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24. ORGANIC CARBON ACCUMULATION AT SOUTHEAST GREENLAND SITE 918: IMPLICATIONS ON PALEOENVIRONMENT AND PALEOCEANOGRAPHY DURING LATE CENOZOIC TIMES[1]

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ABSTRACT

Site 918 was drilled in the western part of the Irminger Basin to sample sediments comprising major changes in paleoclimate and paleoceanography of the last 51 m.y. Organic geochemical investigations were performed to study the quality and quantity of organic matter within the distinct lithologic units. At Site 918, changes in the lithologic composition recognized in the sedimentary column correlate very well with changes in the organic fraction, which is used for paleoenvironmental reconstructions. The accumulation of organic carbon at Site 918 is mainly controlled by the interaction between surface-water productivity, bottom-water oxygenation, burial rates, and terrigenous organic supply. One of the main organic constituents is plant detritus deposited in preglacial times. Planktonic organic material dominates during glacial times (i.e., the last 5 m.y.).

INTRODUCTION

The Southeast Greenland Transect, Ocean Drilling Program (ODP) Leg 152, was drilled from September to November 1993 to gain information about (1) the nature and subsidence history of the seaward-dipping reflector sequence (SDRS), (2) the paleoceanographic and glaciation history of the southeast Greenland shelf and the Irminger Basin, and (3) the evolution of the break-up volcanism of the North Atlantic (Larsen, Saunders, Clift, et al., 1994). The sediments of the Irminger Basin probably record several important paleoceanographic events (e.g., the initial overflow of the North Atlantic Deep Water [NADW] and the onset of major Northern Hemisphere glaciations).

Site 918 is located on the upper continental rise, approximately 130 km off the east Greenland coast, at a water depth of 1868.5 m (Fig. 1; Larsen, Saunders, Clift, et al., 1994). The volcanic basement of the SDRS is overlain by about 1200 m of sediment, spanning in age from Paleocene to Holocene. As already shown by shipboard analyses, total organic carbon (TOC) contents of the sediments recovered at Site 918 are relatively low, ranging between 0.1 and 0.5 wt% (Fig. 2). In this study, the major aim is to investigate the quantity and quality of organic matter in terms of a correlation of changes in the composition with changes in lithology and, thus, in paleoclimatic and paleoceanographic conditions. Several different methods were applied to study the organic carbon fraction of sediments at Site 918: elemental analyses (total organic carbon and total nitrogen content), Rock-Eval pyrolysis parameters, maceral microscopy, and specific biomarker extraction.

Major Lithologies at Site 918

The sedimentary sequence of Site 918 comprises six major lithologic units (cf. Larsen, Saunders, Clift, et al., 1994). Unit I (0–600 m below seafloor [mbsf]; Quaternary to late Miocene age) contains five subunits and mainly consists of dark gray silt with volcanic and nonvolcanic components. Ice-rafted debris (IRD) and dropstones occur throughout the entire unit except in Subunit IE. Lithologic Unit II (600–806.5 mbsf; early to late Miocene age) comprises nannofossil chalk and very dark gray silt with nannofossils. Sediments of this unit are heavily bioturbated and contain bivalve shells, sponge spicules, and radiolarians. In contrast to the carbonate-rich chalks of Unit II, the sediments of Unit III (806.5–1108.2 mbsf; late Oligocene age) are characterized by massive or laminated sand, silt, and frequently interbedded nannofossil chalks. Lithologic Unit IV (1108.2–1157.9 mbsf; early to middle Eocene age) consists of nannofossil chalk and silt with nannofossils, whereas Unit V (1157.9–1189.4 mbsf; early Eocene age) is dominated by glauconitic sands with interbedded calcareous sands. Remarkable is the lack of microfossils in Unit V (Larsen, Saunders, Clift, et al., 1994). The top of the basaltic pile is described in lithologic Unit VI (1189.4–1204.4 mbsf; unknown age).

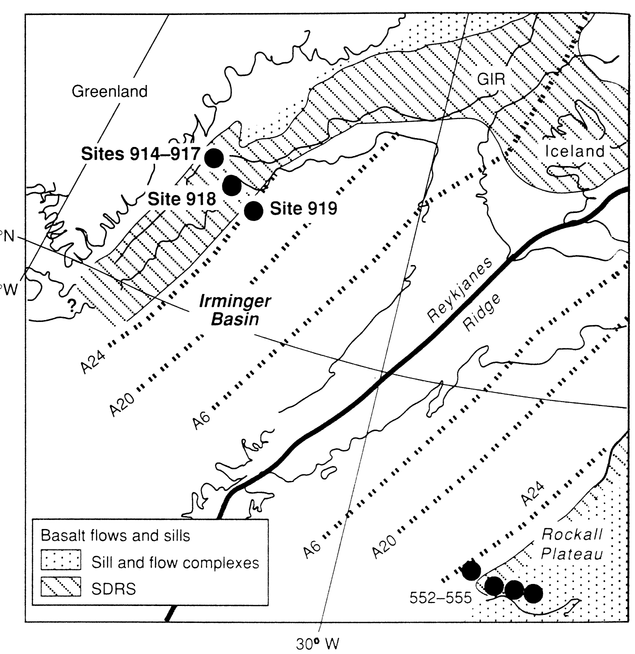

Figure 1. Map of the southeast Greenland Margin with locations of ODP Sites 914–919 and DSDP Sites 552–555. SDRS = seaward-dipping reflector sequence. GIR = Greenland-Iceland Ridge. A6–A24 indicate geomagnetic anomalies.

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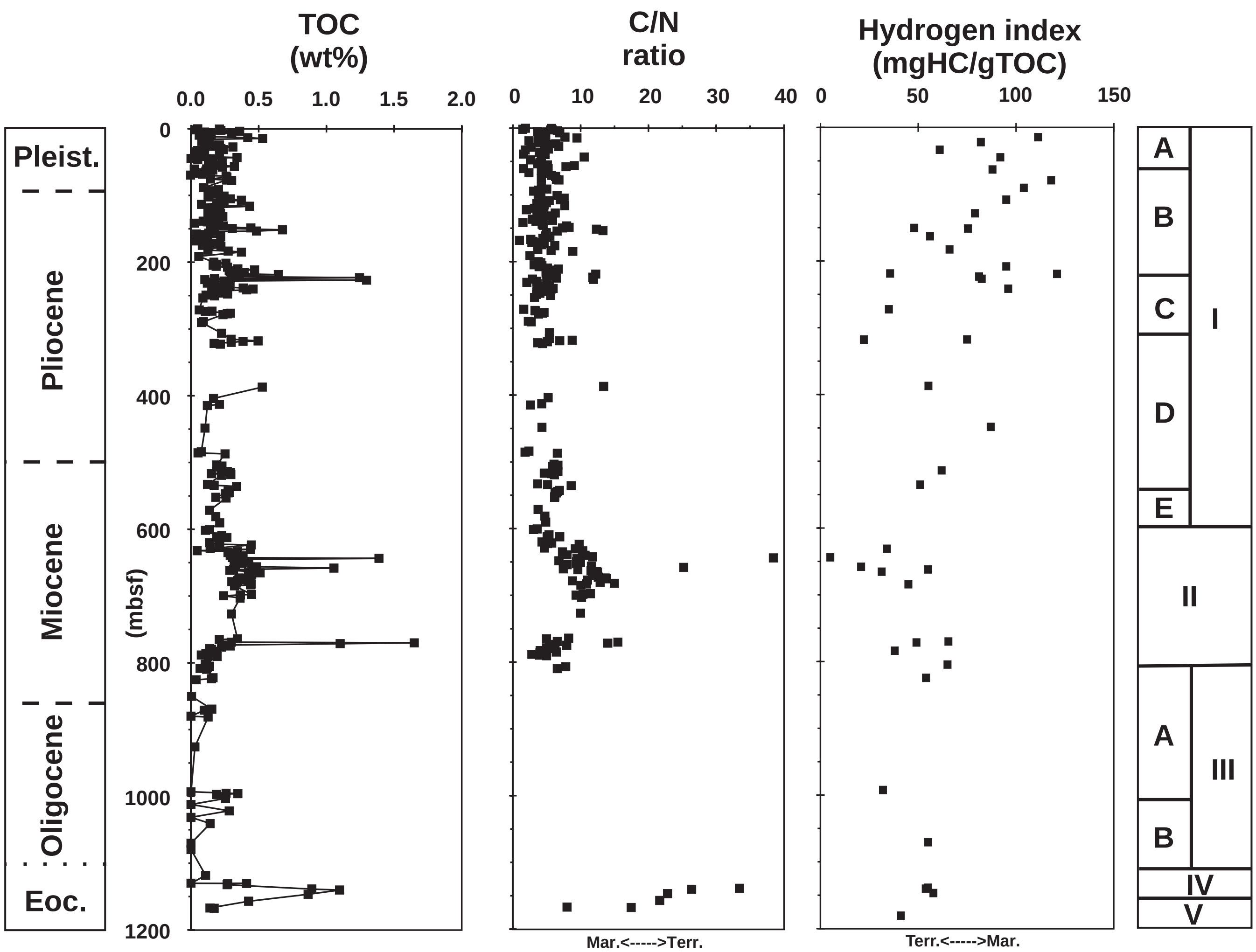

Figure 2. Total organic carbon, total organic carbon/total nitrogen ratios, and hydrogen index of Site 918 sediments vs. depth values. Left column indicates ages after preliminary shipboard stratigraphy (Larsen, Saunders, Clift, et al., 1994). Right column indicates lithologic units.

