27. C_1-C_7 HYDROCARBONS IN HOLES 378A, 380/380A, AND 381

Jean K. Whelan and John M. Hunt,, Department of Chemistry,
Woods Hole. Oceanographic Institution,
Woods Hole, Massachusetts

ABSTRACT

Light hydrocarbons in the C_1-C_7 range have been found in three drilling sites in the Black Sea. Light hydrocarbons in the C_4-C_7 range have been found in quantities ranging from 2.1 to 1432 ng/g (PPB). The C_2-C_3 hydrocarbons were present in amounts from 0.06 to 239 ng/g (PPB). The deeper sediments from Hole 380A yielded more C_4-C_7/C_0 than the shallower but probably older sediments from Hole 381.

RESULTS AND DISCUSSION

The distribution of individual sediment hydrocarbons in the C_1-C_7 range were determined for 9 samples from Hole 379A, 55 samples from Holes 380/380A, and 25 samples from Hole 381. The samples from Hole 379A are youngest, with the deepest being Pleistocene. The depth range of samples in 379A is 52 to 454 meters. Holes 380/380A ranged in depth from 0 to 1074 meters with the bottom sample being upper Miocene. Hole 381 samples reached about the same depth, 494 meters, as 379A. However, bottom sediments from this hole are of late Miocene age and are probably older than those at Hole 380A (Stoffers et al., this volume). Thus, the three holes offered good opportunity to compare effects of age and depth of burial (or temperature) on generation of light hydrocarbons in Recent sediments.

Representative analytical data for Holes 379, 380/380A, and 381 are shown in Tables 1, 2, and 3, respectively. The analytical techniques were previously reported in Initial Reports, Leg 22.

The total yields of C_2+C_3 and C_4-C_7 hydrocarbons per gram of organic carbon are shown in Table 4. There is a general increase in C_4-C_7 yield with depth in all three holes. However, the increase is most marked in the deepest Holes 380/380A—1.3 μg/g C_0 at 0 meter and 36 μg/g C_0 at 1075 meters. The depth of Holes 381 and 379 is approximately the same. Most of the yields of C_4-C_7 hydrocarbons at the bottom of Hole 381 are a little larger than those of Hole 379 which is consistent with the longer time of burial of material from Hole 381. The slight increase in yields of C_4-C_7 hydrocarbons with increasing sediment age and the much larger increase with increasing temperature and depth of burial indicate these compounds are formed in situ by low-temperature degradation of organic matter. Similar trends in C_2-C_3/g C_0 can be seen in Holes 380/380A and 381.

High yields of C_4-C_7 hydrocarbons can be seen at intermediate depths in both Holes 381 and 380/380A. These peaks sometimes correspond to a change in lithology and organic source material from terrigenous mud and clay to either a more calcareous or diatomaceous input. For example, in Hole 380A, high yields occur at 334 meters and in the 475 to 675 meter sequence. These intervals correspond to an organic-rich mud and to a Seekreide-diatomaceous clay sequence, respectively. A more spectacular change occurs at the bottom of the hole in going from a marl at 864.5 meters (2.5 μg C_4-C_7/g C_0) through a laminated carbonate at 981 meters (25.6 μg C_4-C_7/g C_0). The high yield of C_4-C_7 hydrocarbons then gradually increases through a dolomite to black shale sequence from 981 meters to 1075 meters. The increase in C_4-C_7 hydrocarbons from 864 meters to 931 meters corresponds to the sequence where iC_5/nC_5 gas ratios change slope and where others have found that, in the higher hydrocarbon range (C_{14} to C_{35}), the *n*-alkanes decrease and cyclic saturated hydrocarbons increase.

Toluene was present in all sediments examined from Holes 381 and 380/380A. It was absent in some of the shallower sections of Hole 379 indicating that this compound forms with increasing time and depth of burial. Benzene also appeared sporadically in these sediments. The quantity of toluene is higher than that of benzene in most samples as shown by the toluene/benzene ratios in Table 4. Sections where benzene exceeds toluene occur below 722 meters in Hole 380A. The variability of the toluene/benzene ratio in shallower sections probably reflects differences in organic source material.

There is a decrease in benzene/nC_6 with depth in Hole 380/380A. However, the decrease is very irregular and probably reflects organic source material rather than maturation.

Both Holes 380/380A and 381 are unusual in showing relatively high amounts of gem dimethyl alkanes such as 3,3-dimethylpentane, 1,1-dimethylcyclopentane, 2,2-dimethylbutane, and neopentane. These compounds may reflect the remains of carbon skeletons of terpene precursors which have not undergone drastic chemical alteration.

