TEST RESULTS

1549.6 1556

Test No. 1 (5084-5105 feet RKB)

Schlumberger perforated the interval using 1 11/16-inch Unijets at four shots per foot, 0° phasing, at 2046 hours June 5, 1975. Halliburton ran in with test tools with 72-hour B.T. gages. The clocks were started at 2130 hours, June 5. (See Enclosure 1 for test string configuration) The packer was set at 5054 feet RKB at 0425, June 6, with 2000 feet of seawater cushion.

IFP	:	0.5 hours started at 0432, June 6, 1975
ISIP	:	1.5 hours
FFP	:	9 hours
FSIP	:	12 hours

The blow increased slowly during the IFP. After ISIP, however, the blow slowly decreased and fluid did not reach surface. Gas samples from drillpipe above water cushion were taken for hydrocarbon analyses. During FSIP, fluid samples were circulated from the well for field determined R_w and salinity. See Enclosure 3 for the Expro test report.

1489.6m 1496.6

Test No. 2 (4887 - 4910 feet RKB)

Schlumberger perforated the interval using 1 11/16-inch Unijets at 4 shots per foot, 0° phasing, at 0043 June 8, 1975. Halliburton run in with test tools with 2 sets of 48-hour B.T. gages. The clock was started at 0140 hours, June 8. (See Enclosure 2 for test string configuration). The packer was set at 4867 feet RKB with 1000 feet of seawater cushion.

IFP : 8 hours started at 0625, June 8, 1975
FSIP : 16 hours

The blow from the well was fairly good during the first 5 minutes of the IFP. It then decreased slowly and died. No fluid reached surface. Gas samples from drillpipe above the water cushion were taken for hydrocarbon analyses. During FSIP, fluid samples was circulated from the well for field determined Rw, salinity, and dissolved hydrocarbon content. The fluid level in the drillpipe was just below the rotary table when reverse circulation was started.

Samples

During flow periods on Test Nos. 1 and 2, gas samples were taken from the test string as the water cushion was displaced upwards by inflowing mud filtrate and formation fluids. Exlog determined the concentration of light hydrocarbons in the samples. The results are provided in Enclosure 4, pages 1 and 2.

Water samples were collected from the test string after each test as the test string contents were reverse circulated. The resistivity of each sample from both tests was determined by Schlumberger and the salinity by Milchem. See Enclosure 4 page 4 and 5 . Exlog conducted a hydrocarbon analyses on the waters from Test No. 2. These results are also given in Enclosure 4, page 3.

Selected reversed water samples and mud samples were furnished to Statex for analyses. These results are included in Enclosure 4, pages 6 through 11. Note that the Schlumberger resistivities vary significantly from the Statex measured resistivities. This may be due to miscalibration of instruments or changes in the water samples from the time of collection to time of analyses.

TABLE 4

STATOIL AMOCO MOBIL 36 1-1

MUD MATERIALS USED

HOLE SIZE	INTERVAL	MILGEL	LIME	CAUSTIC	FLOSAL	S.W. GEL	DRISPAC	MICA	MILPLUG	MILBEN	KWICKSEAL	SODA ASH	UNICAL	BARITE	CALSIUM CLORIDE	LO 7	C M C	BICARD OF SODA	NITRATE	COST PER FOOT ($)	REMARKS
36"	RKB 0 - 940	136		4	58	195	6			90								2		7.05	Bridge @ 741' Circ w/water
26"	940 - 1690	19		12	52	290	7			240		6			38					9.56	No problems encoutered
17 1/2"	1690 - 4810	133	13	157	20	119	8			470		20	65	31 ST.			53	6		8.10	No problems encoutered
12 1/4"	4810 5235	90	5	33		38	10	30	5	50			68	ST. 56	25		24	10		28.93	Bad loss @ 5235'. Not total loss, but 300 bbls total. Decreased m.wt. to 10.0#
9 5/8"	Completion	88			25	92								M.T. 20				3			
									5												
		466	18	206	155	350 L 260 S	31			550 16 S.T.		26	133	124 S.T.	63 -		77	21			Total mud materials used for well

Enclosure 2

FLUID SAMPLE DATA

Sampler Pressure _____ P.S.I.G. at Surface
Recovery: Cu. Ft. Gas _____
cc. Oil _____
cc. Water _____
cc. Mud _____
Tot. Liquid cc. _____
Gravity _____ ° API @ _____ °F.
Gas/Oil Ratio _____ cu. ft./bbl.

