25. INTERSTITIAL WATER STUDIES ON SMALL CORE SAMPLES, DEEP SEA DRILLING PROJECT, LEG 6[1]

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INTRODUCTION

Sediments from Leg 6 sites, west of the Hawaiian Islands, consisted primarily of various combinations of deep-sea biogenic oozes, volcanic ash, and its breakdown products. Pore fluids from most of the sites were similar in composition to present day ocean water, and in some sites almost identical. However, interstitial fluids from Site 53 (Philippine Sea) showed changes in ionic composition which were beyond those previously considered attributable to diagenetic influence. These samples show the beginnings of metamorphism by dramatic increases in calcium concentrations and corresponding decreases in alkali concentrations.

Analytical methods were similar to those outlined in previous Leg Reports. However, obvious contamination of aliquots for sodium determination in the laboratory made it necessary to determine all sodium values by difference between anion and cation balances. These values are, if anything, more accurate than direct determinations which have been discussed in earlier legs. However, the authors will continue to analyze sodium directly, and in the future they may be able to improve the precision of the determinations to the point where small losses and gains of sodium in the pore fluids may be established accurately.

Agreement between colorimetric and spectrometric determinations of silicon has improved, but there are still occasional marked differences for which the writers have no explanation. T. Takahashi has allowed the authors to compare total Carbon Dioxide (CO_2) measurements from his laboratory with their alkalinity determinations: both sets of data were obtained from fluids from the same squeezings of sediments and should give similar values at the indicated *p*H levels. Some disturbingly large discrepancies in the two sets of data are evident. The authors do not think that their back-titration alkalinity technique alone is responsible for the differences. However, they have not evaluated the possible influence of the heat-sealed polyethylene pipes on the alkalinity values; this should be considered a potential source of error.

The *p*H data from water samples processed and measured on shipboard are reported here. In view of the major changes in pressure and temperature (laboratory temperatures were reported to be 26 to 28°C) and the sediments to new gaseous regimes prior to *p*H measurement, these values should be interpreted mainly as applying to the squeezed effluents, not to *in situ* values.

The authors wish to acknowledge the efforts of Charlotte Lawson and Heidi Richards on the laboratory determinations, and the loan of atomic absorption equipment by Derek Spencer of the Woods Hole Oceanographic Institution.

RESULTS

The data are presented in Tables 1 and 2 (major and minor constituents, respectively). Relatively minor changes in ionic composition characterize most sites, with a very minor fluctuation of chloride around 19.6 o/oo (g/kg). Drastic increases in calcium concentration to over 3000 ppm (3.0 g/kg) were encountered in Site 53; these contrast sharply with values of about 400 ppm for oceanic waters and common pore fluid values. The highest calcium value was obtained from a section of alternating ash and lithified, recrystallized chalk ooze, regarded by shipboard observers as "baked" and apparently subjected to hydrothermal action. The high calcium value at 166 meters depth (Sample 53-0-4-1) is accompanied by a sharp depletion in potassium and sodium; chloride showed no significant change. Elsewhere, the presence of volcanic ash did not produce chemical changes in pore fluids which were substantially different from those encountered in biogenic oozes, with the possible exception of lower alkalinity.

DISCUSSION

The presence of some very pure calcareous (coccolith-foraminiferal) oozes offers the opportunity to evaluate the possible uptake of magnesium (with resulting depletion in pore fluid) by the solid carbonates. No evidence of depletion was found; Site 55 clearly demonstrates this. These results tend to confirm previous

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conclusions that uptake of magnesium from pore solutions is chiefly accomplished by clayey sediments (Manheim *et al.*, 1970; Let 5 Report).

For sediment from Site 53, it was noted that the uptake of alkalis (sodium and potassium) in the solid phases and the loss of calcium into the pore fluids, presumably from attack of volcanic ash by hot solutions, was in the right direction for beginning metamorphism. Unlike sites from the Gulf of Mexico (Leg 1), where gains in calcium were also quite marked, no corresponding increases in concentrations of strontium and barium were observed.

The authors have no clear explanation of the relative increases in boron concentrations in the sediments, except that boron values tend to be higher in the highly carbonate-rich zones, and tend to be lower in volcanic ash or otherwise siliceous zones. The uptake of boron by marine calcareous organisms (and, perhaps the partial loss in the course of diagenesis) deserves more detailed study than it has received to date.

