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9. Data Report: Dissolved Organic Carbon in Interstitial Waters, Equatorial Pacific and Peru Margin, ODP Leg 201[1]

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ABSTRACT

This report contains dissolved organic carbon (DOC) concentration data from interstitial waters collected at three open-ocean sites (1225, 1226, and 1231) and four sites cored along the Peru margin (1227, 1228, 1229, and 1230) during Ocean Drilling Program Leg 201. The sites were selected to represent a wide range of habitats for subsurface life based on organic carbon input to the sediments. Subsurface maxima of DOC at the ocean-margin sites is consistent with in situ production of DOC through active hydrolysis of particulate organic carbon. These downhole profiles agree well with the dissolved inorganic carbon (DIC) concentrations indicating complete remineralization of some fraction DOC to DIC. The open-ocean sites exhibit relatively flat downhole profiles, indicating that diagenesis is occurring at a much lower rate at these sites.

INTRODUCTION

Dissolved organic carbon (DOC) in marine interstitial waters has been extensively studied in surficial sediments. These studies, conducted on short cores at the centimeter scale, have led to important conclusions regarding the role of DOC in carbon remineralization, nutrient recycling, and dissolved metal complexation in marine sediments (reviewed in Burdige, 2002). The pool of DOC comprises a heteroge-

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neous assemblage of organic molecules that vary greatly in their composition and molecular weight. The concentration of DOC in sediments is higher than DOC concentrations in the overlying water column, indicating that DOC is produced in the sediments from the degradation of particulate organic carbon (POC). Diagenesis sequentially produces more and more refractory organic material, and size fractionation studies indicate that the refractory products of diagenesis are of relatively low molecular weight (Amon and Benner, 1994; Benner et al., 1992). Although the measurement of DOC as a bulk property can indicate metabolic activity, it does not distinguish between the individual components, or even classes of organic matter.

METHODS/MATERIALS

Dissolved organic carbon was analyzed on interstitial water samples collected from 5- to 30-cm-long whole-round intervals. The interstitial water was extracted shipboard within hours of core retrieval. The outer edge of the whole-round sample was removed, and the inner core was placed into a titanium squeezer (modified from Manheim and Sayles, 1974). The interstitial water was extruded from the squeezer through a filter (0.45 µm polysulfone; Gelman) into an acid-washed plastic syringe. Aliquots for DOC analysis were transferred to baked (450°C) glass ampoules and heat sealed. The ampoules were stored at 4°C and transported for shore-based analysis.

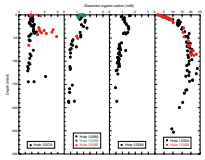
Dissolved organic carbon concentrations were determined using the high-temperature catalytic oxidation method with a Shimadzu TOC-V analyzer (Sharp et al., 2002). The combustion tube contained a platinum catalyst and was maintained at 680°C during the analysis. The interstitial water samples were acidified with HCl and sparged with N_2 gas in order to drive off the inorganic carbon prior to injection. Samples (100 µL) were manually injected onto the combustion column. Replicate aliquots were injected until the standard deviation was <5% of the total peak area. A solution of potassium hydrogen phthalate ($C_8H_5O_4K$) was used to construct a calibration curve.

CONCLUSIONS/SUMMARY

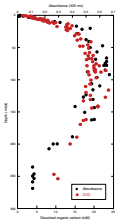
Dissolved organic carbon concentrations were determined in 336 individual interstitial water samples (Table **T1**). The ocean-margin sites (1227, 1228, 1229, and 1230) show distinct subsurface maxima in the downhole DOC profiles (Fig. **F1**). The peaks are shallow (~20–40 meters below seafloor [mbsf]) for Sites 1227, 1228, and 1229, whereas the peak at Site 1230 is located at ~120 mbsf. The DOC values at Site 1230 are extremely high, and the great depth of the maximum value indicates that the POC burial rate greatly exceeds the remineralization rate. High DOC concentrations have been previously measured at margin sites in the Guaymas Basin (Michaelis et al., 1982). Oxidation to dissolved inorganic carbon (DIC) is the final step in organic carbon remineralization, and the DOC profiles at these sites are very similar to the DIC profiles (Shipboard Scientific Party, 2003). The DOC profile at Site 1230 is also consistent with the profile of the coloration of the interstitial water at that site (Shipboard Science Party, 2003), strongly suggesting that the coloration is due to chromophoric dissolved organic matter (Fig **F2**). The open-ocean sites, in contrast, have low DOC concentrations and

T1. DOC concentrations, p. 9.