ACKNOWLEDGMENT

We thank Nancy Stewart and Marta Tarafa for their help in these analyses. This research was supported by National Science Foundation Grant OCE73-06575.

TABLE 1
C_4-C_7 Hydrocarbons – Hole 379, Leg 42B

Sample	6-5 btm. Terr. Mud	8-0-top Diatom Terr. Mud	9, CC Diatom Terr. Mud	10-5-btm. Terr. Mud	13-top Terr. Mud	14-top Terr. Mud	16, CC Terr. Mud	17, CC Terr. Mud	49-btm Terr. Mud
Depth (m)	52.5	64.0	83.0	90.5	111.5	121.0	149.5	159.0	453.5
Hydrocarbons	Concentration in ng/g dry weight								
Methane	476	1540	1158	1386	568	1030	32.4	1106	26
Ethane	0.40	2.81	1.58	1.86	1.00	1.59	0.06	1.77	0.2
Propane	0.32	1.29	0.90	1.62	0.59	0.28	0.28	0.63	0.06
i-Butane	0.21	0.63	0.28	0.83	0.25	0.17	0.16	0.44	0.03
n-Butane	0.08	0.30	0.15	0.37	0.12	0.05	0.12	0.08	0.02
neo-Pentane	0	0.06	0.08	0.24	0.03	0	0	0	0
i-Pentane	0.17	0.67	0.11	0.40	0.24	0.12	0.26	0.50	0.05
n-Pentane	Trace	Trace	0.03	0.08	0.01	0.01	0.03	0	0.02
Cyclopentane	0	0	0	0.01	0	0	Trace	0	0
2, 2-DiMebutane	n.d.	0	n.d.[a]	n.d.	n.d.	n.d.	0.37	0.03	0.22
2, 3-DiMebutane	0.09	0.31	0	0	0.13	0.25	0.32	0.25	0.21
2-Mepentane	0.19		0	0	0.22	0.12	1.36	0.52	0.11
3-Mepentane	0.10	0.28	0.38	0	0.15	0.34	0.59	0.24	0.23
n-Hexane	0.16	0.34	0.30	0.37	0.20	0.54	1.50	0.44	0.60
Mecyclopentane	0.11	0.38	0.44	0.16	0.13	0.12	0.33	0.53	0.46
2, 2-DiMepentane	0	0	0	0	0	0.11	0.36	0.19	0.03
Benzene	0.08	0.26	0.11	0.26	0.29	0.31	0.31	Trace	0.15
2, 4-DiMepentane	0	0	0	0	0	0.05	0	0.17	0.04
2, 2, 3-TriMebutane	0	0	0	0	0	0	0	0.47	0
Cyclohexane	0.26	0.58	0.34	0.61	1.13	0.43	0.74	0.91	0.04
3, 3-DiMepentane	0.03	0.069	0	0	0	0.13	0.13	0.11	0
1, 1-DiMecyclopentane	0	0	0	0	0	0	0	0.18	0
2-Mehexane	0.14	0.17	0	0	0	0.14	0	0	0.25
2, 3-DiMepentane		0.15	0	0	0	0.17	0	0	
1-cis-3-DiMecyclopentane	0	0	0	0	0	0	0	0	0
3-Mehexane	0.07	0	0	0	0	0.20	0.51	0.28	0.07
1-Trans-3-DiMecyclopentane	0.03	0	0	0	0	0	0.23	0.17	0
1-Trans-2-DiMecyclopentane	0.11	0	0	0.15	0	0.44	0.44	0.31	0.11
3-Ethylpentane	0	0	0	0	0	0	0	0	0
n-Heptane	0.06	0.20	0.52	0.38	0	0.38	0.61	0.07	0.20
1-c-2-DiMecyclopentane	0	0	0	0	0	0.08	0	0	0
Mecyclohexane	0.16	1.02	0.49	1.23	0	0.57	1.48	3.25	0.21
Ethylcyclopentane	0	0	0	0	0	0	0.06	0	0
Toluene	0	0.49	0.22	0	0	0.76	4.18	1.07	2.32
Total C_4-C_7	2.2	5.9	3.4	5.09	2.91	5.5	14.1	10.2	5.4
Total C_2-C_3	0.72	4.10	2.48	3.48	1.59	1.87	0.34	2.40	0.24
Wt % org. C	0.76	1.15	0.82	1.46	0.39	0.37	0.76	0.9	0.19

[a]Not determined.