		RESISTIVITY		CHLORIDE CONTENT
Recovery Water	@	°F.		ppm
Recovery Mud	@	°F.		ppm
Recovery Mud Filtrate	@	°F.		ppm
Mud Pit Sample	@	°F.		ppm
Mud Pit Sample Filtrate	@	°F.		ppm

Mud Weight _____ vis _____ cp

Date June 1975. Ticket Number HI 54259
Kind of Job D.S.T. Halliburton District Norway
Tester V. Ireland Witness R. Kolewanski
Drilling Contractor DYUI - ALPHA

EQUIPMENT & HOLE DATA

Formation Tested _____
Elevation _____ Ft.
Net Productive Interval _____ Ft.
All Depths Measured From K.B.
Total Depth _____ Ft.
Main Hole/Casing Size 9⅝"
Drill Collar Length 280.72' I.D. 2.5"
Drill Pipe Length 4521.59' I.D. 4.276"
Packer Depth(s) 4867' Ft.
Depth Tester Valve _____ Ft.

Cushion TYPE Seawater AMOUNT 1000' Ft. Depth Back Pres. Valve _____ Surface Choke .50" Bottom Choke .75"

Recovered _____ Feet of _____
Recovered _____ Feet of _____
Recovered _____ Feet of _____
Recovered _____ Feet of _____
Recovered _____ Feet of _____

Remarks Start clocks 01.40 - June 8th, 1975. Strong initial blow, well dead at 08.05. Tight Hole

TEMPERATURE	Gauge No. 2549 Depth: 4858 Ft.	Gauge No. 2650 Depth: 4888 Ft.	Gauge No. Depth: Ft.	TIME
	48 Hour Clock	48 Hour Clock	Hour Clock	Tool 06.25 A.M.
Est. °F.	Blanked Off	Blanked Off YES	Blanked Off	Opened P.M.
Actual °F.	Pressures	Pressures	Pressures	Opened A.M. Bypass P.M.

	Field	Office	Field	Office	Field	Office	Reported Minutes	Computed Minutes
Initial Hydrostatic	2550.5	2561	2547	2582				
First Period Flow — Initial		1376		1409			——	——
First Period Flow — Final	2160.6	2149	2026	2167			480	478
First Period Closed in	2160.6	2149	2026	2167			960	962
Second Period Flow — Initial							——	——
Second Period Flow — Final								
Second Period Closed in								
Third Period Flow — Initial							——	——
Third Period Flow — Final								
Third Period Closed in								
Final Hydrostatic	2550.5	2603	2526	2613			——	——

Test Location Well No. Test No. Tested Interval Field Area County State NORWAY Lease Owner/Company Name

FORM 101-R1—PRINTED IN U.S.A.

FORMATION TEST DATA

LITTLE'S MULTILITH 6/74

ROBERTSON RESEARCH INTERNATIONAL LIMITED

MEMORANDUM NO. 2666

A VITRINITE REFLECTIVITY AND HYDROCARBON SOURCE EVALUATION STUDY OF THE 36/1-1 WELL, NORWEGIAN NORTH SEA

Project No. RRI/756/IID/2101

I

INTRODUCTION

A total of seventeen samples has been examined for vitrinite reflectivity and hydrocarbon source potential from the 36/1-1 well, Norwegian North Sea. Of these, fifteen were side wall core samples selected from the intervals 2,104 feet to 3,054 feet and 4,460 feet to 5,108 feet and two were cuttings samples composited over the intervals 3,570-600 feet and 3,950-80 feet. The cuttings samples were run as a check to cover the gap in the side wall core record between 3,054 feet and 4,460 feet but since excessive caving is reported, the reliability of results from them maybe of a low order.

The side wall cores were scraped free of drilling mud and dried before submission for examination. Cuttings samples were washed free of drilling mud and dried, after which the grey shale fractions were concentrated by sieving off as much sand as possible and by hand picking. Coal fragments in the sample from 3,950-80 feet were hand picked for vitrinite reflectivity examination.

II

RESULTS AND INTERPRETATION

A. MATURATION EVALUATION - VITRINITE REFLECTIVITY

An attempt was made to mount small fragments of the side wall cores in

resin blocks for polishing but the soft nature of the silt and mudstones involved did not allow a suitable polished surface to develop and no reflectivity determinations were made on the raw side wall core samples. Consequently, kerogen concentrates were prepared by solution of the mineral matter in concentrated hydrochloric and hydrofluoric acids and the dried residues mounted in resin blocks and polished in the usual manner. Grey shales and coal fragments were hand picked from the cuttings samples and mounted directly in resin blocks. The results of reflectivity determinations are listed in Table 1 and plotted on Figure 1. A gradient of low value has been found with values rising from 0.34% at 2,104 feet to 0.40% at 4,760 feet. Samples from 4,988 feet and deeper appear to have been subjected at some period in their history to rapid heating as evidenced by the development of granularity and micro-brecciation within the organic particles. No reliable values for vitrinite reflectivity could be obtained over this interval and the figures listed (Table 1) have probably been recorded on caved material.