F1. DOC concentrations at ocean-margin sites, p. 5.



F2. DOC and absorbance, Site 1230, p. 6.



relatively flat downhole profiles (Fig. F3). The strong contrast in the open-ocean and the ocean-margin sites is shown in Figure F4.

ACKNOWLEDGMENTS

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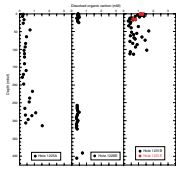

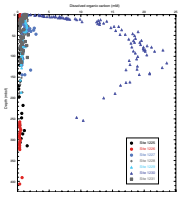

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Figure F1. Downhole profiles of dissolved organic carbon concentrations at the four ocean-margin sites cored during ODP Leg 201 (Sites 1227, 1228, 1229, and 1230).

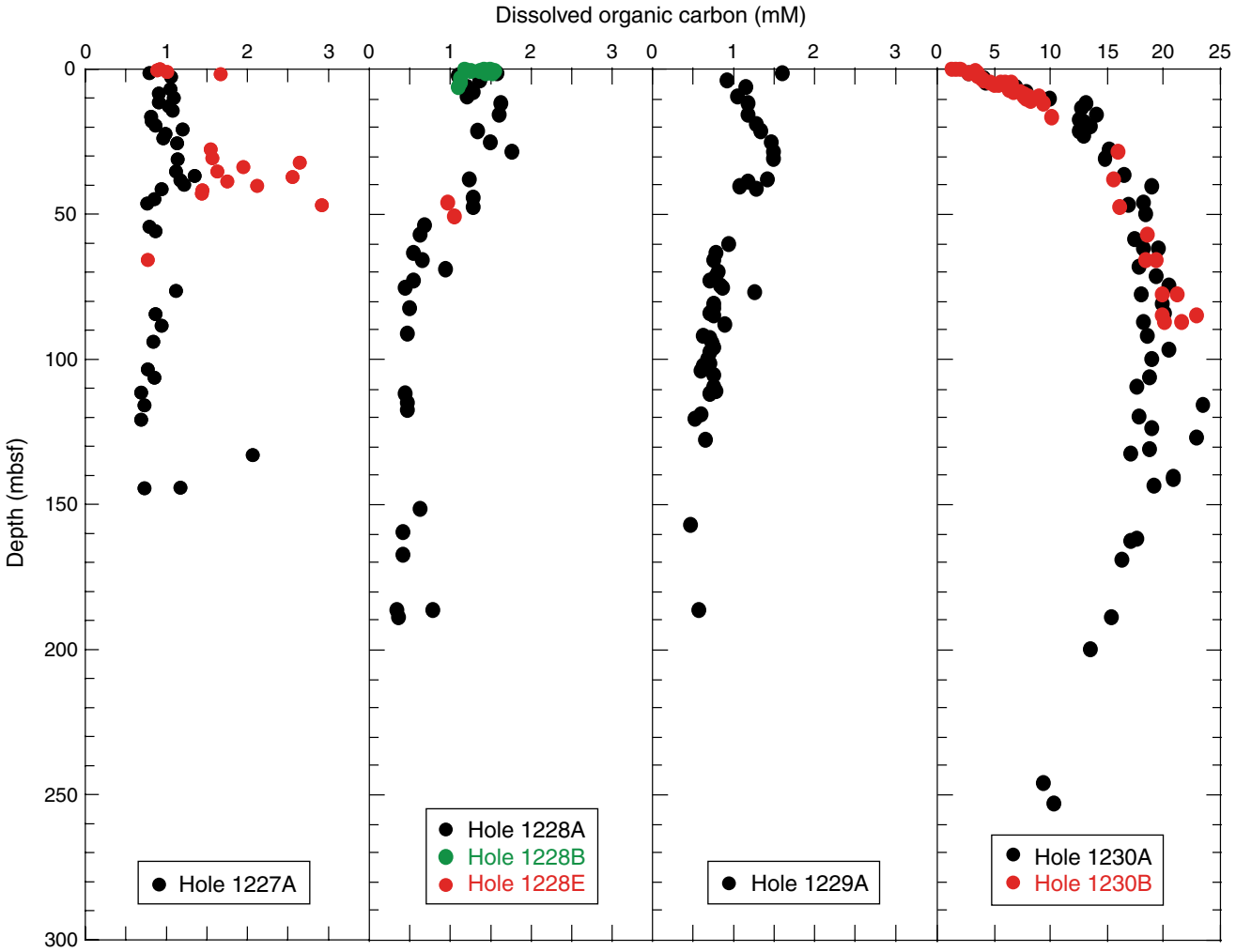

Figure F2. Downhole profiles of dissolved organic carbon (DOC) and absorbance at 325 nm at Site 1230.

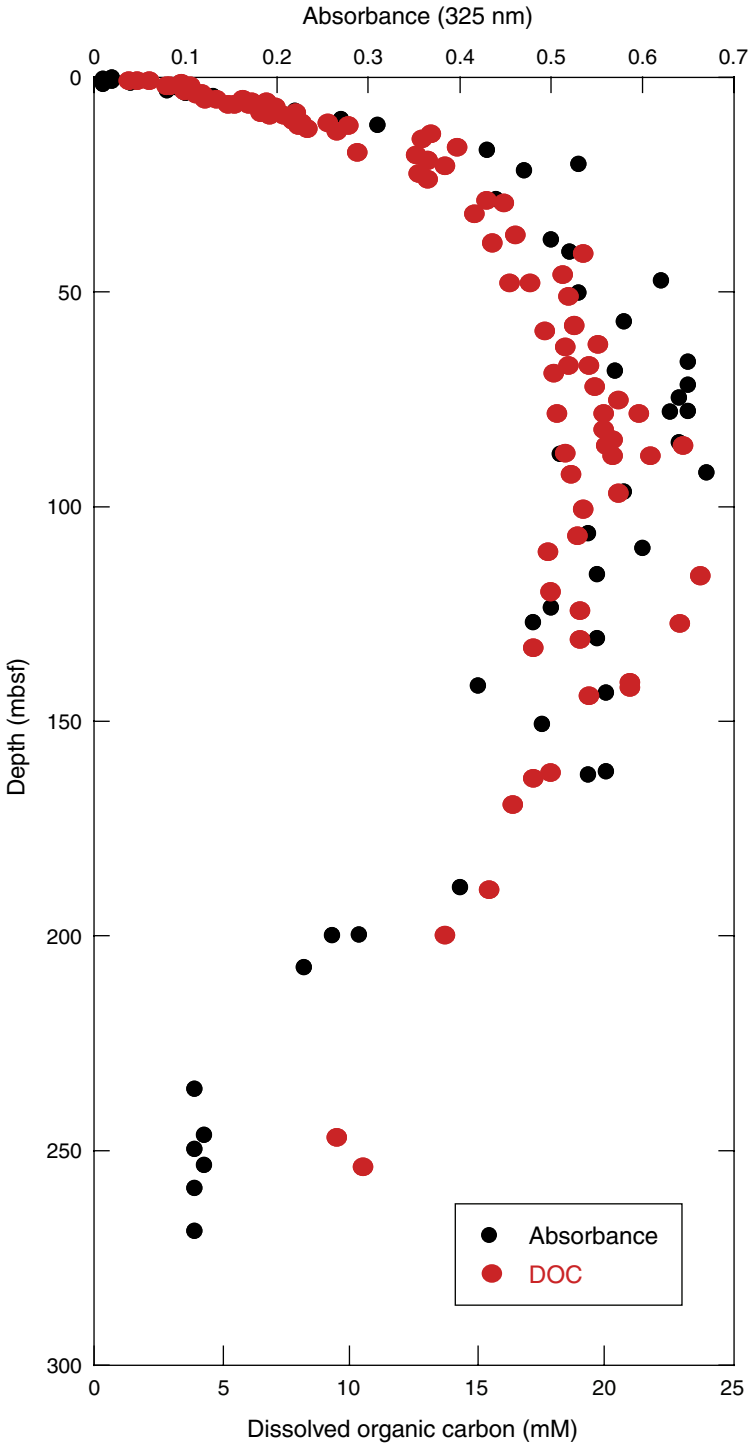

Figure F3. Downhole profiles of dissolved organic carbon concentrations at the three open-ocean sites cored during ODP Leg 201 (Sites 1225, 1226, and 1231).

