20. INTERSTITIAL WATER STUDIES ON SMALL CORE SAMPLES, DEEP SEA DRILLING PROJECT, LEG 5[1]

F. T. Manheim[2], U. S. Geological Survey, Woods Hole Oceanographic Institution
Woods Hole, Massachusetts,
K. M. Chan, Department of Geology, California State College at Long Beach
and
F. L. Sayles, Woods Hole Oceanographic Institution, Woods Hole, Massachusetts

INTRODUCTION

Leg 5 samples fall into two categories with respect to interstitial water composition: 1) rapidly deposited terrigenous or appreciably terrigenous deposits, such as in Hole 35 (western Escanaba trough, off Cape Mendocino, California); and, 2) slowly deposited pelagic clays and biogenic muds and oozes. Interstitial waters in the former show modest to slight variations in chloride and sodium, but drastic changes in non-conservative ions such as magnesium and sulfate. The pelagic deposits show only relatively minor changes in both conservative and non-conservative pore fluid constituents. As was pointed out in earlier Leg Reports, it is believed that much of the variation in chloride in pore fluids within individual holes is attributable to the manipulation of samples on board ship and in the laboratory. On the other hand, the scatter in sodium is due in part to analytical error (on the order of 2 to 3 per cent, in terms of a standard deviation), and it probably accounts for most of the discrepancies in total anion and cation balance.

All constituents reported here, with the exception of bulk water content, were analyzed on water samples which were sealed in plastic tubes aboard ship and were subsequently opened and divided into weighed aliquots in the laboratory. Analytical methods follow the atomic absorption, wet chemical and emission spectrochemical techniques briefly summarized in previous reports, e.g. Manheim *et al.*, 1969, and Chan and Manheim, 1970. The authors acknowledge assistance from W. Sunda, D. Kerr, C. Lawson and H. Richards, and thank D. Spencer, P. Brewer and E. Degens for allowing the use of equipment and laboratory facilities.

RESULTS

Tables 1 and 2 show the major and minor constituents in the pore waters. Particularly noteworthy is the extreme depletion of magnesium and sulfate to 0.22 and 0.11 o/oo, respectively, in cores from Hole 35. The magnesium values are the lowest recorded to date in any oceanic pore fluids. At the same time, potassium depletions are recorded in the intermediate portions of the hole, and a near-doubling in calcium is observed below about 160 meters.

One should also note the low water content (20 to 30 per cent) in these sediments, in comparison to the levels in all other sites from Leg 5. The slight increase in chlorinity toward the bottom of the hole appears to be real. Trace elements also show marked deviations from oceanic levels in Hole 35. Strontium levels increased steadily with depth to 20 mg/kg (ppm) and barium reached the highest values recorded in the oceanic pore waters to date (8 ppm).

In contrast, Holes 37 through 43, in the open Pacific between the west coast of the North American continent and the Hawaiian Islands, have interstitial waters which probably show the least differences from present ocean water of any pore fluids in the drill cores studied to date. This is especially true if one allows for corrections of potassium and magnesium to somewhat lower and higher values, respectively, owing to the temperature of squeezing effect reported independently by Kazintsev (1968), Krasintseva and Korunova (1968), Mangelsdorf *et al.* (1969) and confirmed by Bischoff *et al.* (1970) and the authors (unpublished information). In Holes 39 through 43 even minor constituents such as lithium, boron, strontium and barium showed concentration levels differing only slightly from those obtained in sea water.

Agreement between the spectrochemical and colorimetric silica determinations is not satisfactory, and the authors are currently checking on potential sources of error in these determinations. The spectrochemical method determines total (in filtered water) silica whereas the colorimetric method determines soluble orthosilicate.

DISCUSSION

The consistent and transitional decline of magnesium values in Hole 35 from 1.23 o/oo at 41 meters to only 0.22 o/oo (220 ppm) at 360 meters has important

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implications. First, the linear decrease to such low values offers support to the belief that with appropriate techniques interstitial waters which are virtually free from contamination with drilling fluid can be obtained from the cores. This conclusion can also be drawn from the very low sulfate concentrations in the lower portions of Hole 35. If even 5 per cent drilling fluid (sea water) were mixed with the extracted pore fluid from Sample 13-4 in Hole 35, the net sulfate concentration due to the sea water component alone would be greater than that actually observed (0.11 o/oo).