REFERENCES

Manheim, F. T., Chan, K. M. and Sayles, F. L., 1970. Interstitial water studies on small core samples, Deep Sea Drilling Project, Leg 5. In McManus, D. *et al.* Initial Reports of the Deep Sea Drilling Project, Volume V, Washington (U.S. Government Printing Office).

TABLE 1
Major Element Composition of Pore Fluids
Reported in g/kg Fluid

Sample Designation	Depth (m)	Age	Description	Na[a]	K	Ca	Mg	Total Cations (meq/kg)[a]	Cl	SO_4	Alk (meq/kg)	HCO_3^c	Total Anions (meq/kg)	Sum	H_2O(%)[d]	pH[e]
Hole 44.1 (19° 18.5′N, 169° 00.0′W, water depth 1478 m, Horizon Ridge, Mid-Pacific mountain Southwest of Hawaii)																
1-3	43	Lower Oligocene	Light nannoplankton foraminiferal ooze	10.7	0.47	0.41	1.26	(602)	19.4	2.65	3.4	0.20	602	35.1	55	–
Hole 45.1 (24° 15.9′N, 178° 30.5′W, water depth 5508 m, southwest of Midway Island)																
1-1	2	?	Brown zeolitic clay	10.5	0.46	0.37	1.32	(596)	19.5	2.27	2.4	0.15	596	34.5	59	–
Hole 47.0 (32°26.9′N, 157° 42.7′E, water depth 2689 m, West part of crest of Shatsky Rise)																
1-3	8	Pleistocene	Olive-gray foraminiferal nannoplankton ooze	10.5	0.46	0.38	1.36	(597)	19.2	2.73	1.9	0.12	597	34.7	57	7.6
Hole 47.2 (32° 26.9′N, 157° 42.7′E water depth 2689 m, West part of crest of Shatsky Rise)																
2-3	22	Pleistocene	Light gray chalk ooze with glass	10.9	0.54	0.33	1.28	(608)	19.7	2.59	1.0	0.06	608	35.3		7.9
4-3	42	Upper Pleistocene	Light gray chalk ooze	11.0	0.50	0.36	1.20	(606)	19.7	2.38	1.5	0.09	606	35.2	40	7.6
7-1	65	Lower Eocene	Pale yellow chalk ooze	10.7	0.34	0.47	1.33	(607)	19.8	2.37	1.5	0.09	607	35.1		7.6
Hole 48.2 (32°24.5′N, 158° 01.3′E, water depth 2619 m, West part of crest of Shatsky Rise)																
1-2	53	Lower Pliocene	Mottled chalk ooze	11.1	0.50	0.35	1.35	(623)	19.9	2.92	1.7	0.10	623	35.8	45	7.7
2-2	63	Upper Cretaceous	White chalk ooze	10.8	0.42	0.40	1.31	(610)	19.7	2.65	–	–	610	35.3	34	7.6
Hole 49.0 (32° 24.1′N, 156° 35.0′E, water depth 4282 m, West flank Shatsky Rise; sediment subcrop)																
1-2	3	Pleistocene	Brown mud with volcanic glass	10.7	0.44	0.41	1.32	(602)	19.3	2.76	1.6	0.10	602	35.1	56	7.6
Hole 49.1 (32° 24.1′N, 156° 35.0′E, water depth 4282 m, West flank Shatsky Rise; sediment subcrop)																
1-3	6	Upper Jurassic Lower Cretaceous	Brown sandy zeolitic mud	10.6	0.46	0.44	1.28	(601)	19.4	2.62	–	–	601	34.8	60	7.5

