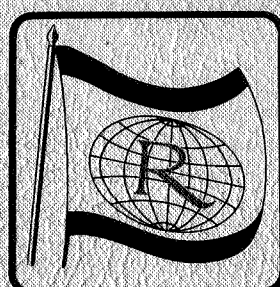


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4.3

Norway II study - preliminary reports
G 24 to G 31.
and preliminary reports B 20 to B 34
(Geostat. breakdown included)



Geochemistry.

Wells: 15/3-1

25/8-1

25/11-5

30/10-5

UK 3/4-1

UK 3/25-1

UK 16/23-1

UK 30/24-4

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NORWAY II STUDY - PRELIMINARY REPORTS G24 TO G31

AND PRELIMINARY REPORTS B20 TO B34

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NORWAY II STUDY - PRELIMINARY REPORTS G24 TO G31

Project No. RRPS/8182/B/2043

PRELIMINARY PETROLEUM GEOCHEMISTRY RESULTS OF

15/3-1, 25/8-2, 25/11-5, 30/10-5, UK 3/4-1,

UK 3/25-1, UK 16/23-1 AND UK 30/24-4 WELLS

JUNE 1981



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ROBERTSON RESEARCH INTERNATIONAL LIMITED

Project No. RRPS/8182/B/2043

NORWAY II STUDY - PRELIMINARY REPORT G24 (9/6/81)

PRELIMINARY PETROLEUM GEOCHEMISTRY RESULTS OF 15/3-1 WELL

SUMMARY

The analysed section, 3810m to 5125m, is middle to late mature for oil generation. Shales between 3935m and 5125m have had good to very good original hydrocarbon generating potential, which has been partly realised between 3935m and 4180m, but is almost fully realised between 4745m and 5125m. Oil stain is recognised at 3990m-4000m and between 4895m and 4990m. The Early Cretaceous interval (3810m to 3930m) contains mainly inertinitic kerogen and has no source potential.

GENERAL COMMENTS

Well status: Plugged and abandoned, oil and gas well (Gudrun field).

Drilling data: Drilled with FCL/sea water to 5129m (T.D.). Casing points at 198m (30"), 612m (20"), 2842m (13 $\frac{3}{8}$ "), 3950m (9 $\frac{5}{8}$ "), 4374m (7"). BHT 200°F at 3957m, 252°F at 4375m, 292°F at 4963m and 302°F at 5129m (T.D.).

Interval analysed: 3810m to 5125m (T.D. 5129m).

Age of analysed interval: Late Jurassic to Early Cretaceous.

Sample type and quality: 55 dried ditch cuttings samples of adequate quality.

Maturation data quality: Poor.

Source rock data quality: Adequate.

Gas chromatography run at: 3810m-3830m, 3835m-3855m, 3990m-4000m, 4055m-4065m, 4200m-4210m, 4745m-4765m, 4795m-4815m, 4845m-4865m, 4895m-4915m, 4945m-4965m, 4970m-4990m, 5020m-5040m, 5070m-5095m.

MATURATION (Table 1; Figures 1 and 2)

The analysed interval, 3810m to 5125m, is middle to late mature for oil generation. The spore colour indices increase from 3.5 in the Early Cretaceous to about 8 near T.D. in the Late Jurassic; vitrinite reflectivities range from 0.54% up to 0.71% in the Late Jurassic. However, both sporomorphs and vitrinite are rare in the analysed section and the interpretation of the data has been more dependent on bottom hole temperature data and pyrolysis temperatures than is usually the case.

SAMPLE DEPTH (METRES)	SAMPLE TYPE	GENERALISED LITHOLOGY	SPORE COLOUR INDEX (1-10)	VITRINITE REFLECTIVITY IN OIL, R _{av} %	KEROGEN COMPOSITION (%) (by microscopic examination)			KEROGEN COMPOSITION (%) (by calculation from pyrolysis data)			
					INERTINITE	VITRINITE	SAPROPEL	INERTINITE	VITRINITE	ALGAL SAPROPEL	WAXY SAPROPEL
3810-830	Ctgs	SH, med-dk gy+ mnr SH, dk gy	3.5	*	30	50	20	95	5	*	*
		After Extraction						95	5	*	*
3835-855	"	SH, med gy+40% SH, med-dk gy+ mnr SH, gy-red						95	5	*	*
		After Extraction						95	5	*	*
3885-905	"	SH, a/a+30% SH, a/a+10% SH, a/a						95	5	*	*
3935-955	"	SH, med-dk gy+ 20% SH, dk gy+ mnr SH, gy-red						20	35	*	45
3960-970	"	SH, med-dk gy						20	30	*	50
3975-985	"	SH, dk gy						25	55	5	15
3990-4000	"	A/a						35	55	5	5
		After Extraction						45	50	*	5
4005-015	"	A/a	3-5	*	30	40	30	20	70	*	10
4025-035	"	A/a						15	70	*	15
4040-050	"	A/a						15	70	5	10
4055-065	"	A/a						15	70	*	15
		After Extraction						40	20	*	40
4070-080	"	A/a						10	65	*	25
4085-105	"	A/a						40	45	*	15
4110-120	"	SH, a/a+50% SND						35	60	*	5
4125-135	"	A/a						40	60	*	*
4140-150	"	A/a						40	60	*	*
4155-165	"	A/a						25	55	5	15
4170-180	"	A/a						20	50	*	30
4185-195	"	A/a						40	60	*	*
4200-210	"	A/a	3-6	0.71(5)	30	40	30	40	60	*	*
		After Extraction						20	80	*	*
4215-225	"	A/a						30	55	5	10
4230-250	"	A/a						30	60	10	*
4255-275	"	A/a						40	55	5	*
4280-300	"	SND+SH, a/a						40	55	5	*
4310-330	"	A/a						30	70	*	*
4335-375	"	SH, gy-blk	24-7	0.54(4); 0.36(6); 0.79(3)	30	mnr	70	30	70	*	*
4380-400	"	SH, a/a+SND						30	70	*	*
4405-425	"	A/a						30	65	5	*
4435-455	"	A/a						25	65	10	*
4460-480	"	A/a						20	60	15	5

TABLE 1A Maturity and Kerogen Data

WELL: 15/3-1

SAMPLE DEPTH (METRES)	SAMPLE TYPE	GENERALISED LITHOLOGY	SPORE COLOUR INDEX (1 - 10)	VITRINITE REFLECTIVITY IN OIL, R av%	KEROGEN COMPOSITION (%) (by microscopic examination)			KEROGEN COMPOSITION (%) (by calculation from pyrolysis data)			
					INERTINITE	VITRINITE	SAPROPEL	INERTINITE	VITRINITE	ALGAL SAPROPEL	WAXY SAPROPEL
4490-520	Ctgs	SH, gy-blk+SND						30	70	*	*
4535-545	"	A/a						30	70	*	*
4575-590	"	A/a						30	65	5	*
4600-625	"	A/a	?7	*	20	50	30	30	70	*	*
4630-645	"	SH, a/a						50	50	*	*
4665-685	"	SH, a/a+SND						45	45	5	5
4690-715	"	A/a						50	50	*	*
4720-740	"	SH, a/a						50	50	*	*
4770-790	"	A/a	6-9	1.13(3)	A M O R P H O U S						
4970-990	"	A/a	6-9	1.16(4)	A M O R P H O U S						
5100-125	"	A/a	?8	*	A M O R P H O U S						

NOTE: CALCULATIONS OF KEROGEN COMPOSITION (%) FROM PYROLYSIS DATA NOT POSSIBLE WHERE THERMAL MATURITY IS HIGH.

TABLE 1 B Maturity and Kerogen Data

GENERAL DATA			CHEMICAL ANALYSIS DATA											
SAMPLE DEPTH (METRES)	SAMPLE TYPE	ANALYSED LITHOLOGY	ORGANIC CARBON % OF ROCK	PYROLYSIS					SOLVENT EXTRACTION					
				TEMP - °C ERATURE	HYDROGEN INDEX	OXYGEN INDEX	PRODUCTION INDEX	POTENTIAL YIELD (ppm)	TOTAL EXTRACT (ppm)	HYDRO-CARBONS (ppm)	EXTRACT % OF ORGANIC CARBON	HYDROCARBONS		
												mg/g OF ORGANIC CARBON	% OF EXTRACT	ALKANES % OF HYDRO-CARBONS
3810-830	Ctgs	SH, med-dk gy+mnr SH, dk gy	1.00	*	32	180	0.3	300						
		After Extraction	1.10	*	26	101	0.2	300						
3835-855	"	SH, med gy+40% SH, med-dk gy+mnr SH, gy-red	1.50	440	23	135	0.1	400						
		After Extraction	1.49	440	20	71	0.1	300						
3860-880	"	SH, a/a+40% SH, a/a+10% SH, a/a	0.69											
3885-905	"	SH, a/a+30% SH, a/a+10% SH, a/a	0.72	442	34	139	0.1	300						
3910-930	"	SH, gn-gy+20% SH, med-dk gy+10% SH, gy-red	0.62											
3935-955	"	SH, med-dk gy+20% SH, dk gy+mnr SH, gy-red	1.85	448	269	75	0.1	5000						
3960-970	"	SH, med-dk gy	3.79	447	291	50	0.2	11000						
3975-985	"	SH, dk gy	4.18	442	183	73	0.3	7600						
3990-4000	"	A/a	7.88	440	144	80	0.5	11400						
		After Extraction	6.46	440	118	61	0.01	7600						
4005-015	"	A/a	4.95	438	164	105	0.6	8100						
4025-035	"	A/a	6.93	441	190	64	0.3	13100						
4040-050	"	A/a	6.79	440	192	39	0.3	13100						
4055-065	"	A/a	8.03	440	208	30	0.3	16700						
		After Extraction	6.44	442	243	17	0.01	15700						
4070-080	"	A/a	5.98	441	228	43	0.1	13600						
4085-105	"	A/a	4.08	444	137	82	0.3	5600						
4110-120	"	SH, a/a+50% SND	5.44	443	117	62	0.3	6400						
4125-135	"	A/a	9.89	444	99	71	0.3	9800						
4140-150	"	A/a	8.16	440	100	88	0.2	8200						
4155-165	"	A/a	2.97	442	186	81	0.3	5500						
4170-180	"	A/a	2.26	444	244	82	0.3	5500						
4185-195	"	A/a	3.52	442	100	57	0.3	3500						
4200-210	"	A/a	4.96	440	101	33	0.3	5000						
		After Extraction	4.01	441	96	37	0.03	3900						
4215-225	"	A/a	2.24	440	166	73	0.5	3700						
4230-250	"	A/a	5.25	436	154	40	0.6	8100						
4255-275	"	A/a	3.52	438	82	83	0.3	2900						
4280-300	"	SND+SH, a/a	3.31	436	99	81	0.6	3300						
4310-330	"	A/a	4.94	438	73	67	0.3	3600						
4335-375	"	SH, gy-blk	6.23	440	63	27	0.5	3900						
4380-400	"	SH, a/a+SND	9.07	441	66	61	0.4	6000						
4405-425	"	A/a	7.62	440	106	63	0.3	8100						

TABLE 2A Chemical Analysis Data

GENERAL DATA			CHEMICAL ANALYSIS DATA										
SAMPLE DEPTH (METRES)	SAMPLE TYPE	ANALYSED LITHOLOGY	ORGANIC CARBON % OF ROCK	PYROLYSIS					SOLVENT EXTRACTION				
				TEMP - ERATURE °C	HYDROGEN INDEX	OXYGEN INDEX	PRODUCTION INDEX	POTENTIAL YIELD (ppm)	TOTAL EXTRACT (ppm)	HYDRO - CARBONS (ppm)	EXTRACT % OF ORGANIC CARBON	HYDROCARBONS	
												mg/g of ORGANIC CARBON	% OF EXTRACT
4435-455	Ctgs	SH, gy-blk+SND	3.28	436	159	81	0.4	5200					
4460-480	"	A/a	6.12	437	199	64	0.4	12200					
4490-520	"	A/a	9.09	436	89	97	0.7	8100					
4535-545	"	A/a	2.38	435	85	63	0.4	2000					
4575-590	"	A/a	1.84	434	114	59	0.6	2100					
4600-625	"	A/a	7.14	442	60	48	0.3	4300					
4630-645	"	SH, a/a	6.76	443	44	49	0.4	2900					
4665-685	"	SH, a/a+SND	9.20	440	124	75	0.5	11400					
4960-715	"	A/a	8.76	438	82	64	0.3	7200					
4720-740	"	SH, a/a	9.51	439	55	57	0.4	5300					
4745-765	"	A/a	5.82	446	25	36	0.6	1400					
		After Extraction	5.25	442	26	27	0.1	1300					
4770-790	"	A/a	4.11	*	20	49	0.5	800					
4795-815	"	A/a	4.99	445	14	44	0.4	700					
		After Extraction	4.94	446	19	49	0.1	900					
4820-840	"	A/a	3.39	445	29	44	0.6	1000					
4845-865	"	A/a	3.49	*	7	43	0.6	300					
		After Extraction	3.48	*	11	41	0.2	400					
4870-890	"	A/a	2.88	446	27	57	0.7	800					
4895-915	"	A/a	2.39	*	16	60	0.6	400					
		After Extraction	2.38	444	12	51	0.2	300					
4920-940	"	A/a	3.79	*	12	38	0.7	500					
4945-965	"	A/a	4.52	433	207	46	0.3	9400					
		After Extraction	3.77	439	36	47	0.1	1400					
4970-990	"	A/a	5.87	432	209	39	0.2	12200					
		After Extraction	4.89	440	101	35	0.03	5000					
4995-5015	"	A/a	5.62	468	98	39	0.4	5500					
5020-040	"	A/a	14.86	454	59	30	0.3	8800					
		After Extraction	14.21	458	50	35	0.04	7100					
5045-065	"	A/a	12.54	*	44	37	0.3	5500					
5070-095	"	A/a	8.16	475	29	32	0.5	2300					
		After Extraction	7.73	*	29	30	0.1	2300					
5100-125	"	A/a	6.36	*	33	33	0.6	2100					