The data suggest that the interval from 2,104 feet to 4,760 feet is immature for the generation of gas from gas-prone organic matter.

Examination of the samples in ultraviolet light has shown yellow fluorescence colours on liptinitic (exinitic) components over most of the analysed section though orange and faded brown colours were encountered over the interval 4,988 feet to 5,108 feet. The interval from 2,104 feet to 4,760 feet would appear immature for the generation of oil from oil-prone organic matter.

B. HYDROCARBON SOURCE EVALUATION

The results of hydrocarbon source evaluation are listed in Table 2 and plotted on Figures 2, 3 and 4. The organic carbon content of the side wall core and cuttings samples varies between 0.47% and 3.22%, values which are a little below to a little above average. Exceptions are found in samples 13 to 16 (4,988-5,076 feet) where values rise to as high as 55.3% due to the coal-rich nature of the sediments over this interval. The amount of solvent extractable organic matter varies from 250 ppm to 3,270 ppm with the exception

of the coal-rich samples 13 to 16 (9,440-42,400 ppm). Extractability of the organic matter as related to organic carbon content varies within normal values from 2.9% to 9.0% apart from samples 1 and 3 which at 20.7% and 34.1% respectively show values indicative of contamination. Hydrocarbon abundances are, in general, low with the exception of samples 13 to 16 (380-1,170 ppm).

The likely product from these source rocks is gas. Samples 4 and 5, though showing relatively high hydrocarbon abundance appear anomalous (Figure 3) and may be contaminated.

C. CONCLUSIONS

Vitrinite reflectivity analysis and examination in incident ultraviolet light indicate that the analysed section is immature both for the generation of gas from gas-prone organic matter and oil from oil-prone organic matter. The heat-affected nature of the organic matter over the interval 4,988 feet to 5,108 feet suggests a short-lived thermal event, possibly associated with a period of igneous intrusion.

Chemical analysis of the sediments has shown them to be capable of sourcing gas but at the level of maturity attained only small quantities can be expected.

28th July, 1975

AGC/VSR

TABLE 1

MATURATION EVALUATION DATA

COMPANY AMOCO NORWAY WELL: 36/1-1 LOCATION: NORTH SEA

SAMPLE DEPTH (FEET) OR NOTATION	SAMPLE TYPE	GENERALISED LITHOLOGY	MAXIMUM PALAEOTEMP-ERATURE °F	VITRINITE REFLECTIVITY %	SPORE COLOURATION (1-10)	LIGHT HYDROCARBONS
1. 2104	SWC	Gy mdst		0.34 (0.96)		
2. 2250	"	Ditto		0.32(0.66, 0.94)		
3. 2618	"	Ditto		0.37 (0.91)		
4. 2810	"	Ditto		(0.54,0.74, 0.99)		
5. 3054	"	Ditto		(0.53,0.77, 1.03)		
6. 3570-600	Ctgs	Gy sh + sand		0.42 (0.75)		
7. 3950-80	"	Ditto		0.33		
8. 4460	SWC	Ol-gy sltst		0.31 (0.77)		
9. 4666	"	Ditto		0.38		
10. 4696	"	Ditto		0.39(0.68, 0.99)		
11. 4714	"	Ditto		0.37		
12. 4760	"	Gy mdst		0.40(1.10)		
13. 4988	"	Blk sltst		0.35+heat affected material		
14. 5022	"	Blk coaly mdst		0.38+ "	"	" "
15. 5062	"	Ditto		0.40+ "	"	" "
16. 5076	"	Ditto		heat affected		
17. 5108	"	Gy mdst		heat affected (Reworked material)		