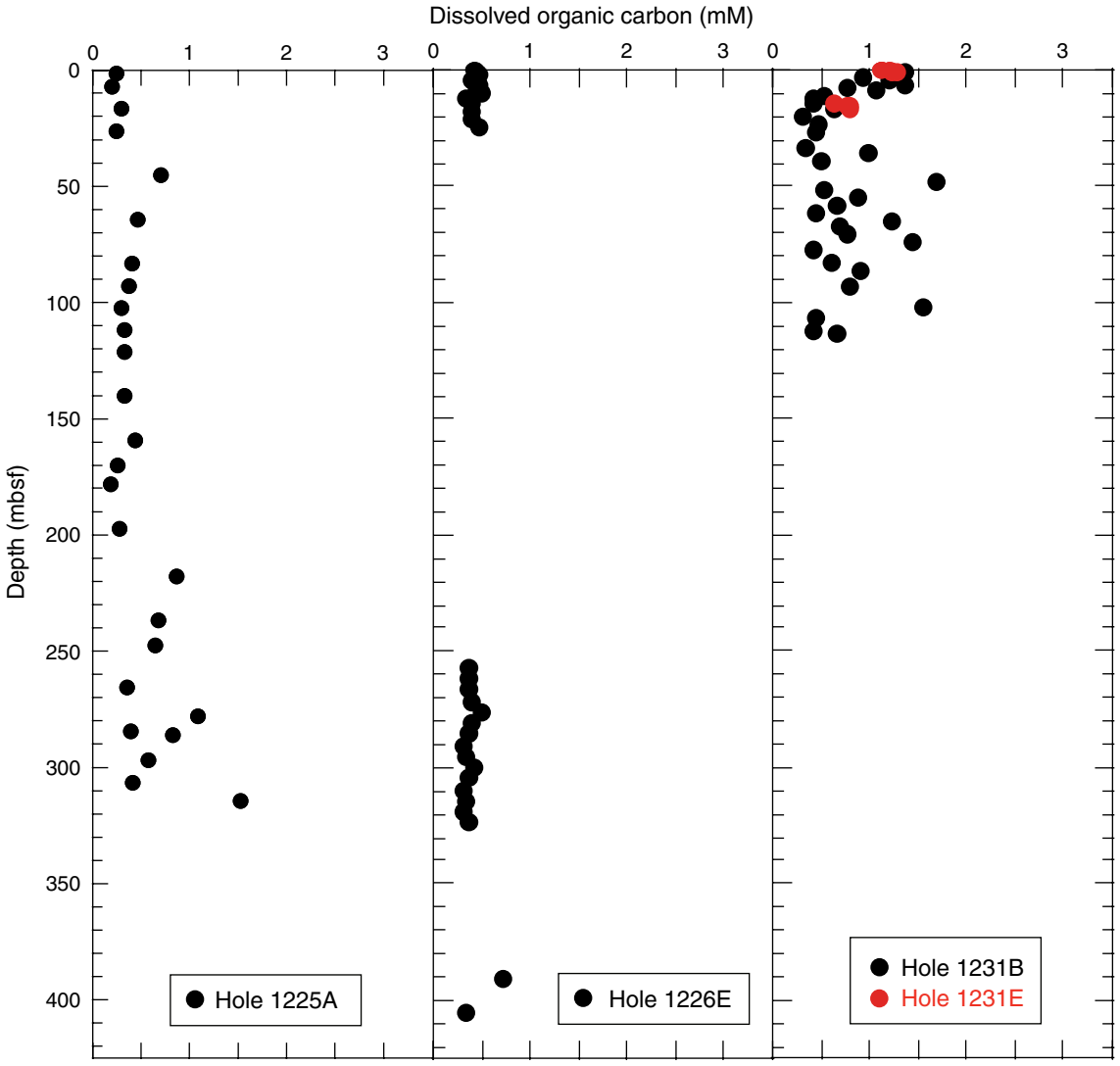

Figure F4. Downhole profiles of dissolved organic carbon concentrations at all seven sites cored during ODP Leg 201 (Sites 1225, 1226, 1227, 1228, 1229, 1230, and 1231).