METHODS

Most of the TOC values are from shipboard data, measured following the analytical procedure described in the "Explanatory Notes" chapter in Larsen, Saunders, Clift, et al. (1994). Additional shore-based samples from Site 918 were examined for total carbon (TC), TOC, and total nitrogen using a Heraeus CHN Analyzer. To separate the organic carbon from carbonate-bonded carbon, the bulk samples were treated with HCl (10%), washed, and dried (Froelich, 1980; Weliky et al., 1983). The accuracy of the CHN analysis is 0.02%, and the relative standard deviation of control measurements about 0.2%. The carbonate content was calculated as

$$CaCO_3 = (TC - TOC) \times 8.333,$$

where TC and TOC are given in weight percent (wt%) of the bulk sample. This calculation assumes that all carbonate in the sediment is calcite. The organic carbon/total nitrogen (C/N) ratio was calculated as an indicator for the composition of the organic carbon from TOC and total nitrogen content. Marine phyto- and zooplankton are characterized by mean C/N ratios of 6–10, whereas terrigenous organic matter shows values of more than 15.

For an initial characterization of the organic material, Rock-Eval pyrolysis measurements were performed on ground bulk samples using a Delsi, Inc., Rock-Eval II instrument and following the standard procedures described by Espitalié et al. (1977). The Rock-Eval parameters used are the hydrogen index (HI corresponds to the quantity of pyrolyzable hydrocarbons per gram TOC; mg HC/g C) and the oxygen index (OI corresponds to the quantity of carbon dioxide per gram TOC; mg CO_2/g C). In a van Krevelen diagram, a classification of the organic matter in terms of marine vs. terrigenous kerogen type is possible (see "Results" section below). In carbon-lean sediments, the organic matter may be strongly bonded to clay minerals (mineral matrix effect), which results in lower values. These values have to be interpreted cautiously (Peters, 1986; Katz, 1983). The temperature of maximum hydrocarbon yield during pyrolysis (T_{max}) provides additional information about the maturity of the organic matter in the sediment. Immature organic matter has T_{max} values of less than 435°C (Tissot and Welte, 1984).

Long-chain *n*-alkanes are very indicative biomarkers for the composition of organic material. *N*-alkanes from C_{27} through C_{31} point to a terrigenous source, whereas *n*-alkanes with lower molecular weights (C_{15} through C_{19}) mainly derive from marine organisms.

To examine the ground bulk sample for *n*-alkanes, the sediments were treated successively with methanol, methanol/dichloromethane (1:1), and dichloromethane (cf. Farrimond et al., 1990). After centrifuging, the three extracts were combined, and squalene was added as an internal standard. The hydrocarbon fraction was removed from the bulk extract by column chromatography, eluted with hexane, and injected into a HP (Series II) gas chromatograph. Helium was used as the carrier gas. An HP1 capillary column was used (50 m × 0.32 mm; 0.17-µm film of dimethyl-polysiloxane), and the temperature program was as follows: 60°C for 1 min; 60°–150°C at 10°C/min; 150°–300°C at 4°C/min, and isothermal at 300°C for 45 min.

Microscopic investigation of the maceral composition was performed on a selected set of samples distributed over the entire core. Due to the low organic carbon content and the extremely small particle size, the amounts of macerals were estimated and presented as trends. To distinguish between marine and terrigenous organic particles, the maceral classification was performed according to Stach et al. (1982) and Hutton et al. (1980). Vitrinites, pollenites (terrigenous), and alginites (marine) are the dominant components; however, if these macerals are strongly destroyed, the terms lipto- and vitrodetrinite were used to be indicative of the presence of marine and terrigenous organic matter, respectively.

RESULTS

Quantity of Organic Carbon

The sediments drilled at Site 918 are characterized by low to very low organic carbon contents throughout the cores (Fig. 2; Table 1). Most of the values are between 0 and 0.5 wt%, which is within the fluctuation observed in sediments of the North Atlantic Ocean (e.g., Eldholm, Thiede, Taylor, et al., 1987; Srivastava, Arthur, Clement, et al., 1987). In a few samples, higher values of 1–1.5 wt% TOC were measured.

The lowermost part of the sediment column at Site 918 (Eocene glauconitic sands of lithologic Units V and IV) shows high organic carbon contents, whereas in the Oligocene interval the values decrease (up to 0.4 wt%). A distinct increase in TOC can be recognized in the Miocene sediments (500–800 mbsf), with a maximum at about 650 mbsf (Fig. 2). This interval also includes some single spikes, with values as high as 1.6 wt%. The Pliocene–Pleistocene sediments are characterized by a higher fluctuation of the TOC contents, with values between 0 and 0.5 wt%.

Composition of Organic Carbon

For paleoenvironmental interpretations, the information about marine and terrigenous proportions of the organic carbon fraction is absolutely necessary. To determine the quality of the organic matter, several different methods were used. The interpretation of the data is based on the combination of the different approaches because all methods have their specific limits (cf. Stein, 1991). Data from Rock-Eval pyrolysis, kerogen microscopy, biomarker (*n*-alkane) extractions, and organic carbon/nitrogen ratios were used in this study to gain information about the composition and provenance of the organic matter.

Rock-Eval Data

Rock-Eval pyrolysis provides a rapid evaluation method of organic carbon. Due to the mineral matrix effect (Katz, 1983), however, the values are relatively low, and only trends are important for the distinction of marine vs. terrigenous origin. The sediments of Site 918 generally contain a mixture of marine and terrigenous organic matter. Based on the hydrogen index values, the record can be subdivided into a lower, terrigenous-influenced interval (1150–500 mbsf; 5–60 mg HC/g TOC) and an upper, marine-dominated section (500–0 mbsf; 20–110 mg HC/g TOC; Fig. 2; Table 2).

C/N Ratios

Organic carbon/total nitrogen ratios were used to characterize the quality of the organic matter (Scheffer and Schachtschabel, 1984; Stein, 1991; Stax, 1994). The data vary between 3 and 15, with maximum values up to 36 at 650 and 1150 mbsf (Fig. 2; Table 1). These spikes are probably the result of an enhanced content of wood pieces in the sediment. In most of the Eocene–Oligocene samples, the total nitrogen content is below the detection limit, indicating a terrigenous organic matter source. A slight maximum between 600 and 800 mbsf coincides with high organic carbon values, indicating increased terrigenous organic matter accumulation during this time interval.

Maceral Data

Kerogen microscopy was performed on 11 resin-impregnated specimens; the results are shown in Table 3. The Eocene–Oligocene sediments are dominated by terrigenous macerals as vitrinite and vitrodetrinite. Pollenites are rare, and background fluorescence is very low. Abundant wood pieces show the characteristic tissue structure.

In the middle Miocene interval (lithologic Unit II) background fluorescence increases, whereas single macerals disappear. Vitrodetrinite and liptodetrinite dominate in the maceral composition. Pollenite is rare.

The Pliocene–Pleistocene interval displays a very low maceral content (Table 3). Background fluorescence intensity as an indicator for marine organic matter varies between medium and low. Terrigenous macerals are absent.

Biomarker Data

Biomarkers (e.g., *n*-alkanes) may give important information about the composition of organic matter [Prahl and Muehlhausen, 1989]). The aliphatic fraction of the lower part of Site 918 is dominated by long-chain *n*-alkanes (C_{27} through C_{31}), indicating a terrigenous source of organic matter (Fig. 3; Table 4). In the middle and upper part of the sedimentary sequence, the pattern points to a mixture of marine and terrigenous organic carbon. However, due to the very low organic carbon content the biomarker data have to be interpreted very cautiously and need confirmation by further analyses.

Flux of Organic Carbon

Mass accumulation (flux) rates were calculated for the upper 3.6 m.y. to interpret the data in terms of organic carbon supply (cf. van Andel et al., 1975). The values are based on shipboard stratigraphy and index property data (Larsen, Saunders, Clift, et al., 1994; Fig. 4; Table 1). Between 3.6 and 2.4 Ma, the flux rates of organic carbon are relatively high (up to 0.35 g/cm^2/k.y.). Most of the values in this time interval vary between 0.01 and 0.2 g/cm^2/k.y. During the last 2.4 m.y., they decrease below 0.05 g/cm^2/k.y.