The entire sediment sequence in Hole 35 has been labeled Pleistocene, and the total time involved has been estimated at less than 800,000 years (preliminary Hole Summaries for Leg 5). This time is probably short enough to allow retention of substantial concentrative anomalies in the face of the tendency for diffusional communication throughout the sediment column. Without completely excluding the possibility that a concentrated sink for magnesium exists at greater depth (which would cause a diffusional depletion in the magnesium above it), it seems clear that there is a continuing loss of magnesium from the pore fluids to the zeolitic clay sediments with time. Corroborating evidence that clay minerals and possibly zeolites are the most important factor in the loss of magnesium from the pore solutions is the fact that no dolomite was reported from this hole. The loss from the pore waters is especially noticeable because of the preponderance of sediment over fluid in cores from this particular hole.

Loss of sulfate in the interstitial water of Pacific piston cores has been shown by Shishkina (1965) to be frequently accompanied by gains in alkalinity, as a consequence of the replacement of sulfate by bicarbonate from the organic matter oxidized in the bacterial reduction of sulfate. Although alkalinity is high in the top 160 meters of Hole 35, it drops to approximately oceanic values at depth. One might suppose that a portion of the bicarbonate alkalinity has become incorporated in authigenic carbonates, but there is no evidence that such carbonate precipitation has withdrawn net calcium and strontium from solution, for both of these constituents are enriched in the pore waters. The presence of abundant zeolites, however, suggests that alteration and solution of metastable silicates (volcanic ash ?) has gone on in the sediments and that the metals for carbonate precipitation could have come from this source. Similar depletion of bicarbonate has been found in other deep holes where drastic reduction of sulfate has occurred, as in Holes 26 and 30 of Leg 4 (Sayles *et al.*, 1970). The former site lies in the *Vema* Fracture Zone and appears to be a depositional environment similar to Hole 35 (600 meters of predominantly terrigenous sediments of Middle Pleistocene and younger age).

As in previous legs, the water content of the open ocean samples again shows no appreciable decrease with depth. This contrasts strikingly with the terrigenous sediments cored in Hole 35. The details of origin for this divergent behavior remain uncertain.

INTERLABORATORY ANALYTICAL COMPARISON

At a meeting of the Interstitial Water Panel on February 10, 1970, chaired by R. M. Garrels, and attended by active collaborators in the pore water studies, evaluation of the accuracy of the pore fluid data was discussed. The decision was reached that although overlap in data would be reduced in the future, interlaboratory comparisons of data for Leg 5 would be helpful to assess the degree to which natural variations in the pore water chemistry were obscured by analytical scatter. The comparisons for Leg 5 would be particularly significant since (unlike parallel samples Legs 1 and 2) the fluids sent to both the University of California at Los Angeles (I. R. Kaplan and B. J. Presley) and to Woods Hole (F. T. Manheim, K. M. Chan and F. L. Sayles) were aliquots of the same shipboard squeezings.

Through the courtesy of Kaplan and Presley, an advance copy of their analytical data has been received for inclusion in this comparison. Since their data are reported in weight/volume units, whereas, the authors have reported theirs in weight/weight units, both sets of data have been converted to chloride ratios. This removes the effect of the different units, and eliminates the need for stating the weight/volume data in terms of a given temperature. Chloride concentrations are not compared here, but this constituent is presumed to be determined with an accuracy greater than any other component.

The results of the comparison are shown in Table 3, encompassing the elements: sodium, potassium, calcium, magnesium, sulfate, bromine, strontium, boron and lithium. Total carbonate (UCLA) was also compared with bicarbonate (Woods Hole), but these data are not shown on the table because neither the ranges nor the relative variations showed any coherence. The UCLA values are lower than the WHOI values by as much as a factor of 10.

With respect to sample-to-sample variation, adequate agreement is obtained between the two sets of data for potassium, calcium, magnesium, strontium and boron. Agreement is remarkably close for magnesium and strontium, especially when one considers the small volume of water used, the limitations of the techniques and the fact that two different methods, atomic absorption (A) and emission (spark) spectrometry (B), were utilized for the strontium determinations. The authors are aware that sodium determinations by single-channel

atomic absorption spectrometry are inadequately precise to reflect real variations; from experience, determinations of sodium by difference are usually closer to the mark. In the future the hope is to evaluate real sodium variations either by means of a dual channel (internal standard) atomic absorption instrument, or by gravimetric techniques, such as were utilized by Shishkina (1965). Bromide/chloride ratios show scatter; the relatively constant bromide/chloride values in the "B" group are probably more reasonable in the light of Shishkina's data. For a trace constituent, the lithium ratios compare rather well in the sea water range, but diverge for higher values. Finally, the agreement for sulfate is not good; the "B" values are consistently lower than the "A" values.