TABLE 2B Chemical Analysis Data

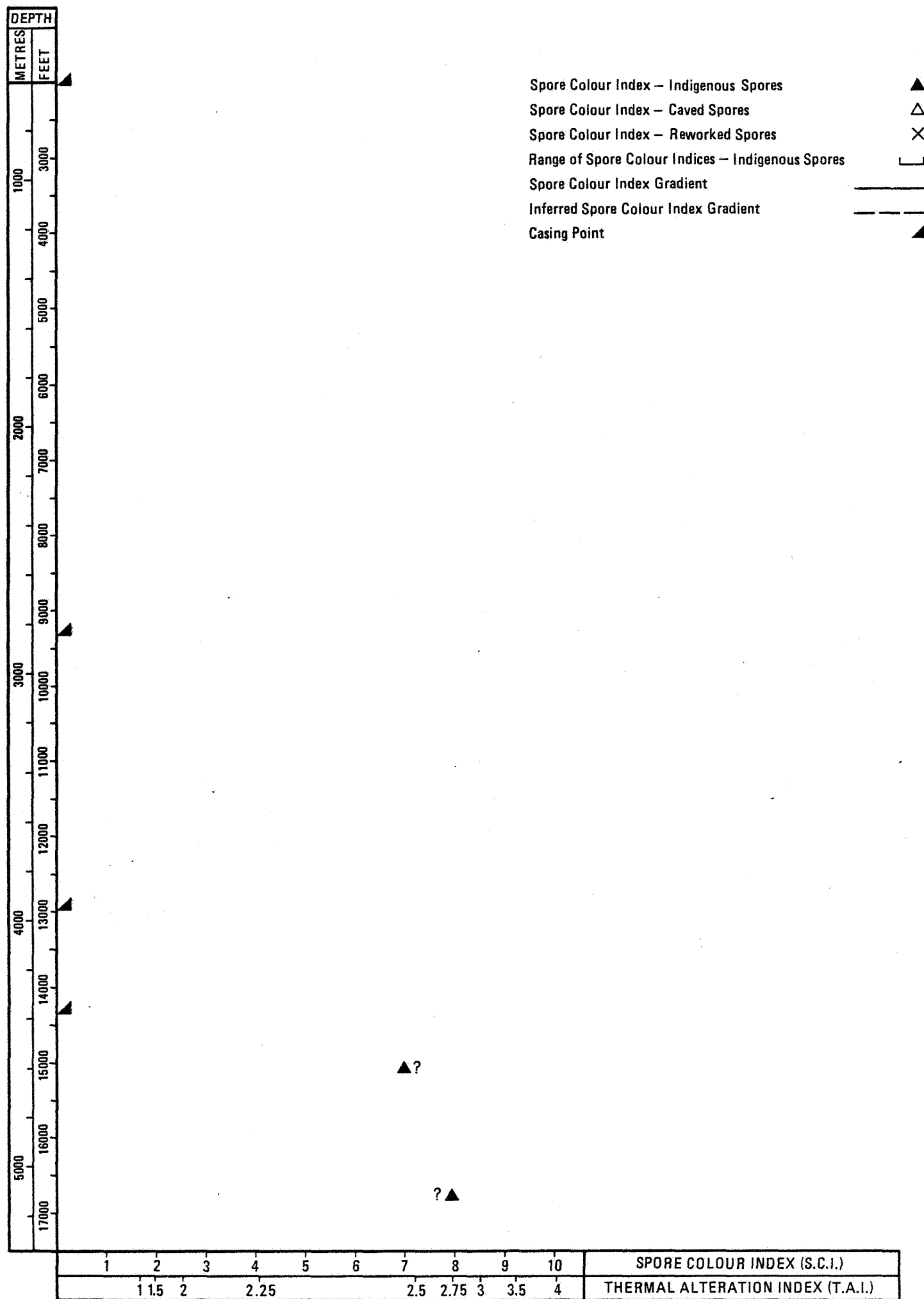


FIGURE 1 Spore Colour Indices against Depth

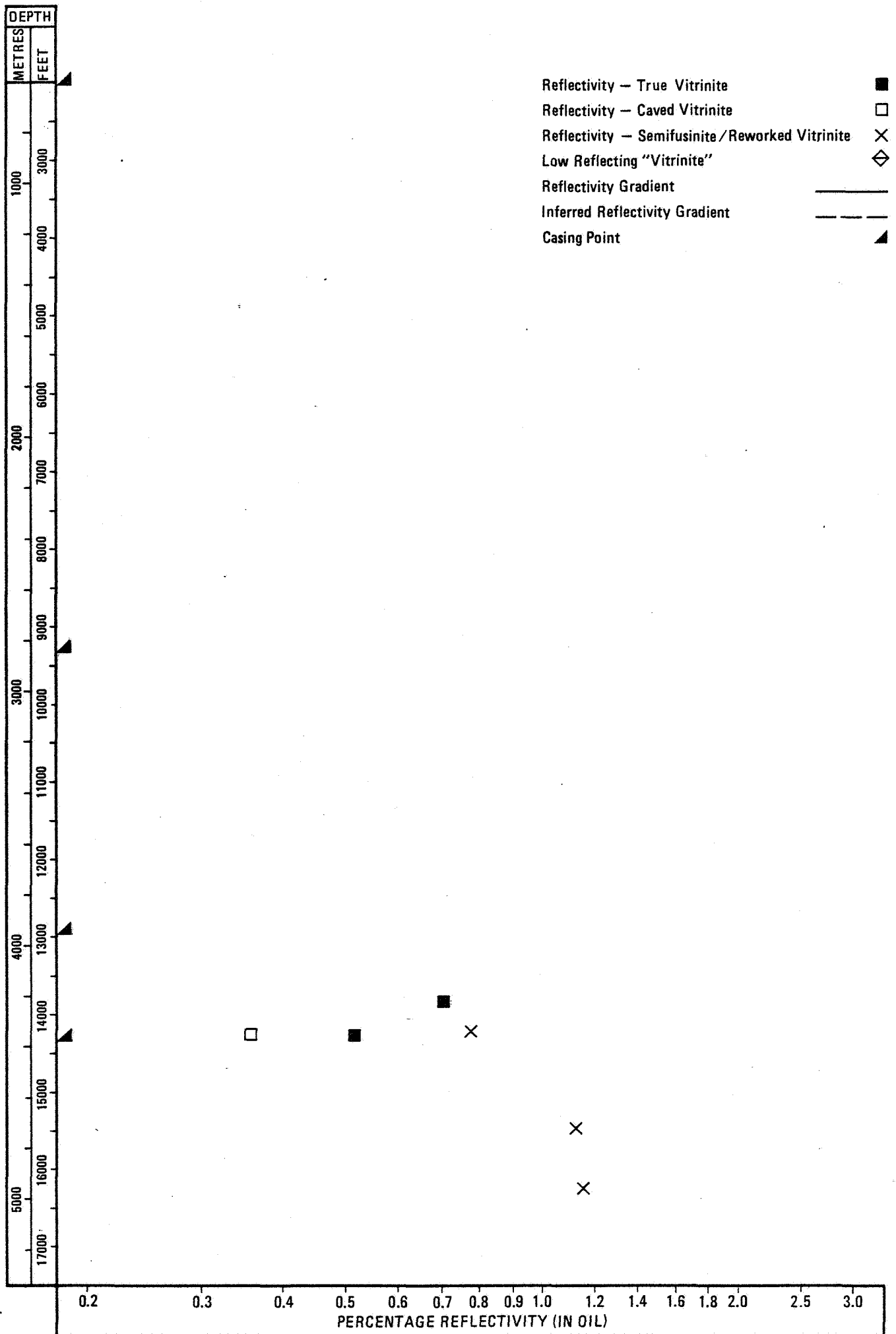


FIGURE 2 Vitrinite Reflectivity against Depth

ROBERTSON RESEARCH INTERNATIONAL LIMITED

Project No. RRPS/8182/B/2043

NORWAY II STUDY - PRELIMINARY REPORT G25 (9/6/81)

PRELIMINARY PETROLEUM GEOCHEMISTRY RESULTS OF 25/8-2 WELL

SUMMARY

The interval 7500' to 8450' is early mature. Some dark grey shales, probably derived from the interval between 7504' and 7878', have good to very good oil generating potential and would generate fair quantities of oil at an elevated level of thermal maturity. The remaining intervals are without source potential because of insufficient or unsuitable kerogens.

GENERAL COMMENTS

Well status: Plugged and abandoned, dry hole.

Drilling data: Drilled with sea water gel and sea water gel/
lignosulphonate based muds to 8458' (T.D.). Casing
points at 615' (30"), 1295' (20"), 4126' (13 $\frac{3}{8}$ "). BHT
95°F at 4160' and 178°F at 8458' (T.D.).

Interval analysed: 7500' to 8450' (T.D. 8458').

Age of analysed interval: Triassic to Jurassic.

Sample type and quality: 14 composited dried ditch cuttings samples of
poor to fair quality.

Maturation data quality: Fair.

Source rock data quality: Fair.

Gas chromatography run at: 7510'-7570', 7570'-7630', 7630'-7690'

MATURATION (Table 1; Figures 1 and 2)

Spore colour indices range from 3.5 to 4.5 and indigenous vitrinite reflectivities range from 0.41% to 0.48% within the interval 7500' to 8400', indicating a state of early thermal maturity. Any oil-prone kerogen within the analysed interval may have already commenced oil generation, but not to any significant degree.

OIL SOURCE ROCKS (Tables 1 and 2)

Dark grey shales from sample intervals 7510' to 7640' and 8060' to 8180' contain secondary quantities of waxy sapropel and show high to very high (7900 ppm to 28700ppm) pyrolysis potential yields. These shales are probably derived from the interval 7504' to 7878' which includes some shales with a high or relatively high gamma ray log response (7504' to 7536' and 7803' to 7865'). At

an elevated level of thermal maturity the interval 7504' to 7878' could generate fair quantities of oil.

Solvent extraction and gas chromatography reveal indigenous hydrocarbons between 7510' and 7690' with alkane distributions generally characteristic of land derived 'waxy' sapropelic organic matter.

GEOCHEMICAL CHARACTERISTICS OF THE REMAINING SEDIMENTS

Shales and sandstones from the intervals 8200' to 8450' and 7640' to 8060' lack significant source potential because of insufficient or unsuitable kerogens, although the coaly horizons may generate minor amounts of gas at much elevated levels of maturity.

SAMPLE DEPTH (FEET)	SAMPLE TYPE	GENERALISED LITHOLOGY	SPORE COLOUR INDEX (1-10)	VITRINITE REFLECTIVITY IN OIL, R _{av} %	KEROGEN COMPOSITION (%) (by microscopic examination)			KEROGEN COMPOSITION (%) (by calculation from pyrolysis data)			
					INERTINITE	VITRINITE	SAPROPEL	INERTINITE	VITRINITE	ALGAL SAPROPEL	WAXY SAPROPEL
7500-510	Ctgs	SH, med-dk gy+30% SND+10% SH, gn-gy		0.45(15); 0.57 (2)							
7500-560	"	A/a						70	25	*	5
7510-570	"	SH, ol-gy+30% SH, dk gy+20% SND	3.5		20	20	60	70	20	*	10
	P	SH, dk gy						65	10	*	25
7570-630	Ctgs	SH, ol-gy+20% SH, a/a+30% SND+20% COAL						75	20	*	5
	P	SH, dk gy						75	10	*	15
	P	SH, ol-gy						80	20	*	*
7600-640	Ctgs	SH, med-dk gy+30% SND+20% SH, gn-gy +10% COAL						80	10	*	10
	P	COAL		0.45(23)							
7630-690	Ctgs	SH, ol-gy+30% SH, dk gy+10% SND+10% COAL						70	30	*	*
7670-730	"	SH, gn-gy+20% SND+ 10% SST, v lt gy+ tr COAL						65	35	*	*
7750-820	"	SH, a/a+mnr SND/ SST						80	20	*	*
7810-820	"	A/a		0.41 (9)							
7810-870	"	SH, ol-gy+20% SH, a/a+10% SH, dk gy	3.5-4		20	40	40				
	P	SH, dk gy						65	25	*	10
7840-920	Ctgs	SH, gn-gy+20% SH, a/a+20% SND						85	15	*	*
7960-8010	"	SH, a/a+30% SH, a/a+30% SND						65	35	*	*
8030-090	"	SND, crs+30% SH, dk gy+COAL						80	20	*	*
	P	COAL		0.56(22)							
8060-120	P	SH, gy-blk						70	*	*	30
8120-160	Ctgs	SND, a/a+30% SH, dk gy+COAL		0.45(22)				70	30	*	*
	P	COAL		0.48(18)							
8120-180	Ctgs	SST, wht+20% SST, brn-gy+10% SND+ 30% SH, gy-blk	4		30	70	*				
	P	SH, gy-blk						70	*	*	30
8200-250	Ctgs	SND, crs+20% SH, dk gy+tr COAL						80	20	*	*
8240-300	P	SH, gy-blk						75	10	*	15
8290-360	Ctgs	SST, wht+40% SH, a/a	4.5		40	60	*				
8360-400	"	SND, a/a+30% SH, dk gy						95	5	*	*

TABLE 1 A Maturity and Kerogen Data

GENERAL DATA			CHEMICAL ANALYSIS DATA											
SAMPLE DEPTH (FEET)	SAMPLE TYPE	ANALYSED LITHOLOGY	ORGANIC CARBON % OF ROCK	PYROLYSIS					SOLVENT EXTRACTION					
				TEMP - ERATURE °C	HYDROGEN INDEX	OXYGEN INDEX	PRODUCTION INDEX	POTENTIAL YIELD (ppm)	TOTAL EXTRACT (ppm)	HYDRO- CARBONS (ppm)	EXTRACT % OF ORGANIC CARBON	HYDROCARBONS		
												mg/g OF ORGANIC CARBON	% OF EXTRACT	ALKANES % OF HYDRO- CARBONS
7500-560	Ctgs	SH, med-dk gy+30% SND+10% SH, gn-gy	1.90	430	93	14	0.04	1800						
7510-570	"	SH, ol-gy+30% SH, dk gy+20% SND	1.67	440	67	13	0.05	1100	630	205	3.8	12	33	47
	P	SH, dk gy	4.60	435	173	18	0.02	7900						
7570-630	Ctgs	SH, ol-gy+20% SH, a/a+30% SND/ SST+20% COAL	7.54	434	142	13	0.03	10700	4030	1150	5.3	15	28	28
	P	SH, dk gy	2.78	434	123	13	0.03	3400						
	P	SH, ol-gy	1.21	435	38	36	0.1	500						
7600-640	Ctgs	SH, med-dk gy+30% SND+20% SH, gn-gy+10% COAL	5.78	432	100	10	0.07	5800						
7630-690	"	SH, ol-gy+30% SH, dk gy+10% SND/SST+10% COAL	2.46	452	54	30	0.1	1300	795	260	3.2	11	33	38
	P	SH, dk gy	0.72											
7670-730	Ctgs	SH, gn-gy+20% SND+10% SST, v lt gy+tr COAL	1.14	436	73	66	0.1	800						
7690-750	"	SH, a/a+25% SH, ol-gy+10% SH, dk gy+30% SST, wht+10% SND	0.73											
7750-810	"	SH, a/a+40% SH, a/a+mnr SH, a/a+mnr SST/SND, a/a	0.63											
7750-820	"	SH, gn-gy+mnr SND+mnr SST, v lt gy	0.95	436	43	65	0.2	400						
7810-870	"	SH, ol-gy+20% SH, a/a+10% SH, dk gy+mnr SND/SST	0.58											
	P	SH, dk gy	1.78	440	92	17	0.03	1600						
	P	SH, ol-gy	0.78											
7840-920	Ctgs	SH, gn-gy+20% SH, dk gy+20% SND	0.99	437	33	28	0.1	300						
7890-940	"	SH, ol-gy+10% SH, a/a+30% SH, a/a+mnr SST/SND, wht	0.58											
7940-8000	"	SH, a/a+tr SH, a/a+30% SH, a/a +30% SST/SND	-											
7960-8010	"	SH, gn-gy+30% SH, dk gy+30% SND	3.00	439	47	17	0.1	1400						
8000-060	"	SND+10% SH, gy-blk+10% SH, dk gy+30% SH, ol-gy+20% SST, wht	-											
8030-090	"	SND, crs+30% SH, dk gy+COAL	3.13	436	39	14	0.1	1200						
8060-120	"	SND+20% SH, gy-blk+10% SH, a/a +20% SH, ol-gy+20% SST, a/a	-											
	P	SH, gy-blk	16.63	440	173	13	0.04	28700						
8120-160	Ctgs	SND, a/a+30% SH, dk gy+COAL	3.78	434	58	15	0.1	2200						
8120-180	"	SST, wht+20% SST, brn-gy+10% SND+30% SH, gy-blk+tr SH, ol-gy/gn-gy	-											
	P	SH, gy-blk	12.52	440	170	12	0.04	21300						
8200-250	Ctgs	SND, crs+20% SH, dk gy+tr COAL	1.16	435	42	34	0.2	500						

TABLE 2 A Chemical Analysis Data

GENERAL DATA			CHEMICAL ANALYSIS DATA											
SAMPLE DEPTH (FEET)	SAMPLE TYPE	ANALYSED LITHOLOGY	ORGANIC CARBON % OF ROCK	PYROLYSIS					SOLVENT EXTRACTION					
				TEMP - ERATURE °C	HYDROGEN INDEX	OXYGEN INDEX	PRODUCTION INDEX	POTENTIAL YIELD (ppm)	TOTAL EXTRACT (ppm)	HYDRO-CARBONS (ppm)	EXTRACT % OF ORGANIC CARBON	HYDROCARBONS		ALKANES % OF HYDRO-CARBONS
												mg/g OF ORGANIC CARBON	% OF EXTRACT	
8240-300	Ctgs	SST, wht+30% SH, gy-blk+20% SH, dk gy+tr SH, gn-gy+tr COAL	-											
	P	SH, gy-blk	4.55	445	89	13	0.04	4100						
8270-330	Ctgs	SND, a/a+40% SH, dk gy	0.62											
8290-360	"	SST, a/a+40% SH, gy-blk+mnr SH, dk gy+tr SH, gn-gy	-											
8360-400	"	SND, a/a+30% SH, dk gy	0.84	436	16	19	0.2	100						
8440-450	"	SND, a/a+50% SH, a/a	1.21	*	9	38	0.4	100						