DISCUSSION AND CONCLUSIONS

The marine depositional environment of the Southeast Greenland Margin has undergone strong changes in climate, sea level, and surface-water circulation during the last 51 m.y. These changes regard the lithogenic sediment fraction as well as the organic material in the sediment. For paleoenvironmental reconstructions using the sedimentary record, several different organic and inorganic geochemical, physical, and petrological methods can be applied. Quality and quantity of the organic sedimentary fraction are very important parameters to characterize a depositional system. Climate-induced changes in the siliciclastic fraction of the sediment necessarily lead to changes in the organic fraction; thus, a combined investigation can help to get insight into the paleoenvironmental conditions of the region. In the following, the results of a investigation of the organic matter are interpreted to reconstruct the temporal changes in climatic conditions of the Southeast Greenland Continental Margin. Interpretations are presented in the three main time slices, also recognized as lithologic units in the sedimentary column.

Table 1. Summary table of Site 918 data.

									Accumulation rates		
Core, section, interval (cm)	Depth (mbsf)	Age (Ma)	TC (wt%)	IC (wt%)	TOC (wt%)	$CaCO_3$ (wt%)	TN (wt%)	TOC/N ratio	Bulk (g/cm^2/k.y.)	TOC (g/cm^2/k.y.)	Carbonate (g/cm^2/k.y.)
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1H-1, 33–34	0.33	0.006	0.52	0.47	0.05	3.92	0.03	2	8.400	0.004	0.329
1H-1, 62–63	0.62	0.010	0.51	0.30	0.21	2.50	0.04	6	6.720	0.014	0.168
1H-2, 28–29	1.78	0.030	0.27	0.24	0.03	2.00	0.02	1	9.920	0.003	0.198
2H-1, 73–74	2.53	0.042	0.55	0.33	0.22	2.75	0.04	6	9.920	0.022	0.273
2H-2, 58–59	3.88	0.065	0.54	0.18	0.36	1.50	0.06	7	7.600	0.027	0.114
2H-3, 33–34	5.13	0.086	0.21	0.11	0.10	0.92	0.03	4	9.600	0.010	0.088
2H-4, 65–66	6.95	0.116	0.42	0.12	0.30	1.00	0.04	7	8.320	0.025	0.083
2H-5, 21–22	8.01	0.134	0.29	0.14	0.15	1.17	0.03	4	10.240	0.015	0.119
2H-6, 51–52	9.81	0.164	0.19	0.13	0.06	1.08	0.01	4	12.800	0.008	0.139
3H-1, 36–37	11.66	0.194	0.18	0.09	0.09	0.75	0.02	5	12.240	0.011	0.092
3H-2, 73–74	13.53	0.226	0.57	0.15	0.42	1.25	0.05	8	9.360	0.039	0.117
3H-3, 30–31	14.60	0.243	0.69	0.16	0.53	1.33	0.06	9	8.880	0.047	0.118
3H-4, 27–28	16.07	0.268	0.37	0.27	0.10	2.25	0.03	4	12.000	0.012	0.270
3H-6, 27–28	19.07	0.318	0.56	0.48	0.08	4.00	0.03	2	10.240	0.008	0.409
3H-7, 38–39	20.68	0.345	0.27	0.13	0.14	1.08	0.04	4	11.360	0.016	0.123
4H-1, 76–77	21.56	0.359	0.28	0.16	0.12	1.33	0.03	4	11.600	0.014	0.155
4H-2, 125–126	23.55	0.393	0.33	0.21	0.12	1.75	0.02	6	12.160	0.015	0.213
4H-3, 32–33	24.12	0.402	0.31	0.10	0.21	0.83	0.04	5	10.400	0.022	0.087
4H-4, 36–37	25.66	0.428	0.25	0.08	0.17	0.67	0.04	5	12.800	0.022	0.085
4H-5, 63–64	27.43	0.457	0.45	0.14	0.31	1.17	0.05	7	10.480	0.032	0.122
4H-6, 31–32	28.61	0.477	1.06	0.96	0.10	8.00	0.04	3	7.760	0.008	0.621
4H-7, 13–14	29.93	0.499	0.29	0.07	0.22	0.58	0.05	5	9.520	0.021	0.056
5H-1, 126–127	31.56	0.526	0.46	0.22	0.24	1.83	0.05	5	9.920	0.024	0.182
5H-2, 80–81	32.60	0.543	0.13	0.08	0.05	0.67	0.03	2	11.840	0.006	0.079
5H-3, 128–129	34.58	0.576	0.10	0.06	0.04	0.50	0.00		13.680	0.005	0.068
5H-4, 126–127	36.06	0.601	0.18	0.08	0.10	0.67	0.03	4	13.040	0.013	0.087
5H-5, 133–134	37.63	0.627	0.49	0.43	0.06	3.58	0.00		11.280	0.007	0.404
5H-6, 132–133	39.12	0.652	0.12	0.04	0.08	0.33	0.05	2	10.000	0.008	0.033
5H-7, 27–28	39.57	0.660	0.27	0.06	0.21	0.50	0.04	5	11.520	0.024	0.058
6H-2, 40–41	41.70	0.695	0.38	0.31	0.07	2.58	0.00		7.200	0.005	0.186
6H-3, 41–42	43.21	0.720	0.80	0.46	0.34	3.83	0.03	11	8.720	0.030	0.334
6H-4, 40–41	44.70	0.745	0.20	0.21	0.00	1.75	0.00		13.200	0.000	0.231
6H-5, 40–41	46.20	0.770	0.26	0.21	0.05	1.75	0.00		12.480	0.006	0.218
