32. INTERSTITIAL WATER CHEMISTRY: DEEP SEA DRILLING PROJECT, LEG 19

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INTRODUCTION AND PROCEDURES

Leg 19 of the Deep Sea Drilling Project began at Kodiak, Alaska, consisted of operations in the North Pacific and Bering Sea, and ended in Yokohama, Japan. Drilling was conducted at 11 sites and pore water collected at 10 of these was received at Texas A&M.

The sedimentary section was similar at all Leg 19 sites, consisting basically of various admixtures of diatomaceous muds, terrigenous detritus, and volcanic debris, but the relative proportions of these varied considerably from site to site, and with depth at any one site. The complicated lithology and the rather unusual structural setting of these sites, combined with the apparently active biological processes at work in the sediment column (high NH_3 concentrations, presence of natural gas, etc.) makes interpretation of observed changes in pore water chemistry difficult, but the pore water data do show this to be one of the most diagenetically active areas yet sampled.

The analytical procedures used for these samples are essentially the same as those described in an earlier DSDP report (Presley, 1971; Presley and Claypool, 1971), but small modifications have been made in order to facilitate sample handling.

RESULTS AND DISCUSSION

All data obtained from the interstitial water samples received are given in Table 1, except for major cation concentrations which are the responsibility of the Woods Hole group. The total dissolved CO_2 and carbon isotope data which the UCLA group has included as part of our past reports were not available for this leg.

On all previous legs the Cl and Br content of the pore water has been close to that of average seawater, except for those locations where evaporites were known or suspected to be present in the sedimentary column. A second exception is that a few near-shore holes have encountered fresher water at depth, apparently due to an influx of continental fresh water.

This second phenomenon seems to be at work in much of the Leg 19 area, because the salinity measurements made on board ship show slightly fresher water at depth in many of the holes. Our laboratory measurements, based on fewer samples, show this best at Site 184 where there is an approximately 4 percent increase in Cl with depth, and at Site 186 where the samples below 100 meters depth are depleted in Cl by about 12.5 percent compared to the average near-surface Cl value in this area.

Our measured Br values show considerable scatter, but only in a few cases does this result in a Cl/Br ratio which differs from that in seawater by more than 5 to 6 percent. The anomalous numbers, for example the low Br at the bottom of Site 183 and at the top of Site 184 and the high values at the bottom of Sites 190, 191, and 192 may be real, but they differ from the seawater value by only about 10 percent and thus do not show any large-scale effects such as those found near evaporites.

Boron concentrations for samples from previous legs have generally not varied greatly from the normal seawater value, and this is also true for Leg 19 samples, No trend with depth is apparent that would suggest either uptake or release by solid phases.

Dissolved silica concentrations are very high, as would be expected in view of the abundance of amorphous silica, both biogenic and volcanic. It is interesting to note, however, that there is commonly as much as 30 percent variation in the silica concentration from site to site or with depth at a given site, even when the lithologic description of the sediments is identical. Part of this variation might be caused by differential warming of the sediment after collection and before and during squeezing, but in some cases smooth trends with depth make this seem unlikely. The overall control of lithology on the dissolved silica is nevertheless shown very well at Site 183 where the bottom two samples, which are lithologically different, are also vastly different in dissolved silica.

Ammonia concentrations were very high in all samples except those from Sites 183 and 193 and generally show increasing concentrations with depth in the sediment column to all depths sampled. This means that ammonia is being generated at all depths and raises a question as to its source, Is the ammonia biologically produced or does it have some other source?

Lithium concentrations were more variable in these samples than in any group previously analyzed. In a few cases Li was greatly impoverished, but in general there was an enrichment, one which became greater with depth in the sediment column. This same phenomenon has been observed on many of the previous legs, but no explanation for it is yet available.

Manganese also behaved in a manner expected from previous work. That is, its concentration was highly variable and seems not to be related to any of the other measured parameters.

ACKNOWLEDGMENTS

This work was supported in part by AEC Grant AT (11-1)-34 P.A. 134 and NSF Grant GA-20715.

REFERENCES

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TABLE 1
Selected Major and Minor Constituents, Interstitial Water, Leg 19

