-04GC Stable and isotopic Carbon

Sample depth mid- point (cm)	Ž^{13}C$_{(VPDB)}$	TOC (%)	Sample depth mid- point (cm)	Ž^{13}C$_{(VPDB)}$	TOC (%)
0.5	-21.5	1.446	116.5	-22.9	1.114
2.5	-21.4	1.332	118.5	-22.8	1.155
4.5	-21.7	1.263	120.5		1.192
6.5	-21.8	1.18	122.5	-22.8	1.112
8.5	-21.7	1.275	124.5	-22.7	1.121
10.5	-21.8	1.24	126.5	-22.6	1.109
12.5	-22.0	1.134	128.5	-22.5	1.193
14.5	-22.0	1.186	130.5	-22.6	1.208
16.5	-22.3	1.139	132.5	-22.7	1.169
18.5	-22.5	1.138	134.5	-22.6	1.157
20.5	-22.6	1.104	136.5	-22.3	1.131
22.5	-23.2	1.021	138.5	-22.2	1.106
24.5	-22.8	1.066	140.5	-22.2	1.149
26.5	-22.6	1.122	142.5	ND	1.122
28.5	-22.2	1.154	144.5	-22.0	1.162
30.5	-22.3	1.099	146.5	-22.0	1.058
32.5	-22.6	1.336	148.5	-21.9	1.197
34.5	-22.2	1.154	150.5	-22.1	1.083
36.5	-22.0	1.2	152.5	-22.1	1.144
38.5	-22.1	1.176	154.5	-22.4	0.98
40.5	-21.9	ND	156.5	-22.6	1.097
42.5	-22.0	1.175	158.5	-22.8	0.921
44.5	-22.1	1.045	160.5	-21.8	1.11
46.5	-22.1	1.213	162.5	-21.7	1.187
48.5	-22.2	1.187	164.5	-21.8	1.121
50.5	-22.2	1.257	166.5	-21.7	1.095
52.5	-22.1	1.296	168.5	-21.7	1.176
54.5	-22.1	1.199	170.5	ND	1.136
56.5	-22.2	1.288	172.5	-21.5	1.115
58.5	-22.3	1.269	174.5	-21.3	1.152
60.5	-22.5	1.075	176.5	-21.3	1.086
62.5	-22.0	1.333	178.5	-21.2	1.207
64.5	-21.9	1.206	180.5	-21.2	1.206
66.5	-21.8	1.224	182.5	-21.2	1.203
68.5	-21.9	1.248	184.5	-21.6	1.267
70.5	-22.1	1.254	186.5	-22.4	1.46
72.5	-22.2	1.252	188.5	-22.5	1.048
74.5	-22.1	1.257	190.5	-22.1	1.149
76.5	-22.2	1.293	192.5	-23.1	1.312
78.5	-22.1	1.343	194.5	-22.7	1.224
80.5	-22.1	1.206	196.5	-23.2	1.149
82.5	-23.7	1.127	198.5	-23.1	1.264
84.5	-22.3	1.237	200.5	-23.0	1.129
86.5	-22.3	1.245	202.5	-23.1	1.126
88.5	-22.7	1.183	204.5	-23.1	1.133
90.5	-22.6	1.253	206.5	-23.0	1.177
92.5	-22.3	1.294	208.5	-23.1	1.15
94.5	-22.6	1.252	210.5	-23.1	1.156
96.5	-22.9	1.296	212.5	-23.0	1.187
98.5	-23.2	1.152	214.5	-23.0	1.136
100.5	-23.1	1.194	216.5	-23.0	1.249
102.5	-23.3	1.278	218.5	-22.8	1.193
104.5	-23.5	1.269	220.5	-22.4	1.213
106.5	-23.3	1.276	222.5	-22.2	1.205
108.5	-23.6	1.267	224.5	-22.4	1.244
110.5	-23.3	1.285	226.5	-23.0	1.069
112.5	-23.1	1.151	228.5	-23.0	1.108
114.5	-22.9	1.097	ND= no data		

Table 10. Vanadium concentration MRD05-04BC	
sample depth mid-point (cm)	V (µg g^{-1})
0.5	132
1.5	130
2.5	131
3.5	130
4.5	127
5.5	127
6.5	134
7.5	137
8.5	139
9.5	137
10.5	135
11.5	142
12.5	138
13.5	132
14.5	134
15.5	138
16.5	143
17.5	139
18.5	141
19.5	145
20.5	142
21.5	134
22.5	139
23.5	140
24.5	141
25.5	136
26.5	144
27.5	146
28.5	145
29.5	144
30.5	149
31.5	144
32.5	151
33.5	150
34.5	148
35.5	142
36.5	144
37.5	143
38.5	128
39.5	129
4.05	126

Table 11. Vanadium concentration MRD05-04GC

Sample depth mid-point (cm)	V (µg g-1)		Sample depth mid-point (cm)	V (µg g-1)
0.5	136		108.5	139
2.5	146		110.5	142
4.5	137		112.5	152
6.5	140		114.5	154
8.5	138		116.5	148
10.5	143		118.5	148
12.5	146		120.5	144
14.5	146		122.5	142
16.5	145		124.5	141
18.5	144		126.5	144
20.5	144		128.5	144
22.5	103		130.5	130
24.5	124		132.5	131
26.5	127		134.5	131
28.5	145		136.5	145
30.5	144		138.5	149
32.5	146		140.5	143
34.5	147		142.5	148
36.5	147		144.5	148
38.5	148		146.5	148
40.5	144		148.5	150
42.5	147		150.5	130
44.5	146		152.5	146
46.5	147		154.5	110
48.5	146		156.5	127
50.5	146		158.5	101
52.5	148		160.5	143
54.5	147		162.5	155
56.5	138		164.5	150
58.5	137		166.5	141
60.5	114		168.5	142
62.5	142		170.5	136
64.5	148		172.5	140
66.5	149		174.5	135
68.5	145		176.5	136
70.5	149		178.5	143
72.5	147		180.5	143
74.5	143		182.5	144
76.5	133		184.5	149
78.5	136		186.5	147
80.5	138		188.5	122
82.5	130		190.5	150
84.5	141		192.5	156
86.5	145		194.5	158
88.5	159		196.5	151
90.5	155		198.5	152
92.5	150		200.5	136
94.5	151		202.5	139
96.5	155		204.5	145
98.5	156		208.5	138
100.5	140		212.5	153
102.5	145		216.5	154
104.5	139		220.5	157
106.5	142		224.5	155
			228.75	127