6H-6, 33–34	47.63	0.794	0.74	0.61	0.13	5.08	0.05	3	9.520	0.012	0.484
6H-7, 41–42	49.21	0.820	0.31	0.08	0.23	0.67	0.05	4	11.120	0.026	0.074
7H-1, 122–123	50.52	0.842	0.95	0.79	0.16	6.58	0.00		9.920	0.016	0.653
7H-2, 30–31	51.10	0.852	0.40	0.24	0.16	2.00	0.04	4	10.720	0.017	0.214
7H-3, 123–124	53.53	0.892	0.25	0.12	0.13	1.00	0.04	4	11.040	0.014	0.110
7H-4, 112–113	54.92	0.915	0.30	0.09	0.21	0.75	0.04	5	12.160	0.026	0.091
7H-5, 111–112	56.41	0.940	0.42	0.10	0.32	0.83	0.04	9	11.600	0.037	0.097
7H-6, 94–95	57.74	0.962	0.38	0.15	0.23	1.25	0.03	8	11.520	0.027	0.144
8H-1, 139–140	60.19	1.803	0.46	0.34	0.12	2.83	0.02	5	10.650	0.012	0.302
8H-2, 34–35	60.64	1.810	0.09	0.07	0.02	0.58	0.01	2	12.225	0.003	0.071
8H-3, 34–35	62.14	1.832	0.33	0.17	0.16	1.42	0.03	5	9.750	0.016	0.138
8H-4, 23–24	63.53	1.853	0.51	0.40	0.11	3.33	0.03	4	10.500	0.012	0.350
8H-5, 125–126	66.05	1.891	0.14	0.04	0.10	0.33	0.02	5	12.000	0.012	0.040
8H-6, 35–36	66.65	1.900	0.13	0.07	0.06	0.58	0.03	2	11.775	0.007	0.069
8H-7, 33–34	68.13	1.922	0.15	0.06	0.09	0.50	0.02	5	12.150	0.010	0.061
9H-1, 127–128	69.57	1.944	0.95	0.95	0.00	7.91	0.03		8.775	0.000	0.694
9H-2, 113–114	70.93	1.964	0.39	0.13	0.26	1.08	0.05	6	8.175	0.021	0.089
9H-3, 114–115	72.44	1.987	0.33	0.06	0.27	0.50	0.04	6	10.050	0.027	0.050
9H-5, 113–114	75.43	2.031	0.16	0.02	0.14	0.17	0.03	4	10.050	0.014	0.017
9H-7, 37–38	77.67	2.065	0.36	0.06	0.30	0.50	0.04	7	10.650	0.032	0.053
9H-6, 112–113	76.92	2.054	0.34	0.08	0.26	0.67	0.04	6	10.275	0.027	0.068
11H-1, 122–123	88.52	2.228	0.34	0.25	0.09	2.08	0.02	4	10.875	0.010	0.226
11H-3, 110–111	91.40	2.271	0.24	0.04	0.20	0.33	0.04	5	10.350	0.021	0.034
11H-4, 104–105	92.84	2.293	0.21	0.05	0.16	0.42	0.04	4	8.025	0.013	0.033
11H-5, 105–106	94.35	2.315	0.17	0.04	0.13	0.33	0.04	3	6.900	0.009	0.023
12H-1, 109–110	97.89	2.368	0.36	0.17	0.19	1.42	0.05	4	9.675	0.018	0.137
12H-2, 113–114	99.43	2.391	0.18	0.05	0.13	0.42	0.03	4	12.375	0.016	0.052
12H-3, 113–114	100.93	2.405	0.32	0.08	0.24	0.67	0.04	7	25.870	0.063	0.172
12H-4, 108–109	102.38	2.413	0.18	0.05	0.13	0.42	0.03	4	27.860	0.037	0.116
12H-6, 70–71	105.00	2.428	0.37	0.08	0.29	0.67	0.04	8	26.865	0.078	0.179
13H-1, 101–102	107.31	2.440	0.46	0.09	0.37	0.75	0.05	7	26.467	0.098	0.198
13H-2, 99–100	108.79	2.448	0.34	0.10	0.24	0.83	0.05	5	26.268	0.064	0.219
13H-3, 99–100	110.29	2.457	0.33	0.11	0.22	0.92	0.05	4	25.671	0.055	0.235
13H-4, 97–98	111.77	2.465	0.27	0.08	0.19	0.67	0.04	5	26.865	0.051	0.179
13H-5, 118–119	113.48	2.474	0.18	0.10	0.08	0.83	0.02	4	27.661	0.021	0.230
13H-6, 117–118	114.97	2.482	0.40	0.19	0.21	1.58	0.05	5	28.059	0.060	0.444
14H-1, 34–35	116.14	2.489	0.63	0.20	0.43	1.67	0.06	8	26.865	0.116	0.448
14H-2, 76–77	118.06	2.499	0.34	0.13	0.21	1.08	0.05	4	28.059	0.058	0.304
14H-3, 121–122	120.01	2.510	0.25	0.11	0.14	0.92	0.04	3	27.860	0.039	0.255
14H-4, 87–88	121.17	2.516	0.22	0.07	0.15	0.58	0.04	4	26.268	0.040	0.153
14H-5, 56–57	122.36	2.523	0.27	0.10	0.17	0.83	0.08	2	27.064	0.046	0.225
15H-1, 121–122	126.51	2.546	0.22	0.09	0.13	0.75	0.03	5	29.054	0.037	0.218
15H-2, 31–32	127.11	2.549	0.37	0.15	0.22	1.25	0.03	6	29.054	0.063	0.363
15H-3, 120–121	129.50	2.562	0.38	0.21	0.17	1.75	0.04	4	28.855	0.049	0.505
15H-4, 120–121	131.00	2.571	0.37	0.21	0.16	1.75	0.04	4	30.049	0.047	0.526
15H-5, 31–32	131.61	2.574	0.36	0.13	0.23	1.08	0.04	5	31.044	0.073	0.336
16H-1, 33–34	133.63	2.585	0.26	0.09	0.17	0.75	0.04	5	26.666	0.046	0.200
16H-2, 78–79	135.58	2.596	0.29	0.09	0.20	0.75	0.05	4	27.860	0.057	0.209
16H-3, 29–30	136.59	2.601	0.21	0.07	0.14	0.58	0.05	3	29.452	0.041	0.172
16H-4, 73–74	138.53	2.612	0.18	0.09	0.09	0.75	0.02	6	32.636	0.029	0.245
16H-5, 30–31	139.60	2.618	0.21	0.09	0.12	0.75	0.04	3	28.656	0.036	0.215
16H-6, 78–79	141.58	2.629	0.16	0.14	0.02	1.17	0.02	1	37.810	0.009	0.441