TABLE 2
C_1-C_7 Hydrocarbons – Hole 381, Leg 42B

Sample	8-2-btm. Terr. Clay	10, CC Terr. Clay	14-0 Terr. Clay	17-top Terr. Clay	17, CC Terr. Clay Carbonate Mud	32-0 Diatom-aceous Clay	34-1-top Seekreide	51-1-top Breccia + Terr. Mud	54-0 Terr. Clayey Siltstone
Depth (m)	69.5	95.0	123.5	152	161.5	285	304	465.5	494
Hydrocarbons					Concentration in ng/g dry weight				
Methane	98	37	171	40.3	367	745	368	183	161
Ethane	0.33	0.24	0.43	0.29	1.44	1.81	1.60	5.47	18.0
Propane	0.13	0.20	0.18	0.47	0.63	2.70	0.61	0.59	5.2
i-Butane	0.02	0.18	0.36	0.05	0.26	1.26	0.26	1.09	4.2
n-Butane	0.12	0.21	0.05	0.24	0.52	1.96	0.78	0.17	5.1
neo-Pentane	0	0	0	0.09	0.01	1.25	0.90	0.18	0.21
i-Pentane	0.12	0.44	0.06	0.06	0.36	2.98	1.23	0.48	4.9
n-Pentane	0.15	0.30	0.10	0.24	0.67	2.25	1.41	Trace	2.3
Cyclopentane	0	Trace	Trace	0.11	0.02	0.07	Trace	0	0.3
2, 2-DiMebutane	0.08	0	0.17	0	0.13	1.24	n.d.[a]	n.d.	0.5
2, 3-DiMebutane	0.04	0	0.05	0	0.08	1.39	1.10	0.04	0.86
2-Mepentane	0.25	0.76	0.30	0.04	0.39	4.39	3.00	0.01	2.74
3-Mepentane	0.06	0.43	0.18	n.d.	0.21	1.04	0.92	0.02	1.13
n-Hexane	0.33	4.06	0.62	0.06	4.30	2.97	9.78	0.04	3.47
Mecyclopentane	0.07	0.59	0.10	0.01	0.34	1.54	1.57	0.01	1.10
2, 2-DiMepentane	0.02	0.13	0	0.02	0.11	2.32	0.28	0.002	0.54
Benzene	0.21	0.62	0.24	0.03	0.47	0	2.52	0.006	0.10
2, 4-DiMepentane	0.02	0.13	0.06	0	0.02	0.15	0.56	0	1.10
2, 2, 3-TriMebutane	0	0	0	0	0	0	0.03	0	0.08
Cyclohexane	0.11	0.55	0.12	0.01	0.19	0.53	0.86	0.003	1.10
3, 3-DiMepentane	0.008	0.10	0.06	Trace	0.05	0.82	0.19	0	0.04
1, 1-DiMecyclopentane	0.20	0.35	0.07	Trace	0	0	0.22	0	0.15
2-Mehexane	0.008	0.13	0.10	0.002	0.40	0	0.28	0	0.28
2, 3-DiMepentane	0.02	0.35	0.14	0.009	0	0	0.97	0	1.03
1-cis-3-DiMecyclo-pentane	0.17	0	0	0	0.30	0	0	0	n.d.
3-Mehexane	0	0.64	0.26	0.02	0	1.21	1.03	0.01	1.82
1-Trans-3-DiMecyclo-pentane	0.01	0.21	0	0.005	0	4.25	0.95	0	2.17
1-Trans-2-DiMecyclo-pentane	0.15	0.50	0.37	0.006	0	0	0.41	0	0.31
3-Ethylpentane	0	0.26	0	Trace	0	0	0.69	0	n.d.
n-Heptane	0.09	0.77	0.20	0.03	0.67	1.18	0.79	0	1.58
1-c-2-DiMecyclo-pentane	0	0	0	0	0	0	0.11	0	0.32
Mecyclohexane	0.30	2.98	1.67	0.07	0.93	2.58	1.94	0.004	1.90
Ethylcyclopentane	0	0.12	0	0	0	0	0.36	0	0.30
Toluene	0.60	4.50	2.13	1.87	2.79	2.18	2.00	0.04	1.50
Total C_4-C_7	3.28	19.3	7.4	3.0	13.2	37.6	35.2	2.11	40.6
Total C_2-C_3	0.46	0.44	0.61	0.76	2.1	4.5	2.2	6.1	23.2
Wt % org. C	0.5	0.76	0.55	0.45	0.7	2.1	1.29	0.78	1.9

[a]Not determined.