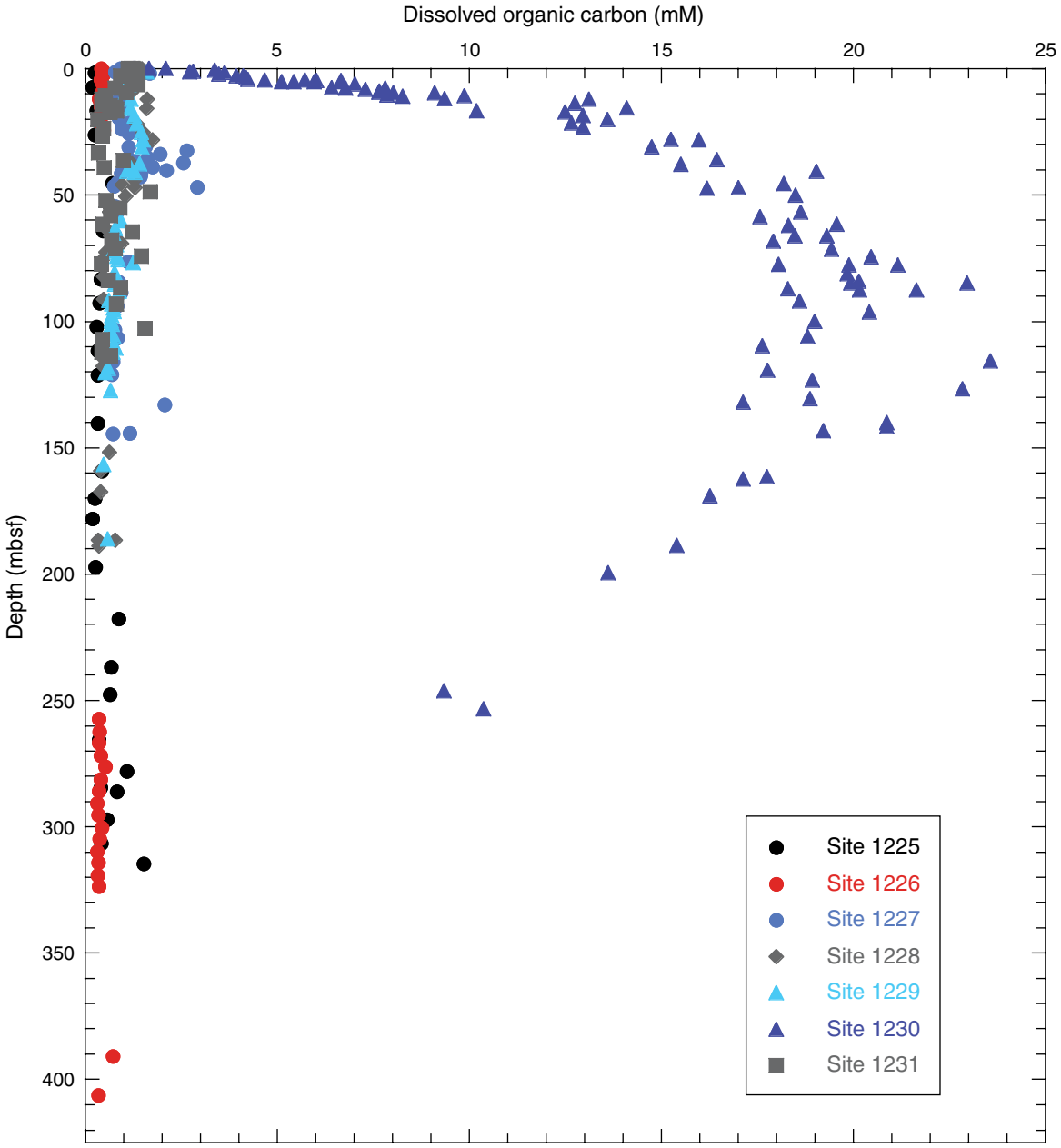

Table T1. Dissolved organic carbon concentrations for interstitial water from seven sites cored during ODP Leg 201. (Continued on next page.)