TABLE 2 B Chemical Analysis Data

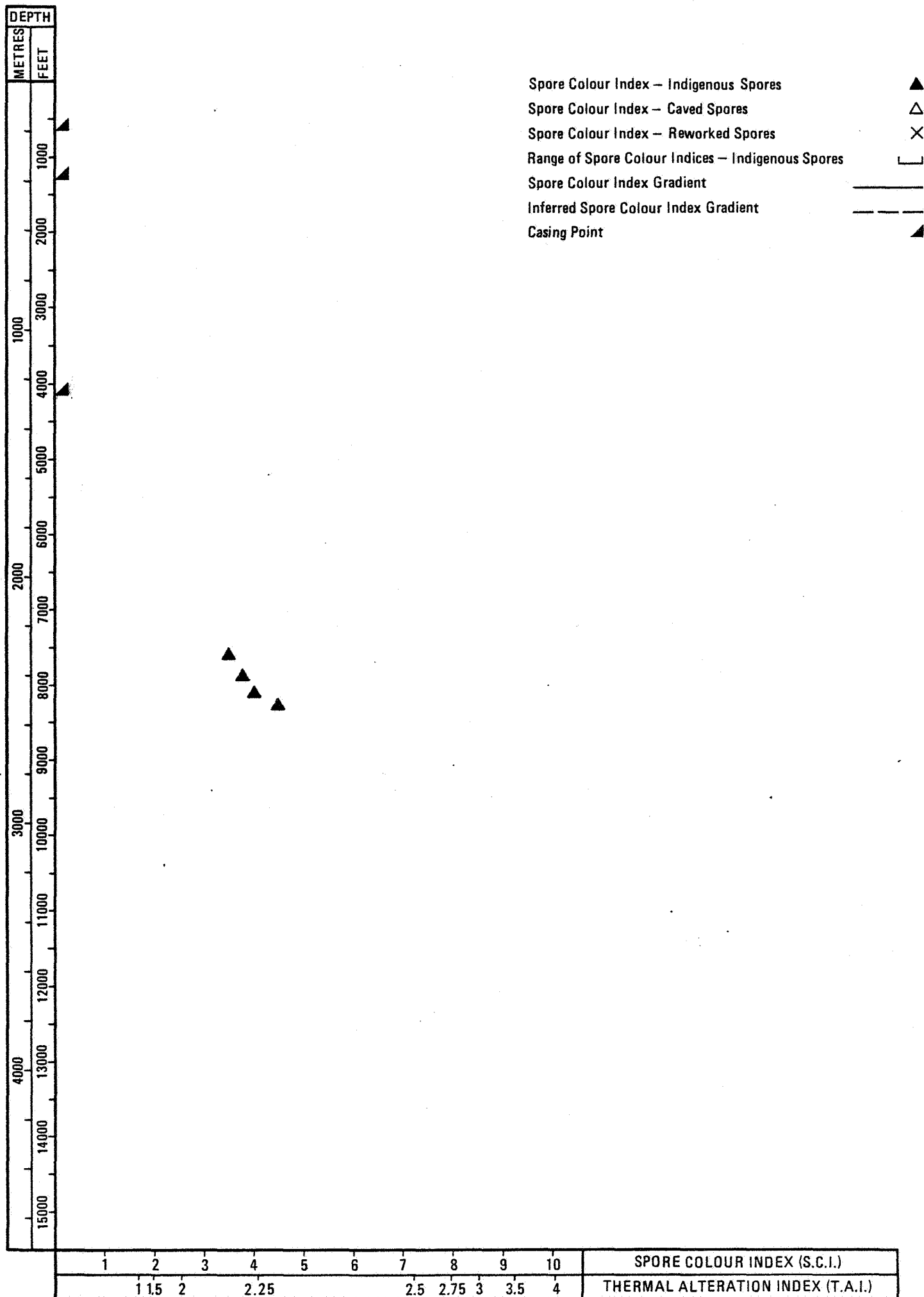


FIGURE 1 Spore Colour Indices against Depth

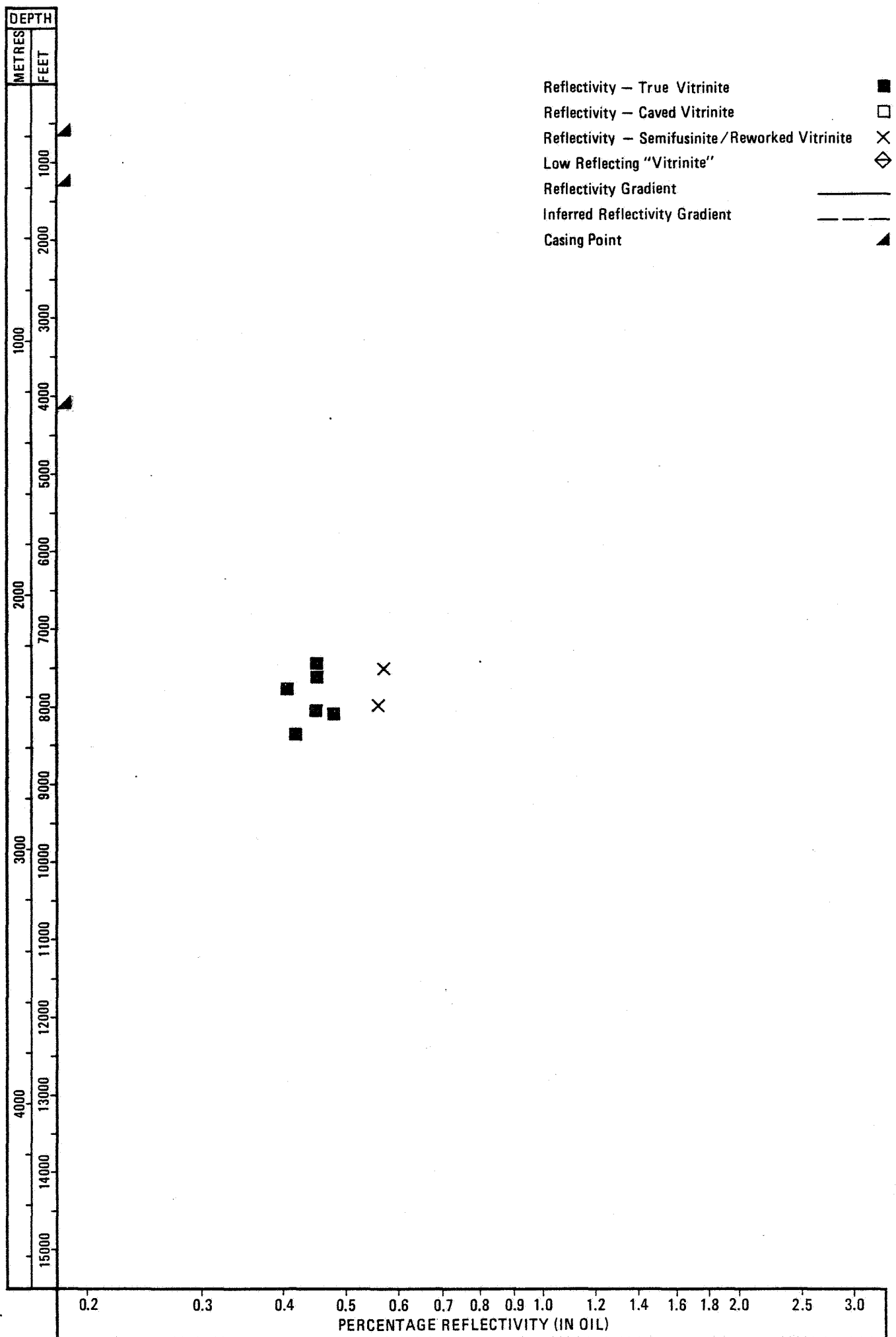


FIGURE 2 Vitrinite Reflectivity against Depth

ROBERTSON RESEARCH INTERNATIONAL LIMITED

Project No. RRPS/8182/B/2043

NORWAY II STUDY - PRELIMINARY REPORT G26 (9/6/81)

PRELIMINARY PETROLEUM GEOCHEMISTRY RESULTS OF 25/11-5 WELL

SUMMARY

Dark grey shales attributed to the interval with a high gamma ray log response between 6402' and 6415' could generate fair quantities of oil and gas when mature. No other source rocks have been identified in the analysed interval, which is mostly immature. Minor migrated oil is noted at 6500'-6600' and 6800'-6900'. Mixed biodegraded oil and light oil is noted between 5590' and 5650'.

GENERAL COMMENTS

Well status: Plugged and abandoned, oil well.

Drilling data: Drilled with sea water and drispac based mud to 7100' (T.D.) Casing points at 613' (30"), 1301' (13 $\frac{3}{8}$ "), 4582' (9 $\frac{5}{8}$ "), 6202' (7"). BHT 162°F at 5820'.

Interval analysed: 5590' to 7000' (T.D. 7100').

Age of analysed interval: Triassic to Tertiary.

Sample type and quality: 10 composite ditch cuttings samples of fair quality.

Maturation data quality: Fair.

Source rock data quality: Fair.

Gas chromatography run at: 5590'-5650', 6500'-6600', 6800'-6900'.

MATURATION (Table 1; Figures 1 and 2)

The spore colour indices increase from 2.5 to 3-3.5 and the vitrinite reflectivities increase from 0.42% to 0.49% over the analysed interval. These data indicate that the section is mostly immature.

OIL SOURCE ROCKS (Tables 1 and 2)

Picked dark grey shale lithologies from the interval between 6430' and 6900' are organically rich and show high to very high pyrolysis potential yields. These samples are attributed to the shale interval between 6402' and 6415' which has a high gamma ray log response. These shales are generally oil prone, containing sub-dominant quantities of rather oxygen poor waxy sapropel, but some (e.g. at 6800'-6900') are entirely humic. At optimum maturity the interval between 6402' and 6415' could generate fair quantities of oil and

minor gas.

Gas chromatography analysis of the hydrocarbons extracted from samples at 6500'-6600' and 6800'-6900', reveals mature alkane distributions resembling light oils. These hydrocarbons have migrated into the section, but could possibly have been sourced from a mature equivalent of the interval between 6402' and 6415'.

GEOCHEMICAL CHARACTERISTICS OF THE REMAINING SEDIMENTS

None of the remaining sediments analysed has any significant source potential. The shales from between 6240' and 6402' contain insufficient organic matter to source significant quantities of hydrocarbons, and the sediments below 6415' contain either inertinitic or insufficient organic matter.

An alkane distribution resembling a mixture of a biodegraded ('dead') oil and a light oil is noted in the oil show on the mud log from the Tertiary sand interval 5590' to 5650'.

SAMPLE DEPTH (FEET)	SAMPLE TYPE	GENERALISED LITHOLOGY	SPORE COLOUR INDEX (1-10)	VITRINITE REFLECTIVITY IN OIL, R _{av} %	KEROGEN COMPOSITION (%) (by microscopic examination)			KEROGEN COMPOSITION (%) (by calculation from pyrolysis data)			
					INERTINITE	VITRINITE	SAPROPEL	INERTINITE	VITRINITE	ALGAL SAPROPEL	WAXY SAPROPEL
6240-300	Ctgs	SH, ol-gy+30% SH gy-red+mnr CHK	2.5	0.45(2); 0.32(3)	30	60	10				
6360-430	"	SH, a/a+30% SH, a/a+10% CHK	2.5-3	0.44(5)	20	40	40				
	P	SH, ol-gy						85	15	*	*
6430-500	Ctgs	SH, a/a+10% SH, gy-red+SH, dk gy +mnr CHK						45	55	*	*
	P	SH, ol-gy						40	30	5	25
	P	SH, dk gy						60	35	mnr	mnr
6500-600	Ctgs	SH, a/a, mic+10% SH, med gy+30% LST, wht+mnr SH, dk gn-gy, mic+ mnr SH, gy-red						75	20	mnr	mnr
	P	SH, dk gy, mic						25	35	*	40
6600-700	Ctgs	SH, gy-brn+10% SH, gy-blk+20% SH, dk gn-gy+10% SH, med-lt gy+ 20% LST, a/a	3	0.46(15)	20	40	40	75	25	*	*
6700-800	"	SH, lt ol-gy+10% SH, gy-blk+20% SH, pale brn+20% LST, a/a+20% SND						75	20	mnr	mnr
	P	SH, gy-blk						60	20	5	15
6800-900	Ctgs	SND+20% SH, a/a +10% SH, gy-blk+ 10% SH, pale brn+ 20% LST, a/a	3-3.5	0.46(14)	20	40	40	80	20	*	*
	P	SH, gy-blk		0.42(16); 0.61(13)				80	20	*	*
6900-7000	Ctgs	SND+30% SH, lt ol -gy+10% SH, gy- blk+10% SH, pale brn+20% LST, a/a	3	0.49(7)	20	40	40	85	15	*	*

TABLE 1 Maturity and Kerogen Data

GENERAL DATA			CHEMICAL ANALYSIS DATA											
SAMPLE DEPTH (FEET)	SAMPLE TYPE	ANALYSED LITHOLOGY	ORGANIC CARBON % OF ROCK	PYROLYSIS					SOLVENT EXTRACTION					
				TEMP ERATURE °C	HYDROGEN INDEX	OXYGEN INDEX	PRODUCTION INDEX	POTENTIAL YIELD (ppm)	TOTAL EXTRACT (ppm)	HYDRO-CARBONS (ppm)	EXTRACT % OF ORGANIC CARBON	HYDROCARBONS		ALKANES % OF HYDRO-CARBONS
												mg/gf ORGANIC CARBON	% OF EXTRACT	
6240-300	Ctgs	SH, ol-gy+30% SH, gy-red+mnr CHK	0.34											
	P	SH, ol-gy	0.52											
	P	SH, gy-red	0.26											
6300-360	Ctgs	SH, ol-gy+30% SH, gy-red+20% CHK	0.22											
	P	SH, ol-gy	0.44											
6360-430	Ctgs	SH, a/a+30% SH, gy-red+10% CHK	0.52											
	P	SH, ol-gy	0.85	430	27	26	0.1	200						
6430-500	Ctgs	SH, a/a+10% SH, gy-red+tr SH, dk gy+mnr CHK	1.60	*	62	28	0.1	1000						
	P	SH, ol-gy	6.98	428	311	19	0.03	21700						
	P	SH, dk gy	3.50	428	109	18	0.04	3800						
6500-600	Ctgs	SH, a/a, mic+10% SH, med gy +30% LST, wht+mnr SH, dk gn-gy, mic+mnr SH, gy-red	0.97	431	41	104	0.03	400	655	185	6.8	19	28	72
	P	SH, dk gy, mic	6.62	437	367	21	0.02	24300						
	P	SH, med gy, mic	0.43											
6600-700	Ctgs	SH, gy-brn+10% SH, gy-blk +20% SH, dk gn-gy+10% SH, med-lt gy+20% LST, a/a	0.78	433	34	145	0.03	300						
6700-800	"	SH, lt ol-gy+10% SH, gy-blk +20% SH, pale brn+20% LST, a/a+20% SND	0.74	439	34	71	0.02	300						
	P	SH, gy-blk	10.28	426	183	57	0.05	18800						
	P	SH, lt ol-gy	0.57											
6800-900	Ctgs	SND+20% SH, a/a+10% SH, gy-blk+10% SH, pale brn+20% LST, a/a	1.78	436	35	37	0.02	600	225	120	1.3	7	53	68
	P	SH, gy-blk	31.43	427	36	25	0.1	11300						
6900-7000	Ctgs	SND+30% SH,lt ol-gy+10% SH, gy-blk+10% SH, pale brn+20% LST, a/a	0.44	439	30	75	0.04	100						

