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ROBERTSON RESEARCH INTERNATIONAL LIMITED

MEMORANDUM NO. 2708

INTERIM REPORT ON THE GEOCHEMISTRY OF  
THE CONOCO NORWAY 8/9-1 WELL, NORWEGIAN NORTH SEA

Project No. RRI/756/IID/2282

BA 76-0573-1

30 APR 1976  
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I

INTRODUCTION

A Maturation and Source Rock Evaluation Study has been carried out on the interval 3,320 to 7,800 feet of the Conoco Norway 8/9-1 well using a selection of ditch cuttings and sidewall cores.

II

RESULTS AND INTERPRETATION

A. MATURATION EVALUATION

1. Maximum Palaeotemperature Analysis

Maximum Palaeotemperature analysis was carried out on seventeen samples each of which gave consistent values for the measured parameters. On plotting the results against depth a fairly uniform increase in values can be seen, the palaeotemperatures being interpreted as increasing from approximately 200°F at 3,500 feet to about 260°F at 7,500 feet depth. These values are however considered to be higher than would be expected for the present depth of burial and in view of the results of the other maturation parameters.

## 2. Spore Colouration Analysis

Spore colouration indices were found to increase from a value of 2.5 , at 3,320-400 feet to values of 4 at 7,100-200 feet. Samples from greater depths contained only caved assemblages of palynomorphs of Jurassic age. The results suggest that the Tertiary and Upper Cretaceous sediments are immature for the generation of oil from suitable types of organic matter but Lower Cretaceous and Jurassic sediments are at an early stage of maturity for oil generation.

## 3. Light Hydrocarbon Analysis

### (a) Headspace gas

Throughout the section, the samples yielded fairly substantial amounts of headspace gas of which methane was the dominant component.

### (b) Cuttings gas

Methane contents of greater than 80% of the total C<sub>1</sub> to C<sub>4</sub> gases were generally seen through the section from 3,320 to 6,200 feet. From 6,200 to 7,000 wet gas (C<sub>2</sub> - C<sub>4</sub>) becomes of significant (50-90%) proportion while the amounts of gas observed were very low at not more than 1,068 ppb throughout the section.

### (c) Gasolines

Amounts of the gasoline range hydrocarbons were generally below 1,000 ppb throughout the section with the exception of samples at 6,900-7,000, 7,100-7,200 and 7,700-7,800 feet. In composition, a mature oil-like range of components only appeared in the samples at 6,900-7,000 and below.

These light hydrocarbon analyses indicate maturity to be reached at 6,900.

## 4. Vitrinite Reflectivity Analysis

Samples analysed at present have shown that vitrinite reflectivity rises from 0.19% at 3,900 feet to about 0.38% at 7,700 feet. These values suggest that humic, gas-prone types of organic matter will be immature for gas generation throughout the analysed section. The reflectivities are consistent

with the temperatures reached as indicated by spore colouration data.

#### B. SOURCE ROCK EVALUATION

Samples of Tertiary age show a wide range of organic carbon content, 0.36% to 11.3% the siltstones having a highly variable content of organic matter. The Upper Cretaceous sediments contain low amounts of organic carbon, ranging from 0.18 to 0.38% in the samples analysed, which is to be expected in view of the chalk dominated lithologies. The shales and mudstones of Lower Cretaceous age have generally average organic carbon contents for their lithology type ranging from about 0.56% (S.W.C) to 3.8% (cuttings sample). Within the Jurassic interval the quantity of organic carbon in the dominantly black and grey shales is above average, the majority of samples containing organic carbon contents of greater than 4% and rising in some cases to greater than 10%. Within the supposed Permian interval organic carbon contents are still above average for the shales present in the samples though it is suggested that the shale is probably caved from the overlying Jurassic.

The proportion of the organic material extractable in organic solvents is quite low for all the samples ranging from 0.7% to 6.4% apart from a 9.7% extractability obtained from the 7,700-800 foot sample. Hydrocarbon contents are very low to average, less than 20 ppm to 220 ppm in all but the deepest samples with 1,470 ppm hydrocarbons though, as discussed above, the validity of the results particularly below 7,400 feet is questionable in view of the suggested caving.