TABLE 2

SOURCE ROCK EVALUATION DATA

COMPANY: AMOCO NORWAY WELL: 36/1-1 LOCATION: NORTH SEA

SAMPLE DEPTH (FEET) OR NOTATION	SAMPLE TYPE	ANALYSED LITHOLOGY	ORGANIC CARBON % OF ROCK	TOTAL EXTRACT PPM	EXTRACT % OF ORGANIC CARBON	HYDRO--CARBONS PPM OF ROCK	HYDRO-CARBONS % OF EXTRACT	TOTAL ALKANES % HYDRO-CARBONS
1. 2104	SWC	Ol-gy calc mdst	0.90	1860	20.7	75	4	100
2. 2250	"	Ol-blk mdst	1.52	630	4.1	80	13	100
3. 2618	"	Ol-gy calc mdst	0.96	3270	34.1	55	2	100
4. 2810	"	Brn-gy calc lam sltst	1.57	500	3.2	120	25	100
5. 3054	"	Ol-gy mdst	0.47	250	5.3	150	60	100
6. 3570 - 600	Ctgs	Med gy sh+20% calc sltst+40% sand	0.94	270	2.9	30	12	100
7. 3950-80	"	Med gy calc sh+70% sand	0.95	470	4.9	<20	*	*
8. 4460	SWC	Ol-gy sltst	2.88	1460	5.0	130	9	77
9. 4666	"	Ditto	2.00	1880	9.0	190	10	88
10. 4696	"	Ditto	3.22	1940	6.1	50	2	96
11. 4714	"	Ditto	1.94	990	5.1	75	8	83
12. 4760	"	Dk gn-gy mdst	1.18	670	5.7	75	11	100
13. 4988	"	Brn-blk sl mic sltst	11.9	9440	7.9	1170	12	33
14. 5022	"	Blk coaly mdst	54.6	42400	7.8	1070	3	30
15. 5062	"	Ditto	50.8	19030	4.0	990	5	37
16. 5076	"	Ditto	55.3	22110	4.0	380	2	48
17. 5108	"	Lt ol-gy sl mic mdst	1.70	1100	6.3	140	13	71

