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9. Data Report: Pore Water Chemical and Isotopic Compositions from the West Philippine Basin, Ocean Drilling Program Site 1201[1]

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ABSTRACT

This report summarizes chemical and isotopic data from Ocean Drilling Program Leg 195 Site 1201. Pore water is divided into three intervals based on the rate of chemical change with depth. The shallowest interval is the red clay unit between 1.26 and 56.40 meters below seafloor (mbsf). In this section, there are overall decreases in the concentrations of alkalinity, boron, lithium, magnesium, potassium, sodium, and sulfate, whereas concentrations of calcium and chloride increase. Values of $\delta^{18}O$ and δD plot near standard mean ocean water to the right of the global meteoric water line (GMWL). Five samples from 72.60 and 83.33 mbsf yielded pore water for analyses. These samples help define a trend in the second interval, which is between 56.4 and 238.98 mbsf. Here, concentrations of magnesium, potassium, sodium, and sulfate decease, whereas concentrations of boron, calcium, and chloride increase. Concentrations of alkalinity and lithium remain roughly constant. The deepest interval, between 238.04 and 504.8 mbsf, has comparatively slower decreases of sodium and sulfate, increases of calcium and chloride, slow increases of alkalinity and lithium, and roughly constant concentrations of magnesium, potassium, and boron. Values of $\delta^{18}O$ and δD in pore water between 146.98 and 504.80 mbsf plot in a linear trend to the right of the GMWL.

[1] Komor, S.C., and Mottl, M.J., 2006. Data report: Pore water chemical and isotopic compositions from the West Philippine Basin, Ocean Drilling Program Site 1201. *In* Shinohara, M., Salisbury, M.H., and Richter, C. (Eds.), *Proc. ODP, Sci. Results,* 195, 1–14 [Online]. Available from World Wide Web: <http://www-odp.tamu.edu/publications/195_SR/VOLUME/CHAPTERS/110.PDF>. [Cited YYYY-MM-DD]

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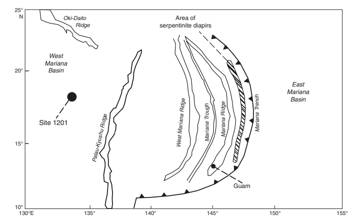
INTRODUCTION

This data report concerns the chemistry of pore water in sediments drilled during Ocean Drilling Program Leg 195 (Salisbury, Shinohara, Richter, et al., 2002). Site 1201 is in the West Philippine Basin ~100 km west of the Kyushu-Palau Ridge at 19°17.82′N, 135°5.95′E (Fig. F1). The water depth is 5711 m. Three boreholes, here treated as one long continuous hole, penetrated 510 m of upper Eocene through Lower Pliocene sediments and 90 m into basalt basement. Pore water at Site 1201 is similar in composition to that discovered in the two holes drilled in the Izu-Bonin forearc sedimentary basin during Leg 126 (Egeberg et al., 1990; Egeberg, 1992). The distinctive features of these waters are very large chloride concentrations, large Ca/Na ratios, and extreme depletion of potassium and magnesium (Egeberg et al., 1990; Torres et al., 1995). The compositions are the products of extensive diagenetic reactions among seawater, volcanic ash and glass, and detrital minerals deposited by turbidity currents. Several factors contribute to the extreme alteration of these sediments. One is the high solubility of volcanic glass in seawater, a process that yields clays and zeolites (e.g., Tazaki and Fyfe, 1992). Plagioclase feldspar also alters in this manner. Another factor is the periodic high deposition rates in the form of ash falls and turbidity flows, which contribute new reactants to the system. In addition, volcanic ash has large surface areas that provide numerous reaction sites. Finally, high geothermal gradients in this tectonically active part of the Earth promote fast reaction rates.



F1. Site location, p. 6.

ANALYTICAL METHODS

Cores recovered by drilling were brought on deck in plastic liners and sectioned with pipe cutters and a spatula. Pore water was squeezed from selected sections in a hydraulic ram that reached pressures of 0.28 GPa (40,000 psi). Water samples were filtered through 0.45-µm cellulose filters. Alkalinity was measured by automated titration with a strong acid at 25°C. Sulfate concentrations were measured by ion chromatography. Fluoride concentrations were measured with an ion-specific electrode. Chloride and calcium concentrations were measured by electrochemical titration. Ammonium and phosphate concentrations were measured by colorimetry. Aluminum, barium, boron, iron, lithium, magnesium, manganese, potassium, silicon, and strontium concentrations were measured by inductively coupled plasma (ICP)–atomic emission spectroscopy. Cesium and rubidium concentrations were measured by ICP-mass spectrometry. Sodium concentrations were determined by charge-balance requirements.

Samples for δD and $\delta^{18}O$ analyses were sealed in glass vials with polytetrafluoroethylene (PTFE)-lined caps and refrigerated. Samples for $\delta^{13}C$ analyses were transferred to a nitrogen-filled glove bag as soon as they were squeezed from the cores, treated with HgCl to arrest bacterial activity, and refrigerated in crimp-seal vials. All isotopic analyses were done at the University of Waterloo's (Ontario, Canada) Environmental Isotope Laboratory. The errors of the isotopic analyses are 0.1‰ for $\delta^{18}O$, 1.0‰ for δD, and 0.1‰ for $\delta^{13}C$.

SAMPLE CHARACTERISTICS

Lithology

The sedimentary section at Site 1201 is composed of two units: an upper unit characterized by red clays and a lower unit consisting of volcanic ash and glass and detritus in turbidite deposits. The upper unit extends from the ocean floor to 56.40 meters below seafloor (mbsf) and consists of pelagic red clays, cherts, and interbedded sandstones and silty claystones. Magnetic and paleontological evidence indicate that the upper unit is middle Oligocene to Early Pliocene in age. The entire Pleistocene and most of the Pliocene sections are absent at this location. The uppermost 25 m of this unit is bioturbated and contains manganese nodules. Chert layers are common between 25 and 44 mbsf. Sediments between 44 and 56.40 mbsf include interbedded sandstone and silty claystone with breccia units and low-energy turbidite deposits. Common minerals in the upper section include detrital quartz and plagioclase, mixed-layer illite/smectite clays, and authigenic phillipsite ($K_Z[Ca_{0.5},Na]_4[A_{16}Si_{10}O_{32}]\cdot 12H_2O$). Quartz concentrations decrease with depth, whereas plagioclase and phillipsite concentrations increase toward the base of this unit.