Table 1 (continued).

Core, section, interval (cm)	Depth (mbsf)	Age (Ma)	TC (wt%)	IC (wt%)	TOC (wt%)	$CaCO_3$ (wt%)	TN (wt%)	TOC/N ratio	Accumulation rates Bulk ($g/cm^2/k.y.$)	TOC ($g/cm^2/k.y.$)	Carbonate ($g/cm^2/k.y.$)
17H-1, 115–116	143.95	2.642	0.25	0.05	0.20	0.42	0.05	4	25.870	0.053	0.108
17H-2, 114–115	145.44	2.650	0.31	0.07	0.24	0.58	0.05	5	24.477	0.059	0.143
17H-3, 73–74	146.53	2.656	0.59	0.44	0.15	3.67	0.02	8	27.860	0.041	1.021
17H-4, 127–128	148.57	2.667	0.45	0.01	0.44	0.08	0.05	8	29.651	0.131	0.025
17H-5, 74–75	149.54	2.672	0.43	0.13	0.30	1.08	0.04	7	32.238	0.098	0.349
17H-6, 122–123	151.52	2.683	1.00	0.32	0.68	2.67	0.05	12	32.835	0.222	0.875
18H-1, 119–120	153.49	2.694	0.62	0.14	0.48	1.17	0.04	13	30.646	0.148	0.357
18H-2, 28–29	154.08	2.697	0.33	0.16	0.17	1.33	0.03	7	31.243	0.054	0.416
18H-3, 128–129	156.58	2.711	0.19	0.06	0.13	0.50	0.03	5	27.263	0.036	0.136
18H-4, 82–83	157.62	2.717	0.08	0.04	0.04	0.33	0.00		34.825	0.014	0.116
18H-5, 23–24	158.53	2.722	0.17	0.08	0.09	0.67	0.00		33.830	0.031	0.225
18H-6, 43–44	160.23	2.731	0.13	0.06	0.07	0.50	0.00		32.636	0.023	0.163
18H-7, 48–49	161.78	2.740	0.16	0.07	0.09	0.58	0.02	5	31.044	0.029	0.181
19H-1, 23–24	162.03	2.741	0.27	0.05	0.22	0.42	0.04	5	24.676	0.054	0.103
19H-2, 35–36	163.65	2.750	0.19	0.08	0.11	0.67	0.02	5	31.442	0.036	0.210
19H-3, 34–35	165.14	2.758	0.40	0.30	0.10	2.50	0.02	4	31.641	0.032	0.791
19H-4, 34–35	166.64	2.767	0.22	0.11	0.11	0.92	0.04	3	29.651	0.032	0.272
19H-5, 35–36	168.15	2.775	0.12	0.09	0.03	0.75	0.03	1	29.452	0.009	0.221
19H-6, 34–35	169.64	2.783	0.18	0.06	0.12	0.50	0.04	3	31.840	0.039	0.159
19H-7, 35–36	171.15	2.791	0.18	0.06	0.12	0.50	0.04	3	26.069	0.032	0.130
20X-1, 37–38	171.67	2.794	0.22	0.06	0.16	0.50	0.05	3	28.059	0.044	0.140
20X-2, 27–28	173.07	2.802	0.28	0.07	0.21	0.58	0.05	5	26.666	0.056	0.155
20X-3, 27–28	174.57	2.810	0.20	0.12	0.08	1.00	0.02	4	34.228	0.028	0.342
20X-4, 26–27	176.06	2.818	0.34	0.12	0.22	1.00	0.04	6	31.840	0.070	0.318
21X-1, 35–36	181.85	2.850	0.30	0.17	0.13	1.42	0.03	4	32.238	0.040	0.457
21X-2, 34–35	183.34	2.858	0.41	0.14	0.27	1.17	0.05	6	28.059	0.077	0.327
21X-3, 20–21	184.70	2.866	0.50	0.13	0.37	1.08	0.04	9	28.855	0.107	0.312
22X-1, 26–27	191.16	2.901	0.16	0.10	0.06	0.83	0.02	3	27.263	0.016	0.227
23X-1, 26–27	200.06	2.950	0.28	0.11	0.17	0.92	0.05	4	28.059	0.048	0.257
23X-2, 26–27	201.56	2.959	0.85	0.59	0.26	4.91	0.06	4	26.069	0.067	1.281
23X-3, 26–27	203.06	2.967	0.23	0.04	0.19	0.33	0.05	4	26.467	0.050	0.088
23X-4, 27–28	204.57	2.975	0.20	0.04	0.16	0.33	0.05	3	28.457	0.047	0.095
23X-5, 32–33	206.12	2.984	0.35	0.16	0.19	1.33	0.04	4	27.860	0.052	0.371
23X-6, 32–33	207.62	2.992	0.35	0.08	0.27	0.67	0.07	4	27.263	0.074	0.182
24X-1, 106–107	209.76	3.004	0.46	0.11	0.35	0.92	0.07	5	27.462	0.095	0.252
24X-2, 109–110	211.29	3.012	0.60	0.13	0.47	1.08	0.07	7	29.850	0.140	0.323
24X-3, 108–109	212.78	3.020	0.39	0.11	0.28	0.92	0.05	6	31.442	0.089	0.288
24X-4, 109–110	214.29	3.029	0.51	0.22	0.29	1.83	0.06	5	29.850	0.087	0.547
24X-5, 107–108	215.77	3.037	0.65	0.26	0.39	2.17	0.07	6	30.447	0.120	0.659
24X-6, 94–95	217.14	3.044	0.41	0.11	0.30	0.92	0.06	5	29.850	0.090	0.274
25X-1, 107–108	218.67	3.053	0.82	0.17	0.65	1.42	0.05	12	29.253	0.189	0.414
25X-2, 108–109	220.18	3.061	0.45	0.09	0.36	0.75	0.07	5	30.845	0.111	0.231
25X-3, 107–108	221.67	3.069	0.42	0.09	0.33	0.75	0.05	6	29.850	0.098	0.224
25X-4, 107–108	223.17	3.077	1.91	0.66	1.25	5.50	0.11	12	28.855	0.359	1.586
25X-5, 107–108	224.67	3.086	0.18	0.01	0.17	0.08	0.03	6	30.646	0.053	0.026
25X-6, 108–109	226.18	3.094	0.18	0.08	0.10	0.67	0.04	3	28.258	0.029	0.188
26X-1, 21–22	226.71	3.097	2.06	0.76	1.30	6.33	0.11	12	27.263	0.353	1.726
26X-2, 21–22	228.21	3.105	0.94	0.70	0.24	5.83	0.05	5	29.253	0.071	1.706
26X-3, 21–22	229.71	3.113	0.32	0.16	0.16	1.33	0.05	4	23.283	0.038	0.310
26X-4, 21–22	231.21	3.122	0.25	0.13	0.12	1.08	0.06	2	25.870	0.031	0.280
26X-5, 21–22	232.71	3.130	0.26	0.09	0.17	0.75	0.05	4	25.074	0.042	0.188
26X-6, 25–26	234.25	3.138	0.23	0.05	0.18	0.42	0.05	4	26.865	0.048	0.112
27X-1, 44–45	235.64	3.146	0.38	0.09	0.29	0.75	0.05	5	24.875	0.072	0.186
27X-2, 42–43	237.12	3.154	0.30	0.06	0.24	0.50	0.06	4	23.482	0.056	0.117
27X-3, 44–45	238.64	3.163	0.52	0.13	0.39	1.08	0.10	4	25.870	0.100	0.280
27X-4, 42–43	240.12	3.171	0.57	0.11	0.46	0.92	0.08	6	25.472	0.117	0.233
27X-5, 41–42	241.61	3.179	0.52	0.11	0.41	0.92	0.07	6	23.880	0.098	0.219
27X-6, 41–42	243.11	3.187	0.23	0.08	0.15	0.67	0.04	4	23.084	0.035	0.154
28X-1, 24–25	244.34	3.194	0.39	0.12	0.27	1.00	0.05	5	25.273	0.068	0.253
28X-2, 32–33	245.92	3.203	0.40	0.18	0.22	1.50	0.06	4	25.671	0.056	0.385
28X-3, 36–37	247.46	3.211	0.79	0.52	0.27	4.33	0.07	4	25.273	0.068	1.095
28X-4, 55–56	249.15	3.220	0.22	0.11	0.11	0.92	0.03	3	38.805	0.043	0.356
28X-5, 35–36	250.45	3.227	0.24	0.07	0.17	0.58	0.03	6	32.835	0.057	0.191
29X-1, 82–83	253.62	3.245	0.19	0.10	0.09	0.83	0.03	3	37.213	0.033	0.310
31X-1, 80–81	271.40	3.343	0.24	0.18	0.06	1.50	0.04	2	23.482	0.014	0.352
31X-2, 114–115	273.24	3.353	0.62	0.46	0.16	3.83	0.05	3	29.253	0.045	1.121
31X-3, 7–8	273.67	3.355	0.48	0.37	0.11	3.08	0.03	3	28.855	0.031	0.889
31X-4, 120–121	276.30	3.370	0.37	0.08	0.29	0.67	0.06	5	26.865	0.078	0.179
31X-5, 75–76	277.35	3.375	0.39	0.12	0.27	1.00	0.06	4	24.875	0.067	0.249
31X-6, 51–52	278.61	3.382	0.36	0.12	0.24	1.00	0.06	4	24.875	0.059	0.249
33X-1, 76–77	289.16	3.440	0.22	0.13	0.09	1.08	0.04	2	28.258	0.026	0.306
33X-2, 36–37	290.26	3.446	0.16	0.08	0.08	0.67	0.03	3	30.248	0.024	0.202
35X-1, 14–15	306.34	3.535	0.29	0.06	0.23	0.50	0.04	5	26.069	0.059	0.130
37X-1, 25–26	315.35	3.584	0.37	0.07	0.30	0.58	0.05	5	29.253	0.086	0.171
37X-2, 124–125	317.84	3.598	2.18	1.68	0.50	13.99	0.06	9	29.452	0.146	4.122
37X-3, 39–40	318.49	3.602	0.50	0.12	0.38	1.00	0.06	7	29.452	0.113	0.294
37X-4, 46–47	320.06	3.610	0.37	0.07	0.30	0.58	0.06	5	30.248	0.090	0.176
37X-5, 55–56	321.65	3.619	0.28	0.11	0.17	0.92	0.05	4	29.850	0.051	0.274
37X-6, 27–28	322.87	3.626	0.30	0.08	0.22	0.67	0.05	4	28.855	0.063	0.192
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11R-1, 101–102	387.11		0.71	0.18	0.53	1.50	0.04	13			
13R-1, 25–26	404.15		0.28	0.11	0.17	0.92	0.03	5			
14R-1, 12–13	412.92		0.41	0.20	0.21	1.67	0.05	4			
14R-2, 56–57	414.86		0.47	0.35	0.12	2.92	0.05	3			
18R-1, 21–24	448.41		0.26	0.16	0.10	1.33	0.02	4			
22R-1, 24–26	484.04		0.19	0.11	0.08	0.92	0.03	2			
22R-2, 22–23	485.52		0.10	0.05	0.05	0.42	0.03	2			

Table 1 (continued).