The most likely present hydrocarbon product from the sediments of Jurassic age is indicated to be gas in view of the high richness in organic carbon and low concentrations of hydrocarbons. The Lower Cretaceous interval appears to be insufficiently rich in organic carbon and hydrocarbons to have any source potential on the basis of the samples analysed.

### III

#### CONCLUSIONS

On integration of the maturation data the section appears to be at a very

early state of maturity for hydrocarbon generation below 6,900 though the data does become obscure below 7,400 feet. Good potential source rocks are present almost throughout the Jurassic though, due to the low state of maturity only small amounts of hydrocarbons have been generated; heavy oil and minor gas only being possible products from these sediments.

15th April, 1976

CD/vsr

TABLE 1

MAXIMUM PALAEOTEMPERATURE DATA

<u>Sample No.</u>	<u>Depth in Feet</u>	<u>Maximum Palaeotemperature</u> <u>Degrees Fahrenheit</u>
3	3500 - 600	207
6	3800 - 900	200
8	4000 - 100	200
11	4300 - 400	227
13	4500 - 600	239
16	4800 - 900	258
20	5000 - 100	224
23	5300 - 400	247
25	5500 - 600	236
28	5800 - 900	239
30	6000 - 100	253
33	6300 - 400	231
40	6500 - 600	270
51	6800 - 900	259
59	7000 - 100	253
72	7300 - 400	263
78	7500 - 600	259

TABLE 1

## SOURCE ROCK EVALUATION DATA

COMPANY: CONOCO NORWAY

WELL: 8/9-1

LOCATION: NORWEGIAN N. SEA

SAMPLE DEPTH ( FEET ) OR NOTATION	SAMPLE TYPE	ANALYSED LITHOLOGY	ORGANIC CARBON % OF ROCK	TOTAL EXTRACT P.P.M.	EXTRACT % OF ORGANIC CARBON	HYDRO- CARBONS P.P.M. OF ROCK	HYDRO- CARBONS % OF EXTRACT	TOTAL ALKANES % HYDRO- CARBONS
3. 3500- 600	Ctgs	Gy calc sltst	11.3					
4. 3800- 900	"	Dk gy calc sltst	3.9					
8. 4000- 100	"	Lt brn/dk gy calc sltst	3.3					
11. 4300- 400	"	Med gy-brn calc sltst	1.24					
13. 4500- 600	"	Ditto	0.92					
16. 4800- 900	"	Med gy calc sltst+ 20% wht chk	0.69					
17. 4846	SWC	Lt gy calc sltst	0.79					
19. 4950	"	Lt gn-gy sltst	0.36					
20. 5000- 100	Ctgs	Wht chk+30% med gy sltst	0.29					
23. 5300- 400	"	Ditto+ditto	0.38					
25. 5500- 600	"	Ditto+mnr ditto	0.28					
28. 5800- 900	"	Ditto+tr ditto	0.19					
30. 6000- 100	"	Ditto+tr ditto	0.18					
33. 6300- 400	"	Ditto+tr ditto	0.84					
35. 6380	SWC	Gy calc mdst	0.67					
36. 6400- 500	Ctgs	Med gy calc sh+10% red marl+10% chk+mnr mdst	0.72	140	1.9	<20	-	-
38. 6500	SWC	Ol gy calc mdst	0.56					
39. 6500	Ctgs	Med gy calc sh+20% dk gy calc sltst+mnr red mdst	0.78					
40. 6500- 600	"	Brn gy/dk gy calc sh + tr chk	1.23	90	0.7	<20	-	-
41. 6550	"	Med gy calc sh+mnr dk gy sltst+mnr red mdst	3.8					
42. 6600	Ctgs	Med gy calc sh+30% chk	2.88					

TABLE 1 (Cont'd.)