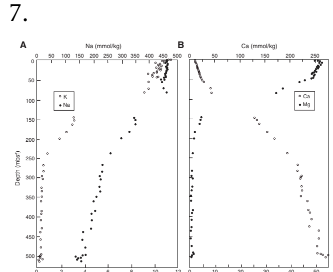
The lower unit extends from 56 to 510 mbsf, where it rests on pillow basalts. It is late Eocene to middle Oligocene in age. The unit consists of interbedded sandstones, bioturbated siltstones, and volcanic breccias deposited by high-energy turbidity currents. Red clays are absent. Reworked detrital plagioclase and clinopyroxene, cemented by carbonates, dominate the upper part of the sequence. Smectite clays become more ordered with depth in the unit, whereas volcanic glass and plagioclase phenocrysts are altered to zeolites and clays. Phillipsite dominates the zeolite assemblage in the upper part of the unit, whereas analcime ($NaAlSi_2O_6\cdot H_2O$), clinoptilolite ($[Na,Ca,K])_6[Si,Al]_{36}O_{72} \cdot 20H_2O$), heulandite ($[Ca,Na_2,K_2]_4[Al_8Si_{28}O_{72}]\cdot 24H_2O$), and wairikite ($CaAl_2Si_4O_{12}\cdot 2H_2O$) are more common below 250 mbsf. Gypsum concentrations increase with depth in the lower unit. The lowermost part of this unit, between 484 and 509 mbsf, consists of massive yellow clay that has been chemically modified by interaction with the basalt.

PORE WATER CHEMISTRY AND ISOTOPIC COMPOSITIONS

Pore water is divided into three intervals based on the rate of chemical change with depth. The shallowest interval is the red clay unit between 1.26 and 56.40 mbsf. In this section, there are overall decreases in sulfate, alkalinity, potassium, magnesium, and sodium concentrations and increases in calcium and chloride concentrations (Table T1; Fig. F2A–F2B, F2C–F2E). Sediments between 56.40 and 146.98 mbsf are well-indurated, and only samples from 72.60 and 83.33 mbsf yielded pore water for analyses. These samples help define a zone of strong chemical gradients between 56.40 and 238.98 mbsf, which constitutes the second interval. The deepest section, from 238.04 to 504.80 mbsf, has comparatively slower decreases in potassium, sodium, and sulfate concentrations and slower increases in calcium and chloride concentrations. Trace constituents such as lithium and boron also help define the three depth intervals (Fig. F2F, F2G). Both constituents decrease in the

T1. Pore water chemistry, p. 12.

F2. Composition depth profiles, p. 7.



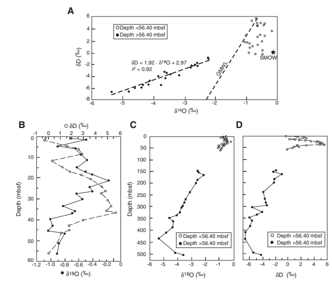
red clay unit, reach minimum concentrations between 56.40 and 238.04 mbsf, and then increase by small amounts between 238.04 and 504.80 mbsf.

Values of $\delta^{18}O$ and δD in pore water above 56.40 mbsf are distinctly different from those in deeper pore water (Table T2). Most water from the red clays and other rocks shallower than 56.40 mbsf plots near standard mean ocean water to the right of the global meteoric water line (GMWL) (Fig. F3A). In contrast, samples from 146.98 to 504.80 mbsf plot in a linear array (r^2 = 0.92) to the left of the GMWL. Changes in $\delta^{18}O$ and δD values in pore water from the rocks shallower than 56.40 mbsf define similar but offset depth profiles (Fig. F3B). For example, the maximum $\delta^{18}O$ value of –0.16‰ occurs at 21.20 mbsf, whereas the maximum δD value of 5.66‰ is at 37.20 mbsf. Isotopic values in pore water from the turbidites decrease with depth between 147 and 437 mbsf but then reverse between 495.20 and 504.98 mbsf (Fig. F3C, F3D). Proximity to the basalts probably affects the isotopic compositions of the two deepest samples.

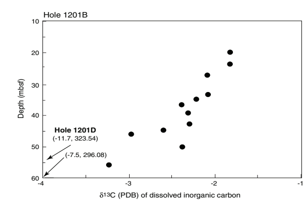
Values of $\delta^{13}C$ in dissolved inorganic carbon (DIC) ($\delta^{13}C_{DIC}$) decrease irregularly with depth from –1.8‰ to –3.4‰ in the red clays and other rocks above 56.40 mbsf (Table T2; Fig. F4). Only two $\delta^{13}C$ isotopic analyses were obtained from pore water in the turbidites because they yielded very small volumes of pore water.

T2. O, H, and C isotopes, p. 14.

F3. δD and δ18O values and depth profiles, p. 10.



F4. $\delta^{13}C_{DIC}$ depth profile, p. 11.



ACKNOWLEDGMENTS

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Figure F1. Location of Site 1201 in the West Philippine Basin.