									Accumulation rates		
Core, section, interval (cm)	Depth (mbsf)	Age (Ma)	TC (wt%)	IC (wt%)	TOC (wt%)	$CaCO_3$ (wt%)	TN (wt%)	TOC/N ratio	Bulk ($g/cm^2/k.y.$)	TOC ($g/cm^2/k.y.$)	Carbonate ($g/cm^2/k.y.$)
22R-3, 33–35	487.13		0.31	0.06	0.25	0.50	0.04	7			
24R-1, 40–41	503.60		0.91	0.72	0.19	6.00	0.03	6			
24R-2, 39–40	505.09		0.49	0.26	0.23	2.17	0.03	7			
24R-3, 47–48	506.67		0.56	0.35	0.21	2.92	0.04	6			
25R-1, 40–42	513.20		0.55	0.28	0.27	2.33	0.04	6			
25R-2, 50–51	514.80		0.55	0.26	0.29	2.17	0.04	7			
25R-3, 100–102	516.80		0.23	0.08	0.15	0.67	0.03	5			
25R-4, 58–60	517.88		4.17	3.88	0.29	32.32	0.05	6			
25R-5, 49–50	519.29		0.45	0.23	0.22	1.92	0.04	6			
27R-1, 81–82	532.91		0.18	0.06	0.12	0.50	0.03	4			
27R-2, 37–38	533.97		0.24	0.07	0.17	0.58	0.03	5			
27R-3, 71–72	535.81		0.40	0.06	0.34	0.50	0.04	9			
28R-1, 97–98	542.77		0.34	0.07	0.27	0.58	0.04	7			
28R-2, 112–113	544.42		0.34	0.06	0.28	0.50	0.04	7			
28R-3, 73–74	545.53		0.39	0.12	0.27	1.00	0.04	6			
28R-4, 42–43	546.72		0.31	0.06	0.25	0.50	0.04	6			
29R-1, 56–57	551.96		0.25	0.07	0.18	0.58	0.03	6			
29R-2, 29–30	553.19		0.30	0.04	0.26	0.33	0.04	6			
31R-1, 77–78	571.47		0.40	0.26	0.14	2.17	0.04	4			
32R-1, 90–92	581.20		0.31	0.13	0.18	1.08	0.04	5			
33R-1, 32–33	590.32		0.58	0.37	0.21	3.08	0.04	5			
34R-1, 90–91	600.50		0.27	0.13	0.14	1.08	0.04	4			
34R-2, 43–45	601.53		0.37	0.26	0.11	2.17	0.04	3			
35R-1, 14–15	609.34		0.43	0.20	0.23	1.67	0.04	5			
35R-2, 73–74	611.43		0.30	0.11	0.19	0.92	0.04	5			
35R-CC, 3–4	612.23		0.48	0.22	0.26	1.83	0.04	7			
36R-1, 117–118	620.07		0.99	0.85	0.14	7.08	0.03	4			
36R-2, 119–120	621.59		0.87	0.66	0.21	5.50	0.04	6			
36R-3, 53–54	622.43		1.41	1.20	0.21	10.00	0.04	5			
36R-CC, 5–6	623.45		1.45	1.00	0.45	8.33	0.05	10			
37R-1, 37–38	628.97		1.00	0.86	0.14	7.16	0.03	5			
37R-2, 18–19	630.28		1.91	1.47	0.44	12.25	0.05	9			
37R-3, 37–38	631.97		4.36	4.31	0.05	35.90	0.00				
37R-4, 25–26	633.35		1.02	0.68	0.34	5.66	0.03	10			
37R-5, 26–27	634.86		3.28	3.01	0.27	25.07	0.04	7			
38R-1, 88–90	639.08		2.87	2.58	0.29	21.49	0.04	8			
38R-2, 25–26	639.95		1.05	0.67	0.38	5.58	0.04	11			
38R-3, 118–120	642.38		0.84	0.53	0.31	4.41	0.03	12			
38R-4, 105–106	643.75		1.49	0.10	1.39	0.83	0.04	38			
38R-5, 76–78	644.96		1.65	1.31	0.34	10.91	0.04	9			
39R-1, 25–26	648.15		1.64	1.21	0.43	10.08	0.06	7			
39R-2, 31–32	649.71		2.62	2.26	0.36	18.83	0.04	9			
39R-3, 18–19	651.08		2.48	2.10	0.38	17.49	0.04	10			
39R-4, 20–22	652.60		1.53	1.20	0.33	10.00	0.03	9			
39R-5, 35–37	654.25		4.15	3.83	0.32	31.90	0.04	8			
39R-6, 80–82	656.20		4.11	3.63	0.48	30.24	0.04	12			
40R-1, 44–45	657.94		3.26	2.20	1.06	18.33	0.04	25			
40R-2, 128–129	660.28		3.53	3.22	0.31	26.82	0.04	7			
40R-3, 113–114	661.63		1.64	1.35	0.29	11.25	0.03	10			
40R-4, 118–120	663.18		2.09	1.64	0.45	13.66	0.04	12			
40R-5, 71–72	664.21		1.83	1.40	0.43	11.66	0.03	12			
40R-6, 28–30	665.28		2.86	2.35	0.51	19.58	0.04	12			
41R-1, 78–79	667.98		3.21	2.76	0.45	22.99	0.04	12			
41R-2, 119–120	669.89		1.68	1.26	0.42	10.50	0.03	12			
41R-3, 34–35	670.54		1.61	1.17	0.44	9.75	0.04	12			
41R-4, 108–109	672.78		1.39	1.04	0.35	8.66	0.03	13			
41R-5, 71–72	673.91		1.22	0.83	0.39	6.91	0.03	14			
41R-6, 27–28	674.97		1.72	1.30	0.42	10.83	0.03	14			
42R-1, 28–29	677.08		3.80	3.46	0.34	28.82	0.03	11			
42R-2, 14–15	678.44		1.78	1.48	0.30	12.33	0.03	9			
42R-3, 53–54	680.33		1.10	0.77	0.33	6.41	0.03	13			
42R-4, 67–68	681.97		1.30	0.86	0.44	7.16	0.03	15			
42R-5, 28–29	683.08		3.80	3.36	0.44	27.99	0.04	11			
42R-6, 40–41	684.70		2.12	1.80	0.32	14.99	0.03	10			
44R-1, 131–132	697.41		3.95	3.50	0.45	29.16	0.04	11			
44R-2, 70–71	698.30		3.92	3.56	0.36	29.65	0.04	10			
44R-3, 54–55	699.64		2.62	2.38	0.24	19.83	0.03	9			
44R-5, 79–81	702.89		2.46	2.10	0.36	17.49	0.04	10			
47R-2, 55–57	726.65		2.09	1.79	0.30	14.91	0.03	10			
51R-1, 75–77	763.95		3.05	2.71	0.34	22.57	0.04	8			
51R-2, 49–50	765.19		3.12	2.91	0.21	24.24	0.04	5			
51R-4, 140–143	769.10		2.59	2.29	0.30	19.08	0.05	7			
51R-5, 78–80	769.98		1.75	0.10	1.65	0.83	0.11	16			
51R-6, 77–80	771.47		1.22	0.12	1.10	1.00	0.08	14			
52R-1, 63–64	773.53		2.16	1.92	0.24	15.99	0.04	6			
52R-2, 24–25	774.64		2.49	2.20	0.29	18.33	0.04	8			
52R-3, 63–64	776.53		3.12	2.89	0.23	24.07	0.04	5			
52R-4, 128–129	778.68		4.05	3.91	0.14	32.57	0.03	5			
52R-5, 59–60	779.49		3.77	3.62	0.15	30.15	0.03	6			
53R-1, 19–20	782.69		3.17	2.98	0.19	24.82	0.05	4			
53R-2, 74–75	784.74		1.68	1.50	0.18	12.50	0.03	6			
53R-3, 53–54	786.03		2.88	2.77	0.11	23.07	0.03	4			
53R-4, 125–126	788.25		1.90	1.82	0.08	15.16	0.03	3			
53R-5, 100–101	789.50		2.29	2.16	0.13	17.99	0.03	4			
53R-6, 48–50	790.48		2.05	1.86	0.19	15.49	0.04	5			
55R-1, 31–32	802.11		5.39	5.29	0.10	44.07	0.00				
55R-2, 21–22	803.51		1.80	1.69	0.11	14.08	0.00				
55R-3, 18–19	804.98		3.26	3.12	0.14	25.99	0.00				

Table 1 (continued).

Core, section, interval (cm)	Depth (mbsf)	Age (Ma)	TC (wt%)	IC (wt%)	TOC (wt%)	$CaCO_3$ (wt%)	TN (wt%)	TOC/N ratio	Accumulation rates		
									Bulk (g/cm^2/k.y.)	TOC (g/cm^2/k.y.)	Carbonate (g/cm^2/k.y.)
55R-4, 65–66	806.95		3.98	3.86	0.12	32.15	0.02	8			
55R-5, 56–57	808.36		0.70	0.63	0.07	5.25	0.00				
55R-6, 37–38	809.67		3.92	3.80	0.12	31.65	0.02	7			
57R-1, 138–139	822.38		4.47	4.31	0.16	35.90	0.00				
57R-2, 137–138	823.87		5.57	5.42	0.15	45.15	0.00				
57R-3, 146–147	825.46		2.83	2.79	0.04	23.24	0.00				
60R-1, 23–25	850.23		1.89	1.89	0.00	15.74	0.00				
62R-1, 23–24	869.53		1.51	1.36	0.15	11.33	0.00				
62R-2, 20–22	871.00		2.85	2.75	0.10	22.91	0.00				
63R-1, 108–110	879.98		0.87	0.89	0.00	7.41	0.00				
63R-2, 88–90	881.28		0.87	0.74	0.13	6.16	0.00				
68R-1, 86–87	925.86		0.64	0.61	0.03	5.08	0.00				
75R-1, 75–76	993.05		0.02	0.11	0.00	0.92	0.00				
75R-2, 130–132	995.10		2.48	2.22	0.26	18.49	0.00				
75R-3, 59–61	995.89		3.53	3.18	0.35	26.49	0.00				
75R-4, 31–33	997.11		2.39	2.20	0.19	18.33	0.00				
76R-1, 108–110	1003.08		1.89	1.64	0.25	13.66	0.00				
77R-1, 54–55	1012.14		0.03	0.13	0.00	1.08	0.00				
78R-1, 50–51	1021.70		2.78	2.50	0.28	20.83	0.00				
79R-1, 40–41	1031.30		0.23	0.31	0.00	2.58	0.00				
80R-1, 17–18	1040.77		1.78	1.64	0.14	13.66	0.00				
83R-1, 56–57	1070.16		0.21	0.48	0.00	4.00	0.00				
84R-1, 40–41	1079.70		0.35	0.44	0.00	3.67	0.00				
88R-1, 47–49	1118.27		2.62	2.51	0.11	20.91	0.00				
89R-2, 135–137	1130.25		4.82	4.88	0.00	40.65	0.00				
89R-3, 11–12	1130.51		4.83	4.42	0.41	36.82	0.00				
89R-3, 54–56	1130.94		3.70	3.43	0.27	28.57	0.00				
89R-4, 50–51	1132.40		4.60	4.33	0.27	36.07	0.00				
90R-2, 25–26	1138.85		3.12	2.23	0.89	18.58	0.03	33			
90R-3, 24–25	1140.34		2.89	1.79	1.10	14.91	0.04	26			
91R-1, 26–27	1146.76		2.21	1.34	0.87	11.16	0.04	23			
92R-1, 97–98	1157.17		1.91	1.49	0.42	12.41	0.02	22			
93R-1, 131–132	1167.11		0.51	0.37	0.14	3.08	0.02	8			
93R-2, 20–21	1167.50		0.80	0.63	0.17	5.25	0.01	17			

Notes: TC = total carbon, IC = inorganic carbon, TOC = total organic carbon, and TN = total nitrogen.

