34. HYDROCARBONS IN CANNED MUDS FROM SITES 185, 186, 189, and 191 – Leg 19

Richard D. McIver, Esso Production Research Company, Houston, Texas

INTRODUCTION

As part of our program of analyzing occasional canned mud samples for their residual hydrocarbon gas contents and determining the composition of those gases, we acquired a suite of samples from DSDP Leg 19. These were analyzed (for their organic carbon and gas contents) by the same procedures described in the similar study of 29 samples from Leg 18 (McIver, in preparation) which were the first set in this program. In addition, we determined the bitumen content and its composition of six of the samples, by previously reported procedures (Koons and Monaghan, 1969). Results are tabulated in Tables 1 and 2. In addition, in order to make it easier to visualize the differences in gas contents from site to site, and from Leg 19 vs Leg 18, the data are also presented in histogram form in the figures. Figure 1 shows residual gas contents for individual samples from Leg 19 and how they fit in with previous data (from Leg 18); Figure 2 groups all the data obtained to date; and Figure 3 shows the range of residual gas contents per unit percentage of organic carbon, individually for Leg 19 samples, and collectively for Leg 18 samples.

DISCUSSION OF RESULTS

As in Leg 18 samples, residual gas contents of Leg 19 muds cover a broad range, i.e., from only trace amounts to over 216,000 parts per million by volume (ppmv) of methane gas. This variability is also observed in a single hole where we have good stratigraphic coverage, i.e., Site 186. We found the largest quantity of gas (216,700 ppmv in Core 3, Section 6) to date in one of the canned muds from this site. However, an apparent duplicate sample sealed in another can yielded only 49,900 ppmv.

As discussed in an earlier report (McIver, in preparation), wide variations in residual gas content should be expected because of differences in sediment porosity and permeability and because of different periods of time between actual coring at depth and the removal of the sample from the core liner. Even the highest values we observe must be well below the actual gas content at depth. Lower values, especially just trace amounts, may be due to very low gas contents of the sediments themselves, but it is more likely that these are products of longer exposure to the atmosphere before the canning step, or of poor seals, or leaks in the cans themselves. A few of the cans show evidence of leakage – i.e., salt crystals around tiny spots on the shipboard-sealed rim. These samples are not run for residual gas contents. But it is entirely possible that other leaking cans, without visible manifestations of a leak, were submitted for analysis.

The data presented in Figure 2 suggest that residual gas contents are bimodally distributed in deep-sea sediments.

TABLE 1
Organic Carbon and Gas Contents

Site	Core	Section	Depth Below Sea Floor (m)	Age	Organic Carbon (%)	Hydrocarbon Gas (ppmv)	Methane in Gas (%)
185	20	2 (0cm)	664	U. Mio.	0.49	39,700	100
185	20	2 (150cm)	665	U. Mio.	0.57	11,000	100
185	21	3 (0cm)	674	U. Mio.	0.45	101,800	100
186	3	2 (0cm)	1	Pleisto.	0.53	112,900	100
186	3	3 (150cm)	3	Pleisto.	0.46	17,100	100
186	3	5 (0cm)	6	Pleisto.	0.89	40,800	100
186	3	5 (150cm)	6	Pleisto.	0.68	3,400	100
186	3	6 (150cm)-1	15	Pleisto.	0.74	27,600	100
186	3	6 (150cm)-2	15	Pleisto.	0.62	216,700	100
186	4	5 (150cm)	55	Pleisto.	0.50	49,900	100
186	6	1 (150cm)	107	Pleisto.	0.36	26,800	100
186	8	1 (0cm)	132	Pleisto.	0.38	1,400	91[a]
186	9	7 (lower)	167	Pleisto.	0.56	28,900	100
186	20	5 (0cm)	465	Pleisto.	0.40	27,800	100
189	5	4 (0cm)	152	Pleisto.	0.26	trace	N/A
189	6	1 (150cm)	212	Plio.	0.47	19,900	100
191	4	5 (150cm)	84	Pleisto.	0.66	119,000	100
191	4	6 (150cm)	86	Pleisto.	0.71	48,000	100
191	5	5 (150cm)	140	Pleisto.	0.40	107,100	100

[a]At this low level of hydrocarbon, this value is not significantly different than 100 percent.

TABLE 2
Organic Carbon and Bitumen Contents

Site	Core	Section	Organic Carbon (%)	Triple-Solvent-Soluble Bitumens Total (ppm)	NSO's (ppm)	Asphaltenes (ppm)	Hydrocarbons (ppm)
185	20	2 (0cm)	0.49	259	117	69	73
186	3	6 (150cm)	0.62	277	147	122	8
186	9	7 (lower)	0.56	206	123	72	11
189	6	1 (150 cm)	0.47	231	117	86	28
191	4	5 (150 cm)	0.66	294	142	116	36
191	5	5(150 cm)	0.40	113	61	28	24