TABLE 2 Chemical Analysis Data

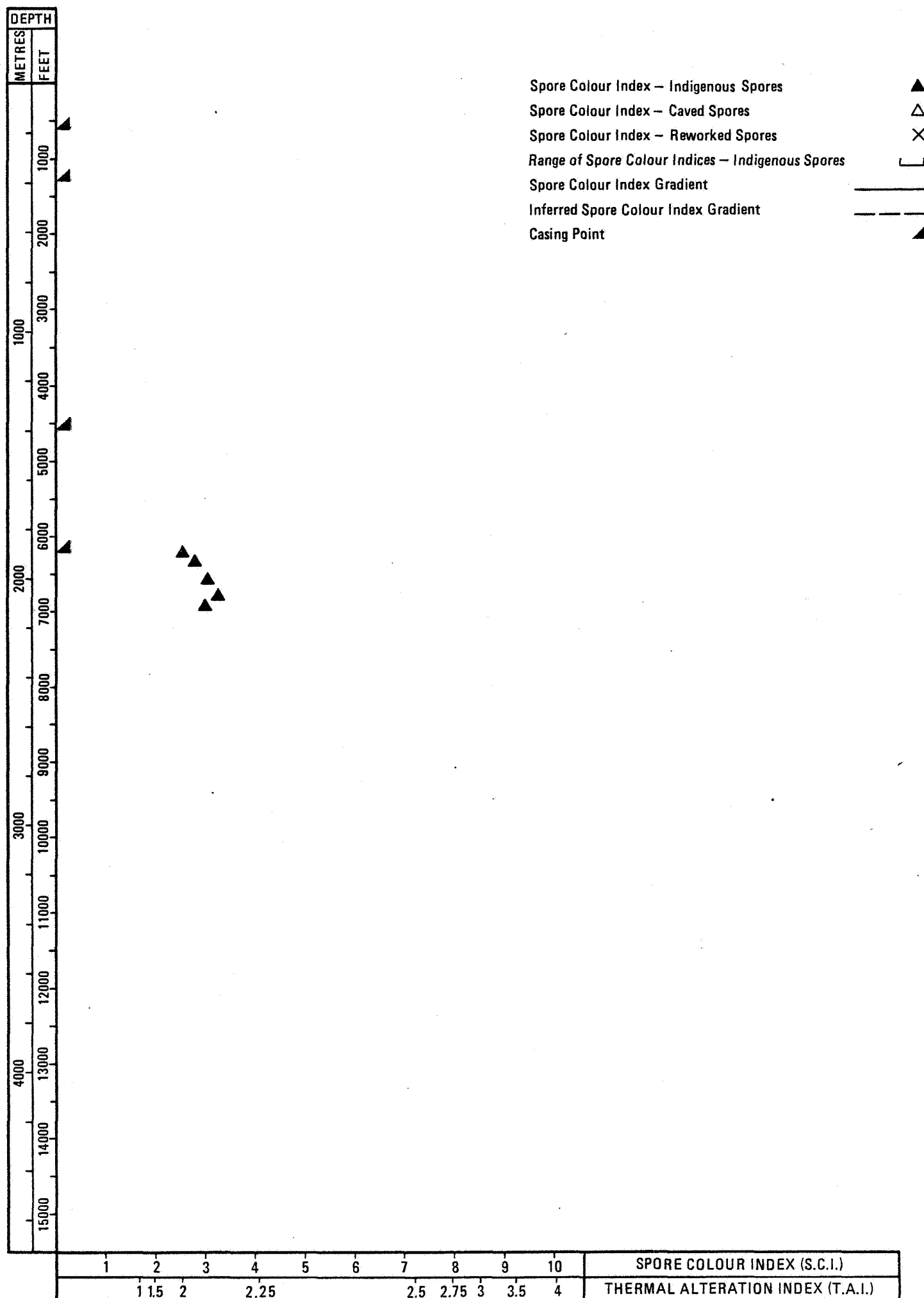


FIGURE 1 Spore Colour Indices against Depth

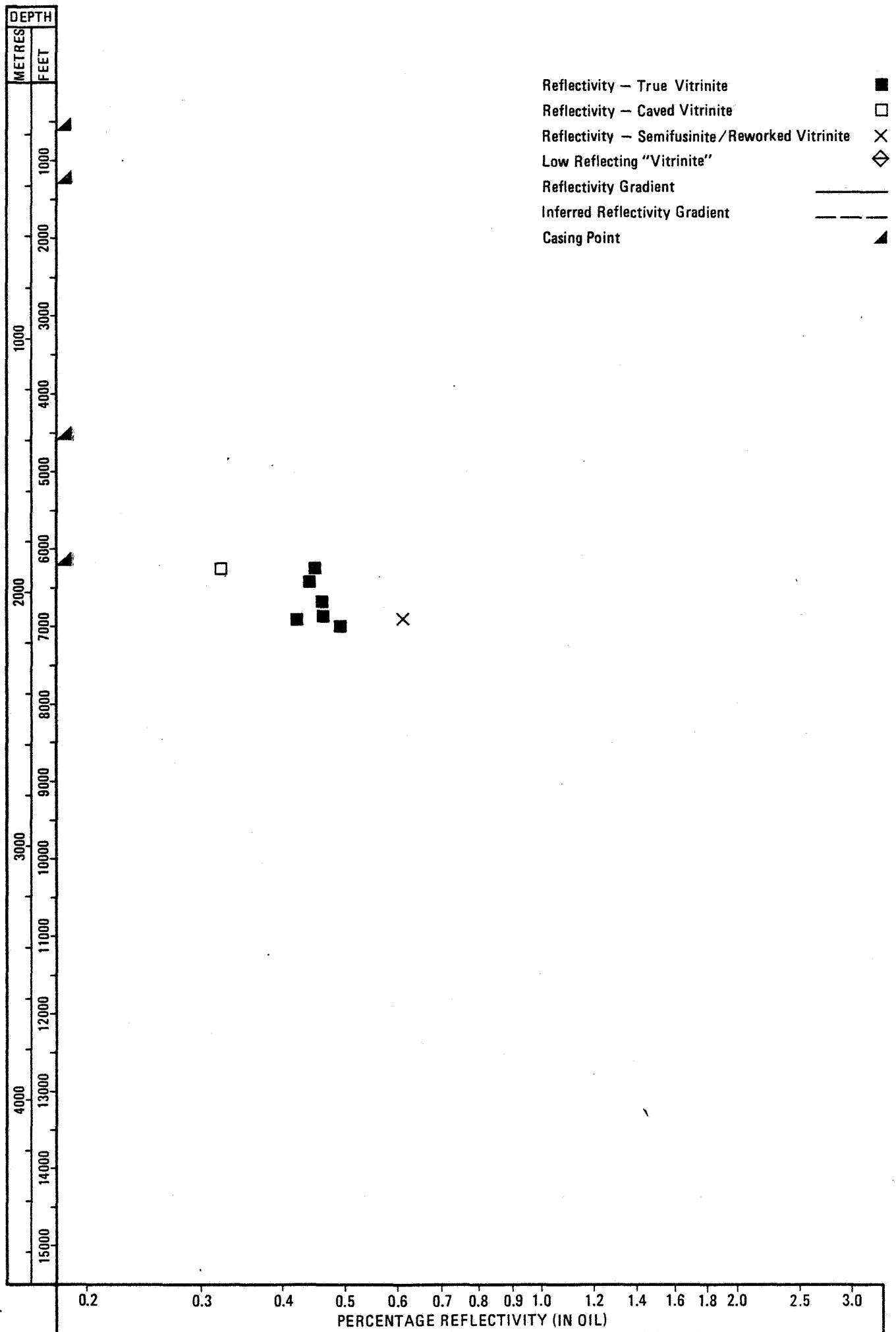


FIGURE 2 Vitrinite Reflectivity against Depth

ROBERTSON RESEARCH INTERNATIONAL LIMITED

Project No. RRPS/8182/B/2043

NORWAY II STUDY - PRELIMINARY REPORT G27 (9/6/81)

PRELIMINARY PETROLEUM GEOCHEMISTRY RESULTS OF 30/10-5 WELL

SUMMARY

The analysed section is immature down to about 3000m, early mature to 3700m, middle mature between 3700m and 3900m, late mature between 3900m and 4400m and post-mature from 4400m to 5185m (T.D.). Up to 1000m of Tertiary section may be missing by erosion. None of the analysed section has any significant oil generating potential. However, biodegraded oil stain, representing an early phase of oil generation and accumulation, is noted mainly between 4690m and 5185m (T.D.), but also to a lesser extent between 3975m and 4506m. Coals in the interval 4630m to 5185m (T.D.) are at a sufficient level of maturity to have generated fair quantities of gas and still have fair to good gas potential remaining.

GENERAL COMMENTS

Well status: Gas well (Odin field).

Drilling data: Drilled with FCL-LC and lignosulphonate based muds to 5185m (T.D.). Casing points at 162m (30"), 730m (20"), 2697m (13 $\frac{3}{8}$ "), 3779m (9 $\frac{5}{8}$ "), 4498m (7"). BHT 196°F at 3800m, 260°F at 4500m and 326°F at 5185m (T.D.).

Interval analysed: 800m to 5185m (T.D.).

Age of analysed interval: Triassic to Tertiary.

Sample type and quality: Composite dried ditch cuttings samples of generally fair to good quality.

Maturation data quality: Good.

Source rock data quality: Good.

Gas chromatography run at: 3975m-3995m, 4095m-4116m, 4216m-4236m, 4484m-4506m, 4690m-4710m, 4920m-4940m, 4950m-4970m, 4980m-5000m, 5010m-5030m, 5040m-5060m, 5065m-5085m, 5165m-5185m.

MATURATION (Table 1; Figures 1 and 2)

Over the interval 800m to 5185m (T.D.), the spore colour indices increase with depth from 2 to 9-10 and the vitrinite reflectivities from 0.3% to 2.1%. These data are in reasonable accord and indicate a transition to early thermal maturity at about 3000m. The interval 3000m to 3700m is early mature, that between 3700m and 3900m is middle mature, and the interval 3900m to 4400m is

late mature for oil generation. Gas prone kerogen will be early mature and start to generate gas at about 3700m and major gas generation will occur at and below about 4400m. The interpreted maturity gradients indicate that as much as 1000m of Tertiary section may be missing by erosion.

OIL SOURCE ROCKS (Tables 1 and 2)

No significant oil source rocks have been identified in the analysed section of this well.

GEOCHEMICAL CHARACTERISTICS OF THE SEDIMENTS

Coals between 4630m and 5185m (T.D.) have fair to good gas generating potential, with pyrolysis potential yields of up to 8200 ppm (at 4920m-4940m) and 9100 ppm (at 4980m-5000m). Given their present level of maturity they have already generated fair quantities of gas. Oil-stain is present in several of the sandy Triassic to Late Jurassic intervals between 4690m and 5185m (T.D.) in concentrations of up to 10650 ppm of hydrocarbons (at 4980m-5000m).

Gas chromatography analysis has shown that the alkane distribution of the hydrocarbons in the interval between 4690m and 5185m (T.D.) is mainly an unresolved envelope of branched and cyclic components with maxima in the C₃₀ region, indicating the presence of biodegraded ('dead') oil. A strong humic source component is anticipated in the source rock of these oils and is particularly evident at 4690m-4710m where the alkanes show a very marked triterpane and sterane component. It is noted that the depth of these sediments is incompatible with the presence of meteoric waters and their present day temperature is incompatible with bacterial activity. A trace of a light oil type alkane distribution is also present, superimposed on the bulk of the 'dead' oil, suggesting a later post-alteration phase of oil generation and accumulation.

Late Jurassic to Early Cretaceous shales between 3975m and 4580m contain about average quantities of predominantly humic organic matter, although their low pyrolysis potential yield values may reflect their high maturity as much as their kerogen composition. These shales contain up to 1225 ppm of extractable hydrocarbons (at 4484m to 4506m) most of which may be indigenous. Gas chromatography analysis reveals that the alkane distribution of the hydrocarbons is mainly of a high maturity type, similar to that of a light oil. However, in addition, the sample at 4484m-4506m contains a major component of biodegraded oil while the samples between 3975m and 4236m contain minor components, this oil being similar to that present in the underlying sands.

The interval 800m to 3960m generally has below average organic carbon contents and in the few horizons having average to above average quantities, the organic matter is generally humic. A sapropelic horizon is noted at about 800m in the Tertiary, but this is unlikely to achieve significance without an improbably large increase in level of maturity. Overall, the interval 800m to 3960m has no significant oil generating potential.

SAMPLE DEPTH (METRES)	SAMPLE TYPE	GENERALISED LITHOLOGY	SPORE COLOUR INDEX (1-10)	VITRINITE REFLECTIVITY IN OIL, R _{av} %	KEROGEN COMPOSITION (%) (by microscopic examination)			KEROGEN COMPOSITION (%) (by calculation from pyrolysis data)			
					INERTINITE	VITRINITE	SAPROPEL	INERTINITE	VITRINITE	ALGAL SAPROPEL	WAXY SAPROPEL
800	Ctgs	SLTST, lt gy	2	0.30 (1)	mnr	mnr	95				
1400	"	MDST, ol-gy, slty	2.5	0.40 (7)	20	60	20				
1650	"	A/a	2.5-3		30	70	*				
1900	"	SH, ol-gy, slty	2.5-3	*	30	70	mnr				
2100	"	A/a	2.5-3	*	10	90	mnr				
2280	"	MDST, med gy, slty	2.5	0.41 (4)	40	50	10				
2520	"	SH, med gy	2.5-3	0.44 (2)	60	40	*				
2700	"	SH, dk gy	3	0.47 (5)	60	40	*				
2940	"	SH, med gy	3-4.5	*	80	20	mnr				
3140	"	A/a	3.5-4	0.46 (3)	80	20	*				
3320	"	A/a	4	0.55 (7)	70	30	*				
3480	"	A/a	3.5	0.53 (1)	70	30	*				
3620	"	A/a	24.5-5	0.73 (6)	70	30	*				
3700	"	A/a		0.80 (5)							
3780	"	A/a	24-5	0.75 (5)	70	30	*				
3900	"	SH, a/a+MDST, v calc	*		*	*	*				
3980	"	MDST/LST, v calc		0.72 (1)							
4005	"	SH, med-dk gy+ mnr SH, dk gy	28	*	*	*	*				
4060-090	"	SH, a/a+10%SH, a/a	28	0.85 (5)	AMORPHOUS						
4080	"	SH, med-dk gy		1.12 (7)							
4110	"	SH, a/a+20% SH, dk gy	8.5	*	80	20	*				
4192-212	"	A/a	8-8.5	1.06(12)	90	10	*				
4200	"	A/a	8-8.5	1.04(20)	90	10	*				
4280	"	SH, med-dk gy	7	1.01(10)							
4286-308	"	SH, a/a+10% SH, dk gy	8.5	*	90	10	*				
4305	"	A/a	8.5	*	90	10	*				
4384-408	"	SH, a/a+20% SH, a/a	8.5	$\frac{1.15 (2)}{0.89 (2)}$	90	10	*				
4412	"	A/a	28.5	1.16 (5)	90	10	*				
4420	"	SH, med-dk gy	7.5-8	0.70 (2)							
4484-506	"	SH, a/a+10% SH, dk gy	28.5	1.20 (4)	80	20	*				
4500	"	A/a	28.5	*	60	20	20				
4540	"	CMT+mnr SH	7.5-8	1.21 (9)							
4615	"	SH, dk gy	*	1.47(18)	~100	*	*				
4630-650	"	SLTST, pale yel- brn+20% COAL		1.43(16)							
4680	"	CMT+mnr SH	8.5-9								

TABLE 1 A Maturity and Kerogen Data

WELL: 30/10-5

SAMPLE DEPTH (METRES)	SAMPLE TYPE	GENERALISED LITHOLOGY	SPORE COLOUR INDEX (1-10)	VITRINITE REFLECTIVITY IN OIL, R av%	KEROGEN COMPOSITION (%) (by microscopic examination)			KEROGEN COMPOSITION (%) (by calculation from pyrolysis data)			
					INERTINITE	VITRINITE	SAPROPEL	INERTINITE	VITRINITE	ALGAL SAPROPEL	WAXY SAPROPEL
4710	Ctgs	SLTST, pale yel-brn+mnr COAL	*	1.48 (7)	~100	*	*				
4810	"	A/a	?9	1.70(24)	~100	*	*				
4900	"	A/a	*	1.61(18)	?50	?50	*				
4980-5000	"	SLTST, a/a+30% COAL		*							
5000	"	A/a	?9	1.72(24)	HUMIC + AMORPHOUS						
5040-060	"	SLTST, a/a+30% COAL+10% SH, a/a	8	1.73(21)	HUMIC		*				
	P	COAL		2.00(19)							
5090-110	Ctgs	SH, a/a+20% COAL +mnr SLTST, a/a	9	1.90 (2)	HUMIC		*				
5100	"	A/a	9-10	2.10(15)	HUMIC		*				
5165-185	"	SH, a/a+10% COAL	9-10	1.90(20)	HUMIC		*				
5180	"	SH, a/a+COAL+ SLTST, a/a	9-10	2.00(21)	HUMIC		*				
NOTE: CALCULATIONS OF KEROGEN COMPOSITION (%) FROM PYROLYSIS DATA NOT POSSIBLE BECAUSE OF HIGH LEVELS OF THERMAL MATURITY											

TABLE 1 B Maturity and Kerogen Data

GENERAL DATA			CHEMICAL ANALYSIS DATA											
SAMPLE DEPTH (METRES)	SAMPLE TYPE	ANALYSED LITHOLOGY	ORGANIC CARBON % OF ROCK	PYROLYSIS					SOLVENT EXTRACTION					
				TEMP - ERATURE °C	HYDROGEN INDEX	OXYGEN INDEX	PRODUCTION INDEX	POTENTIAL YIELD (ppm)	TOTAL EXTRACT (ppm)	HYDRO- CARBONS (ppm)	EXTRACT % OF ORGANIC CARBON	HYDROCARBONS		ALKANES % OF HYDRO- CARBONS
				mg/g OF ORGANIC CARBON	% OF EXTRACT									
800	Ctgs	SLTST, lt gy/buff, calc	0.96											
850	"	SLT+SLTST, a/a	0.79											
900	"	SST/SLTST	0.61											
950	"	A/a	1.67											
1000	"	MDST, med-dk gy	1.30											
1050	"	A/a	1.38											
1100	"	A/a	1.27											
1150	"	A/a	1.20											
1200	"	A/a	1.45											
1250	"	A/a	1.80											
1300	"	A/a	1.88											
1350	"	A/a	1.20											
1400	"	A/a	1.31											
1450	"	SH, ol-gy, sl slty	0.99											
1500	"	A/a	0.87											
1550	"	A/a	0.87											
1600	"	A/a	0.84											
1650	"	A/a	0.85											
1700	"	A/a	0.99											
1750	"	A/a	0.80											
1800	"	A/a	0.79											
1820	"	A/a	0.70											
1840	"	A/a	0.59											
1860	"	A/a	0.65											
1880	"	A/a	0.53											
1900	"	A/a	0.64											
1920	"	A/a	0.69											
1940	"	A/a	0.68											
1960	"	A/a	0.93											
1980	"	A/a	1.06											
2000	"	MDST, lt ol-gy, slty	0.99											
2020	"	A/a	0.91											
2040	"	A/a	1.23											
2060	"	A/a	1.00											
2080	"	MDST/SLTST, ol-gy, slty	0.86											
2100	"	A/a	1.24											
2120	"	A/a	1.46											