## SOURCE ROCK EVALUATION DATA

COMPANY: CONOCO NORWAY

WELL: 8/9-1

LOCATION: NORWEGIAN N. SEA

SAMPLE DEPTH ( FEET ) OR NOTATION	SAMPLE TYPE	ANALYSED LITHOLOGY	ORGANIC CARBON % OF ROCK	TOTAL EXTRACT P.P.M.	EXTRACT % OF ORGANIC CARBON	HYDRO- CARBONS P.P.M. OF ROCK	HYDRO- CARBONS % OF EXTRACT	TOTAL ALKANES % HYDRO- CARBONS
43. 6600- 700	Ctgs	Med gy calc sh	1.19	380	3.2	75	20	83
44. 6626	SWC	Lt ol-gy mdst	0.99					
45. 6650	Ctgs	Med gy calc sh+mnr chk	3.7					
46. 6700	"	Ditto	1.80					
47. 6700- 800	"	Ditto	1.21	455	3.8	20	5	100
48. 6750	"	Ditto	1.86					
49. 6784	SWC	Gy sh	3.2					
50. 6800	Ctgs	Med gy calc sh	2.36					
51. 6800- 900	"	Dk gy sh	3.60	1585	4.4	110	7	83
52. 6850	"	Med dk gy sh	3.3					
53. 6900	"	Ditto	5.0					
54. 6909	SWC	Ditto with carbonaceous matter	17.5					
55. 6900- 7000	Ctgs	Dk gy coaly sh	4.6	1315	2.8	180	14	35
56. 6950	"	Ditto	4.5					
57. 7000	"	Ditto	4.7					
58. 7000	SWC	Gy sltst	1.64					
59. 7000- 100	Ctgs	Dk gy coaly sh+mnr sltst	4.5	1940	4.2	180	9	52
60. 7050	"	Ditto	5.1					
61. 7068	SWC	Gy-brn sh	5.9					
62. 7100	Ctgs	Dk gy coaly sh+50% gy- brn sh+tr coal	10.8					
63. 7100- 200	Ctgs	Dk gy coaly sh+mnr gy sltst+mnr snd	7.3	4440	6.2	220	5	43
64. 7109	SWC	Blk mic sh	29.3					
65. 7126	"	Lt gy mdst	0.46					
66. 7150	Ctgs	Med dk gy sh+snd+tr coal	6.0					
67. 7200	"	Ditto+ditto	6.3					
68. 7200- 300	"	Dk gy coaly sh+50% snd	6.1	3905	6.4	200	5	27
69. 7210	SWC	Gy mdst	1.91					

TABLE 1 (Cont'd.)

## SOURCE ROCK EVALUATION DATA

COMPANY: CONOCO NORWAY

WELL: 8/9-1

LOCATION: NORWEGIAN N. SEA

SAMPLE DEPTH ( FEET ) OR NOTATION	SAMPLE TYPE	ANALYSED LITHOLOGY	ORGANIC CARBON % OF ROCK	TOTAL EXTRACT P.P.M.	EXTRACT % OF ORGANIC CARBON	HYDRO- CARBONS P.P.M. OF ROCK	HYDRO- CARBONS % OF EXTRACT	TOTAL ALKANES %HYDRO- CARBONS
70. 7250	Ctgs	Med dk gy sh+40% wht fn sst+coal	4.7					
71. 7300	"	.Ditto+20% lt gy sh+ mnr snd	4.7					
72. 7300- 400	"	Med gy sltst+30% snd/ sst+mnr dk gy coaly sh	2.90	1370	4.7	115	8	58
73. 7350	"	Med dk gy sh+mnr lt gy sh+mnr snd	4.1					
74. 7400	"	Med gy sh+mnr dk gy sh+10% snd/sst	2.71					
75. 7400- 500	"	Med gy sltst+10% snd/ sst+10% dk gy coaly sh	2.34	1175	5.0	140	12	60
76. 7450	"	Med gy sh+mnr sst	1.96					
77. 7500	"	Ditto+mnr sst+tr coal	2.72					
78. 7500- 600	"	Med gy slty sh+70% dk gy sh	2.70	1250	4.6	60	5	87
79. 7550	"	Ditto+mnr dk gy sh+tr snd	5.59					
80. 7600	"	Ditto+mnr ditto+mnr ditto	2.96					
81. 7600- 700	"	Dk gy coaly sh+20% sltst+snd	3.45	1270	3.7	135	11	55
82. 7650	"	Med gy slty sh+mnr dk gy sh+snd	3.1					
83. 7700	"	Dk gy sh+20% med gy sh	3.8					
84. 7700- 800	"	Dk gy coaly sh+mnr sltst	4.6	4445	9.7	1490	33	72
85. 7750	"	Med gy sh+15% dk gy sh	3.7					
86. 7790	"	Ditto+30% ditto+mnr snd	3.8					