TABLE 1 – *Continued*

Sample Designation	Depth (m)	Age	Description	Na[a]	K	Ca	Mg	Total Cations (meq/kg)[a]	Cl	SO_4	Alk (meq/kg)	HCO_3^c	Total Anions (meq/kg)	Sum	H_2O(%)[d]	pH[e]
Hole 50.1 (32° 24.2′N, 156° 36.0′E, water depth 4487 m, West flank Shatsky Rise; basement subcrop)																
1-4	7	Pleistocene	Brown clay with nanoplankton	10.6	(0.45)	0.36	1.33	(601)	19.4	2.63	1.7	0.10	601	34.8	50	7.6
3-5	30	?	Brown zeolitic clay	10.8	0.46	0.31	1.32	(608)	19.5	2.78	–	–	608	35.2	60	7.5
Hole 51.0 (33° 28.5′N, 153° 24.3′E, water depth 5981 m, West flank Shatsky Rise; sediment pond)																
1-4	119	Miocene	Brown zeolitic clay with clay breccia (deformed)	10.6	0.40	0.46	1.27	(598)	19.4	2.43	1.8	0.11	598	34.7	57	7.5
Hole 51.1 (33° 28.5′N, 153° 24.3′E, water depth 5981 m, West flank Shatsky Rise; sediment pond)																
1-5	25	Pleistocene	Gray-brown sandy volcanic mud	10.9	0.46	0.41	1.24	(610)	19.6	2.68	2.4	0.15	610	35.5	58	8.1
Hole 52.0 (27° 46.3′N, 147° 07.8′E, water depth 5744 m, Abyssal swale E. of Bonin Trench)																
1-4	6	?	Brown glassy clay	10.8	0.45	0.38	1.23	(603)	19.4	2.72	1.4	0.08	603	35.0	54	7.3
3-2	20	?	Brown clay	10.8	0.44	0.40	1.37	(611)	19.7	2.73	1.6	0.10	611	35.6	58	7.3
5-3	41	?	Brown ashy clay	10.7	0.42	0.40	1.32	(606)	19.5	2.64	3.2	0.20	606	35.2	64	7.4
Hole 53.0 (18° 02.0′N, 141° 11.5′E, water depth 4629 m, Sediment fan on west side of Iwo Jima in Philippine Sea)																
1-2	90	Middle Miocene	Gray sandy volcanic ash	11.3	0.28	1.52	0.48	(612)	19.8	2.56	1.3	0.08	612	36.0	52	8.7
3-1	138	Lower Middle Miocene	Dark silty volcanic ash	10.6	0.28	2.02	0.30	(695)	19.6	2.08	0.8	0.05	595	34.9	41	8.5
4-1	166	Lower Oligocene Lower Miocene	Vari-colored ash	10.8	0.12	2.73	0.18	(626)	19.8	3.13	0.8	0.05	626	36.8	42	7.6
6-2	195	Lower Oligocene Lower Miocene	Interbedded ash and chalk ooze, lithified	9.6	0.08	3.03	0.17	(587)	19.6	1.65	0.5	0.03	587	34.2	30	7.8
Hole 53.1 (18° 02.0′N, 141° 11.5′E, water depth 4629 m, Sediment fan on west side of Iwo Jima in Philippine Sea)																
1-4	5	?	Dark brown zeolitic clay	10.4	0.45	1.09	0.90	(591)	19.4	2.05	2.2	0.13	591	34.5	65	7.4
2-5	28	Upper Miocene	Dark sandy volcanic ash	10.7	0.41	1.90	0.44	(605)	19.8	2.27	0.6	0.04	605	35.6	48	7.3
3-4	63	Middle-Upper Miocene	Gray silty volcanic ash	10.8	0.34	1.71	0.48	(607)	19.8	2.35	0.2	0.01	607	35.6	43	7.2