FIGURE 1

MATURATION INDICES AGAINST DEPTH

COMPANY : AMOCO NORWAY WELL : 36/1-1 LOCATION : NORTH SEA

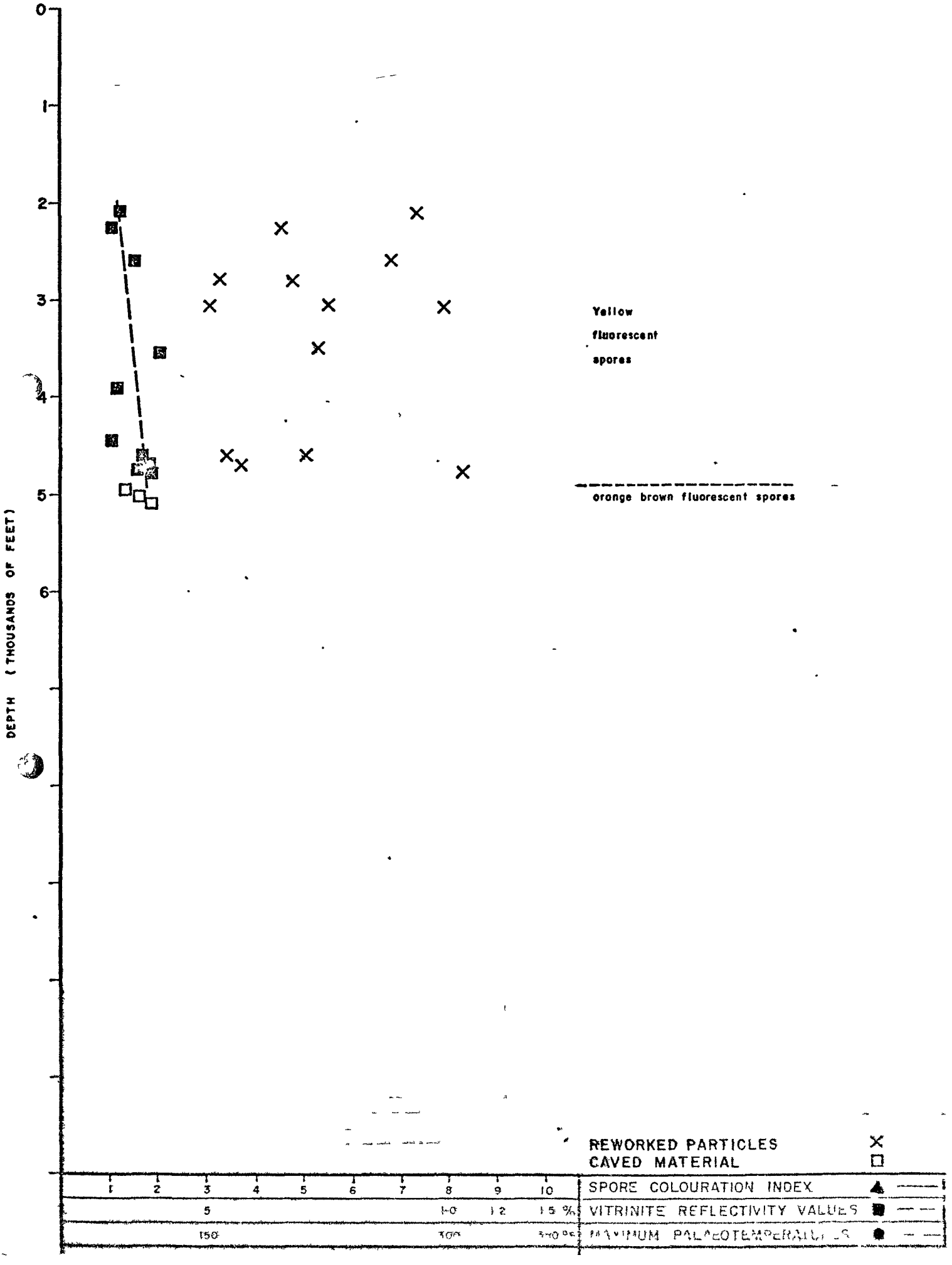


FIGURE 2