TABLE 3
C_1-C_7 Hydrocarbons – Hole 380/380A, Leg 42B

Sample	0-top Sapropel + Calc. Mud	10-4-btm Mud	19-4-20 Mud and Silty Sand	32-0 Mud	1-2-90 Org.-Rich Mud	3-3-btm Diatom. Ooze	8, CC Gray-Grn. Mud	15-6-btm Seekreide	23-3, 148-150 Seekreide and Mud	29-4, 128-150 Seekreide (slumped)
Hole		380					380A			
Depth (m)	0	95.0	175.5	294.5	334.4	356	408.5	475.0	546.0	595.5
Hydrocarbons					Concentration in ng/g dry weight					
Methane	236	299.6	1277	1119	261	463	73	18.0		300
Ethane	0.68	0.06	2.01	4.26	3.50	2.52	1.11	0.13	0.45	3.44
Propane	0.41	Trace	3.82	1.50	8.14	4.18	0.34	0.13	0.23	1.74
i-Butane	0.009	0	3.63	1.00	4.40	5.13	0.49	0.04	0.13	0.64
n-Butane	0.269	0	2.51	0.61	5.07	3.96	0.31	0.14	0	0.49
neo-Pentane	0	0	0.08	0	Trace	Trace	0.02	0	0	0
i-Pentane	0.11	0	4.87	1.59	9.30	10.93	0.51	Trace	0.08	0.41
n-Pentane	0.03	0	0.69	0.36	4.44	2.63	0.18	Trace	0	0.23
Cyclopentane	0		0.21	0.05	0.66	0.65	0.03	0	0	0.04
2, 2-DiMebutane	0.19	0.59	0.32	0.18	0	4.48	n.d.	0.43	0.15	0.22
2, 3-DiMebutane	0.15	0.35	0.22	0	18.3	3.66	0.04	0.28	1.25	0.31
2-Mepentane	1.18	0.65	0.29	1.00	78.2	10.0	0.28	1.25	2.66	1.26
3-Mepentane	0.25	1.34	0.53	0.54	37.0	11.7	0.18	0.66	1.87	0.53
n-Hexane	0.72	0.58	0.24	0.68	475	123	2.30	2.32	38.6	3.9
Mecyclopentane	0.32	0.50	1.00	0.66	66.2	19.8	0.94	1.31	5.14	1.85
2, 2-DiMepentane	0	0.25	1.74	0.18	0	0	0.01	0.22	0.75	0.10
Benzene	1.14	0.80	0.60	0.40	41.4	10.8	0.13	2.54	7.99	10.7
2, 4-DiMepentane	0	0.18	0	0.16	0	0	0.03	0.18	0.15	0.09
2, 2, 3-TriMebutane	0	0	0	0	0	0	0.04	0	0	0
Cyclohexane	0.29	1.63	1.68	0.83	27.0	12.0	0.52	0.99	1.50	0.90
3, 3-DiMepentane	0.08	0.31	0.36	0.07	9.90	0	0	0.16	0.05	0.10
1, 1-DeMecyclopentane	0.23	0.37	0.54	0.15	11.4	0	0.06	0	1.03	0.16
2-Mehexane	0.31	0.17	0.26	0.17	3.7	1.5	0.14	0.84	0.04	0.32
2, 3-DiMepentane	0.02	0.44	1.48	0.38		3.2	0.18	0.70	0	0.39
1-cis-3-DiMecyclopentane	0	0	0	0	0	0	0	0	0	0
3-Mehexane	1.46	0.41	1.03	0.43	7.75	2.66	0.25	1.02	0.81	0.95
1-Trans-3-DiMecyclopentane	0.08	0.10	0.46	0.17	0	6.83	0.10	0.39	0.30	0.61
1-Trans-2-DiMecyclopentane	0.32	0.47	0.78	0.64	15.7		0.39	1.01	1.42	0.77
3-Ethylpentane	0	0	0	0	1.44	0	0	0	0.79	0
n-Heptane	0.71	0.17	0.15	0.26	30.7	3.20	0.18	1.56	0	1.65
1-c-2-DiMecyclopentane	0	0.10	0	0.07	0.83	0	0.05	0.15	0	0.30
Mecyclohexane	0.96	3.78	3.17	2.11	17.4	8.26	1.54	4.32	0	3.56
Ethylcyclopentane	0	0.09	n.d.	0.08	0	0	0.05	0	0	0.18
Toluene	0.23	2.59	1.95	3.94	566	25.2	0.97	9.32	10.1	16.4
Total C_4-C_7	9.1	15.9	28.8	16.7	1432	270	10.0	29.8	74.8	47.1
Total C_2-C_3	1.1	0.06	5.8	5.76	11.6	6.7	1.4	0.26	0.68	5.2
Wt % org. C	0.71	0.44	0.63	0.54	9.21	8.82	0.43	0.46	0.80	0.65