TABLE 2 A Chemical Analysis Data

GENERAL DATA			CHEMICAL ANALYSIS DATA											
SAMPLE DEPTH (METRES)	SAMPLE TYPE	ANALYSED LITHOLOGY	ORGANIC CARBON % OF ROCK	PYROLYSIS					SOLVENT EXTRACTION					
				TEMP - ERATURE °C	HYDROGEN INDEX	OXYGEN INDEX	PRODUCTION INDEX	POTENTIAL YIELD (ppm)	TOTAL EXTRACT (ppm)	HYDRO - CARBONS (ppm)	EXTRACT % OF ORGANIC CARBON	HYDROCARBONS		ALKANES % OF HYDRO - CARBONS
				mg/g OF ORGANIC CARBON	% OF EXTRACT									
2140	Ctgs	MDST/SLTST, ol-gy slty	1.49											
2160	"	SST+mnr SH, ol-gy	0.83											
2180	"	SH, a/a+40% SST	1.57											
2200	"	MDST, med gy, slty+40% SST, calc	2.51											
2220	"	MDST, a/a+20% SST, a/a	2.21											
2240	"	A/a	1.49											
2260	"	SST, wht, calc+20% SH, gy	1.07											
2280	"	SH, a/a+30% SST, a/a	1.84											
2300	"	SST, a/a+20% SH, a/a	1.06											
2320	"	SND+mnr SLT	0.69											
2340	"	A/a	0.74											
2360	"	A/a	0.68											
2380	"	A/a	0.27											
2400	"	A/a	0.37											
2420	"	A/a	0.92											
2440	"	SH, med gy+mnr SLT	0.90											
2460	"	SH, a/a+mnr LST	0.75											
2480	"	A/a	0.70											
2500	"	A/a+mnr SST	0.64											
2520	"	A/a	0.62											
2540	"	SH, a/a	0.86											
2560	"	A/a	0.87											
2580	"	A/a	0.89											
2600	"	A/a	0.83											
2620	"	A/a	0.73											
2640	"	A/a	0.84											
2660	"	CHK/LST+20% SH, dk gy	0.49											
2680	"	CHK/LST	0.29											
2700	"	SH, dk gy	0.79											
2720	"	SH, a/a+50% LST	0.92											
2740	"	LST+10% SH, a/a	0.42											
2760	"	LST+mnr SH, a/a	0.23											
2780	"	LST	0.30											
2797	"	A/a	0.51											
2800	"	A/a	0.55											
2817	"	A/a	0.48											

TABLE 2 B Chemical Analysis Data

GENERAL DATA			CHEMICAL ANALYSIS DATA											
SAMPLE DEPTH (METRES)	SAMPLE TYPE	ANALYSED LITHOLOGY	ORGANIC CARBON % OF ROCK	PYROLYSIS					SOLVENT EXTRACTION					
				TEMP - °C ERATURE	HYDROGEN INDEX	OXYGEN INDEX	PRODUCTION INDEX	POTENTIAL YIELD (ppm)	TOTAL EXTRACT (ppm)	HYDRO-CARBONS (ppm)	EXTRACT % OF ORGANIC CARBON	HYDROCARBONS		ALKANES % OF HYDRO-CARBONS
												mg/g OF ORGANIC CARBON	% OF EXTRACT	
2820	Ctgs	LST	0.59											
2840	"	A/a	0.38											
2860	"	SH, med gy+mnr LST	0.81											
2880	"	SH, a/a	0.68											
2900	"	A/a	0.88											
2920	"	A/a	1.66											
2940	"	A/a	0.82											
2960	"	A/a	0.72											
2980	"	A/a	0.62											
3000	"	A/a	0.47											
3020	"	A/a	0.67											
3040	"	A/a	0.53											
3060	"	A/a	0.64											
3080	"	A/a	1.28											
3100	"	A/a	0.83											
3120	"	A/a	0.68											
3140	"	A/a	1.68											
3160	"	A/a	2.00											
3180	"	A/a	0.60											
3200	"	A/a	1.05											
3220	"	A/a	0.67											
3240	"	A/a	0.78											
3260	"	A/a	0.85											
3280	"	A/a	0.99											
3300	"	A/a	0.79											
3320	"	A/a	1.01											
3340	"	A/a	1.00											
3360	"	A/a	1.55											
3380	"	A/a	0.80											
3400	"	A/a	0.84											
3410	"	A/a	0.82											
3420	"	A/a	0.73											
3440	"	A/a	0.72											
3450	"	A/a	0.68											
3460	"	A/a	0.61											
3480	"	A/a	0.70											
3500	"	A/a	0.62											

TABLE 2 c Chemical Analysis Data

GENERAL DATA			CHEMICAL ANALYSIS DATA											
SAMPLE DEPTH (METRES)	SAMPLE TYPE	ANALYSED LITHOLOGY	ORGANIC CARBON % OF ROCK	PYROLYSIS					SOLVENT EXTRACTION					
				TEMP - ERATURE °C	HYDROGEN INDEX	OXYGEN INDEX	PRODUCTION INDEX	POTENTIAL YIELD (ppm)	TOTAL EXTRACT (ppm)	HYDRO - CARBONS (ppm)	EXTRACT % OF ORGANIC CARBON	HYDROCARBONS		
												mg/g OF ORGANIC CARBON	% OF EXTRACT	ALKANES % OF HYDRO - CARBONS
3520	Ctgs	SH, med gy	0.69											
3540	"	A/a	0.63											
3560	"	A/a	0.60											
3580	"	A/a	0.87											
3620	"	A/a	0.56											
3640	"	A/a	0.71											
3660	"	A/a	0.69											
3660-740	"	A/a	0.66						735	465	11.1	70	63	77
3680	"	A/a	0.66											
3700	"	A/a	0.71											
3740	"	A/a	0.74											
3760	"	SH, a/a+mnr SST, calc	0.64											
3780	"	A/a	0.84											
3800	"	SH, a/a+mnr LIG	2.00											
3820	"	SH, a/a+mnr SH, blk	1.16											
3840	"	MDST, med-lt gy, calc slty	0.75											
3860	"	A/a	2.22											
3880	"	A/a	0.75											
3900	"	MDST, v calc, slty	0.88											
3900-940	"	A/a	0.90						620	265	6.9	29	43	77
3920	"	A/a	0.68											
3940	"	A/a	0.82											
3960	"	A/a	0.69											
3975-995	"	SH, med-dk gy+mnr SH, dk gy	1.27	*	21	154	0.5	300	530	280	4.2	22	54	84
3980	"	MDST/SH, v calc, slty	1.15											
4000	"	SH/LST, v calc, slty	1.10											
4000-025	"	SH, med-dk gy+mnr SH, dk gy	1.39	436	25	158	0.5	300						
4020	"	SH/LST, a/a	1.24											
4030-055	"	SH, a/a+10% SH, a/a	1.36	436	54	132	0.4	700						
4040	"	SH, med-dk gy+SLT	0.97											
4060	"	SH, a/a	0.93											
4060-090	"	SH, a/a+10% SH, dk gy	0.99	435	38	179	0.4	400						
4080	"	SH, med-dk gy, v splintery	1.08											
4095-116	"	SH, med-dk gy+20% SH, dk gy	1.15	438	36	73	0.4	400	635	575	5.5	50	90	75
4100	"	SH, med-dk gy	1.03											
4120	"	A/a	1.26											
4120-140	"	SH, a/a+20% SH, dk gy	0.99	445	27	67	0.4	300						

TABLE 2 D Chemical Analysis Data

GENERAL DATA			CHEMICAL ANALYSIS DATA											
SAMPLE DEPTH (METRES)	SAMPLE TYPE	ANALYSED LITHOLOGY	ORGANIC CARBON % OF ROCK	PYROLYSIS					SOLVENT EXTRACTION					
				TEMP - ERATURE °C	HYDROGEN INDEX	OXYGEN INDEX	PRODUCTION INDEX	POTENTIAL YIELD (ppm)	TOTAL EXTRACT (ppm)	HYDRO - CARBONS (ppm)	EXTRACT % OF ORGANIC CARBON	HYDROCARBONS		ALKANES % OF HYDRO - CARBONS
4120-160	Ctgs	SH, med-dk gy	1.57						360	20	2.3	1	5	80
4140	"	A/a	1.24											
4144-164	"	SH, a/a+20% SH, dk gy	0.91	450	22	55	0.4	200						
4160	"	SH, med-dk gy	0.93											
4168-188	"	SH, a/a+30% SH, dk gy	1.71	453	29	40	0.3	500						
	P	SH, dk gy	1.45	458	22	29	0.6	300						
4180	Ctgs	SH, med-dk gy	1.36											
4192-212	"	SH, a/a+20% SH, dk gy	2.60	454	30	40	0.4	800						
4200	"	SH, med-dk gy	2.33											
4216-230	"	SH, a/a+20% SH, dk gy	2.60	454	56	152	0.7	1500	970	740	3.7	28	76	41
4220	"	SH, med-dk gy	2.52											
4240	"	A/a	1.46											
4240-260	"	SH, a/a+10% SH, dk gy	1.49	455	29	59	0.4	400						
4260	"	SH, med-dk gy	1.48											
4264-284	"	SH, a/a+20% SH, a/a	1.54	454	22	57	0.4	300						
4280	"	SH, med-dk gy	1.66											
4286-308	"	SH, a/a+10% SH, a/a	1.19	454	23	56	0.3	300						
4300	"	SH, med-dk gy	1.80											
4300-340	"	SH, dk gy, sl calc	1.93						450	85	2.3	4	18	66
4312-332	"	SH, med-dk gy+20% SH, dk gy	1.07	455	21	44	0.4	200						
4320	"	SH, dk gy, sl calc	1.66											
4336-356	"	SH, med-dk gy+20% SH, dk gy	1.03	453	22	45	0.4	200						
4340	"	SH, dk gy, sl calc	1.78											
4360	"	SH, a/a+mmr SLT	1.69											
4360-380	"	SH, med-dk gy+20% SH, dk gy	1.22	445	36	47	0.4	400						
4380	"	SH, dk gy, sl calc	1.86											
4384-408	"	SH, med-dk gy+20% SH, dk gy	1.18	452	36	45	0.3	400						
4400	"	SH, med-dk gy	1.61											
4412-432	"	SH, a/a+20% SH, dk gy	1.26	*	28	29	0.4	400						
4420	"	SH, med-dk gy	2.32											
4436-452	"	SH, a/a+20% SH, dk gy	1.22	450	25	30	0.5	300						
4440	"	SH, med-dk gy	1.22											
4460	"	A/a	1.18											
4460-480	"	SH, a/a+20% SH, dk gy	1.07	*	31	41	0.4	300						
4460-500	"	SH, med-dk gy	1.82						745	380	4.1	21	51	63
4480	"	A/a	1.05											
4484-506	"	SH, a/a+10% SH, dk gy	1.70	425	203	53	0.1	3400	2190	1225	12.9	72	56	77

TABLE 2 E Chemical Analysis Data

GENERAL DATA			CHEMICAL ANALYSIS DATA											
SAMPLE DEPTH (METRES)	SAMPLE TYPE	ANALYSED LITHOLOGY	ORGANIC CARBON % OF ROCK	PYROLYSIS					SOLVENT EXTRACTION					
				TEMP - ERATURE °C	HYDROGEN INDEX	OXYGEN INDEX	PRODUCTION INDEX	POTENTIAL YIELD (ppm)	TOTAL EXTRACT (ppm)	HYDRO-CARBONS (ppm)	EXTRACT % OF ORGANIC CARBON	HYDROCARBONS		ALKANES % OF HYDRO-CARBONS
												mg/g of ORGANIC CARBON	% OF EXTRACT	
4500	Ctgs	SH, med-dk gy	1.37											
4508-528	"	SH, dk gy+30% SLTST, pale yel-brn	-											
4570	"	SH, med-dk gy	1.71											
4580	"	A/a	1.58											
4590	"	A/a	1.50											
4620	"	SH, med-dk gy+SLT	6.13											
4690-710	"	SLTST, pale yel-brn+mnr COAL+tr SH, a/a	4.13	432	398	141	0.3	16400	9540	2780	23.1	67	29	65
4820	"	SH, med gy+10% COAL	15.20											
4840	"	A/a	6.80											
4915	"	SH, med gy+LST	7.90											
4920-940	"	SLTST, mod brn+10% COAL+10% SH, dk gy	10.62	*	77	60	0.6	8200	13150	6830	12.4	64	52	75
4945	"	SH, med gy+mnr LST+mnr COAL	14.50											
4945-5000	"	SH, a/a+mnr LST	4.80						20850	450	43.4	9	2	64
4950-970	"	SLTST, a/a+10% COAL+mnr SH, dk gy	12.14	450	64	58	0.7	7800	15915	8820	13.4	73	55	90
4960	"	SH, med gy+mnr LST+mnr COAL	7.50											
4980-5000	"	SLTST, a/a+30% COAL+mnr SH, dk gy	17.20	483	53	34	0.6	9100	14790	10650	8.6	62	72	72
4985	"	SH, med gy+mnr LST+mnr COAL	13.00											
5000	"	SH, a/a	17.10											
5010-030	"	SLTST, a/a+10% COAL+mnr SH, dk gy	6.65	440	70	62	0.7	4700	16125	10280	24.2	155	64	81
5040	"	SH, med-dk gy+SST/LST+mnr COAL	16.30											
5040-060	"	SLTST, a/a+30% COAL+10% SH, dk gy	13.76	*	32	10	0.4	4400	5830	3405	4.2	25	59	67
5060	"	SH, med-dk gy	24.60											
5065-085	"	SH, dk gy+30% COAL+mnr SLTST, a/a	6.88	*	53	15	0.2	3600	3300	2710	4.8	39	82	74
	P	SH, dk gy	0.86	*	36	39	0.6	300						
5080	Ctgs	SH, med-dk gy+mnr COAL	1.59											
5090-110	"	SH, dk gy+20% COAL+mnr SLTST, mod brn	3.95	433	62	14	0.1	2400						
5100	"	SH, med-dk gy+10% COAL	2.82											
5115-135	"	SH, dk gy+10% COAL+mnr SLTST, a/a	1.10	440	50	57	0.1	500						
	P	SH, dk gy	0.73	450	14	31	0.6	100						
5120	Ctgs	SH, med-dk gy	1.98											
5140	"	SH, a/a+15% COAL	5.70											
5140-160	"	SH, dk gy+30% COAL+mnr SLTST, a/a	4.26	442	33	14	0.2	1400						

TABLE 2 F Chemical Analysis Data

GENERAL DATA			CHEMICAL ANALYSIS DATA											
SAMPLE DEPTH (METRES)	SAMPLE TYPE	ANALYSED LITHOLOGY	ORGANIC CARBON % OF ROCK	PYROLYSIS					SOLVENT EXTRACTION					
				TEMP - °C ERATURE	HYDROGEN INDEX	OXYGEN INDEX	PRODUCTION INDEX	POTENTIAL YIELD (ppm)	TOTAL EXTRACT (ppm)	HYDRO-CARBONS (ppm)	EXTRACT % OF ORGANIC CARBON	HYDROCARBONS		ALKANES % OF HYDRO-CARBONS
5140-180	Ctgs	SH, med-dk gy	2.83						*	<20	*	*	*	*
5160	"	SH, a/a+15% COAL	6.10											
5165-185	"	SH, dk gy+10% COAL+mnr SLTST, a/a	2.94	433	95	24	0.1	2800	3090	2225	10.5	76	72	78
	P	SH, dk gy	3.07	450	13	12	0.4	400						
5180	Ctgs	SH, med-dk gy+20% COAL	11.50											
5185	"	SH, a/a+10% COAL	2.53											