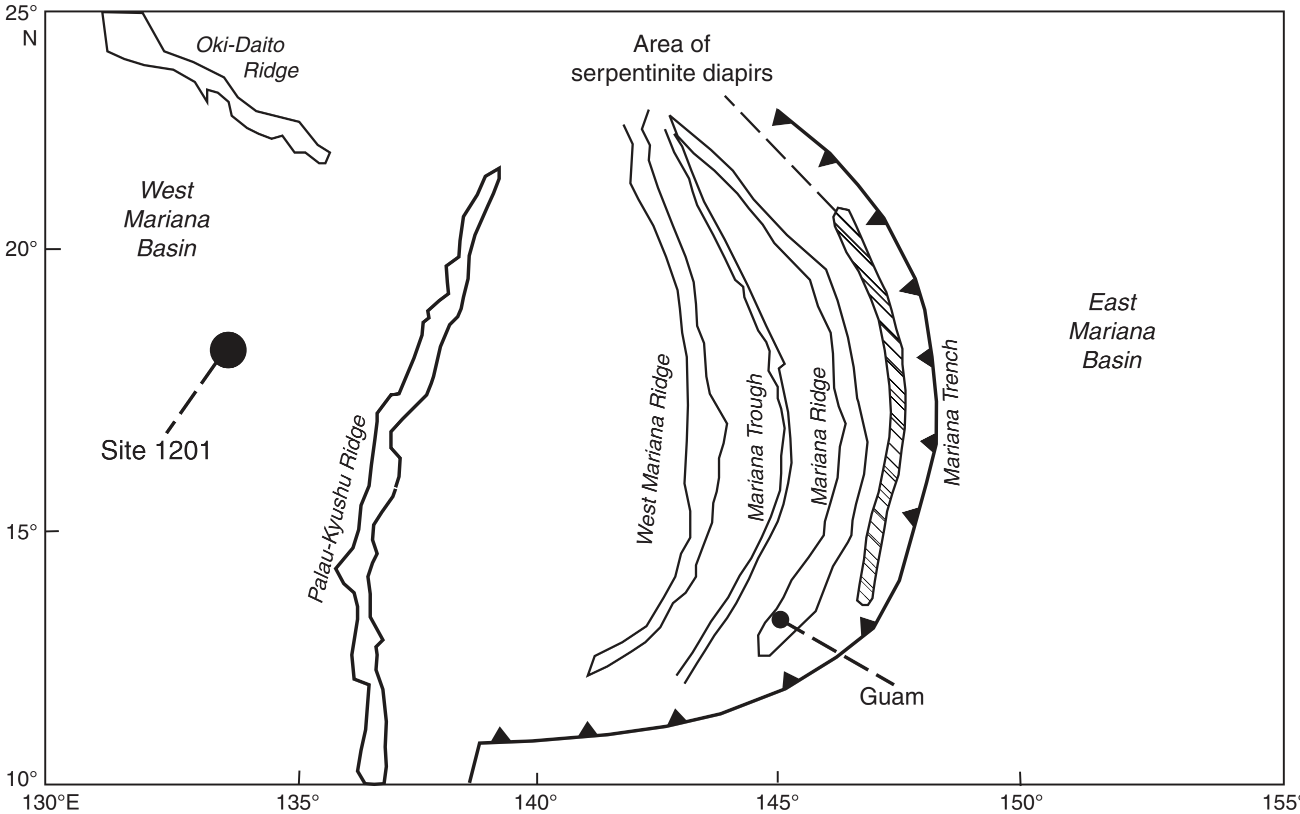

Figure F2. Depth profiles of pore water compositions. **A.** Potassium and sodium. **B.** Magnesium and calcium. (Continued on next two pages.)

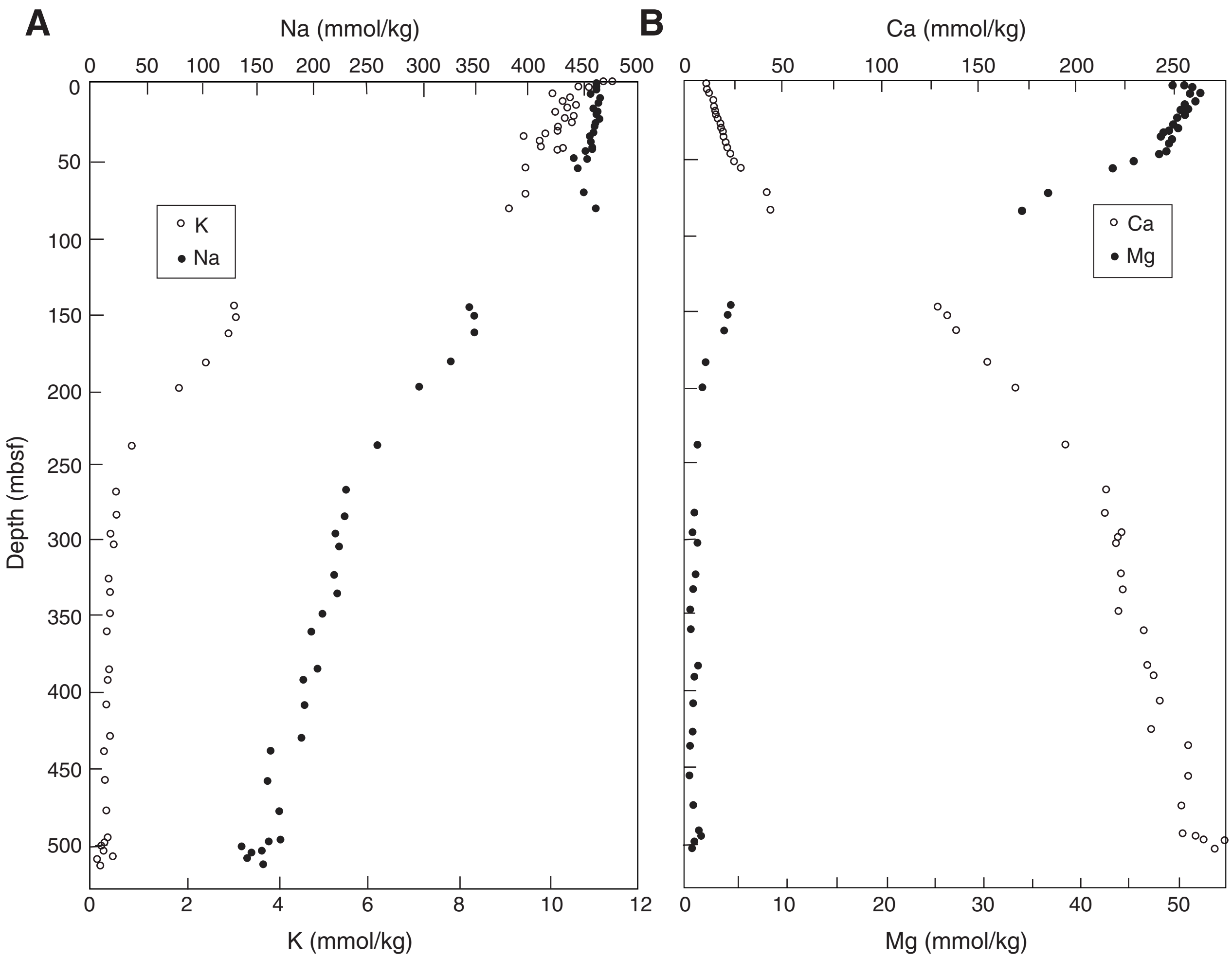

Figure F2 (continued). C. Sulfate. D. Chloride. E. Alkalinity.