Further data comparisons are available for Legs 1, 2 and 4 (including a special set of unpublished analyses by J. L. Bischoff and his associates). These data, not coming from homogeneous aliquots, show greater divergence than the values in Table 3.

In conclusion, although there is clearly room for further improvement in data quality, major diagenetic changes have not been obscured. Scientists must reduce the errors in sampling and sample manipulation, come to grips with the influence of temperature on extraction, and exert greater care in all areas if they wish to evaluate significant changes in the conservative properties of pore fluids.

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TABLE 1
Major Constituents of Samples from Leg 5. Reported in q/kg (unless otherwise indicated)[a]

Sample Designation	Depth Below Sea Bed (m)	Age	Description	Na	K	Ca	Mg	Total Cations (meq/kg)	Cl	SO_4	Alk (meq/kg)	HCO_3[b]	Total Anions (meq/kg)	Sum[d]	H_2O (%)
Hole 32 (37°07.6′N, 127°33.4′W, water depth 4758 m) Outer Delgada Fan (Continental Rise)															
1-3	4	Pleistocene	Gray-green clay, silty-sandy	11.1	0.51	0.36	1.16	609	19.5	2.55	7.3	0.44	609	35.7	54.2
4-4	97	Lower Pliocene	Olive radiolarian silty clay	11.4	0.43	0.38	1.15	621	19.5	2.00	6.6	0.40	598	35.3	52.8
6-6	116	Lower Pliocene	Gray siliceous silty clay	10.5	0.40	0.37	1.13	578	19.6	2.01	8.4	0.51	602	34.5	–
8-1	168	Upper Miocene	Yellow-brown, radiolarian mud	10.5	0.36	0.41	1.15	581	19.6	2.05	5.8	0.35	602	34.5	59.0
10-3	188	Miocene?	Various colored zeolitic clay with glass	(10.7)[c]	0.32	0.50	1.23	(597)	19.4	2.12	5.4	0.33	597	34.6	–
12-2	206	Upper Oligocene	Red zeolitic clay with ash	10.5	0.32	0.50	1.18	587	19.2	(2.1)[c]	3.9	0.24	(587)	34.0	52.0
Hole 33 (39°28.5′N, 127°29.8′W, water depth 4284 m)															
1-6	8	Pleistocene	Dark gray clayey mud	10.7	0.47	0.32	1.19	591	19.5	2.61	5.9	0.36	610	35.1	53.4
3-3	51	Pleistocene	Dark green-gray radiolarian mud	10.7	0.43	0.34	1.20	592	19.5	2.28	8.3	0.50	606	35.0	57.2
4-3	99	Upper Pliocene	Dark green-gray clayey mud	10.6	0.43	0.37	1.12	583	19.3	2.21	7.0	0.43	597	34.5	55.7
5-6	160	Lower Pliocene	Dark clayey mud	10.8	0.37	0.39	1.09	588	19.6	2.04	6.4	0.38	600	34.6	53.5
6-6	227	Middle Miocene	Varicolored nannofossil mud	10.8	0.48	0.36	1.06	587	19.4	1.68	6.0	0.37	587	34.2	–
8-3	235	Middle Miocene	Dark zeolitic clay	10.9	0.37	0.49	1.03	592	19.4	1.82	6.7	0.41	593	34.5	59.3
10-5	263	Middle Miocene	Nannofossil chalk ooze	10.8	0.42	0.44	0.96	582	19.4	1.78	2.7	0.16	588	34.0	57.8
Hole 34 (39°28.2′N, 127°16.5′W, water depth 4322 m)															
1-4	25	Pleistocene	Greenish-gray clay, ashy	10.7	0.45	0.39	1.23	597	19.6	(1.8)[c]	8.1	0.49	(597)	34.6	53.2
3-5	82	Upper Pliocene	Radiolarian mud	10.8	0.44	0.33	1.11	588	19.6	1.81	4.1	0.25	596	34.4	–
5-2	118	Lower Pliocene	Clay mud, ashy, distrubed	10.9	0.39	0.42	1.02	591	19.4	1.66	6.7	0.41	588	34.3	51.7
7-6	143	Upper Miocene	Clay mud, disturbed	11.0	0.43	0.42	0.96	589	19.4	1.41	5.0	0.31	584	34.1	56.5
8-6	173	Upper Miocene	Clay mud	10.9	0.37	0.46	0.95	584	19.5	1.26	7.1	0.43	582	33.0	50.3
9-5	219	Middle Miocene	Radiolarian diatom clay	10.9	0.37	0.52	0.85	579	19.5	1.29	3.1	0.18	579	33.6	57.6
10-3	273	Middle Miocene	Radiolarian clay, siliceous pebbles	10.9	0.38	0.60	0.79	579	19.3	1.08	3.0	0.18	569	33.6	58.2
11-2	280	Middle Miocene	Clay mud with nannofossil ooze	10.7	0.31	0.74	0.71	573	19.3	1.44	3.4	0.21	578	33.5	58.4
14-2	340	Lower Miocene	Zeolitic dolomitic clay	9.6	0.18	0.42	0.49	534	17.9	1.14	2.7	0.17	533	30.9	36.5
Hole 35 (40°40.4′N, 127°28.5′W, water depth 3373 m) W. Escanaba Trough (alternating terrigenous and pelagic muds)															
2-2	41	Pleistocene	Dark green-gray silty clay	11.1	0.48	0.32	1.23	612	19.2	1.64	17.6	1.08	594	35.1	37.1
6-2	160	Pleistocene	Dark zeolitic clay, banded	10.9	0.48	0.31	0.95	580	19.7	0.34	7.1	1.04	580	33.7	32.8
7-3	237	Pleistocene	Olive silty clay mud	11.0	0.20	0.73	0.60	568	19.9	0.21	4.7	0.28	571	33.0	26.2
9-2	287	Pleistocene	Calcareous zeolitic clay	11.4	0.15	0.81	0.46	578	19.9	0.20	2.9	0.17	571	33.2	25.4