TABLE 2 G Chemical Analysis Data

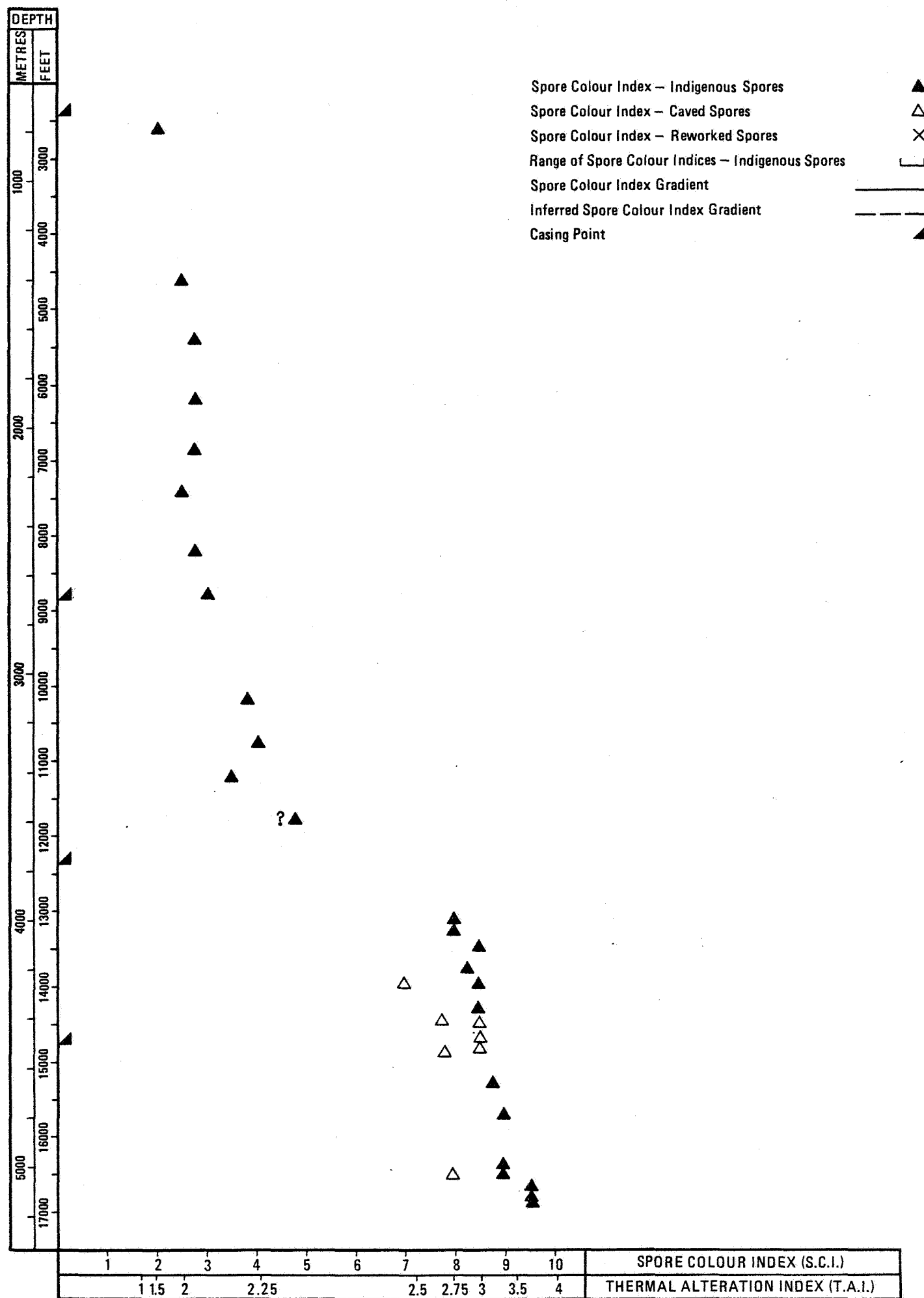


FIGURE 1 Spore Colour Indices against Depth

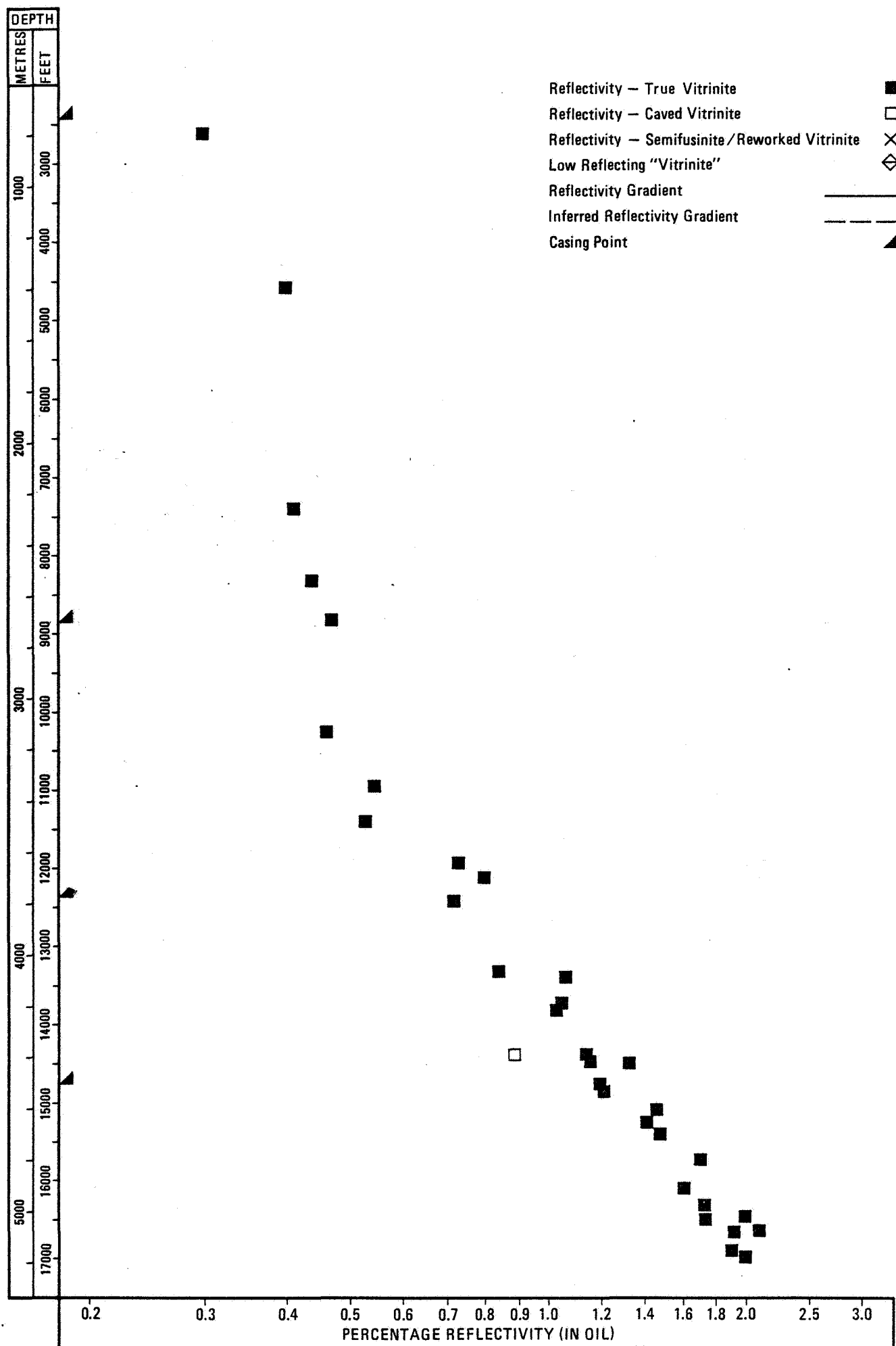


FIGURE 2 Vitrinite Reflectivity against Depth

ROBERTSON RESEARCH INTERNATIONAL LIMITED

Project No. RRPS/8182/B/2043

NORWAY II STUDY - PRELIMINARY REPORT G28 (9/6/81)

PRELIMINARY PETROLEUM GEOCHEMISTRY RESULTS OF UK 3/4-1 WELL

SUMMARY

The analysed section, 7020' to 10823' (T.D.), is early mature. Shales in the mainly Late Jurassic interval 8840' to 8981' have fair oil generating potential, but on-structure little of this potential will have been realised. Coals in the Middle Jurassic interval between 9210' and 9600' may have minor gas source potential at a much elevated level of maturity. None of the remaining intervals have any oil source potential due to generally inertinitic or insufficient kerogen, but minor gas potential is noted between 9610' and 10823' (T.D.). Migrated oil with a mature alkane distribution is common throughout the analysed section.

GENERAL COMMENTS

Well status: Plugged and abandoned, oil well.

Drilling data: Drilled with sea water/gel based mud to 10823' (T.D.).
Casing points at 826' (30"), 1742' (18 $\frac{1}{2}$ "), 5516' (13 $\frac{3}{8}$ "),
8412' (9 $\frac{3}{8}$ "), 9511' (7"). BHT 196°F at 10823' (T.D.).

Interval analysed: 7020' to 10823' (T.D.).

Age of analysed interval: Triassic to Late Cretaceous.

Sample type and quality: 57 composite ditch cuttings samples and 13 core samples of fair quality.

Maturation data quality: Adequate.

Source rock data quality: Adequate.

Gas chromatography run at: 8140'-8190', 8840'-8895', 8950'-8975',
9210'-9265', 9270'-9320', 9330'-9400', 9410'-9480',
9490'-9540', 9550'-9600', 9850'-9900', 9970'-10020',
10030'-10080', 10090'-10140', 10630'-10680'.

MATURATION (Table 1; Figures 1 and 2)

The spore colour indices increase from 3 at 7020' to 4.5-5 (interpreted) at 10823' (T.D.) and the vitrinite reflectivity increases from 0.35% (interpreted) to 0.47% (interpreted) over the same interval, indicating a level of early thermal maturity for the analysed interval. Oil-prone kerogen at these levels of maturity will generate only minor quantities of hydrocarbons.

OIL SOURCE ROCKS (Tables 1 and 2)

Shales in the interval 8840' to 8981' (mainly Late Jurassic) contain above average quantities of organic matter and overall have fair oil source potential, as reflected by pyrolysis potential yields of up to 19900 ppm. It is unlikely that these shales have sourced any significant amounts of oil on-structure.

Solvent extraction analysis reveals contamination by migrated hydrocarbons at several horizons and gas chromatography shows that these hydrocarbons have a mature oil-like alkane distribution. It is probable that a lateral equivalent of the source rock occurring within the interval 8840' to 8981' is the source of the oil stain noted between 9210' and 10680' which has a very similar alkane distribution.

GEOCHEMICAL CHARACTERISTICS OF THE REMAINING SEDIMENTS

The interval 9610' to 10823' (T.D.) contains shales with average and above average organic carbon contents, but the organic matter is dominantly inertinitic and will have only minor gas generating potential at optimum levels of maturity.

The interval 9210' to 9600' (Middle Jurassic) contains coaly horizons which may have fair gas generating potential at optimum maturity. The interval is oil-stained.

The Late Cretaceous interval (7020' to 8835') is organically lean and has no hydrocarbon generating potential.

SAMPLE DEPTH (FEET)	SAMPLE TYPE	GENERALISED LITHOLOGY	SPORE COLOUR INDEX (1-10)	VITRINITE REFLECTIVITY IN OIL, R av%	KEROGEN COMPOSITION (%) (by microscopic examination)			KEROGEN COMPOSITION (%) (by calculation from pyrolysis data)			
					INERTINITE	VITRINITE	SAPROPEL	INERTINITE	VITRINITE	ALGAL SAPROPEL	WAXY SAPROPEL
7020-080	Ctgs	SH, ol-gy	3								
8140	"	A/a						65	35	*	*
8840-895	"	SH, med-dk gy+ mnr LST, wht+mnr SND/SST						70	30	*	*
	P	SH, med-dk gy						25	60	5	10
8855-885	Ctgs	SH, a/a+mnr LST +mnr SND/SST	4	*	30	40	30				
8900-945	"	SH, a/a+20% SH, dk gy+20% SND						80	20	*	*
	P	SH, med-dk gy						40	30	5	25
	P	SH, dk gy						30	30	5	35
8925-965	Ctgs	SH, med-dk gy+SH, a/a+SND	4-4.5	0.52(19)	60	20	20				
8943	Core	SST	4								
8950-960	Ctgs	SH, gy, calc		0.41(20)							
8950-975	"	SH, med-dk gy+SH, dk gy+20% SND						85	15	*	*
	P	SH, dk gy						40	20	10	30
9093	Core	SST						75	25	*	*
9210-265	Ctgs	SH, med-dk gy+ 10% COAL+SLTST, carb		0.54(19)				45	50	*	5
	P	SLTST, carb						50	50	*	*
9270-320	Ctgs	SH, a/a+20% COAL +SLTST, a/a						35	50	5	10
9330-400	"	SH, a/a+30% COAL +SLTST, a/a		*				65	20	*	15
9340-420	"	A/a	4	0.39(21)							
9410-480	"	SH, a/a+10% COAL +SLTST, a/a						50	35	*	15
	P	SLTST, a/a						15	80	5	*
9490-540	Ctgs	SH, a/a+10% COAL +SLTST, a/a						50	45	*	5
9550-600	"	SH, a/a+SLTST, a/a						65	35	*	*
	P	SH, med-dk gy						65	10	5	20
9580	Ctgs	SH, a/a	4.5		20	50	30				
9580-660	"	A/a		*							
9590-610	"	SH, gy, calc+SH, lt brn-gy		0.44(11)							
9610	P	SH, med-dk gy						50	50	*	*
9620	Ctgs	SH, a/a	5.5-6		10	10	80				
9660	"	A/a	5		50	30	20				
9730-780	P	SH, med-dk gy						10	90	*	*
9800-850	Ctgs	SH, lt gy, calc		*							

TABLE 1 A Maturity and Kerogen Data

WELL: UK 3/4-1

SAMPLE DEPTH (FEET)	SAMPLE TYPE	GENERALISED LITHOLOGY	SPORE COLOUR INDEX (1-10)	VITRINITE REFLECTIVITY IN OIL, R _{av} %	KEROGEN COMPOSITION (%) (by microscopic examination)			KEROGEN COMPOSITION (%) (by calculation from pyrolysis data)			
					INERTINITE	VITRINITE	SAPROPEL	INERTINITE	VITRINITE	ALGAL SAPROPEL	WAXY SAPROPEL
9850-900	Ctgs	SH, med-dk gy+ SLTST, carb						75	25	*	*
9860-940	"	A/a	4.5		40	40	20				
9910-960	P	SH, med-dk gy						70	30	*	*
9970-10020	Ctgs	SH, a/a+SLTST, a/a						75	25	*	*
10030-080	"	A/a						80	20	*	*
10080-160	"	A/a	4-4.5	0.43(18)	40	20	40				
10090-130	"	SH, gy		0.45 (9)							
10090-140	"	SH, med-dk gy						75	25	*	*
10150-200	P	SH, med-dk gy						65	10	*	25
10200-250	Ctgs	SH, gy, calc		0.44(10)							
10270-320	P	SH, med-dk gy						40	60	*	*
10320-400	Ctgs	SND+SH, a/a+ SLTST, a/a	4-4.5	0.42(14)	70	20	10				
10450-500	P	SH, med-dk gy						40	60	*	*
10500	Ctgs	SH, gy, calc		0.44 (7)							
10510-560	P	SH, med-dk gy						15	85	*	*
10560-640	Ctgs	SND+SH, a/a+ SLTST, a/a	4.5-5	0.46(35)	70	20	10				
10570-620	P	SH, med-dk gy						50	50	*	*
10630-680	Ctgs	SND+40% SH, a/a						75	25	*	*
10750-800	P	SH, med-dk gy						75	25	*	*
10760-840	Ctgs	SND+SH, a/a	5	*	70	20	10				
10780	"	SH, gy, mic+40% SND		*							

TABLE 1 B Maturity and Kerogen Data

GENERAL DATA			CHEMICAL ANALYSIS DATA											
SAMPLE DEPTH (FEET)	SAMPLE TYPE	ANALYSED LITHOLOGY	ORGANIC CARBON % OF ROCK	PYROLYSIS					SOLVENT EXTRACTION					
				TEMP - ERATURE °C	HYDROGEN INDEX	OXYGEN INDEX	PRODUCTION INDEX	POTENTIAL YIELD (ppm)	TOTAL EXTRACT (ppm)	HYDRO-CARBONS (ppm)	EXTRACT % OF ORGANIC CARBON	HYDROCARBONS		
												mg/g of ORGANIC CARBON	% OF EXTRACT	ALKANES % OF HYDRO-CARBONS
7020-080	Ctgs	SH, ol-gy	0.34											
7100-160	"	A/a	0.26											
7180-240	"	SH, a/a+tr SLTST, brn	0.27											
7260-320	"	SH, a/a	0.20											
7340-400	"	A/a	0.26											
7420-480	"	SH, a/a+tr SH, dk gy	0.19											
7500-560	"	SH, ol-gy	0.02											
7580-640	"	A/a	0.27											
7660-720	"	SH, a/a+tr SH, dk gy	0.21											
7740-800	"	SH, ol-gy	0.34											
7820-880	"	A/a	0.41											
7900-950	"	A/a	0.39											
7960-8010	"	A/a	0.30											
8020-070	"	A/a	0.32											
8080-130	"	A/a	0.29											
8140-190	"	A/a	0.78	435	88	136	0.1	700	4415	3435	56.6	440	78	65
8200-250	"	A/a	0.31											
8260-310	"	A/a	0.36											
8320-370	"	A/a	0.62											
8380-430	"	SH, a/a+tr SH, gn-gy	0.46											
8440-490	"	SH, ol-gy	0.52											
8500-555	"	SH, med gy+40% LST, yel-gy+mnr SLTST, gy-red	0.52											
	P	SH, med gy	0.57											
8565-614	Ctgs	SH, a/a+mnr LST, a/a	0.58											
8620-665	"	SH, a/a+10% LST, a/a	0.40											
8670-715	"	SH, a/a+mnr LST, a/a	0.46											
8720-775	"	SH, med-dk gy	0.28											
8780-835	"	A/a	0.37											
8840-895	"	SH, a/a+mnr LST, wht+mnr SND/SST	1.65	429	71	117	0.3	1200	2475	1340	15.0	81	54	83
	P	SH, med-dk gy	1.95	432	191	33	0.2	3700						
8900-945	Ctgs	SH, a/a+20% SH, dk gy+20% SND	1.64	436	33	81	0.5	500						
	P	SH, med-dk gy	2.38	432	230	24	0.2	5500						
	P	SH, dk gy	4.23	432	313	28	0.2	13200						
8910	Ctgs	SH, ol-gy	1.83						2370	710	7.5	39	30	69
8935-940	"	SH, lt/dk gy	2.00						2820	1000	14.1	50	36	53
8950-960	"	SH, gy, calc	4.70						4520	>880	9.6	19	19	76