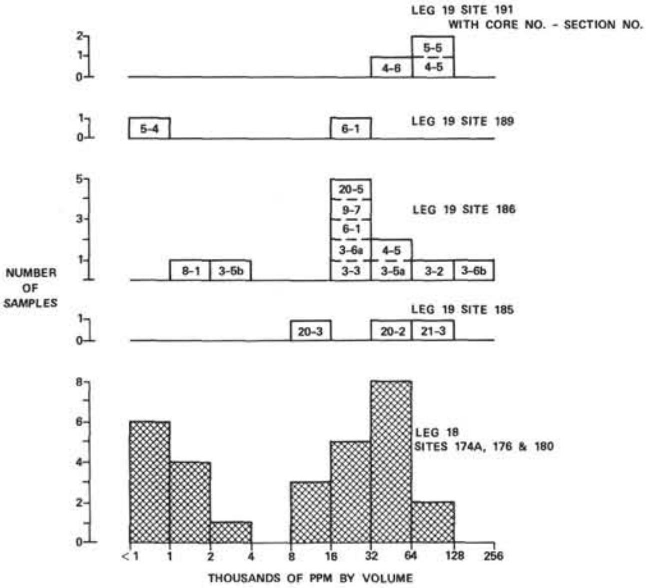

Figure 1. *Range of residual gas contents of canned muds, DSDP Legs 18 and 19.*

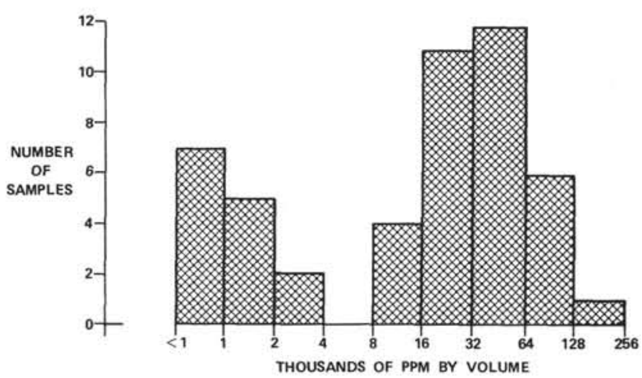

Figure 2. *Range of residual gas contents of canned muds, DSDP Legs 18 and 19.*

Even the distribution of ratios of residual gas to content of organic carbon (Figure 3) suggests that some types of organic matter do not produce as much gas as others. The elongated end of this skewed distribution may be due to causes relating to gas origin, but they may also reflect loss of most of the gas from the containers before analysis, as

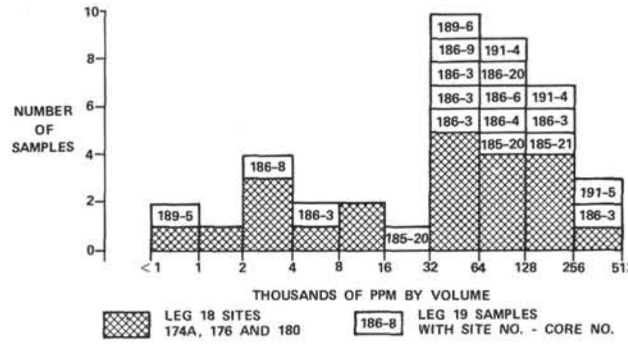

Figure 3. *Distribution of residual gas contents as a function of organic carbon contents.*

discussed above. Nevertheless, the data from the 48 residual gas determinations serve as a basis for comparing and contrasting results from individual sites or samples.

Site 185 was one of two chosen for study of a "bottom-simulating reflector" that has been attributed to gas-hydrate zones in near-bottom, deep-sea sediments. A major gassy zone was penetrated bracketing the 670 meter depth of the reflector, and an attempt was made to collect some cores at in situ pressures (R. Stoll, personal communication). This pressure coring failed. Three samples were taken from the regular cores, sealed in cans, and sent to us. These three samples had moderate to high residual gas contents. The one from beneath the "reflector" had over 100,000 ppmv methane gas, which is well beneath the theoretical solubility (~400,000 ppm) at this depth (pressure) and estimated temperature in the sediment's interstitial water. Still, it is a large quantity of gas when the coring and handling procedures are considered.

In addition to the moderate to high gas contents, the three samples also contained moderate quantities of organic carbon (Table 1), and one even contained 73 ppm of C_{15+} hydrocarbons (Table 2), which might justify labeling it a potential future oil-source rock (Phillipi, 1956). The paucity of ethane and heavier hydrocarbons in the gas and the kerogen appearance we observed on this sample (alteration index about 1 to 1.5 on the Staplin, 1969, scale) show that it has not undergone extensive thermal alteration. However, the high percentage (28%) of hydrocarbon in the solvent-soluble bitumen suggests that the heavier material may be in the very early stages of hydrocarbon formation from labile precursors. This is in keeping with the depth, 664 meters, of the sample analyzed.

The residual gas contents of the Site 186 samples are very erratic, but they do include the gassiest sample run in this program to date. The 216,700 ppmv methane gas in Core 3, Section 6, is only about a third of the gas theoretically soluble in the interstitial water of this sediment—remarkable retention considering the coring and handling procedures, unless the gas were tied up as the hydrate which decomposed slowly after removing the core from its original setting.

The organic carbon and bitumen contents of the samples from this site are also sufficient for them to be considered potential source rocks of petroleum (Phillipi, 1956). However, unlike the sample from Site 185, they are still virtually unaltered, evidenced by the low hydrocarbon to total bitumen ratio of their solvent extracts (Table 2). Of course, they are buried much less deeply than the Site 185 sample.

The two samples from Site 189 are on the low side of the mean of samples run to date. One had but a trace, less than 100 ppm of methane by volume, the other, 19,900 ppmv. The deeper one also had enough organic carbon to be considered a future source, but it too is unaltered. The Site 191 samples tend to be uniformly rich in gas, relative to previously analyzed samples. They are also moderately rich in organic carbon and virtually unaltered thermally. They can also be classed as potential future sources of petroleum if buried deeply enough for thermal alteration to produce hydrocarbons from their apparently abundant precursor material.

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