Sample	38-0 Diatom Clay	42, CC Clayey Siderite	45-0-top Diatom Clay	52, CC Diatom Marl	57, CC Black Marl	64, CC Laminated Carbonate	70-2 Dolomites	73, CC Blk. Shale Silty Sand	78, CC Blk. Shale	80-1, 0-150 Blk, Shale
Hole						380A				
Depth (m)	674.5	722	741	817	864.5	931	980	1016.5	1064	1075
Hydrocarbons						Concentration in ng/g dry wt.				
Methane	790	1944	1550	644	402	93.2	222	109.8	183	191
Ethane	2.48	6.13	3.07	2.68	44.1	14.8	52.3	7.67	41.2	38.6
Propane	4.52	11.4	2.13	7.62	48.5	41.9	59.6	5.81	198.1	136.5
i-Butane	3.20	5.92	2.17	7.12	23.2	36.4	41.4	13.63	82.9	62.8
n-Butane	4.54	4.91	1.17	1.96	5.9	15.7	12.0	6.61	34.5	33.7
neo-Pentane	Trace	Trace	0	0	0.86	0.05	0.45	0.21	0.93	0.81
i-Pentane	3.84	7.62	3.82	7.97	5.49	31.0	3.05	23.5	61.2	67.4
n-Pentane	3.65	4.19	1.67	2.06	1.77	8.69	8.82	9.83	23.2	26.5
Cyclopentane	0.13	0.21	Trace	0.15	0.46	4.29	1.74	1.28	3.92	2.50
2, 2-DiMebutane	1.29	0.16	0.29	0.18	0.14	1.59	1.4	2.75	14.9	12.3
2, 3-DiMebutane	1.77	1.53	0.57	7.16	0.93	4.72	3.30	9.43	21.6	16.7
2-Mepentane	14.0	3.98	1.85	12.4	3.55	18.4	7.07	18.9	80.5	64.6
3-Mepentane	3.9	2.01	0.74	4.08	1.02	5.79	3.05	9.93	25.1	18.1
n-Hexane	31.3	15.5	4.92	11.3	7.56	36.8	4.65	100.5	112.5	84.0
Mecyclopentane	7.41	4.34	1.50	5.26	2.36	25.1	17.60	31.4	83.9	65.7
2, 2-DiMepentane	0.81	0.16	0.06	24.2	0.14	0.67	1.29	0.53	0	0.91
Benzene	42.4	13.6	4.65	1.30	23.1	38.3	6.63	10.9	49.7	28.2
2, 4-DiMepentane	0.66	0.38	0.20	0	0.37	0.83	1.53	1.23	2.70	1.54
2, 2, 3-TriMebutane	0	0	0.26	2.73	0	0	0	0	0	0
Cyclohexane	3.13	0.85	1.0	1.54	0	6.54	4.44	4.10	0	24.2
3, 3-DiMepentane	0.45	0.08	0	0.17	0	0.12	0.31	0.16	1.21	0.42
1, 1-DeMecyclopentane	0	0.15	0	0	0.09	0.51	0	0	0	0
2-Mehexane	4.73	0	0.22	1.57	0.53	1.39	2.77	4.09	30.4	3.67
2, 3-DiMepentane		1.33	0.75	3.47	1.10	5.00	5.54	8.33		7.11
1-cis-3-DiMecyclopentane	0	0	0	0	0	0	n.d.	0	0	0
3-Mehexane	3.47	1.38	1.06	6.53	1.43	8.47	12.4	11.5	24.6	14.2
1-Trans-3-DiMecyclopentane	1.0	2.57	2.02	5.58	2.52	8.70	13.5	12.6	19.6	15.3
1-Trans-2-DiMecyclopentane	3.75	0.26	0.02	3.24	0	10.48	17.3	18.3	44.9	25.0
3-Ethylpentane	0.92	0.14	0	0	0	0	0	0	0	0
n-Heptane	13.9	1.88	0.79	5.29	1.75	5.78	3.31	9.13	13.8	9.42
1-c-2-DiMecyclopentane	0.90	0.12	0.14	0.36	0.30	0.79	3.45	3.09	9.9	7.92
Mecyclohexane	9.41	1.22	0.93	6.67	1.22	11.5	20.7	21.0	37.0	32.0
Ethylcyclopentane	0.75	0.23	0.14	1.96	0	2.46	2.90	3.35	7.96	6.39
Toluene	120.3	10.5	3.42	45.4	8.84	21.8	33.7	89.0	23.5	33.2
Total C_4-C_7	282	85.2	34.4	170.2	94.5	312.4	234.3	433.6	849.8	664
Total C_2-C_3	7.0	17.5	5.2	10.3	92.5	56.8	111.9	13.5	239.3	175
Wt % org. C	2.01	2.0	2.2	3.5	3.8	1.22	0.9	1.42	2.54	1.85