Hole 1225A		Hole 1226E		Hole 1227A		Hole 1227D		Hole 1228A		Hole 1228B		Hole 1228E	
Depth (mbsf)	DOC (mM)	Depth (mbsf)	DOC (mM)	Depth (mbsf)	DOC (mM)	Depth (mbsf)	DOC (mM)	Depth (mbsf)	DOC (mM)	Depth (mbsf)	DOC (mM)	Depth (mbsf)	DOC (mM)
1.50	0.25	0.00	0.42	1.35	0.79	0.00	0.92	1.26	1.58	46.10	0.97	0.30	1.18
7.30	0.20	0.95	0.47	2.85	1.06	0.60	0.89	2.76	1.11	50.60	1.06	0.45	1.25
16.65	0.30	1.80	0.45	6.95	1.05	1.00	1.01	4.26	1.36			0.60	1.38
26.30	0.25	2.35	0.48	8.45	0.91	1.80	1.67	6.25	1.22			0.75	1.46
45.30	0.71	4.30	0.41	9.95	1.09	27.85	1.55	7.90	1.30			0.90	1.43
64.30	0.47	5.85	0.45	11.45	0.91	30.85	1.57	9.25	1.20			1.05	1.54
83.30	0.41	7.26	0.48	12.95	1.03	32.35	2.65	12.25	1.62			1.20	1.46
92.80	0.38	8.90	0.46	14.45	1.08	33.85	1.95	15.75	1.61			1.35	1.52
102.30	0.30	10.40	0.50	16.45	0.81	35.35	1.63	21.75	1.35			0.12	1.42
111.80	0.33	11.90	0.36	17.95	0.82	37.35	2.56	25.25	1.51			0.25	1.49
121.30	0.33	14.90	0.40	19.45	0.87	38.85	1.75	28.25	1.75			3.50	1.12
140.30	0.33	18.40	0.40	20.95	1.20	40.35	2.12	37.75	1.23			4.50	1.13
159.30	0.44	21.45	0.41	22.45	0.99	41.85	1.45	44.25	1.28			6.35	1.10
170.15	0.26	24.45	0.48	23.95	0.96	42.91	1.44	47.25	1.30				
178.30	0.19	257.30	0.37	25.62	1.13	47.00	2.92	53.75	0.69				
197.30	0.28	262.35	0.38	31.21	1.14	65.93	0.77	56.75	0.64				
217.80	0.87	266.80	0.37	35.45	1.12			63.25	0.54				
236.80	0.68	271.85	0.41	36.95	1.35			66.25	0.66				
247.65	0.65	276.35	0.52	38.45	1.17			69.25	0.95				
265.59	0.36	281.35	0.41	39.95	1.22			72.75	0.55				
278.05	1.09	285.85	0.37	41.45	0.94			75.75	0.46				
284.42	0.40	290.85	0.32	44.95	0.85			82.25	0.49				
286.07	0.83	295.35	0.35	46.45	0.76			91.25	0.48				
297.05	0.58	300.30	0.43	54.45	0.79			111.75	0.45				
306.70	0.42	304.80	0.38	55.95	0.87			114.75	0.47				
314.55	1.53	309.80	0.32	76.45	1.12			117.75	0.47				
		314.30	0.35	84.45	0.87			151.75	0.63				
		319.30	0.33	88.51	0.94			159.19	0.41				
		323.80	0.37	93.95	0.84			167.60	0.41				
		390.80	0.72	103.45	0.77			186.60	0.78				
		406.40	0.35	106.45	0.85			186.75	0.35				
				111.45	0.69			189.00	0.36				
				115.95	0.73								
				120.95	0.69								
				132.95	2.07								
				144.30	1.17								
				144.45	0.73								

Note: DOC = dissolved organic carbon.