The composition and amount of organic matter in the sediments of Site 918 very well mirror the long-term changes in climatic development and paleoenvironment of the southeast Greenland region. Paleoceanographic conditions are strongly dependent on the intensity of the East Greenland Current (Larsen, Saunders, Clift, et al., 1994) and, thus, influence the accumulation and preservation of organic carbon.

During Eocene and Oligocene times (lithologic Unit III, ~1180–800 mbsf), the siliciclastic as well as organic sediment parameters (see "Results" section above) indicate relatively warm climatic conditions and shallow water depth (<1500 m). This led to the deposition of mainly terrigenous organic material derived from the surrounding coastal areas. Dense vegetation resulted in enhanced deposition of plant material confirmed by vitrinites and long-chain *n*-alkanes (Fig. 2; Table 3). Finely dispersed wood pieces also indicate transport by rivers or occasional driftwood. Marine production was probably very low during this time. No evidence for increased productivity as diatom or nannofossil remains could be found in the sediment parameters. Additionally, low sedimentation rates (Larsen, Saunders, Clift, et al., 1994) and oxic water column conditions may have caused an intense degradation of the labile marine organic matter (cf. Stein, 1991).

In the lower to upper Miocene sediments of lithologic Unit II (~800–600 mbsf), increased organic carbon contents and amounts of planktonic organisms point to an enhanced surface-water productivity. This is supported by microscopic findings (strong background fluorescence and a lack of terrigenous macerals). The alkane distribution, hydrogen index values, and C/N ratios, however, indicate a mixture of marine and terrigenous organic material (Figs. 2, 3). During this time interval, a highly oxidizing water column (bioturbation) and extremely low sedimentation rates support the diagenesis and remineralization of the organic material. The depositional conditions are comparable to a hemipelagic oxic environment, which is dominated by marine organic matter with a minor terrigenous organic input.

A dramatic change in depositional conditions occurred at Site 918 at about 5 Ma (~500 mbsf; Larsen, Saunders, Clift, et al., 1994). The sedimentation rate of siliciclastic material increased to values as much as 19.5 cm/k.y., and biogenic carbonate production almost terminated. The flux of organic carbon increased (mean values of about 0.7 g/cm^2/k.y.; Fig. 4), and the preservation of organic particles is moderate. Well-preserved alginites are sparse. Climatic conditions probably turned to colder temperatures (increase in dropstone occurrence), and the dense vegetation cover disappeared. Thus, terrigenous organic material is only a minor component of the organic sediment fraction. This is supported by the *n*-alkane pattern, hydrogen index values, and microscopic observations (Figs. 2, 3; Table 3). Rapid burial of the organic matter may have led to a better preservation and higher flux rates during this time interval.

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Table 2. Results of the Rock-Eval pyrolysis.

Core, section, interval (cm)	Depth (mbsf)	TOC (wt%)	S_1	S_2	S_3	HI	OI	T_{max} (°C)
152-918A-								
3H-3, 30–31	14.60	0.53	0.06	0.59	0.47	111	89	515
4H-1, 134–136	22.14	0.47	0.09	0.39	0.73	82	156	432
5H-3, 11–13	33.41	0.53	0.12	0.32	1.14	61	216	422
6H-4, 58–60	44.88	0.42	0.32	0.39	1.08	92	258	441
8H-3, 120–122	63.00	0.38	0.09	0.33	0.09	88	24	451
11H-1, 141–143	79.21	0.40	0.34	0.47	0.21	118	53	433
11H-3, 21–23	90.51	0.51	0.22	0.53	0.67	104	132	412
13H-2, 33–35	108.13	0.44	0.13	0.42	1.17	95	265	432
15H-3, 14–16	128.44	0.37	0.90	0.29	0.83	79	223	432
17H-6, 6–8	150.36	0.42	0.32	0.20	1.19	48	284	500
17H-6, 122–123	151.52	0.68	0.05	0.51	1.08	75	160	438
19H-1, 119–121	162.99	0.29	0.08	0.16	0.23	56	79	436
21X-1, 126–128	182.76	0.39	0.32	0.26	0.62	66	160	435
23X-6, 103–105	208.33	0.40	0.42	0.38	0.22	95	54	423
25X-1, 107–108	218.67	0.65	0.04	0.23	1.09	36	169	517
25X-2, 21–23	219.31	0.43	0.32	0.52	0.57	121	132	432
25X-4, 107–108	223.17	1.25	0.17	1.01	2.96	81	238	430
26X-1, 21–22	226.71	1.30	0.07	1.07	3.72	83	287	424
27X-4, 130–132	241.49	0.52	0.12	0.50	1.18	96	226	452
31X-2, 34–36	272.44	0.38	0.33	0.13	0.21	35	56	418
37X-2, 73–75	317.33	0.51	0.09	0.38	0.41	75	81	398
37X-2, 124–125	317.84	0.50	0.07	0.11	2.54	22	512	395
152-918D-								
11R-1, 101–102	387.11	0.53	0.05	0.29	0.29	55	55	442
18R-1, 45–47	448.65	0.41	0.04	0.36	0.59	87	145	421
25R-1, 83–85	513.63	0.44	0.21	0.27	0.73	62	166	436
27R-2, 140–142	535.00	0.39	0.09	0.20	0.90	51	232	422
37R-2, 97–99	631.07	0.51	0.32	0.17	0.48	34	95	443
38R-4, 105–106	643.75	1.39	0.12	0.07	1.45	5	105	417
40R-1, 44–45	657.94	1.06	0.08	0.22	1.69	21	160	413
40R-4, 5–7	662.05	0.33	0.12	0.18	0.28	55	85	421
40R-6, 28–30	665.28	0.51	0.09	0.16	1.40	31	274	414
42R-5, 138–140	684.18	0.51	0.52	0.23	0.67	45	132	432
51R-5, 78–80	769.98	1.65	0.26	1.08	1.41	65	85	409
51R-6, 77–80	771.47	1.10	0.32	0.54	0.87	49	79	422
53R-1, 108–110	783.58	0.38	0.20	0.14	0.86	38	225	436
55R-2, 106–108	804.36	0.35	0.09	0.23	0.43	65	123	455
57R-3, 26–28	824.26	0.32	0.07	0.17	0.71	54	221	419
75R-1, 7–9	992.37	0.36	0.21	0.12	0.94	32	261	435
83R-1, 96–98	1070.56	0.29	0.90	0.16	0.25	55	85	422
90R-2, 25–26	1138.85	0.89	0.09	0.49	1.45	55	163	435
90R-3, 24–25	1140.34	1.10	0.09	0.59	1.50	54	137	430
91R-1, 26–27	1146.76	0.87	0.58	0.50	1.40	58	162	432
95R-1, 29–31	1180.69	0.51	0.12	0.21	0.29	41	56	432

Notes: S_1 (mg HC/g sediment), S_2 (mg HC/g sediment), and S_3 (mg CO_2/g sediment). HI = hydrogen index (mg HC/g TOC), and OI = oxygen index (mg CO_2/g TOC).

Table 3. Microscopic results of selected resin impregnated specimens.

Core, section, interval (cm)	Depth (mbsf)	TOC (wt%)	HI (mg HC/g C)	OI (mg CO_2/g C)	T_{max} (°C)	Alginite	Liptodetrinite	Vitrinite	Vitrodetrinite	Pollenite	Background fluorescence
152-918A-											
17H-6, 6–8	150.36	0.42	48	284	500	X	X	O	X	O	X
23X-6, 103–105	208.33	0.40	95	54	423	O	X	O	O	O	X
31X-2, 34–36	272.44	0.38	35	56	418	O	X	O	O	X	XX
152-918D-											
18R-1, 45–47	448.65	0.41	87	145	421	X	X	O	O	O	X
27R-2, 140–142	535.00	0.39	51	232	422	O	XX	O	O	X	X
37R-2, 97–99	631.07	0.51	34	95	443	XX	XX	X	O	O	XX
42R-5, 138–140	684.18	0.51	45	132	432	XX	X	X	X	O	XX
55R-2, 106–108	804.36	0.35	65	123	455	X	O	X	XX	O	X
75R-1, 7–9	992.37	0.36	32	261	435	O	O	X	X	X	O
83R-1, 96–98	1070.56	0.29	55	85	422	X	X	XX	XX	X	O
95R-1, 29–31	1180.69	0.51	41	56	432	O	O	X	XX	X	O

Notes: XX = abundant, X = moderate to minor, and O = minor to absent.