TABLE 1 – *Continued*

Sample Designation	Depth Below Sea Bed (m)	Age	Description	Na	K	Ca	Mg	Total Cations (meq/kg)	Cl	SO_4	Alk (meq/kg)	HCO_3[b]	Total Anions (meq/kg)	Sum[d]	H_2O (%)
12-6	330	Pleistocene	Gray calcareous zeolitic clay	11.2	0.25	0.72	0.37	559	19.7	0.20	2.8	0.17	561	32.8	–
13-4	350	Pleistocene	Gray calcareous zeolitic clay	(11.5)[c]	0.28	0.74	0.31	(572)	20.1	0.11	3.9	0.24	572	33.2	25.2
14-4	360	Pleistocene	Gray calcareous zeolitic clay	11.7	0.80	0.79	0.22	587	20.2	0.21	4.2	0.26	580	34.1	21.3
Hole 36 (40°59.1′N, 130°06.6′W, water depth 3273 m)															
2-1	10	Pleistocene	Gray-olive foraminiferal coccolithic ooze	(10.9)[c]	0.45	0.40	1.23	(606)	19.4	2.26	4.2	0.26	606	35.3	–
4-3	31	Pleistocene	Green-gray foraminiferal coccolithic chalk ooze	(10.8)[c]	0.47	0.39	1.19	(595)	19.2	2.43	3.6	0.22	595	34.7	62.7
6-6	56	Upper Pliocene	Green-gray foraminiferal-discoaster-coccolith ooze	(10.9)[c]	0.47	0.36	1.23	(598)	19.2	2.56	3.0	0.18	598	35.0	51.2
8-1	67	Upper Pliocene	Green-gray foraminiferal-nannofossil chalk ooze	10.8	0.57	0.39	1.13	596	19.5	2.68	4.1	0.25	611	35.4	51.6
10-5	90	Lower Pliocene	Green-gray nannofossil chalk ooze	(10.7)[c]	0.48	0.35	1.21	(596)	19.1	2.54	3.3	0.20	596	34.6	58.9
12-3	106	Upper Miocene	Green-gray clayey chalk ooze	11.1	0.49	0.37	1.17	609	19.1	2.58	2.7	0.17	597	35.0	–
Hole 37 (40°58.7′N, 140°43.1′W, water depth 4682 m) Abyssal hills N. of Mendocino fracture zone															
1-2	2	Pleistocene?	Light brown red clay soft	10.5	0.44	0.42	1.24	591	19.3	2.65	4.39	0.27	603	34.8	60.8
3-1	15	Lower Pliocene?	Zeolitic red clay	(10.8)[c]	0.45	0.41	1.24	(604)	19.4	2.58	3.05	0.19	604	35.1	–
Hole 38 (38°42′N, 140°21.3′W, water depth 5137 m)															
2-4	8	?	Yellow-brown zeolitic red clay	11.3	0.43	0.41	1.20	622	19.2	2.80	3.04	0.19	604	35.6	–
4-2	24	?	Yellow-brown zeolitic red clay	11.3	0.45	0.41	1.22	624	19.6	2.84	3.80	0.23	615	36.1	63.6
6-4	45	Lower Eocene	Nannofossil-foraminiferal ooze ferrug.	10.9	0.43	0.37	1.18	600	19.7	2.44	3.03	0.18	609	34.7	53.4
Hole 39 (32°48.3′N, 139°34.3′W, water depth 4929 m)															
1-3	4	?	Zeolitic red clay	10.9	0.45	0.38	1.23	606	19.4	2.74	2.88	0.18	608	35.3	–
Hole 40 (19°47.6′N, 139°54.1′W, water depth 5183 m)															
1-3	4	?	Zeolitic red clay with small Mn nodules	10.6	0.46	0.36	1.19	589	19.3	2.61	2.77	0.17	602	34.7	62.3
8-3	70	Middle Eocene	Brown radiolarian ooze deformed	10.8	0.42	0.39	1.27	604	19.6	2.41	2.80	0.17	602	35.1	77.5
14-3	125	Lower Eocene	Brown radiolarian ooze deformed	11.0	0.41	0.37	1.28	611	19.6	2.70	2.62	0.16	613	35.6	81.2