TABLE 1 – *Continued*

Sample Designation	Depth (m)	Age	Description	Na[a]	K	Ca	Mg	Total Cations (meq/kg)[a]	Cl	SO_4	Alk (meq/kg)	HCO_3^c	Total Anions (meq/kg)	Sum	H_2O(%)[d]	*p*H[e]
Hole 53.2 (18°02.0′N, 141° 11.5′E, water depth 4629 m, Sediment far on west side of Iwo Jima in Philippine Sea)																
1-4	18	Upper Miocene	Brown radiolarian silt with volcanic glass	10.9	0.35	1.87	0.44	(611)	19.8	2.50	0.7	0.04	611	35.9	50	7.2
Hole 54.0 (15° 36.6′N, 140° 18.1′E, water depth 4990 m, West flank Iwo Jima Ridge																
1-2	89	Middle Miocene	Dark gray silty ash	10.5	0.52	0.37	1.27	(593)	19.6	1.85	0.2	(0.01)	593	34.2	44	7.8
2-3	142	Middle Miocene	Gray calcitic sandy volcanic ash	10.6	0.48	0.41	1.24	(597)	19.6	2.06	0.7	0.04	597	34.4	42	7.8
4-2	207	Middle Miocene	Gray firm calcitic volcanic ash	10.7	0.53	0.40	1.23	(601)	19.4	(2.6)[b]	1.1	0.04	601	34.9	42	8.6
6-4	227	Middle Miocene	Gray firm calcitic volcanic ash	11.2	0.48	0.39	1.28	(605)	19.4	2.64	1.0	0.06	605	35.5	42	7.8
7-2	264	Middle Miocene	Gray sandy volcanic ash	10.7	0.42	0.45	1.30	(606)	19.4	2.69	1.1	0.07	606	35.1	41	7.5
Hole 55.0 (09° 18.1′N, 142° 32.9′E, water depth 2850 m, North flank Caroline Ridge)																
1-3	4	Pleistocene	Pale mottled foraminiferal chalk ooze	10.8	0.43	0.38	1.35	(611)	19.6	2.66	2.5	0.15	611	35.4	43	7.8
3-3	64	Upper Pliocene	White foraminiferal chalk ooze	10.8	0.42	0.37	1.31	(606)	19.5	2.65	1.5	0.09	606	35.1	40	7.6
5-3	124	Upper Miocene	White foraminiferal chalk ooze	10.8	0.43	0.38	1.31	(607)	19.5	2.64	2.4	0.15	607	35.2	40	7.6
7-3	184	Middle Miocene	White chalk ooze	10.8	0.44	0.35	1.31	(606)	19.4	2.68	1.6	0.10	606	35.1	42	7.6
10-3	274	Lower Miocene	Pale radiolarian chalk ooze	10.8	0.39	0.37	1.30	(606)	19.5	2.68	0.8	0.05	606	35.1	38	7.6
12-3	334	Upper Oligocene Lower Miocene	White chalk ooze	11.0	0.42	0.25	1.32	(609)	19.6	2.63	1.1	0.06	609	35.3	39	7.6
Hole 56.2 (08° 22.4′N, 143° 33.6′E, water depth 2508 m, Below crest Caroline Ridge)																
1-6	82	Upper Miocene	White foraminiferal-nannoplankton chalk	10.7	0.41	0.41	1.29	(601)	19.4	2.55	0.2	0.01	601	34.8	36	7.5
4-4	106	Middle Miocene	White chalk ooze	10.6	0.42	0.41	1.29	(610)	19.5	2.35	1.6	0.10	600	34.7	36	7.4
6-4	193	Lower Miocene	Matted white chalk ooze	10.6	0.45	0.42	1.30	(600)	19.7	2.64	1.0	0.06	600	35.1	43	7.6
8-4	211	Upper Oligocene	White chalk ooze	10.9	0.42	0.42	(1.25)	(608)	19.6	2.66	1.8	0.11	608	35.3	34	7.6
10-4	229	Upper Oligocene	Pale brown silty foraminiferal sand, with glass	10.9	0.49	0.40	1.27	(612)	19.6	2.61	4.0	0.25	612	35.5	40	7.8