MATURE SOURCE ROCK RICHNESS

COMPANY : AMOCO NORWAY WELL : 36/1-1 LOCATION : NORTH SEA

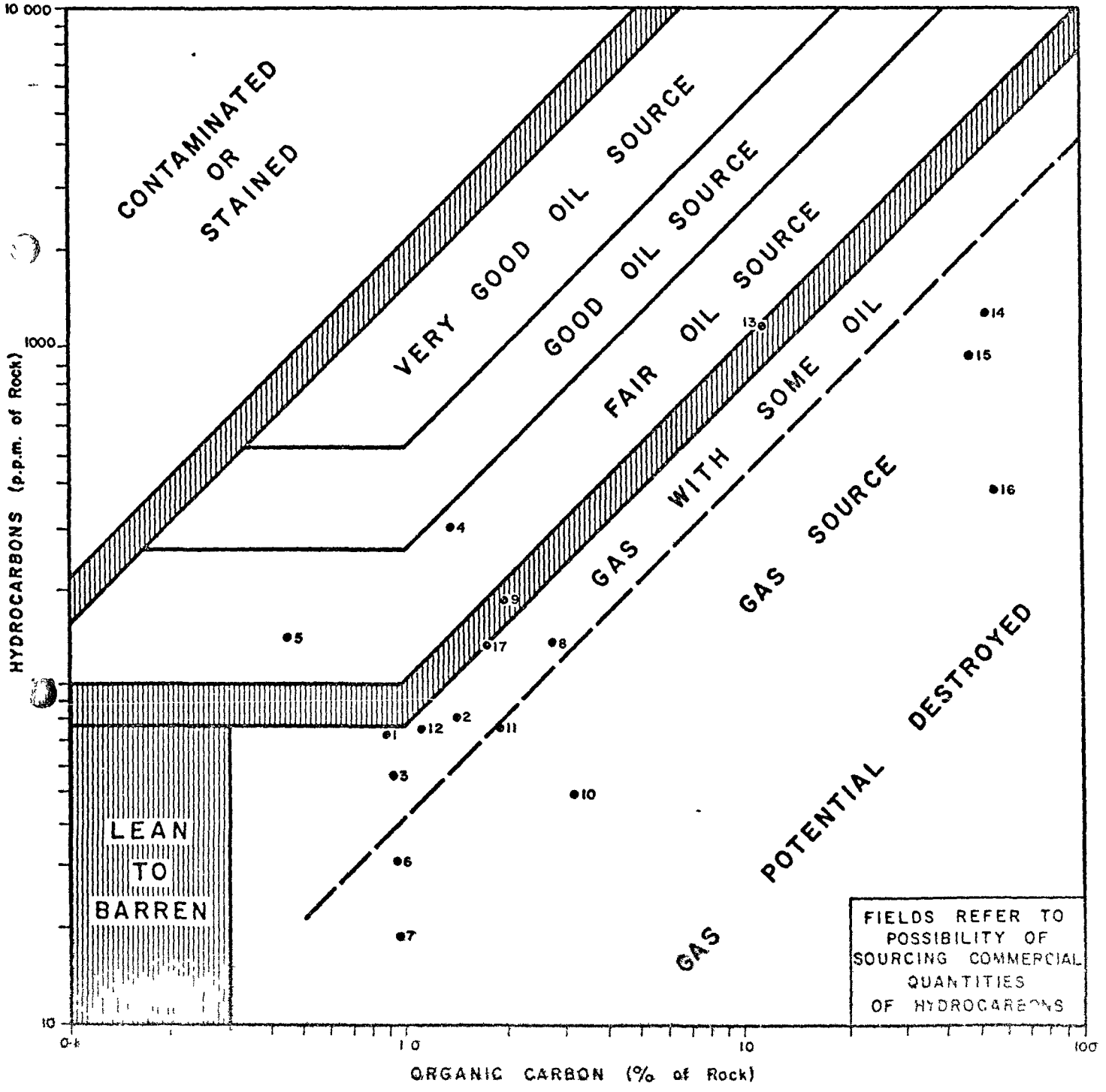
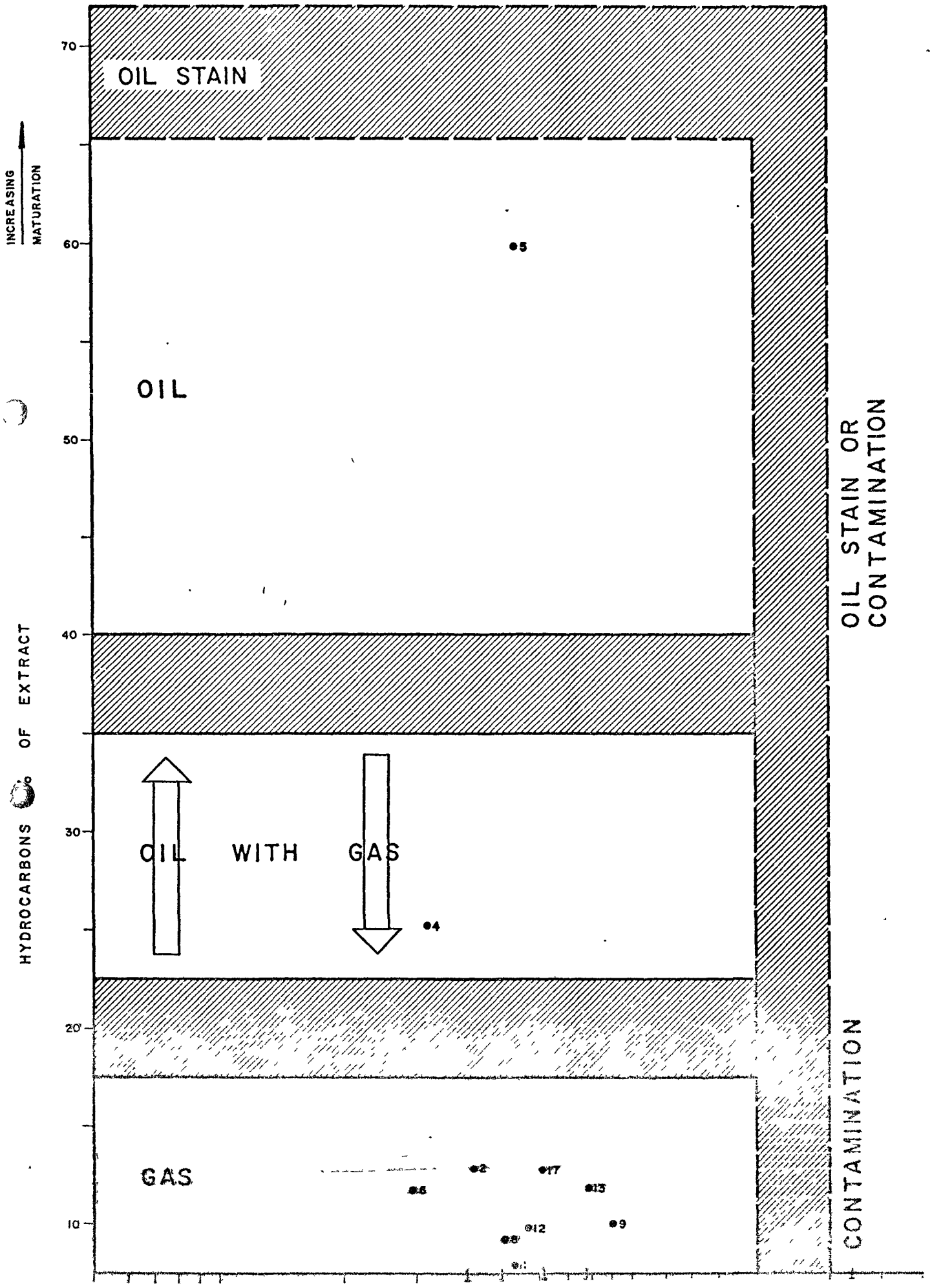