TABLE 1 – *Continued*

Sample Designation	Depth Below Sea Bed (m)	Age	Description	Na	K	Ca	Mg	Total Cations (meq/kg)	Cl	SO_4	Alk (meq/kg)	HCO_3[b]	Total Anions (meq/kg)	Sum[d]	H_2O (%)
16-3	142	Lower Eocene	Brown radiolarian ooze deformed	(11.0)[c]	0.42	0.40	1.29	(613)	19.5	2.77	2.77	0.17	613	35.6	75.7
Hole 41 (19°51.2′N, 140°02.9′W, water depth 5339 m)															
1-3	4	?	Zeolitic red clay	11.2	0.46	0.37	1.22	617	19.4	2.62	2.58	0.16	603	35.4	–
Hole 42 (13°50.6′N, 140°11.3′W, water depth 4848 m) East of Hawaii															
1-3	4	Upper Oligocene	Pale orange, yellow-brown radiolarian nannofossil chalk ooze	10.9	0.46	0.39	1.26	609	19.4	2.62	2.53	0.15	604	35.2	58.7
4-3	31	Lower Oligocene	Pale orange, yellow-brown radiolarian nannofossil chalk ooze	11.3	0.44	0.40	1.27	627	19.7	2.19	(2.8)[c]	(0.17)	(627)	35.4	59.8
6-4	51	Upper Eocene	Brown-yellow nannofossil radiolarian ooze with Mn nodules	11.3	0.42	0.43	1.25	627	19.6	2.58	2.87	0.17	609	35.7	67.3
8-5	71	Middle Eocene	Yellow-brown radiolarian nannofossil ooze	(10.9)[c]	0.41	0.43q	1.26	(607)	19.5	2.51	2.97	0.18	607	35.3	67.1
10-3	86	Middle Eocene	Gray radiolarian nannofossil ooze	11.0	0.40	0.45	1.27	(613)	19.6	2.58	5.16	0.31	613	35.6	67.7
Hole 43 (17°06.6′N, 151°22.5′W, water depth 5405 m)															
2-2	5	?	Yellow-brown silty clay	10.9	0.44	0.34	1.20	627	19.1	2.73	2.89	0.18	599	34.9	64.1
			Sea water	10.8	0.39	0.41	1.29	608	19.4	2.71	(2.5)	(0.14)	607	35.0	–

[a] NH_4 has not been determined here, but should normally not contribute more than about 0.5 meq/kg except where unusually high alkalinities are encountered.

[b] Calculated from total alkalinity assuming alkalinity is entirely attributable to bicarbonate. At the pH levels typical for pore fluids (pH 7.5) this assumption is not strictly correct, but yields results considered adequate in view of the other sources of error in pressure changes, core manipulation, etc.

[c] Determined by difference, utilizing cation-anion balance.