TABLE 2 A Chemical Analysis Data

GENERAL DATA			CHEMICAL ANALYSIS DATA											
SAMPLE DEPTH (FEET)	SAMPLE TYPE	ANALYSED LITHOLOGY	ORGANIC CARBON % OF ROCK	PYROLYSIS					SOLVENT EXTRACTION					
				TEMP - °C	HYDROGEN INDEX	OXYGEN INDEX	PRODUCTION INDEX	POTENTIAL YIELD (ppm)	TOTAL EXTRACT (ppm)	HYDRO-CARBONS (ppm)	EXTRACT % OF ORGANIC CARBON	HYDROCARBONS mg/100g ORGANIC CARBON	% OF EXTRACT	ALKANES % OF TOTAL CARBONS
8950-975	Ctgs	SH, med-dk gy+20% SH, gy, calc, +20% SND	2.23	434	21	61	0.6	500	1875	955	8.4	43	51	83
	P	SH, med-dk gy	0.60											
	P	SH, dk gy	6.18	427	321	22	0.2	19900						
8981	Core	SH, a/a	4.10						2050	310	5.0	8	15	64
9093	"	SST	1.44	439	40	26	0.3	600						
9210-265	Ctgs	SH, med-dk gy+10% COAL+SLTST, carb	6.59	439	117	26	0.6	7700	7080	6705	10.7	102	95	77
	P	SLTST, carb	1.75	*	100	131	0.8	1700						
9225	Ctgs	SH, gy, calc	8.30						12040	780	14.5	9	6	70
9265-270	"	COAL+SLTST	10.60						26270	9800	24.8	92	37	30
9270-290	"	SH, dk gy+SH, lt brn-gy, calc	8.90						24410	9070	27.6	102	37	68
9270-320	"	SH, med-dk gy+20% COAL+SLTST, a/a	9.33	440	147	29	0.5	13700	11435	6900	12.3	74	60	82
9305-370	"	SH, gy, calc	5.80						7310	2390	12.6	41	33	60
9330-400	"	SH, med-dk gy+30% COAL+SLTST, a/a	11.75	437	138	16	0.4	16200	7410	6315	6.3	54	85	61
9410-480	"	SH, a/a+10% COAL+SLTST, a/a	7.02	436	146	21	0.6	10300	16335	10545	23.3	150	65	82
	P	SLTST, a/a	2.41	432	152	38	0.8	3700						
9490-540	Ctgs	SH, a/a+10% COAL+SLTST, a/a	4.12	435	146	43	0.7	6000	13755	9755	33.3	237	70	89
9550-600	"	SH, a/a+SLTST, a/a	2.86	433	79	43	0.8	2300	8355	4200	29.2	147	50	95
	P	SH, med-dk gy	4.21	431	167	13	0.4	7000						
9590-610	Ctgs	SH, gy, calc+SH, lt brn-gy	4.90						9000	3620	18.4	74	40	79
9610-660	"	SH, med-dk gy+SLTST, carb	-											
	P	SH, med-dk gy	1.25	434	103	74	0.8	1300						
9670-720	Ctgs	SH, a/a+SLTST, a/a	-											
9700	"	SH, gy, calc	3.76						5620	2330	14.9	62	41	74
9720-730	"	SH, gy	1.92						3120	1500	16.3	78	48	51
9730-780	"	SH, med-dk gy+SLTST, a/a	-											
	P	SH, med-dk gy	1.75	436	125	42	0.5	2200						
9790-840	Ctgs	SH, a/a+SLTST, a/a	-											
9800-850	"	SH, lt gy, calc	2.30											
9850-900	"	A/a	2.05	434	62	71	0.7	1300	3453	3290	16.8	160	95	81
9910-960	"	A/a	-											
	P	SH, med-dk gy	1.00	*	45	32	0.6	500						
9940-960	Ctgs	SH, gy, calc+SLTST, a/a	2.32											
9970-10020	"	SH, med-dk gy+SLTST, a/a	1.57	438	46	63	0.7	700	1870	1870	11.9	119	100	81
10020-030	"	SH, gy	1.25						1320	490	10.6	39	37	57
10030-080	"	SH, med-dk gy+SLTST, a/a	2.10	437	30	35	0.5	600	330	305	1.6	15	92	79

TABLE 2 B Chemical Analysis Data

GENERAL DATA			CHEMICAL ANALYSIS DATA											
SAMPLE DEPTH (FEET)	SAMPLE TYPE	ANALYSED LITHOLOGY	ORGANIC CARBON % OF ROCK	PYROLYSIS					SOLVENT EXTRACTION					
				TEMP - °C ERATURE °C	HYDROGEN INDEX	OXYGEN INDEX	PRODUCTION INDEX	POTENTIAL YIELD (ppm)	TOTAL EXTRACT (ppm)	HYDRO-CARBONS (ppm)	EXTRACT % OF ORGANIC CARBON	HYDROCARBONS		
												mg/g OF ORGANIC CARBON	% OF EXTRACT	ALKANES % OF HYDRO-CARBONS
10090-130	Ctgs	SH, gy	2.80											
10090-140	"	SH, med-dk gy+SLTST, carb	0.90	*	51	110	0.6	500	1150	955	12.8	106	83	86
10100-150	"	SH, gy	2.34						2340	860	10.0	37	37	69
10150-200	"	SH, med-dk gy+SLTST, a/a	-											
	P	SH, med-dk gy	2.60	440	173	16	0.2	4500						
10200-250	Ctgs	SH, gy, calc	2.50						>2190	>360	8.8	14	16	100
10210-260	"	SH, a/a	-											
	P	SH, med-dk gy	0.96											
10270-320	Ctgs	SH, a/a	-											
	P	SH, med-dk gy	1.27	440	91	29	0.4	1200						
10330-380	Ctgs	SND+30% SH, a/a+SLTST, a/a	0.58											
	P	SH, med-dk gy	0.93											
10340-350	Ctgs	SH, gy, slty	0.96						3370	1400	35.1	146	42	33
10380-400	"	SH, gy/dk gy, mic+40% SND, crs	1.93						2100	690	10.9	36	33	78
10390-440	"	SND+10% SH, med-dk gy	-											
10450-500	"	CHK+30% SH, a/a+SLTST, carb	-											
	P	SH, med-dk gy	1.85	438	134	71	0.7	2500						
10500	Ctgs	SH, gy, calc	2.40						3120	1190	13.0	50	38	81
10510-560	"	SH, med-dk gy+20% CHK+SLTST, a/a	-											
	P	SH, med-dk gy	1.80	437	140	47	0.5	2500						
10540-570	Ctgs	SH, gy, mic+40% SND	3.35						4060	1160	12.1	35	29	67
10570-620	"	SND+30% SH, med-dk gy+SLTST, a/a												
	P	SH, med-dk gy	1.30	438	82	38	0.5	1100						
10620-650	Ctgs	SH, gy, mic+40% SND	3.21						780	160	2.4	5	21	78
10630-680	"	SND+40% SH, med-dk gy	1.06	434	47	85	0.8	500	2515	2195	24.9	207	87	86
10690-700	"	SH, gy, mic+20% SLTST, brn+ 50% SND	0.88						900	210	10.2	24	23	79
10690-740	"	SND+40% SH, med-dk gy	0.57											
10750-800	"	SND+30% SH, a/a	-											
	P	SH, med-dk gy	1.37	442	71	55	0.7	1000						
10780	Ctgs	SH, gy, mic	0.92						>990	>170	10.8	18	17	100
10810-823	"	SND+30% SH, a/a	-											
	P	SH, med-dk gy	0.96											

TABLE 2 c Chemical Analysis Data

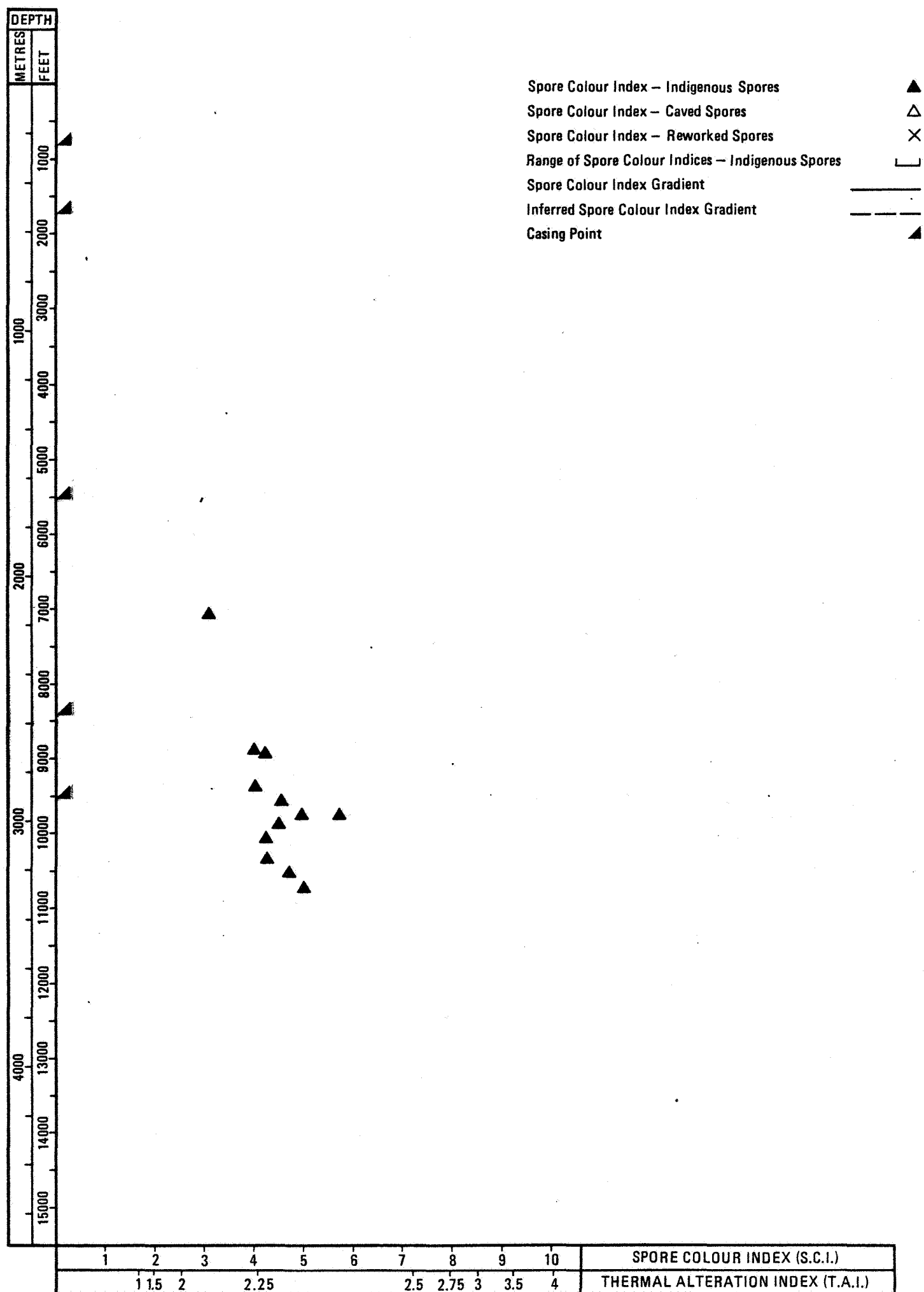


FIGURE 1 Spore Colour Indices against Depth

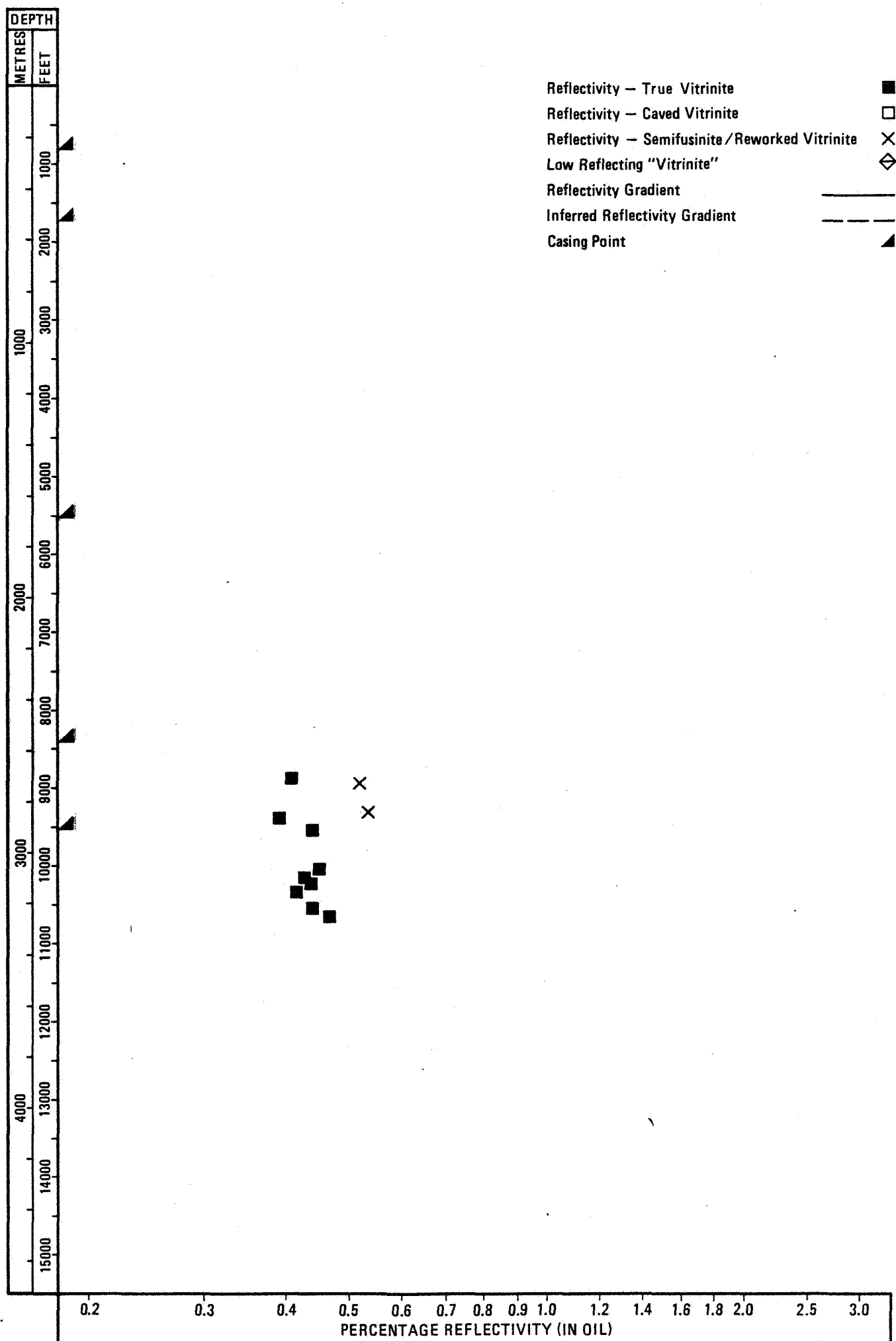


FIGURE 2 Vitrinite Reflectivity against Depth

ROBERTSON RESEARCH INTERNATIONAL LIMITED

Project No. RRPS/8182/B/2043

NORWAY II STUDY - PRELIMINARY REPORT G29 (9/6/81)

PRELIMINARY PETROLEUM GEOCHEMISTRY RESULTS OF UK 3/25-1 WELL

SUMMARY

The analysed section is immature from 850m to 2000m, early mature between 2000m and 3200m, middle mature from 3200m to 3900m and late mature below 3900m. Spore colour data suggest that up to 2000m of Tertiary section may be missing by erosion. No significant oil source rocks have been identified in the section, although some of the shales and siltstones within the interval 3854m to 3906m could have generated minor quantities of oil. This interval is stained by biodegraded migrated oil from an early phase of oil generation mixed with smaller quantities of a lighter, non-degraded oil from a later phase. The intervals 1250m to 3716m and 3909m to 4346m (T.D.) have no significant oil generating potential, although the lower interval contains minor oil stain from a mixture of light and biodegraded oils. This stain is similar to that seen higher in the section except that here the lighter component predominates.

GENERAL COMMENTS

Well status: Plugged and abandoned, dry hole.

Drilling data: Drilled with spersene X-20, bentonite and lignosulphonate based muds to 4346m (T.D.). Turbo drilled from 3190m to 3550m. Casing points at 176m (30"), 381m (18 $\frac{1}{2}$ "), 1779m (13 $\frac{3}{8}$ "), 2852m (9 $\frac{5}{8}$ "), 3683m (7"). BHT 138°F at 1792m, 153°F at 2881m, 198°F at 3580m, 206°F at 3711m and 229°F at 4252m.

Interval analysed: 850m to 4346m (T.D.).

Age of analysed interval: Late Jurassic to Tertiary.

Sample type and quality: 37 composited dried ditch cuttings samples of variable quality.

Maturation data quality: Variable; adequate overall.

Source rock data quality: Adequate to good.

Gas chromatography run at: 3854m-3870m, 3890m-3906m, 4164m-4180m, 4182m-4198m, 4236m-4252m, 4290m-4306m, 4308m-4322m, 4342m-4346m.