FIGURE 3

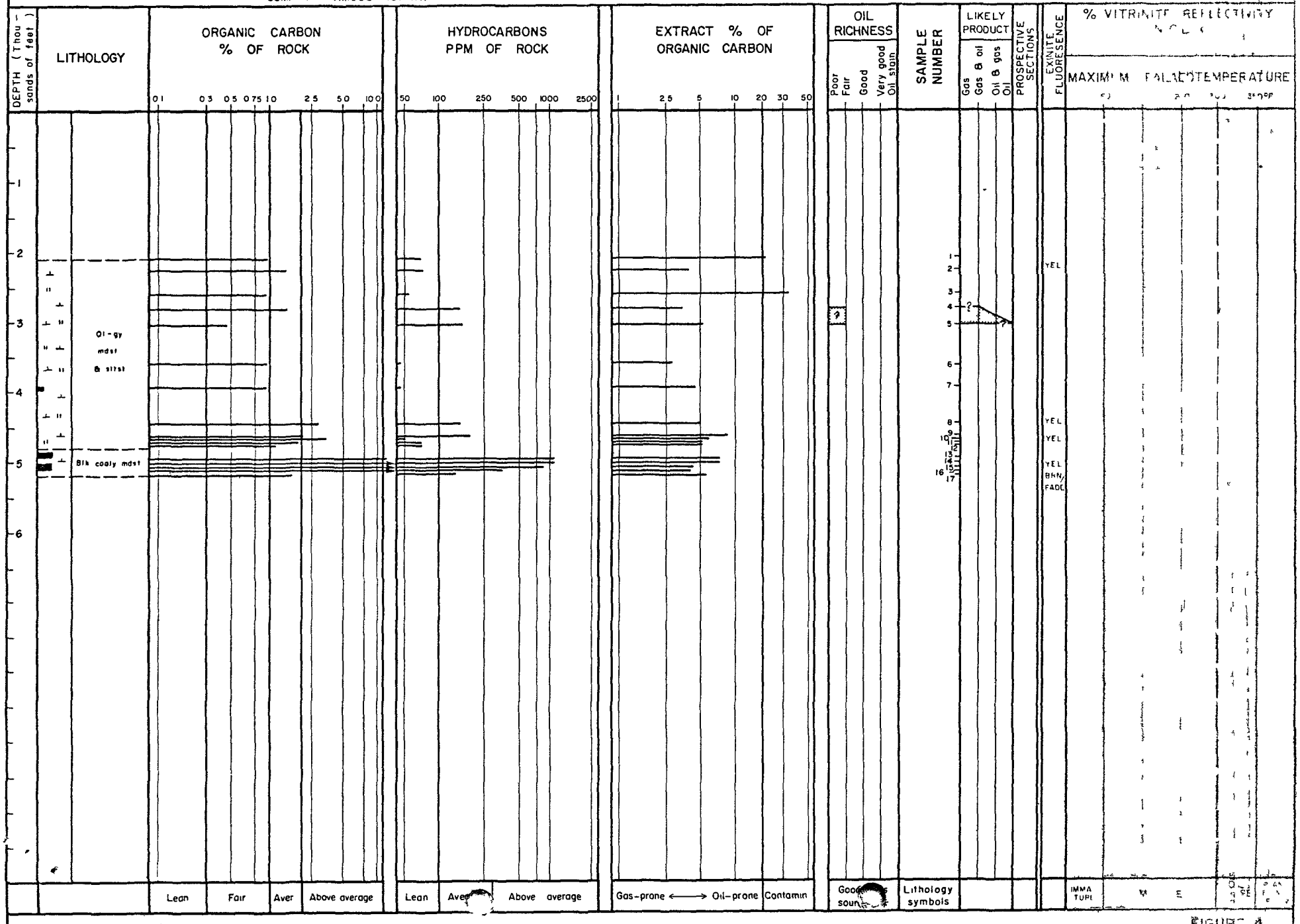
TYPE OF HYDROCARBON PRODUCT FROM SOURCE ROCKS

COMPANY : AMOCO NORWAY WELL · 36/1-1 LOCATION · NORTH SEA



SOURCE ROCK SUMMARY CHART

COMPANY AMOCO NORWAY WELL 36/1-1 LOCATION NORTH SEA



Drawing No 666/2101/3018

FIGURE 4

D. Palynology: Preliminary Report.

AMOCO NORWAY OIL COMPANY

WELL: 36/1-1.
STATUS: T.D.
SAMPLES: Selected cuttings.
CASING: 30" @ 940'; 20" @ 1678'.
ADDITIVES: Not known.

Preamble

Seven wet cuttings samples were selected for routine analysis at 3200', 3300', 3400', 4460', 4510' 4610' & 4710'. In addition, two wet cuttings samples, from 4770' & 4810', were selected for rapid analysis. One further sample, composited from dried, washed cuttings from 4360'-4380' was also examined.

Standard "hot" palynological processing techniques were employed: all samples were palyniferous: all contained Upper Cretaceous - Lower Tertiary palynofloras.