[d] Sum refers to sum of the cations, excluding minor constituents, plus Cl, SO_4 and HCO_3.

TABLE 2
Minor Constituents in Leg 5 Interstitial Waters[a]

Sample Designation	Depth Below Sea Bed (m)	Age	Description	Li	B	Sr	Ba	Si (spec)[b]	Si (col)[b]	Br
			Hole 32							
1-3	4	Pleistocene	Gray-green clay, silty-sdy	0.18	3.0	6.5	0.16	⩽12	–	66
4-4	97	Lower Pliocene	Olive radiolarian silty clay	0.25	3.0	7.0	0.16	23	22.0	69
6-6	116	Lower Pliocene	Gray siliceous silty clay	0.30	4.0	7.6	0.12	26	12.0	–
8-1	168	Upper Miocene	Yellow-brown, radiolarian mud	0.29	3.0	7.8	0.11	26	26.0	72
10-3	188	Miocene?	Various colored zeolitic clay with glass	0.30	3.0	8.0	0.12	22	18.0	66
12-2	206	Upper Oligocene	Red zeolitic clay with ash	0.29	3.5	8.5	0.14	16	11.0	66
			Hole 33							
1-6	8	Pleistocene	Dark gray clayey mud	0.18	4.0	6.8	0.12	17	14.0	67
3-3	51	Pleistocene	Dark green gray radiolarian mud	0.24	4.0	7.4	0.12	26	26.0	67
4-3	99	Upper Pliocene	Dark green gray clayey mud	0.37	3.5	7.5	0.17	24	9.2	67
5-6	160	Lower Pliocene	Dary clayey mud	0.53	3.0	7.9	0.15	24	27.0	–
6-6	227	Middle Miocene	Varicolored nannofossil mud	0.67	4.0	8.6	0.22	27	32.0	67
8-3	235	Middle Miocene	Dark zeolitic clay	0.69	3.5	8.6	0.13	27	33.0	67
10-5	263	Middle Miocene	Nannofossil chalk ooze	0.64	3.0	8.5	0.16	24	22.0	67
			Hole 34							
1-4	25	Pleistocene	Greenish-gray clay, ashy	0.21	4.0	7.3	0.12	20	14.0	68
3-5	82	Upper Pliocene	Radiolarian mud	0.35	4.0	6.8	0.12	24	24.0	68
5-2	118	Lower Pliocene	Clay mud, ashy, disturbed	0.45	4.0	7.7	0.21	27	28.0	68
7-6	143	Upper Miocene	Clay mud, disturbed	0.61	3.0	8.1	0.16	24	22.0	70
8-6	173	Upper Miocene	Clay mud	0.68	3.0	8.4	0.17	25	28.0	69
9-5	219	Middle Miocene	Radiolarian, diatom clay	0.76	4.0	8.0	0.14	23	26.0	69
10-3	273	Middle Miocene	Radiolarian clay, siliceous pebbles	0.85	4.0	9.5	0.14	24	20.0	70
11-2	280	Middle Miocene	Clay mud with nannofossil ooze	0.81	3.0	9.4	0.10	28	23.0	–
14-2	340	Lower Miocene	Zeolitic dolomitic clay	0.72	4.0	12.0	0.31	13	–	–
			Hole 35							
2-2	41	Pleistocene	Dark green-gray silty clay	0.07	5.0	6.9	0.09	21	–	–
6-2	160	Pleistocene	Dark zeolitic clay, banded	0.13	3.0	9.2	4.6	18	12.0	–
7-3	237	Pleistocene	Olive silty clay mud	0.72	3.0	13.0	5.4	<12	5.9	–
9-2	287	Pleistocene	Calcareous zeolitic clay	0.44	3.0	17.0	6.2	<12	3.4	–
12-6	330	Pleistocene	Gray calcareous zeolitic clay	0.71	7.0	14.0	6.2	<12	5.5	–