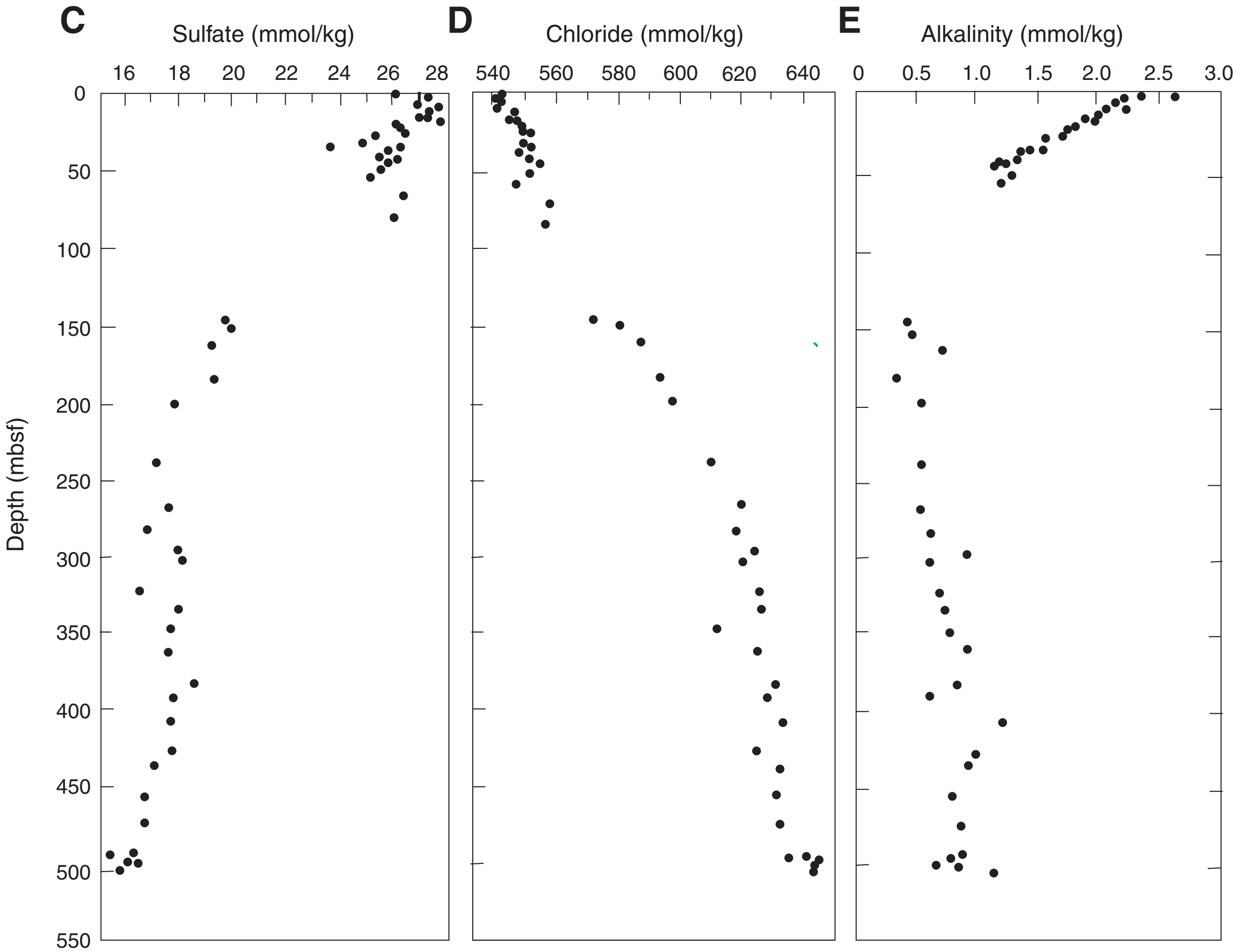

Figure F2 (continued). F. Lithium. G. Boron.