Table T1 (continued).

Hole 1229A		Hole 1230A		Hole 1230B		Hole 1231B		Hole 1231B	
Depth (mbsf)	DOC (mM)	Depth (mbsf)	DOC (mM)	Depth (mbsf)	DOC (mM)	Depth (mbsf)	DOC (mM)	Depth (mbsf)	DOC (mM)
1.35	1.60	1.35	2.73	0.00	1.66	1.35	1.37	0.00	1.13
4.35	0.91	2.85	4.12	0.00	1.27	2.85	0.93	0.10	1.21
6.25	1.15	4.44	4.24	0.00	2.11	4.75	1.20	0.40	1.12
9.25	1.06	6.15	7.03	0.80	3.37	6.25	1.37	0.70	1.28
12.25	1.19	7.65	7.82	1.20	2.82	7.75	0.79	1.00	1.25
15.75	1.18	10.65	9.87	1.50	3.64	9.25	1.07	14.70	0.65
18.75	1.29	12.15	13.12	2.30	3.49	10.75	0.53	15.40	0.79
21.75	1.34	13.65	12.75	3.00	3.93	12.25	0.44	16.20	0.81
25.25	1.47	15.65	14.11	3.60	4.19	14.25	0.43	16.90	0.81
28.25	1.51	17.15	12.50	4.50	5.73	17.25	0.65		
31.25	1.49	18.65	12.97	4.50	4.68	20.25	0.33		
37.75	1.42	20.15	13.60	4.90	6.67	23.75	0.48		
39.25	1.19	21.65	12.66	4.90	6.03	26.75	0.46		
40.75	1.09	23.15	12.97	5.30	6.67	33.25	0.35		
41.25	1.30	28.15	15.26	5.30	5.12	36.25	0.99		
60.25	0.94	31.15	14.76	5.30	5.44	39.25	0.50		
63.25	0.78	36.15	16.45	5.30	5.97	48.75	1.70		
66.25	0.77	40.65	19.05	7.50	6.42	52.25	0.54		
69.75	0.82	45.65	18.19	7.90	6.78	55.25	0.90		
71.25	0.80	47.15	17.01	8.30	7.30	58.25	0.67		
72.75	0.71	50.23	18.50	9.00	7.66	61.75	0.46		
74.25	0.83	58.65	17.57	9.40	7.64	64.75	1.23		
75.75	0.86	61.65	19.57	9.80	8.03	67.75	0.69		
76.85	1.25	62.15	18.32	9.80	9.10	71.25	0.78		
80.75	0.77	68.25	17.92	10.50	7.87	74.25	1.46		
82.25	0.76	71.65	19.44	11.10	8.27	77.25	0.42		
83.75	0.72	74.65	20.47	12.00	9.37	83.70	0.61		
85.25	0.77	77.65	18.06	16.85	10.20	86.75	0.92		
88.14	0.89	81.15	19.84	28.35	15.99	93.25	0.81		
91.75	0.62	84.15	20.15	37.85	15.51	102.75	1.56		
93.25	0.70	87.15	18.30	47.35	16.20	107.25	0.45		
94.75	0.74	92.15	18.60	56.85	18.64	112.25	0.43		
96.25	0.76	96.45	20.42	66.25	19.32	113.75	0.66		
97.75	0.70	100.15	18.99	66.25	18.48				
99.75	0.68	106.15	18.81	77.85	21.17				
101.25	0.71	109.65	17.64	77.85	19.89				
102.75	0.63	115.72	23.58	84.94	22.96				
104.25	0.60	119.47	17.77	84.94	19.93				
105.75	0.75	123.47	18.94	87.69	21.65				
109.25	0.76	126.89	22.84	87.69	20.17				
110.75	0.80	130.65	18.87						
112.25	0.72	132.15	17.14						
118.75	0.61	140.10	20.88						
120.25	0.53	141.65	20.88						
127.39	0.67	143.30	19.22						
156.75	0.48	161.63	17.75						
186.25	0.59	162.47	17.14						
		169.05	16.28						
		188.65	15.40						
		199.62	13.62						
		246.36	9.35						
		253.39	10.38						