TABLE 1 – *Continued*

Sample Designation	Depth (m)	Age	Description	Na[a]	K	Ca	Mg	Total Cations (meq/kg)[a]	Cl	SO_4	Alk (meq/kg)	HCO_3^c	Total Anions (meq/kg)	Sum	H_2O(%)[d]	*p*H[e]
Hole 57.0 (08° 40.9′N, 143° 32.0′E, water depth 3300 m, North flank Caroline Ridge)																
1-1	297	Upper Oligocene	Gray-yellow green marl-chalk	10.9	0.48	0.71	1.11	(613)	19.6	2.76	11.8	0.72	6.13	36.3	(41)	–
Hole 57.1 (08° 40.9′N, 143° 32.0′E, water depth 3300 m, North flank Caroline Ridge)																
1-4	136	Upper Miocene	White chalk ooze	10.8	0.41	0.62	1.18	(610)	19.6	2.65	1.0	0.06	610	35.3	(41)	–
2-2	256	Upper Oligocene	Pale blue-green chalk ooze	10.7	0.47	0.67	1.13	(605)	19.5	2.54	0.9	0.06	605	35.1	(41)	–
4-4	264	Upper Oligocene	Gray nannoplankton chalk ooze with glass	10.6	0.49	0.65	1.22	(605)	19.5	2.61	–	–	605	35.1	(41)	–
Hole 57.2 (08° 40.9′N, 143° 32.0′E, water depth 3300 m, North flank Caroline Ridge)																
1-1	10	Upper Pliocene	White chalk ooze	10.7	0.47	0.54	1.20	(605)	19.6	2.49	0.8	0.05	605	35.0	(41)	–
Hole 58.1 (09° 14.1′N, 144° 25.1′E, water depth 4503 m Abyssal gap S. E. Mariana Trench)																
1-2	3	Pleistocene	Pale brown silty chalk ooze	10.6	0.26	0.42	1.33	(600)	19.4	2.42	2.0	0.12	600	34.6	63	–
Hole 58.2 (09°14.1′N, 144° 25.1′E, water depth 4486 m, Abyssal gap S.E. Mariana Trench)																
1-3	140	Upper Oligocene	Pale brown marl ooze	10.6	0.41	0.73	1.15	(603)	19.5	2.56	1.1	0.07	603	35.0	49	–
Hole 59.1 (11° 46.8′N, 147° 34.9′E, water depth 5554 m, Abyssal plain S.E. Mariana Trench)																
3-3	63	Quaternary	Yellow-brown diatom ooze	10.7	0.45	0.38	1.35	(606)	19.6	2.43	1.7	0.11	606	35.0	54	–
Hole 59.2 (11°46.8′N, 147° 34.9′E, water depth 5547 m, Abyssal plain S.E. Mariana Trench)																
2-3	102	Lower Miocene	Dark brown siliceous ooze	10.8	0.45	0.39	1.28	(605)	19.5	2.56	1.5	0.08	605	35.1	65	–
Hole 60.0 (13° 40.0′N, 143° 41.9′E, water depth 3717 m, West wall Mariana Trench)																
1-1	53	Middle Miocene	Pale brown nannoplankton chalk ooze burrowed	10.3	0.44	1.15	1.10	(608)	19.8	2.33	0.8	0.04	608	35.2	–	–

TABLE 1 – *Continued*

[a]Na values are determined by difference between cation and anion sums. Total cations shown in column is therefore assumed equal to anion sum. NH_4 (not determined) and minor constituents are not included in this calculation, but in most cases their absence will not significantly affect the results.

[b]Determined value was 3.39 g/kg, which may be erroneous, as indicated by both anomalous cation-anion balance and a sum which significantly exceeds the value obtained by determination of refractive index. Value indicated corresponds to correction bringing sum into line with total salt determined by refractive index.

[c]Calculated from alkalinity, assuming all alkalinity is present as bicarbonate.

[d]Water values are approximate ranges taken from preliminary shipboard logs.

[e]*p*H values are taken from preliminary shipboard logs and apply to squeezed effluent.

TABLE 2
Minor Element Composition of Pore Fluids
Units are ppm (mg/kg)[a]