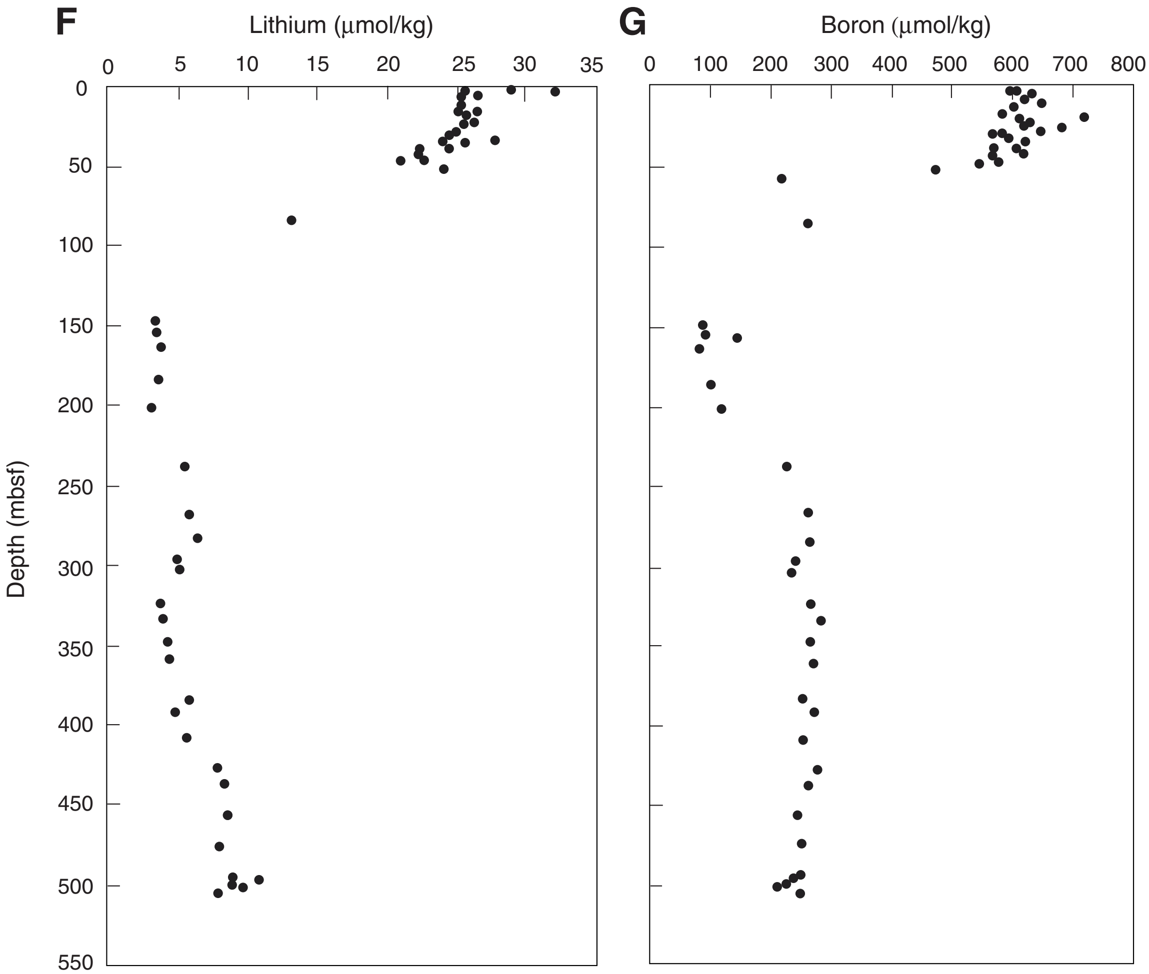

Figure F3. A. Values of δD and $\delta^{18}O$ in pore water. Samples shallower than 56.40 mbsf are from the red clay unit. Deeper samples are from the turbidite unit. The regression line is calculated from pore water from the turbidite unit only. GMWL = global meteoric water line, SMOW = standard mean ocean water. **B.** Depth profiles of δD and $\delta^{18}O$ in pore water from the red clay unit. Maximum δD and $\delta^{18}O$ values occur at different depths. **C.** Depth profile of $\delta^{18}O$ values. **D.** Depth profile of δD values. The deepest two samples in plots C and D are probably affected by interaction with the underlying basalts.

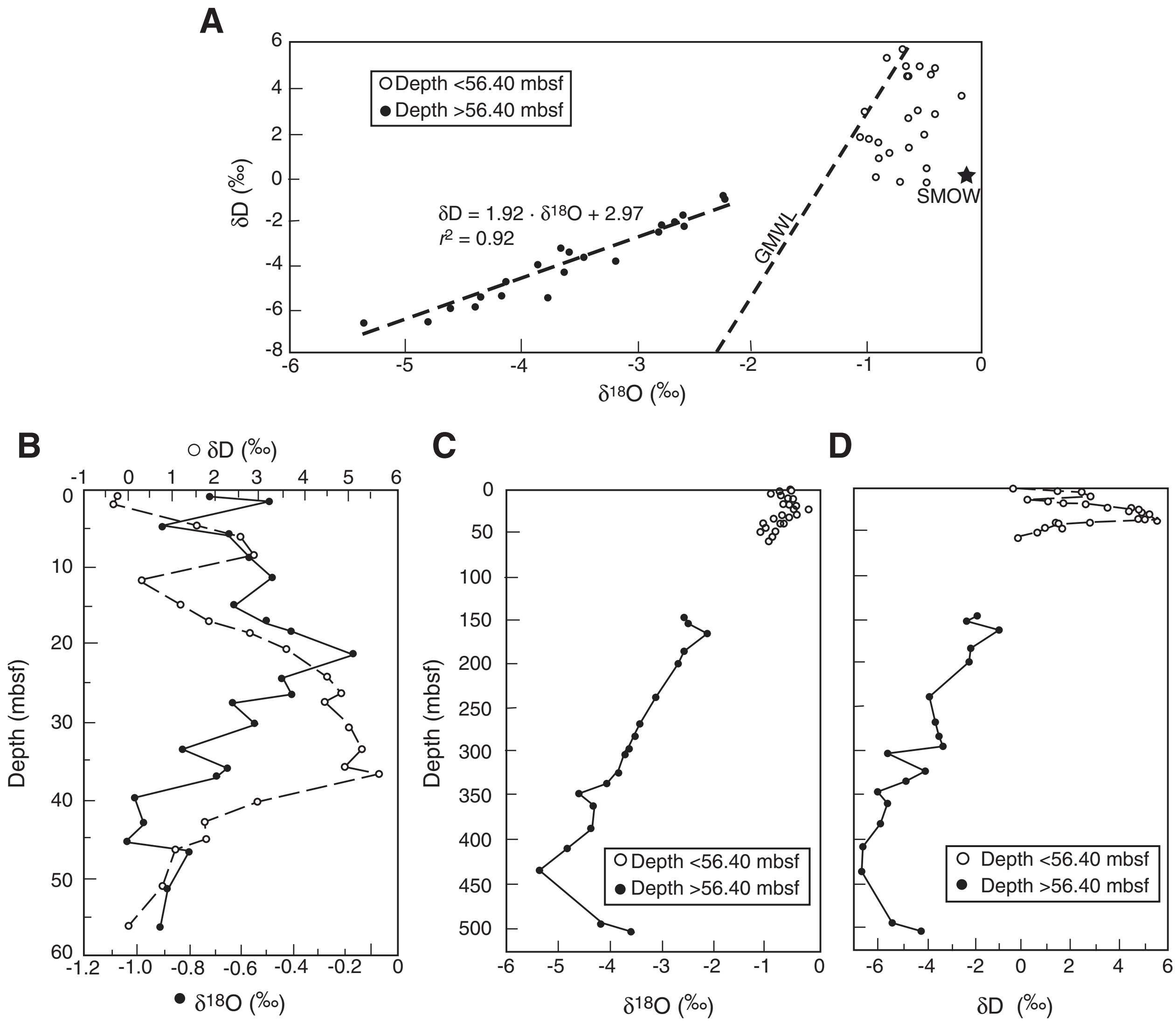

Figure F4. Depth profile of $\delta^{13}C$ in dissolved inorganic carbon ($\delta^{13}C_{DIC}$). PDB = Peedee belemnite.