TABLE 2 – *Continued*

Sample Designation	Depth Below Sea Bed (m)	Age	Description	Li	B	Sr	Ba	Si (spec)[b]	Si (col)[b]	Br
			Hole 35 – *Continued*							
13-4	350	Pleistocene	Gray calcareous zeolitic clay	0.79	10.0	19.0	7.7	<12	5.6	–
14-4	360	Pleistocene	Gray calcareous zeolitic clay	0.92	9.0	20.0	8.1	18	9.9	–
			Hole 36							
2-1	10	Pleistocene	Gray-olive foraminiferal coccolithic ooze	0.15	5.0	7.3	0.07	<12	6.4	68
4-3	31	Pleistocene	Green-gray foraminiferal coccolithic chalk ooze	0.16	5.0	7.5	0.07	<12	7.5	66
6-6	56	Upper Pliocene	Green-gray foraminiferal-discoaster-coccolith ooze	0.18	4.0	6.9	0.06	16	10.0	67
8-1	67	Upper Pliocene	Green-gray foraminiferal nannofossil chalk ooze	0.19	3.0	7.0	0.06	<12	8.6	68
10-5	90	Lower Pliocene	Green-gray nannofossil chalk ooze	0.19	4.0	7.0	0.07	16	12.0	66
12-3	106	Upper Miocene	Green-gray clayey chalk ooze	0.18	4.0	7.1	0.07	13	8.3	66
			Hole 37							
1-2	2	Pleistocene?	Light brown red clay, soft	0.20	5	6.4	0.15	⩽12	–	–
3-1	15	Lower Pliocene?	Zeolitic red clay	0.22	6	6.4	0.16	<12	9.4	67
			Hole 38							
2-4	8	?	Yellow-brown zeolitic red clay	0.20	6	6.2	0.20	<12	5.2	65
4-2	24	?	Yellow-brown zeolitic red clay	0.27	6	6.9	0.11	<12	–	–
6-4	45	Lower Eocene	Nannofossil-foraminiferal ooze, ferrug.	0.24	7	6.6	0.15	<12	4.8	–
			Hole 39							
1-3	4	?	Zeolitic red clay	0.22	7	8.1	<0.06	<12	5.1	67
			Hole 40							
1-3	4	?	Zeolitic red clay with small Mn nodules	0.21	6	7.5	0.06	15	13.0	67
8-3	70	Middle Eocene	Brown radiolarian ooze deformed	0.19	4	7.5	0.06	<12	29.0	68
14-3	125	Lower Eocene	Brown radiolarian ooze deformed	0.18	4	6.9	0.07	24	26.0	68
16-3	142	Lower Eocene	Brown radiolarian ooze deformed	0.17	4	6.6	0.12	23	28.0	67

TABLE 2 – *Continued*

Sample Designation	Depth Below Sea Bed (m)	Age	Description	Li	B	Sr	Ba	Si (spec)[b]	Si (col)[b]	Br
			Hole 42							
1-3	4	?	Zeolitic red clay	0.24	7	7.5	0.07	21	18.0	63
			Hole 42							
1-3	4	Upper Oligocene	Pale orange yellow-brown radiolarian nanno. chalk ooze	0.21	5	7.0	<0.06	20	22.0	67
4-3	31	Lower Oligocene	Pale orange yellow-brown radiolarian nannofossil chalk ooze	0.18	5	7.3	<0.06	26	27.0	67
6-4	51	Upper Eocene	Brown-yellow nannofossil radiolarian ooze with Mn nodules	0.18	4	7.9	0.06	24	26.0	67
8-5	71	Middle Eocene	Yellow-brown radiolarian nannofossil ooze	0.16	5	7.7	<0.06	27	27.0	68
10-3	86	Middle Eocene	Gray radiolarian nannofossil ooze	0.13	5	7.5	<0.06	28	27.0	68
			Hole 43							
2-2	5	?	Yellow-brown silty clay	0.19	5	7.0	<0.06	16	11.0	67
			Sea water	0.18	4.6	8.0	<0.06	<10	<10.0	66

[a]Values in mg/kg (ppm).

[b]Si analyses refer to spectrochemical silica (spec) and colorimetric (col) determinations.

TABLE 3
Intercomparison of Leg 5 Data[a]