Sample Designation	Depth (m)	Age	Description	Sr	Ba	Si (col)	Si (spec)
Hole 44.1 (19° 18.5′N, 169° 00.0′W, Water depth 1478 m, Horizon Ridge, Mid-Pacific mountain S.W. of Hawaii)							
1-3	43	Lower Oligocene	Light nannoplankton foraminiferal ooze	8.8	0.12	9.6	8
Hole 45.1 (24° 15.9′N, 178° 30.5′W, water depth 5508 m, Southwest of Midway Island)							
1-1	2	?	Brown zeolitic clay	8.0	0.08	–	6
Hole 47.0 (32° 26.9′N, 157° 42.7′E, water depth 2689 m, West part Shatsky Rise)							
1-3	8	Pleistocene	Olive-gray. foraminiferal-nannoplankton ooze	–	–	15.1	–
Hole 47.2 (32° 26.9′N, 157° 42.7′E, water depth 2689 m, West part Shatsky Rise)							
2-3	22	Pleistocene	Light gray chalk ooze with glass	10.6	0.09	–	12
4-3	42	Upper Pliocene	Light gray chalk ooze	13.2	0.20	–	17
7-1	65	Lower Eocene	Pale yellow chalk ooze	7.7	0.06	14.4	14
Hole 48.2 (32°24.5′N, 158°01.3′E, water depth 2619 m, West part Shatsky Rise)							
1-2	53	Lower Pliocene	Mottled chalk ooze	11.2	0.10	–	13
2-2	63	Upper Cretaceous	White chalk ooze	12.0	0.10	–	6
Hole 49.0 (32° 24.1′N, 156° 35.0′E, water depth 4282 m, West flank Shatsky Rise; sediment subcrop)							
1-2	3	Pleistocene	Brown mud with volcanic glass	9.0	0.08	9.3	10
Hole 49.1 (32° 24.1′N, 156° 35.0′E, water depth 4282 m, West flank Shatsky Rise; sediment subcrop)							
1-3	6	Upper Jurossic Lower Cretaceous	Brown sandy zeolitic mud	7.9	0.08	–	9

[a]For further trace elements see report of Presley and Kaplan, this volume. Rounding of figures designates estimated reliability of determinations.

TABLE 2 – *Continued*

Sample Designation	Depth (m)	Age	Description	Sr	Ba	Si (col)	Si (spec)
Hole 50.1 (32° 24.2′N, 156° 36.0′E, water depth 4487 m, West flank Shatsky Rise; basement subcrop)							
1-4	7	Pleistocene	Brown clay with nannoplankton	8.0	(0.10)	13.8	13
3-5	30	?	Brown zeolitic clay	9.0	0.07	–	9
Hole 51.0 (33° 28.5′N, 153° 24.3′E, water depth 5981 m, West flank Shatsky Rise; sediment pond)							
1-4	119	Miocene	Brown zeolitic clay with clay breccia (deformed)	7.0	<0.06	5.5	5
Hole 51.1 (33° 28.5′N, 153° 24.3′E, water depth 5981 m, West flank Shatsky Rise; sediment pond)							
1-5	25	Pleistocene	Gray-brown sandy volcanic mud	9.9	0.08	13.0	8
Hole 52.0 (27° 46.3′N, 147° 07.8′E, water depth 5744 m, Abyssal swale E. of Bonin Trench)							
1-4	6	?	Brown glassy clay	11.0	0.30	22.0	12
3-2	20	?	Brown clay	9.0	0.20	15.4	16
5-3	41	?	Brown ashy clay	8.0	0.09	5.2	5
Hole 53.0 (18° 02.0′N, 141° 11.5′E, water depth 4629 m, sediment fan on west side of West Mariana Ridge in Philippine Sea)							
1-2	90	Middle Miocene	Gray sandy volcanic ash	14.0	0.20	15.4	15
3-1	138	Lower Middle Miocene	Dark silty volcanic ash	14.0	0.15	–	13
4-1	166	Lower Oligocene Lower Miocene	Vari-colored ash	12.0	0.07	3.3	2
6-2	195	Lower Oligocene Lower Miocene	Interbedded ash and chalk ooze, lithified	11.0	(0.20)	–	4
Hole 53.1 (18° 02.0′N, 141° 11.5′E, water depth 4629 m, sediment fan on west side of West Mariana Ridge in Philippine Sea)							
1-4	5	?	Dark brown zeolitic clay	10.0	0.10	5.9	6
2-5	28	Upper Miocene	Dark sandy volcanic ash	14.0	0.20	20.5	19
3-4	63	Middle-Upper Miocene	Gray silty volcanic ash	15.0	0.21	16.8	15