Results

The samples from 4770' & 4810' were contaminated with $K^U - Te^L$ caved assemblages. Presumed in situ palynofloras include (*microplankton):

BACULATISPORITES/OSMUNDACIDITES complex.
CALLIALASPORITES DAMPIERI/SEGMENTATUS/TRILOBATUS plexus.
CEREBROPOLLENITES MESOZOICUS
CONTIGNISPORITES PROBLEMATICUS
* CHYTROEISPHAERIDIA spp
* CTENIDODINIUM sp (4770' only)
* ENDOSCRINIUM EISENACKI
* GONYAULACYSTA CLADOPHORA/FILAPICATA (4810' only)
* LEPTODINIUM SUBTILE PECTINIGERUM (4320' only)

* MEIOUROGONYAULAX spp
* NANNOCERATOPSIS PELLUCIDUS (4810' only).
* PAREODINIA sp. Gocht 1970 (4770' only).
* aff SCRINIOCASSIS WEBERI (4770' only).
* VALENSIELLA VERMICULATA group.

From the accompanying table it is evident that the greatest range overlap is in the Bathonian (? early)

Diagnostic spp.	C. dampieri etc.	C. problematicus	*Chytroeisphaeridia spp	Crendodinium spp	Endoscr. eisenacki	Gony. cladophora/filabic.	*L. subtile-pectinigerum	*Meiourogonyaulax spp.	*N. pellucidus	Parodinia sp. Gocht.	*Scriniocassis spp.	Valensiella spp.	*Leptodin. regale	*Pareodinia sp 2	*P. ceratophora	*P. prolongata
J/C																
Call																
Bath																
Baj																
To																

and this is consistent with the relative abundances also.

The Sample from 4710' yielded a similar, if somewhat impoverished assemblage which included:

BACULATISPORITES/OSMUNDACIDITES complex
C. DAMPIERI plexus
C. MESOZOICUS
*? LEPTODINIUM REGALE (fragment)
*L. SUBTILE PECTINIGERUM
*MEIOUROGONYAULAX spp
*PAREODINIA sp 2.
*P. CERATOPHORA
*P./ PROLONGATA
PERINIDINIACEAE

AMOCO NORWAY OIL COMPANY

This sample is considered to be of later Bathonian or early Callovian age (see chart).

The samples from 4460', 4510' & 4610' contained no diagnostic Jurassic morphotypes. The sample from 4360-80', however, included C. DAMPIERI plexus, C. MESOZOICUS, BACULATISPORITES/OSMUNDACIDITES complex and a specimen tentatively assigned to CHYTROEISPHAERIDIA sp B (UBath-L.Call). If this assemblage is in situ, it suggests that the interval 4380'-4810' is of later Middle Jurassic age.

The samples examined from 3200', 3300' & 3400' contained no species indicative of an age older than Senonian.

Palynofacies & Maturation

Spore colouration indices are in the range 6-7 at 4810' equivalent to a maximum palaeotemperature of 250°F ± 25°. This is within the range of medium-light oil production. Above 4770' some more carbonized sporomorphs were noted: this could indicate local metamorphism.

Palynofacies are dominated by humic kerogen: most typical product of which is gas (usually dry).

28.v.75.
M.T. Fisher

7253 36/1-1

13.01 ✠
33100 noped n
33000b amoco n

to: mr.halpin,amerada hess new york
mr.briggs,amerada hess london
mr.lonquist,texas eastern houston
mr.mendes, texas eastern london
mr.myrland, norw.petr. dir.
mr.hamam, statoil
mr.jones, mobil expl. stavanger

no-2343-400(36/1-1)-rh
no-2344-400(36/1-1)-rh
no-2345-400(36/1-1)-rh
no-2346-400(36/1-1)-rh
no-2347-400(36/1-1)-rh
no-2348-400(36/1-1)-rh
no-2349-400(36/1-1)-rh

STAT
DRAT
10043/8/24 JUN75

P
RM

date: june 20, 1975

following are the horizontal air permeability, effective porosity and grain density measurements on sandstone sampless from amoco norway 36/1-1:

gun-sample	depth	permeability	porosity	density
2-20	2160'	0.30	22.5	2.67
2-12	2772'	0,28	28.6	2.60
2-4	3140'	10.9	26.4	2.71
2-3	3208'	16.7	28.4	2.70
2-1	3223'	10.5	30.4	2.67
1-29	3350'	25.4	31.6	2.66
1-28	3358'	7.72	29.9	2.61
1-26	3394'	49.0	29.5	2.62
1-25	3440'	27.1	31.7	2.65
1-23	3490'	60.7	29.3	2.67
1-22	3520'	22.6	27.6	2.64
1-19	3890'	26.4	27.4	2.68
1-16	4040'	5.46	8.6	2.66
1-12	4396'		27.3	2.67
3-64	5138'	(shale no analysis)		
3-65	5128'	11.9	19.3	
3-68	5100'	17	20.4	
3-88	4848'		24.5	

regards
k.d.soule