# FIGURE

## MATURE SOURCE ROCK RICHNESS

COMPANY : CONOCO NORWAY

WELL : 8/9-1

LOCATION : NORWEGIAN NORTH SEA

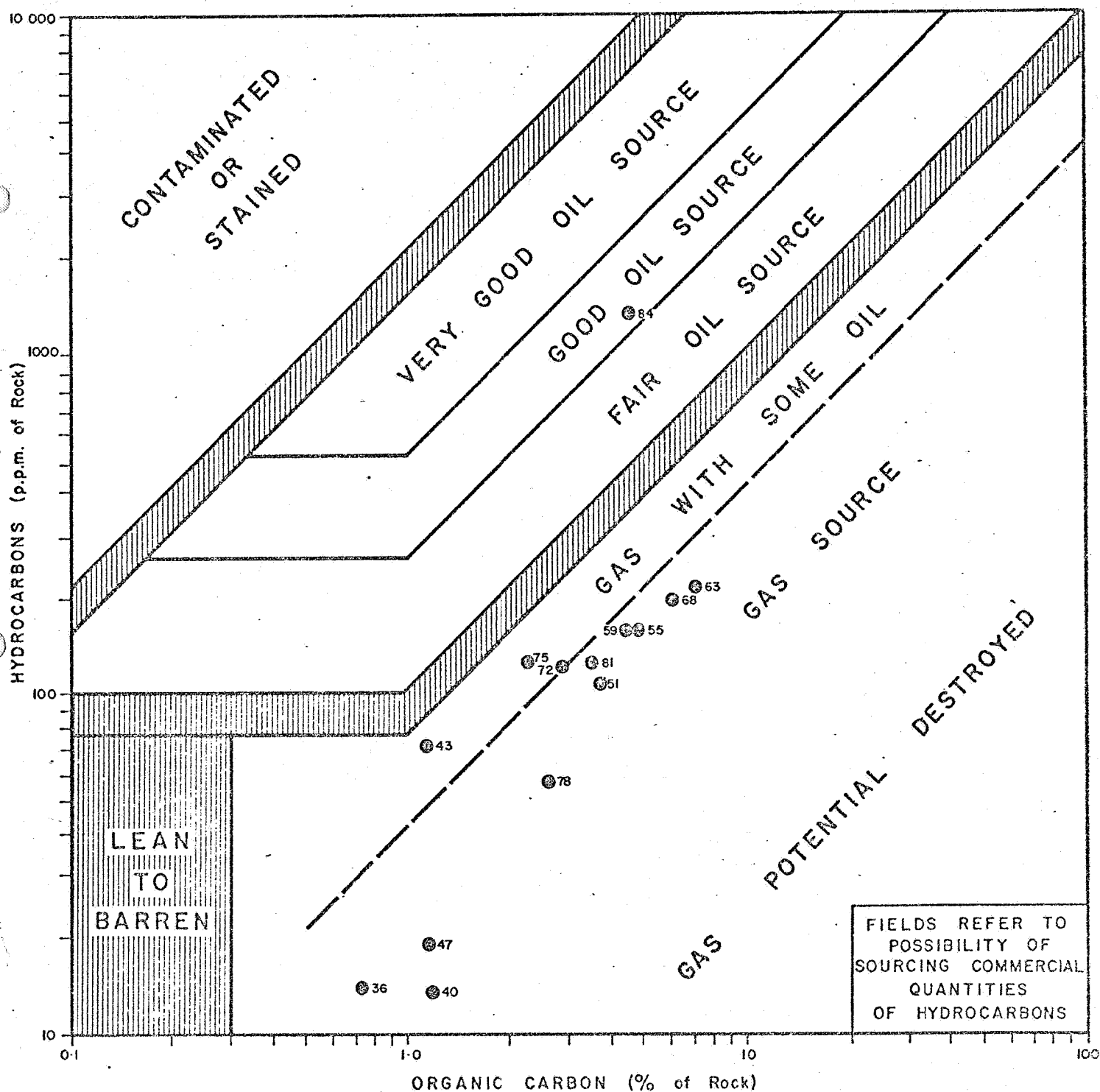


FIGURE  
 TYPE OF HYDROCARBON PRODUCT FROM SOURCE ROCKS  
 COMPANY : CONOCO NORWAY WELL : 8/9-1 LOCATION : NORWEGIAN NORTH SEA