Sample[a] Number	Depth[b] (m)	Age and Description of Sediment[c]	Cl (g/kg)	Br (mg/kg)	B (mg/kg)	Si (mg/kg)	NH_3 (mg/kg)	Mn (mg/kg)	Li (mg/kg)
183-4-3	25	Pleistocene pelagic silty clay with diatoms	20.0	69	4.9	23.1	9.0	5.7	135
183-8-4	64	Pleistocene pelagic silty clay, diatom-rich	20.1	67	4.5	24.2	9.1	3.7	120
183-17-6	172	Miocene diatom ooze with ash	20.0	70	4.9	37.3	5.8	6.3	260
183-19-4	188	Miocene diatom ooze, 10% clay	20.0	71	5.4	27.9	3.3	6.8	270
183-26-2	251	Oligocene clay section of turbidite	20.1	–	5.0	4.1	3.3	1.0	240
183-31-2	298	Oligocene clay section of turbidite	20.0	54	4.9	5.1	3.4	0.4	190
184-3-6	154	Pliocene diatom ooze with clay and silt	20.0	51	5.8	27.8	43.7	0.2	950
184-6-6	210	Pliocene diatom ooze, volcanic silt	20.2	–	6.7	30.2	–	–	–
184-9-6	255	Pliocene diatom ooze, volcanic sand	19.9	73	5.6	30.8	33.1	0.4	930
185-11-4	300	Mio-Pliocene diatom-rich clay, volcanics	19.8	72	6.3	34.3	37.0	0.8	900
184-14-3	383	Late Miocene clay-rich diatom ooze	19.7	71	6.1	27.9	32.3	–	880
184-20-5	545	Late Micoene clay-rich diatom ooze	19.4	65	6.5	33.2	31.7	0.5	700
184-22-6	599	Late Miocene clay-rich diatom ooze	19.3	68	6.6	27.3	33.9	1.0	565
185-5-2	65	Pleistocene clay-rich diatom ooze	20.7	71	5.8	27.8	45.9	0.4	180
185-7-5	135	Pliocene clay-rich diatom ooze, ash	20.0	–	5.5	26.1	51.7	0.6	255
185-10-4	228	Late Miocene silty diatom ooze, spicules	20.0	72	5.6	27.1	50.6	0.6	310
186-3-6	20	Pleistocene clay-rich diatom ooze	18.0	68	5.5	24.9	27.0	0.3	60
186-6-3	110	Pleistocene diatom-rich silty clay	16.0	–	5.2	25.5	61.2	0.2	125
186-9-6	169	Pleistocene diatom-rich silty clay	16.3	54	5.2	25.1	59.3	0.2	175
188-3-5	37	Pleistocene silt-rich diatom ooze	20.4	71	5.0	24.7	17.0	1.1	135
188-5-2	90	Pleistocene silt-rich diatom ooze	20.3	–	5.1	31.1	21.4	0.3	190
188-7-6	178	Pleistocene silt-rich diatom ooze	20.2	71	5.6	33.3	31.7	0.3	235
188-8-6	235	Pliocene silt-rich diatom ooze	20.3	72	3.6	35.2	37.8	0.9	270
189-1-5	6	Pleistocene diatom-rich silty clay	20.2	69	4.9	22.5	–	5.7	130
189-3-5	44	Pleistocene diatom-rich silty clay	20.2	68	5.0	27.8	26.7	0.9	120
189-4-3	87	Pleistocene diatom-rich silty clay, ash	20.2	–	4.8	23.7	43.7	1.0	170
189-5-4	152	Pleistocene diatom-rich silty clay, ash	20.1	72	4.7	24.0	–	0.6	285
190-1-3	3	Pleistocene diatom-rich silty clay	20.0	69	5.1	19.6	–	6.3	140
190-5-6	42	Pleistocene diatom-rich silty clay	20.0	–	6.0	21.7	28.4	2.1	150
190-9-2	114	Pleistocene diatom-bearing clay, ash	20.0	74	7.7	20.2	36.2	1.6	200
190-11-5	204	Pliocene clayey diatom ooze, ash	19.8	–	7.3	25.9	33.9	1.0	610
190-13-3	332	Late Miocene clayey diatom ooze, ash	20.0	75	6.1	32.1	36.2	0.5	1510
190-14-6	429	Late Miocene silty diatom ooze, ash	19.8	74	6.3	34.2	37.6	0.4	1600
191A-1-5	20	Pleistocene silty diatom clay, ash	20.3	70	4.4	18.2	26.4	1.5	80
191A-4-5	48	Pleistocene silty diatom clay, ash	21.6	74	5.0	20.8	39.5	0.3	100
191-4-6	86	Pleistocene silty diatom clay, ash	20.6	78	5.4	26.8	54.8	0.3	125
191-5-6	142	Pleistocene silty diatom clay, ash	20.5	74	5.0	18.5	82.6	0.3	255
192-2-4	5	Pleistocene silty diatom clay, ash	–	72	4.0	19.5	–	7.5	140
192-6-2	57	Pleistocene silty diatom ooze	20.5	72	4.1	23.1	24.2	2.7	165
192-8-6	100	Pliocene silty diatom clay, ash	20.6	–	3.9	22.9	23.1	0.8	185
192-15-4	275	Late Miocene clayey diatom ooze	20.6	75	3.9	30.3	33.7	1.3	465
192-17-3	329	Late Miocene clayey diatom ooze	20.7	78	4.2	28.4	30.9	0.6	620
193-1-2	2	Pleistocene silty diatom clay, ash	20.3	70	4.2	20.5	3.2	8.0	125

[a]Hole, core, section.
[b]Depth in sediment column.
[c]From preliminary hole summaries.