TABLE 4
Hydrocarbon Ratios

Sample	Depth (m)	$\frac{\mu g\ C_2+C_3}{1\ g\ org.\ C}$	$\frac{\mu g\ C_4-C_7}{1\ g\ org.\ C}$	$\frac{Tol}{Benz}$	$\frac{Benz}{nC_6}$	Lithology
Hole 379						
6-5-btm	52.5	0.095	0.29	0	0.50	Terrigenous clay and mud
8-0-top	64.0	0.36	0.51	1.88	0.76	Diatomaceous terrigenous mud
9, CC	83.0	0.30	0.42	2.00	0.37	Diatomaceous terrigenous mud
10-5	90.5	0.24	0.35	0	0.70	Terrigenous clay and mud
13-top	111.5	0.41	0.75	0	1.45	Terrigenous mud
14-top	121.0	0.50	1.49	2.45	0.57	Terrigenous mud
16, CC	149.5	0.04	1.86	13.5	0.21	Terrigenous mud and clay
17, CC	159.0	0.27	1.13	Mostly tol.	0	Terrigenous mud
49-bot	453.5	0.13	2.84	15.5	0.25	Terrigenous mud
Hole 380						
0-top	0	0.15	1.28	0.20	1.58	Sapropel and calcareous mud
10-4-bot	95.0	0.01	3.61	3.24	1.39	Mud
19-4-20	175.5	0.92	4.57	3.25	2.50	Mud and silty sand
32-0	294.5	1.07	3.09	9.85	0.59	Mud
Hole 380A						
1-2, 90	334.4	0.13	15.6	13.7	0.087	Organic-rich mud
3-3-bot	356.0	0.076	3.06	2.33	0.088	Diatomaceous ooze
8, CC	408.5	0.32	2.33	7.46	0.056	Gray-green mud
15-6-bot	475.0	0.056	6.48	3.67	1.10	Seekreide
23-3, 148	546.0	0.085	9.35	1.26	0.21	Seekreide and mud
29-4, 128	595.5	0.80	7.25	1.53	2.74	Seekreide (slumped)
38-0	674.5	0.35	14.0	2.84	1.35	Diatomaceous clay
42, CC	722.0	0.88	4.26	0.77	0.88	Clayey siderite
45-0	741.0	0.24	1.56	0.74	0.94	Diatomaceous clay
52, CC	817.0	0.29	4.86	34.9	0.12	Diatomaceous marl
57, CC	864.5	2.43	2.49	0.38	3.06	Marl
64, CC	931.0	4.66	25.6	0.57	1.04	Laminated carbonate
70-2	980	12.4	26.0	5.08	1.43	Dolomite
73, CC	1016.5	0.95	30.5	8.16	0.11	Black shale
78, CC	1064.0	9.42	33.5	0.47	0.44	Black shale
80-1-0	1075	9.46	35.9	1.18	0.34	Black shale
Hole 381						
8-2-bot	69.5	0.092	0.66	2.86	0.64	Terrigenous clay
10, CC	95.0	0.058	2.54	7.26	0.15	Terrigenous clay
14-0	123.5	0.11	1.34	8.88	0.39	Terrigenous clay
17-top	152	0.17	0.67	62.3	0.50	Terrigenous clay
17, CC	161.5	0.30	1.89	5.94	0.11	Terrigenous clay-carbonate mud
32-0	285	0.21	1.79	–	0	Diatomaceous clay
34-1-top	304	0.17	2.73	0.79	0.26	Seekreide
51-1-top	465.5	0.78	0.27	6.7	0.15	Breccia and terrigenous mud
54-0	494	1.22	2.14	15.0	0.03	Terrigenous clayey siltstone