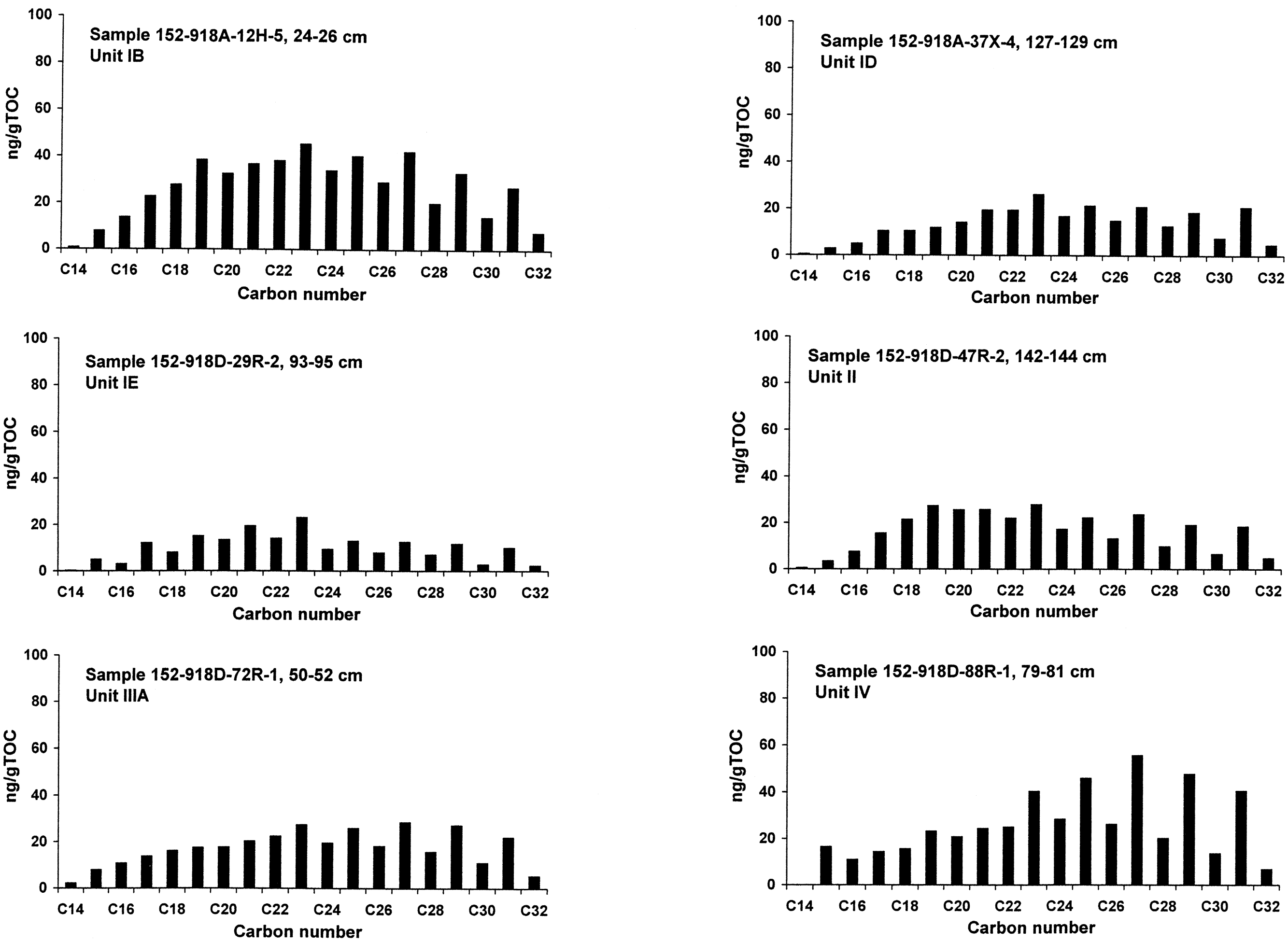

Figure 3. *N*-alkane data listed for six samples from different lithologic units (Larsen, Saunders, Clift, et al., 1994).

Table 4. Distribution of *n*-alkanes in samples from Site 918.

Hole:	918A	918A	918A	918A	918A	918A
Core, section:	12H-5	37X-4	29R-2	47R-2	72R-1	88R-1
Interval (cm):	24	73	93	142	50	79
	(ng/g TOC)	(ng/g TOC)	(ng/g TOC)	(ng/g TOC)	(ng/g TOC)	(ng/g TOC)
C_{14}	0.75	0.20	0.44	0.54	2.19	
C_{15}	7.83	5.00	2.82	3.36	7.93	16.47
C_{16}	13.70	3.02	4.93	7.52	10.76	10.94
C_{17}	22.64	12.09	10.39	15.44	13.73	14.32
C_{18}	27.64	8.00	10.48	21.37	16.18	15.59
C_{19}	38.38	15.02	11.82	27.30	17.47	23.18
C_{20}	32.42	13.33	14.14	25.57	17.70	20.78
C_{21}	36.57	19.32	19.41	25.69	20.30	24.32
C_{22}	38.06	13.98	19.41	21.99	22.44	24.95
C_{23}	45.19	23.00	26.19	27.79	27.40	40.27
C_{24}	33.91	9.35	16.82	17.17	19.54	28.37
C_{25}	40.08	12.85	21.28	22.11	25.87	45.84
C_{26}	28.91	7.77	14.85	13.10	18.16	26.09
C_{27}	42.11	12.43	20.84	23.47	28.39	55.46
C_{28}	19.98	6.95	12.62	9.79	15.72	20.14
C_{29}	32.96	11.60	18.52	19.02	27.17	47.61
C_{30}	14.13	2.78	7.53	6.54	10.99	13.56
C_{31}	26.89	9.93	20.66	18.41	21.98	40.40
C_{32}	7.53	2.36	4.67	4.78	5.39	6.79

Note: C_{14} through C_{32} = carbon numbers.

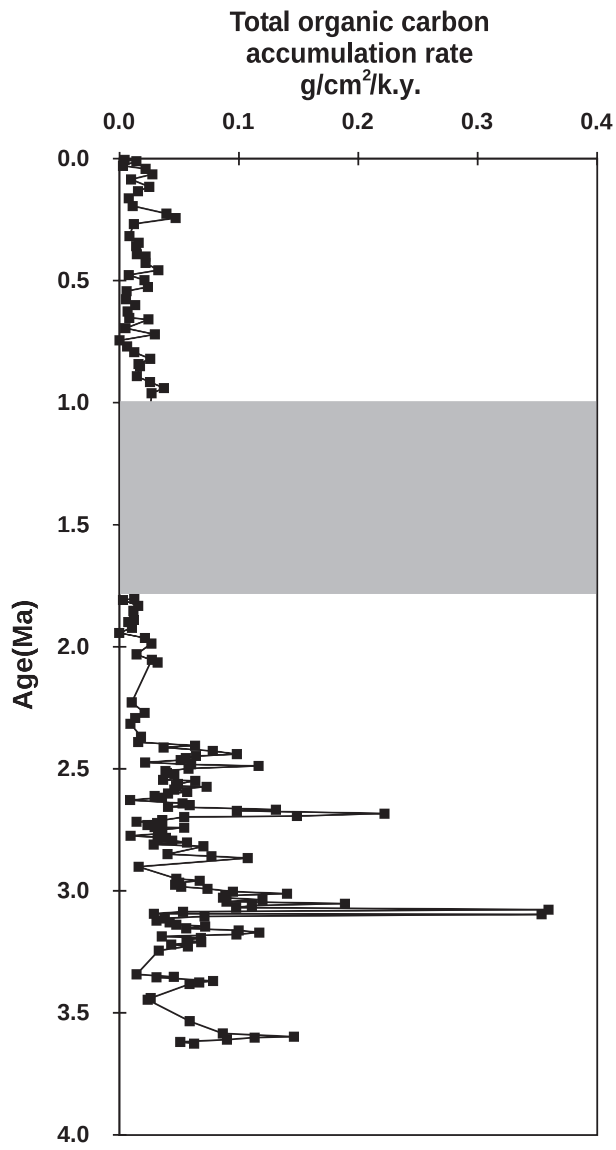

Figure 4. Mass accumulation rates of total organic carbon vs. age of Site 918. Shaded area indicates a possible hiatus (Larsen, Saunders, Clift, et al., 1994).

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