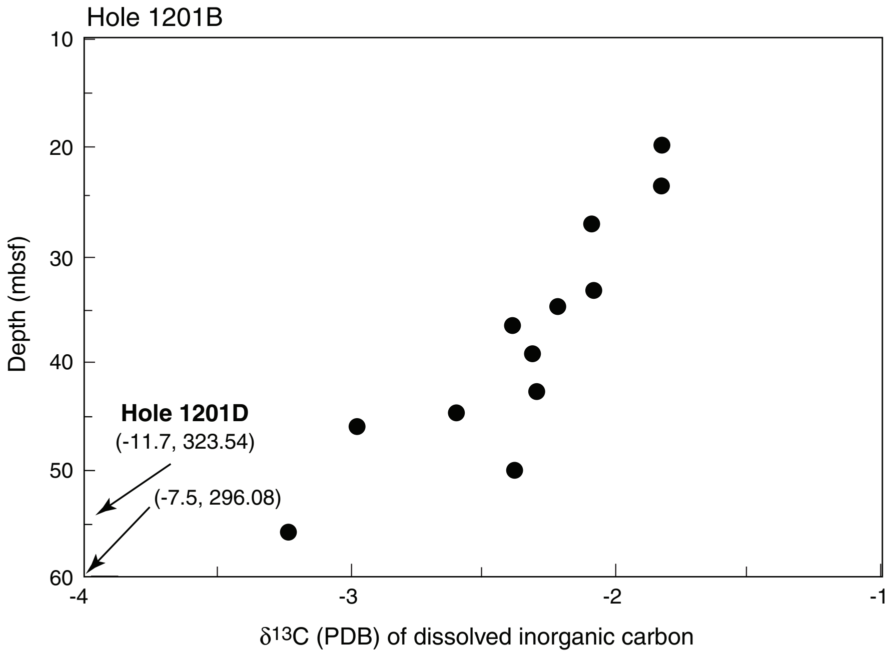

Table T1. Pore water chemistry. (Continued on next page.)