Sample Designation											
Hole	Core	Section	Na/Cl	K/Cl	Ca/Cl	Mg/Cl	SO_4/Cl	Br/Cl x 10^2	Sr/Cl x 10^2	B/Cl x 10^2	Li/Cl x 10^4
34	1-4	A	0.577	–	0.0197	0.0610	0.1270	0.25	0.036	–	0.089
		B	0.547	0.024	0.0199	0.0630	0.0920	0.35	0.037	0.021	0.110
	3-5	A	0.573	0.021	0.0170	0.0560	0.0920	0.28	0.036	0.023	0.120
		B	0.550	0.022	0.0170	0.0560	0.0920	0.35	0.035	0.020	0.180
	5-2	A	0.560	0.019	0.0240	0.0530	0.0950	–	0.040	–	0.160
		B	0.562	0.020	0.0210	0.0520	0.0840	0.35	0.039	0.018	0.230
	7-6	A	0.568	0.022	0.0235	0.0510	0.0775	0.33	0.038	0.017	0.180
		B	0.567	0.022	0.0220	0.0500	0.0730	0.36	0.042	0.016	0.310
	8-6	A	0.546	0.018	0.0280	0.0485	0.0870	0.32	0.044	0.019	0.210
		B	0.562	0.019	0.0240	0.0490	0.0650	0.36	0.043	0.018	0.350
	9-5	A	0.532	0.018	0.0300	0.0440	0.0790	0.35	0.044	0.023	0.240
		B	0.560	0.019	0.0270	0.0440	0.0660	0.35	0.041	0.019	0.390
	10-3	A	0.565	0.017	0.0360	0.0430	0.0680	0.38	0.047	0.022	0.250
		B	0.565	0.020	0.0310	0.0410	0.0560	0.36	0.049	0.021	0.440
	11-2	A	0.582	0.016	0.0370	0.0360	0.0750	0.32	0.044	0.020	0.250
		B	0.553	0.016	0.0380	0.0370	0.0740	–	0.049	0.016	0.420
36	2-1	A	0.551	0.023	0.0190	0.0620	0.1430	0.30	0.038	0.031	0.079
		B	0.561	0.023	0.0210	0.0630	0.1340	0.35	0.038	0.027	0.077
	4-3	A	0.550	–	0.0180	0.0560	0.1090	0.30	0.037	0.025	0.081
		B	0.563	0.024	0.0200	0.0620	0.1260	0.34	0.039	0.026	0.083
	6-6	A	0.545	0.024	0.0180	0.0620	0.1380	0.33	0.036	0.026	0.082
		B	0.567	0.024	0.0190	0.0640	0.1330	0.35	0.036	0.023	0.093
	8-1	A	0.576	0.028	0.0180	0.0600	0.1300	0.29	0.036	0.015	0.086
		B	0.553	0.029	0.0200	0.0580	0.1370	0.35	0.036	0.016	0.092
	10-5	A	0.548	0.023	0.0190	0.0630	0.1560	0.28	0.036	–	0.086
		B	0.559	0.025	0.0180	0.0630	0.1330	0.35	0.037	0.022	0.099
	12-3	A	0.563	0.024	0.0180	0.0610	0.1580	0.31	0.036	0.020	–
		B	0.583	0.026	0.0190	0.0610	0.1350	0.35	0.037	0.022	0.094
42	1-3	A	0.552	0.023	0.0200	0.0640	0.1330	0.44	0.035	0.029	0.093
		B	0.562	0.024	0.0200	0.0650	0.1360	0.35	0.036	0.024	0.110
	4-3	A	0.525	0.023	0.0220	0.0660	0.1390	0.36	0.036	0.028	0.083
		B	(0.577?)	0.022	0.0200	0.0650	0.1110	0.34	0.037	0.026	0.091
	6-4	A	0.547	0.020	0.0220	0.0630	0.1330	0.38	0.034	0.027	0.082
		B	0.577	0.021	0.0220	0.0640	0.1320	0.34	0.040	0.022	0.092
	8-5	A	0.559	0.021	0.0230	0.0640	0.1440	0.37	0.036	0.026	0.079
		B	0.557	0.021	0.0220	0.0630	0.1280	0.35	0.039	0.023	0.082

TABLE 3 – *Continued*

Sample Designation											
Hole	Core	Section	Na/Cl	K/Cl	Ca/Cl	Mg/Cl	SO_4/Cl	Br/Cl x 10^2	Sr/Cl x 10^2	B/Cl x 10^2	Li/Cl x 10^4
42	10-3	A	0.578	0.020	0.0230	0.0670	–	0.33	0.036	0.026	0.086
		B	0.560	0.023	0.0180	0.0630	0.1430	0.35	0.037	0.025	0.099
Sea water			0.556	0.021	0.0210	0.0670	0.1400	0.34	0.036	0.024	0.093

[a]Ratios shown in A are calculated from data of I. R. Kaplan and B. J. Presley (Department of Geological Sciences, University of California, Los Angeles); Ratios indicated as B refer to data from this report. The boron values used for the "B" ratios retain the second decimal, although the values have been rounded for presentation in Table 2.