TABLE 2 – *Continued*

Sample Designation	Depth (m)	Age	Description	Sr	Ba	Si (col)	Si (spec)
Hole 53.2 (18° 02.0′N, 141° 11.5′E, water depth 4629 m, sediment fan on west side of West Mariana Ridge in Philippine Sea)							
1-4	18	Upper Miocene	Brown radiolarian silt with volcanic glass	10.3	0.10	16.6	4
Hole 54.0 (15° 36.6′N, 140° 18.1′E, water depth 4990 m, West flank West Mariana Ridge)							
1-2	89	Middle Miocene	Dark gray silty ash	9.2	0.10	14.0	9
2-3	142	Middle Miocene	Gray calcitic sandy volcanis ash	8.3	<0.10	12.0	10
4-2	207	Middle Miocene	Gray firm calcitic volcanic ash	8.8	<0.10	13.5	14
6-4	227	Middle Miocene	Gray firm calcitic volcanic ash	8.0	<0.10	15.8	5
7-2	264	Middle Miocene	Gray sandy volcanic ash	8.1	<0.10	15.1	14
Hole 55.0 (09° 18.1′N, 142°32.9′E, water depth 2850 m, North flank Caroline Ridge)							
1-3	4	Pleistocene	Pale mottled foraminiferal chalk ooze	9.0	(0.10)	12.4	11
3-3	64	Upper Pliocene	White foraminiferal chalk ooze	12.8	(0.14)	14.2	12
5-3	124	Upper Miocene	White foraminiferal chalk ooze	12.8	<0.10	14.8	13
7-3	184	Middle Miocene	White chalk ooze	11.3	<0.10	19.9	19
10-3	274	Lower Miocene	Pale radiolarian chalk ooze	9.8	<0.10	23.3	8
12-3	334	Upper Oligocene Lower Miocene	White chalk ooze	10.6	(0.15)	19.7	15
Hole 56.2 (08° 22.4′N, 143° 33.6′E, water depth 2508 m, Below crest Caroline Ridge)							
1-6	82	Upper Miocene	White foraminiferal-nanoplankton chalk	21.0	0.20	16.3	15
4-4	106	Middle Miocene	White chalk ooze	17.3	0.20	16.2	18
6-4	193	Lower Miocene	Matted white chalk ooze	10.7	(0.13)	22.7	20
8-4	211	Upper Oligocene	White chalk ooze	9.5	0.20	19.2	18
10-4	229	Upper Oligocene	Pale brown silty foraminiferal sand, with glass	10.0	0.18	25.2	17

TABLE 2 – *Continued*

Sample Designation	Depth (m)	Age	Description	Sr	Ba	Si (col)	Si (spec)
Hole 57.0 (08°40.9′N, 143° 32.0′E, water depth 3300 m, North flank Caroline Ridge)							
1-1	297	Upper Oligocene	Gray-yellow green marl-chalk	11.5	0.20	21.2	20
Hole 57.1 (08°40.9′N, 143° 32.0′E, water depth 3300 m, North flank Caroline Ridge)							
1-4	136	Upper Miocene	White chalk ooze	23.0	(0.13)	27.0	17
2-2	256	Upper Oligocene	Pale blue-green chalk ooze	13.0	0.20	22.4	21
4-4	264	Upper Oligocene	Gray nannoplankton chalk ooze with glass	10.1	0.11	12.1	12
Hole 57.2 (08° 40.9′N, 143° 32.0′E, water depth 3300 m, North flank Caroline Ridge)							
1-1	10	Upper Pliocene	White chalk ooze	24.0	(0.2)	12.3	12
Hole 58.1 (09° 14.1′N, 144°25.1′E, water depth 4503 m, Abyssal gap S.E. Mariana Trench)							
1-2	3	Pleistocene	Pale brown silty chalk ooze	10.8	0.10	17.3	16
Hole 58.2 (09° 14.1′N, 144° 25.1′E, water depth 4486 m, Abyssal gap S.E. Mariana Trench)							
1-3	140	Upper Oligocene	Pale brown marl ooze	12.0	0.15	22.5	21
Hole 59.1 (11° 46.8′N, 147° 34.9′E, water depth 5554 m, Abyssal plain S.E. Mariana Trench)							
3-3	63	Quaternary	Yellow-brown diatom ooze	7.4	(0.15)	7.8	7
Hole 59.2 (11°46.8′N, 147° 34.9′E, water depth 5547 m, Abyssal plain S.E. Mariana Trench)							
2-3	102	Lower Miocene	Dark brown siliceous ooze	8.0	0.10	17.5	16
Hole 60.0 (13° 40.0′N, 143°41.9′E, water depth 3717 m, West wall Mariana Trench)							
1-1	53	Middle Miocene	Pale brown nannoplankton chalk ooze burrowed	15.3	0.10	18.3	17