Core, section	Depth (mbsf)	Volume (mL)	In situ temperature (°C)	pH	Alkalinity (meq/kg)	Chlorinity (mmol/kg)	Sulfate (mmol/kg)	Na (mmol/kg)	NH_3 (mmol/kg)	PO_4 (µmol/kg)	F (µmol/kg)	Sr (µmol/kg)	Mn (µmol/kg)
195-1201A-													
1H-1	1.26	45	1.7	7.83	2.36	541.2	26.00	458.3	ND	1.0	66.6	78.8	0.3
195-1201D-													
1H-1	1.50	42	1.7	7.61	2.62	538.8	25.99	459.9	1.2	0.0	23.6	81.3	0.3
1H-3	4.50	42	2.1	7.54	2.16	539.3	27.30	460.0	1.4	0.0	14.1	79.4	0.2
1H-4	6.00	42	2.3	7.67	2.24	539.8	27.21	459.9	1.2	0.0	13.6	81.3	0.2
2H-1	8.70	22	2.6	7.71	2.24	538.8	27.04	455.6	1.5	0.0	17.7	82.7	0.3
2H-3	11.70	42	3.0	7.76	2.10	544.6	27.67	462.5	1.4	0.0	20.5	79.2	0.1
2H-5	14.70	42	3.3	7.89	2.03	544.6	27.36	461.7	1.2	0.0	20.1	83.2	0.1
2H-7	17.11	59	3.6	7.77	1.90	543.6	27.02	459.3	1.4	0.0	5.6	83.5	0.4
3H-1	18.20	42	3.8	7.77	1.98	546.6	27.29	461.2	1.3	0.0	6.5	85.2	0.2
3H-3	21.20	53	4.2	7.86	1.84	547.5	27.81	462.4	1.4	0.0	5.3	87.4	0.4
3H-5	24.20	52	4.5	7.47	1.77	548.5	26.15	460.2	2.2	0.0	6.2	89.5	0.7
3H-7	26.32	42	4.8	7.76	1.73	548.5	26.38	459.8	1.6	1.3	5.8	87.9	0.4
4H-1	27.70	60	5.0	7.71	1.58	550.4	26.46	459.8	1.4	0.0	4.7	89.7	0.2
4H-3	30.70	50	5.3	7.71	1.58	549.5	25.32	456.8	1.5	0.0	4.4	88.0	0.0
4H-5	33.70	60	5.7	7.71	1.56	551.4	24.88	458.2	1.6	0.0	5.2	85.3	0.6
4H-7	35.97	60	6.0	7.73	1.43	551.4	23.66	456.2	1.1	0.0	4.1	82.7	0.0
5H-1	37.20	57	6.2	7.87	1.40	547.5	26.26	454.0	1.6	0.0	3.3	93.3	0.4
5H-3	40.20	59	6.5	7.77	1.35	550.4	25.81	455.6	1.4	0.0	2.9	90.5	0.6
5H-5	43.20	66	6.9	7.87	1.20	553.3	25.46	455.8	1.1	0.0	2.7	96.3	0.3
5H-7	45.25	57	7.2	7.83	1.23	553.3	26.18	456.4	1.3	0.0	2.9	94.2	0.7
6H-1	46.50	57	7.3	7.85	1.14	550.4	25.82	451.6	1.5	0.0	2.2	95.2	1.0
7X-3	51.20	30	7.9	8.19	1.27	550.4	25.54	452.0	1.5	0.3	3.3	93.7	1.4
8X-3	56.40	52	8.6	8.66	1.18	545.6	25.13	443.6	1.5	0.0	3.2	96.7	2.7
10X-1	72.60	4	10.6	ND	ND	557.2	26.42	447.8	0.9	0.6	4.4	ND	ND
195-1201D-													
1R-2	83.33	8	11.9	8.74	0.90	554.8	26.02	461.7	1.6	0.0	19.9	107.4	11.3
7R-CC	146.98	35	19.9	8.86	0.42	569.9	19.87	346.8	1.6	2.8	9.9	114.7	8.5
8R-4	153.21	54	20.6	9.42	0.48	580.5	20.02	348.5	1.5	0.3	9.6	114.2	4.3
9R-4	163.14	28	21.9	9.45	0.71	586.4	19.28	348.6	1.5	0.3	12.2	105.4	4.0
11R-5	183.41	11	24.4	8.49	0.33	594.1	19.43	325.2	3.1	0.0	14.7	83.8	7.7
13R-3	199.66	22	26.4	9.12	0.52	598.0	17.92	298.2	1.5	0.0	13.4	66.1	3.8
17R-3	238.04	40	31.2	9.15	0.55	610.6	17.30	259.4	1.5	0.0	3.7	47.3	1.1
20R-3	267.16	9	34.9	9.52	0.55	620.3	17.69	230.5	1.6	0.0	4.5	49.4	0.6
22R-1	283.71	28	36.9	9.23	0.61	618.4	17.00	229.3	1.4	0.0	3.3	52.9	0.5
23R-3	296.08	40	38.5	9.39	0.90	625.2	18.01	220.2	1.6	0.6	3.1	47.7	0.5
24R-1	302.88	18	39.3	9.33	0.62	621.3	18.20	222.5	1.6	0.6	3.3	51.6	0.5
26R-2	323.54	54	41.9	9.55	0.71	626.2	16.62	218.7	1.4	1.0	2.7	49.8	0.3
27R-3	334.22	22	43.3	9.45	0.74	627.1	18.04	220.7	1.6	0.6	3.0	48.2	0.5
28R-6	347.97	18	45.0	9.5	0.79	611.6	17.80	208.1	1.6	0.6	3.4	41.1	0.3
30R-1	360.60	25	46.5	9.59	0.93	625.2	17.71	197.6	1.6	0.0	2.5	44.1	0.3
32R-4	383.96	44	49.5	9.41	0.85	631.0	18.68	202.4	2	0.0	2.1	44.4	0.5
33R-3	392.08	32	50.5	9.55	0.60	628.6	17.93	190.2	1.6	0.0	1.7	45.8	0.4
35R-1	408.50	30	52.5	9.95	1.24	633.9	17.77	189.4	1.6	0.0	1.7	51.2	0.2
37R-1	427.81	8	54.9	9.51	0.99	624.2	17.81	189.3	1.8	0.0	1.9	56.4	0.4
38R-1	437.27	34	56.1	9.77	0.93	633.0	17.11	160.1	1.8	0.3	1.3	53.3	0.3
40R-1	456.76	8	58.6	9.47	0.80	632.0	16.74	157.9	1.6	0.3	2.0	47.6	0.6
42R-1	476.00	8	61.0	9.46	0.88	633.9	16.86	168.1	1.6	0.3	2.2	56.5	0.1
44R-1	495.20	25	63.4	9.44	0.77	635.9	16.37	166.3	1.6	0.6	3.0	54.9	0.2
44R-2	496.70	10	63.5	9.48	0.88	641.7	15.45	156.7	1.6	0.3	2.4	53.7	0.3
44R-4	499.70	4	63.9	9.37	0.86	646.5	16.13	133.2	1.6	0.6	2.8	56.3	0.6
44R-5	501.20	4	64.1	9.12	0.67	644.6	16.56	152.2	ND	ND	ND	ND	ND
45R-1	504.80	20	64.6	10.03	1.15	644.6	15.84	140.1	1.8	1.8	0.6	7.8	0.2
45R-3	507.36	0.05	64.9	ND	ND	638.0	15.43	139.1	ND	ND	ND	ND	ND
45R-5	510.01	2	65.2	ND	ND	601.6	13.51	152.7	ND	ND	ND	ND	ND

Note: ND = not determined.

Table T1 (continued).

Core, section	Depth (mbsf)	Fe (µmol/kg)	Al (µmol/kg)	Si (µmol/kg)	B (µmol/kg)	Li (µmol/kg)	Rb (µmol/kg)	Cs (µmol/kg)
195-1201A-								
1H-1	1.26	0.0	2.9	225.4	594.0	32.2	ND	ND
195-1201D-								
1H-1	1.50	0.0	0.0	227.4	605.1	29.2	1.7	8.4
1H-3	4.50	0.0	0.0	154.9	630.3	25.8	ND	ND
1H-4	6.00	0.6	0.6	140.4	619.5	26.5	1.7	13.1
2H-1	8.70	0.7	0.0	128.5	646.1	25.4	ND	ND
2H-3	11.70	0.0	0.0	96.6	600.1	25.4	1.5	3.6
2H-5	14.70	0.0	1.6	79.8	582.0	25.4	ND	ND
2H-7	17.11	0.1	0.0	110.5	715.5	26.5	1.7	3.2
3H-1	18.20	0.0	0.8	100.2	610.2	25.9	ND	ND
3H-3	21.20	0.0	1.2	104.8	622.2	26.2	1.5	6.9
3H-5	24.20	0.0	1.0	108.7	681.3	25.6	ND	ND
3H-7	26.32	0.3	0.0	110.9	645.7	25.3	1.6	4.2
4H-1	27.70	0.0	0.0	107.3	567.4	25.1	ND	ND
4H-3	30.70	0.0	0.4	117.6	588.9	24.8	1.6	14.8
4H-5	33.70	0.5	2.0	126.5	616.7	27.9	ND	ND
4H-7	35.97	0.0	1.8	110.0	570.2	25.5	1.6	4.2
5H-1	37.20	0.3	3.5	109.8	605.6	24.6	ND	ND
5H-3	40.20	0.0	0.0	107.2	615.1	22.3	1.5	3.6
5H-5	43.20	0.0	1.7	106.0	565.0	22.4	ND	ND
5H-7	45.25	0.0	0.0	128.4	571.8	22.6	1.6	4.0
6H-1	46.50	0.0	1.2	104.6	539.4	21.1	ND	ND
7X-3	51.20	0.0	2.3	421.7	471.0	24.2	1.7	4.1
8X-3	56.40	0.0	0.0	284.5	216.4	20.8	1.6	3.9
10X-1	72.60	ND	ND	ND	ND	ND	1.7	6.4
195-1201D-								
1R-2	83.33	0.0	3.2	520.2	260.5	13.3	1.5	8.3
7R-CC	146.98	0.0	9.0	199.7	90.6	3.5	ND	ND
8R-4	153.21	0.0	14.2	253.2	88.4	3.6	0.7	7.0
9R-4	163.14	0.0	14.7	260.8	83.9	3.9	0.6	8.6
11R-5	183.41	1.0	19.2	261.3	100.3	3.6	ND	ND
13R-3	199.66	0.9	18.4	254.8	113.3	3.2	0.5	9.3
17R-3	238.04	0.0	23.1	218.1	223.6	5.6	0.2	2.1
20R-3	267.16	0.0	27.1	204.4	265.0	6.1	ND	ND
22R-1	283.71	0.0	28.2	217.7	261.3	6.4	0.2	2.1
23R-3	296.08	0.0	30.1	223.2	238.8	5.0	ND	ND
24R-1	302.88	0.0	31.7	199.6	230.0	5.1	0.3	1.2
26R-2	323.54	0.0	29.3	221.5	261.6	3.9	ND	ND
27R-3	334.22	0.0	26.2	198.7	281.3	3.7	0.2	0.7
28R-6	347.97	0.0	22.6	203.5	260.8	4.2	ND	ND
30R-1	360.60	0.0	28.1	218.4	269.7	4.4	0.3	0.5
32R-4	383.96	0.1	28.9	215.9	251.8	5.8	ND	ND
33R-3	392.08	0.4	39.9	250.2	268.0	4.9	0.3	0.9
35R-1	408.50	0.0	28.0	207.8	252.4	5.6	ND	ND
37R-1	427.81	3.2	39.1	193.2	271.6	7.8	0.2	0.8
38R-1	437.27	0.0	35.3	246.1	262.4	8.2	0.3	0.9
40R-1	456.76	0.0	30.8	205.4	242.1	8.6	ND	ND
42R-1	476.00	0.0	30.8	213.6	251.1	8.0	0.3	0.4
44R-1	495.20	0.0	28.3	176.4	242.7	8.9	ND	ND
44R-2	496.70	0.0	24.5	146.6	235.8	10.8	0.2	0.5
44R-4	499.70	0.2	36.8	190.4	226.2	8.9	ND	ND
44R-5	501.20	ND	1.9	0.6	2.5	54.4	0.7	0.0
45R-1	504.80	0.0	1.8	0.6	7.8	60.4	0.2	0.0
45R-3	507.36	ND	ND	ND	ND	ND	ND	ND
45R-5	510.01	ND	ND	ND	ND	ND	ND	ND

Table T2. Oxygen, hydrogen, and carbon isotope compositions of pore water at Site 1201.

Core, section	Depth (mbsf)	δ18O (SMOW) (‰)	δD (SMOW) (‰)	δ13C (PDB) (‰)
195-1201A-				
1H-	1.26	–0.71	–0.26	ND
195-1201B-				
1H-1	1.50	–0.48	–0.31	ND
1H-3	4.50	–0.90	1.56	ND
1H-4	6.00	–0.64	2.57	ND
2H-1	8.70	–0.56	2.90	ND
2H-3	11.70	–0.48	0.33	ND
2H-5	14.70	–0.63	1.22	ND
2H-7	17.11	–0.50	1.85	ND
3H-1	18.20	–0.40	2.75	ND
3H-3	21.20	–0.16	3.59	–1.95
3H-5	24.20	–0.44	4.52	–1.97
3H-7	26.32	–0.40	4.79	ND
4H-1	27.70	–0.64	4.45	–2.23
4H-3	30.70	–0.54	4.93	ND
4H-5	33.70	–0.83	5.25	–2.20
4H-7	35.97	–0.65	4.89	–2.34
5H-1	37.20	–0.69	5.66	–2.54
5H-3	40.20	–1.01	2.88	–2.46
5H-5	43.20	–0.98	1.67	–2.42
5H-7	45.25	–1.05	1.73	–2.73
6H-1	46.50	–0.80	1.03	–3.10
7X-3	51.20	–0.89	0.75	–2.49
8X-3	56.40	–0.92	–0.06	–3.37
195-1201D-				
7R-CC	146.98	–2.61	–1.84	ND
8R-4	153.21	–2.56	–2.26	ND
9R-4	163.14	–2.24	–0.89	ND
11R-5	183.41	–2.66	–2.11	ND
13R-3	199.66	–2.77	–2.19	ND
17R-3	238.04	–3.17	–3.85	ND
20R-3	267.16	–3.45	–3.61	ND
22R-1	283.71	–3.59	–3.43	ND
23R-3	296.08	–3.66	–3.30	–7.50
24R-1	302.88	–3.77	–5.48	ND
26R-2	323.54	–3.86	–3.94	–11.65
27R-3	334.22	–4.13	–4.76	ND
28R-6	347.97	–4.60	–5.89	ND
30R-1	360.60	–4.36	–5.58	ND
32R-4	383.96	–4.39	–5.83	ND
33R-3	408.50	4.82	–6.56	ND
38R-1	437.27	–5.35	–6.60	ND
44R-1	495.20	–4.18	–5.36	ND
45R-1	504.80	–3.64	–4.18	ND

Notes: SMOW = standard mean ocean water, PDB = Peedee belemnite. ND = not determined.