MATURATION (Table 1; Figures 1 and 2)

Spore colour indices increase progressively from 2.5-3 at 850m to 8 at 4346m (T.D.). The vitrinite reflectivities in the Tertiary interval range

between 0.22% and 0.32%, but measurable indigenous vitrinite was not observed in the Cretaceous or Jurassic intervals. Vitrinite that is possibly reworked has values of 0.58% at 2450m-2500m and 1.22% at 3908m-3924m, indicating a top limit for indigenous vitrinite. The data indicate an immature to early mature transition at about 2000m, a transition to middle maturity at around 3200m, and late maturity at and below 3900m. The spore colour indices indicate that up to 2000m of section is missing by erosion in the Tertiary.

OIL SOURCE ROCKS (Tables 1 and 2)

No significant oil source rocks have been identified in the analysed section of this well.

GEOCHEMICAL CHARACTERISTICS OF THE SEDIMENTS

The Late Jurassic and Early Cretaceous shales in the interval 3908m to 4346m (T.D.) contain below average quantities of organic matter (most of which is humic) and have no potential for significant oil generation. This interval contains up to 750 ppm of extractable hydrocarbons which, by their quantity, are classed as minor oil stain. These hydrocarbons are all similar and contain a mixture of two oils one of which is mature, while the other contains an unresolved envelope characteristic of a biodegraded oil. It is noted that the proportion of lighter hydrocarbons relative to heavy (C₂₅ plus) hydrocarbons increases with depth.

The shales between 3778m and 3906m are middle to late mature and contain above average organic carbon contents. Their present pyrolysis potential yields of up to 1900 ppm indicate that they may have had some oil generating potential. However, this interval presently has little hydrocarbon generating potential. The samples 3854m-3870m and 3890m-3906m contain relatively large amounts of solvent extractable organic matter of which 2990 ppm and 2190 ppm respectively are hydrocarbons. Gas chromatographic analysis has shown that the bulk of this hydrocarbon is biodegraded, as revealed by their characteristic unresolved alkane distribution, and is mixed with lesser quantities of a lighter, non-degraded oil.

The interval between 1250m and 3716m contains insufficient organic carbon to source significant quantities of hydrocarbons, irrespective of maturity.

SAMPLE DEPTH (METRES)	SAMPLE TYPE	GENERALISED LITHOLOGY	SPORE COLOUR INDEX (1 - 10)	VITRINITE REFLECTIVITY IN OIL, R av%	KEROGEN COMPOSITION (%) (by microscopic examination)			KEROGEN COMPOSITION (%) (by calculation from pyrolysis data)			
					INERTINITE	VITRINITE	SAPROPEL	INERTINITE	VITRINITE	ALGAL SAPROPEL	WAXY SAPROPEL
850-900	Ctgs	SND+SST+SHELL+ GLAUC	2.5-3	*	20	80	*				
1050-100	"	A/a	2.5-3	0.22 (5)	20	80	*				
1250-300	"	SH, dsky yel-gn, slty	3	0.24(20)	20	80	*				
1850-900	"	SH, ol-gy, slty+ 10% SH, mod brn	3-3.5	0.32 (9)	60	40	*				
2250-300	"	SH, med-dk gy+40% SND+mnr SH, gn-gy						80	20	*	*
2450-500	"	SH, a/a+30% SND +mnr SH, a/a	3.5	$\frac{0.29}{0.58}$ (6); (3)	70	30	*				
3700-716	"	SH, med-dk gy+30% LST, brn-gy+20% SND	?6	*	~100	Mnr	*				
3796-814	"	SLTST, med gy+mnr SH, dk gy	?7	*	~100	Mnr	*				
3908-924	"	SH, dk gy+30% SH, med-dk gy+20% SLTST, mod yel- brn		1.22 (2)							
3908-996	"	SH, a/a+SH, a/a+ mnr SLTST	?7		*	*	*				
3980-996	"	SH, a/a+mnr SLTST, lt brn-gy	7.5	*	*	*	*				
4000-030	"	A/a	7.5		90	10	Mnr				
4216-236	"	SH, a/a+SH, med- dk gy+mnr SLTST, a/a	7.5-8		70	30	Mnr				
4320-346	"	A/a	8		70	30	Mnr				

NOTE: CALCULATIONS OF KEROGEN COMPOSITION (%) FROM PYROLYSIS DATA NOT POSSIBLE WHERE THERMAL MATURITY IS HIGH

TABLE 1 Maturity and Kerogen Data

GENERAL DATA			CHEMICAL ANALYSIS DATA											
SAMPLE DEPTH (METRES)	SAMPLE TYPE	ANALYSED LITHOLOGY	ORGANIC CARBON % OF ROCK	PYROLYSIS					SOLVENT EXTRACTION					
				TEMP - ERATURE °C	HYDROGEN INDEX	OXYGEN INDEX	PRODUCTION INDEX	POTENTIAL YIELD (ppm)	TOTAL EXTRACT (ppm)	HYDRO - CARBONS (ppm)	EXTRACT % OF ORGANIC CARBON	HYDROCARBONS		ALKANES % OF HYDRO - CARBONS
												mg/g OF ORGANIC CARBON	% OF EXTRACT	
1250-300	Ctgs	SH, dsky yel-gn, slty	0.50											
1450-500	"	A/a	0.21											
1650-700	"	A/a	0.54											
1850-900	"	SH, ol-gy, slty+10% SH, mod brn	0.39											
2250-300	"	SH, med-dk gy+40% SND+mnr SH, gn-gy	0.55	434	44	59	0.1	300						
2450-500	"	SH, a/a+30% SND+mnr SH, a/a	0.64											
3700-716	"	SH, med-dk gy+30% LST, brn-gy+20% SND	0.76	445	69	85	0.1	600						
	P	SH, med-dk gy	0.87											
3778-794	Ctgs	SLTST, med gy+10% SH, dk gy+10% LST, a/a	-											
	P	SH, dk gy	2.26	428	23	46	0.4	500						
3796-814	Ctgs	SLTST, a/a+mnr SH, a/a	-											
	P	SH, dk gy	1.51	435	19	177	0.2	300						
3854-870	Ctgs	SLTST, a/a+20% SH, a/a	1.43	443	132	86	0.1	1900	3475	2990	24.3	209	86	77
3872-888	"	A/a	-											
	P	SH, dk gy	2.26	440	35	24	0.1	800						
3890-906	Ctgs	SH, a/a+10% SH, med-dk gy+10% SLTST, mod yel-brn	1.28	423	138	73	0.05	1800	3145	2190	24.6	171	70	83
3908-924	"	SH, a/a+30% SH, a/a+20% SLTST, a/a	0.93											
3926-942	"	SH, a/a+45% SH, a/a+10% SLTST, a/a	0.74	438	26	51	0.1	200						
3944-960	"	SH, a/a+50% SH, a/a+10% SLTST, a/a	1.06											
3962-978	"	SH, dk gy+mnr SLTST, lt brn-gy	0.78	447	13	38	0.4	100						
3980-996	"	A/a	1.07											
3998-4016	"	A/a	0.74	442	36	50	0.1	300						
4018-034	"	A/a	0.81	448	31	42	0.1	300						
4036-052	"	A/a	0.69	449	36	36	0.1	300						
4054-070	"	A/a	0.74	*	17	50	0.3	200						
4072-088	"	A/a	0.76	448	27	61	0.2	200						
4090-106	"	A/a	0.75	449	31	60	0.1	300						
4108-124	"	A/a	0.81	448	31	27	0.2	300						
4128-144	"	A/a	0.87	440	32	46	0.2	300						
4146-162	"	A/a	0.92	442	30	58	0.1	300						
4164-180	"	A/a	0.78	*	41	58	0.2	300	650	435	8.4	56	67	86
4182-198	"	SH, a/a+SH, med-dk gy+mnr SLTST, a/a	0.91	435	43	57	0.2	400	870	750	9.6	82	86	88

TABLE 2 A Chemical Analysis Data

GENERAL DATA			CHEMICAL ANALYSIS DATA											
SAMPLE DEPTH (METRES)	SAMPLE TYPE	ANALYSED LITHOLOGY	ORGANIC CARBON % OF ROCK	PYROLYSIS					SOLVENT EXTRACTION					
				TEMP - ERATURE °C	HYDROGEN INDEX	OXYGEN INDEX	PRODUCTION INDEX	POTENTIAL YIELD (ppm)	TOTAL EXTRACT (ppm)	HYDRO-CARBONS (ppm)	EXTRACT % OF ORGANIC CARBON	HYDROCARBONS		ALKANES % OF HYDRO-CARBONS
												mg/g OF ORGANIC CARBON	% OF EXTRACT	
4200-216	Ctgs	SH, dk gy+SH, med-dk gy+mnr SLTST, lt brn-gy	0.79	433	38	89	0.2	300						
4218-234	"	A/a	0.77	428	35	101	0.2	300						
4236-252	"	A/a	0.79	*	30	73	0.3	300	430	290	5.5	37	67	85
4254-270	"	A/a	0.95											
4272-288	"	A/a	0.90											
4290-306	"	A/a	0.85	428	39	87	0.4	400	470	260	5.6	31	56	80
4308-322	"	A/a	0.85	425	39	72	0.3	400	435	310	5.2	36	70	83
4324-340	"	A/a	0.77	426	39	69	0.1	300						
4342-346	"	SH, med-dk gy+20% SH, dk gy+10% SLTST, a/a	0.78	427	29	143	0.3	300	360	160	4.7	21	44	88

TABLE 2 B Chemical Analysis Data

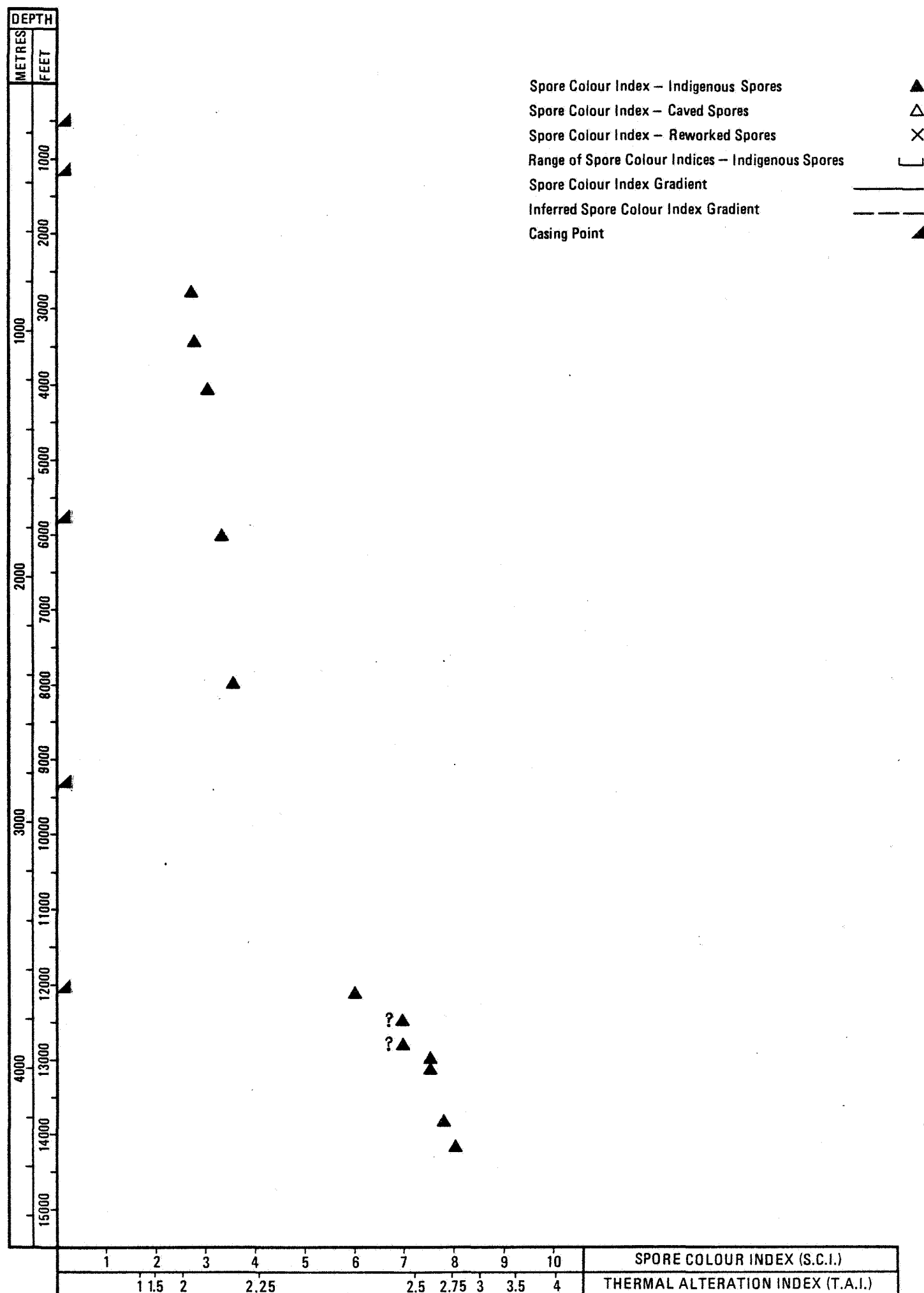


FIGURE 1 Spore Colour Indices against Depth

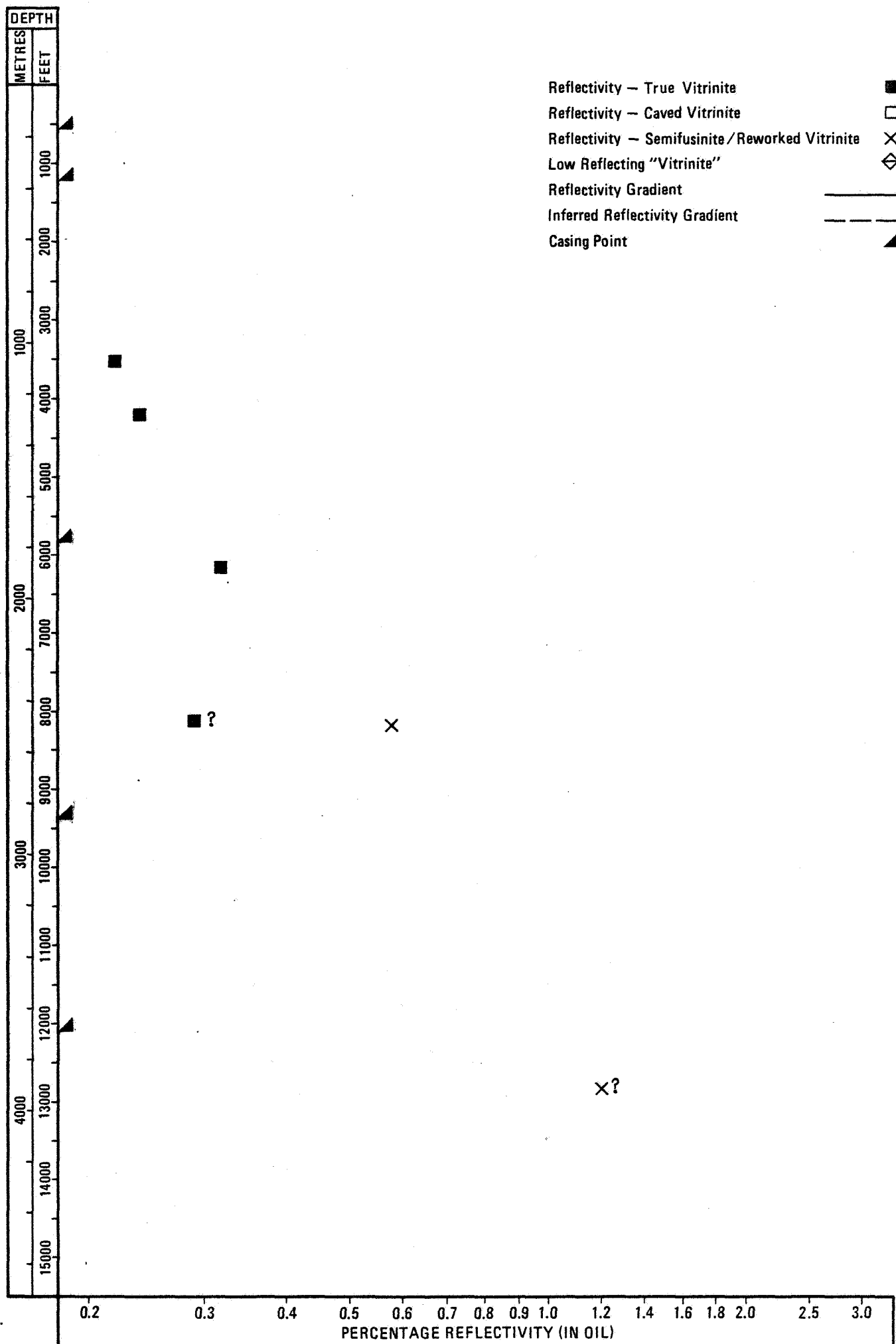


FIGURE 2 Vitrinite Reflectivity against Depth

ROBERTSON RESEARCH INTERNATIONAL LIMITED

Project No. RRPS/8182/B/2043

NORWAY II STUDY - PRELIMINARY REPORT G30 (9/6/81)

PRELIMINARY PETROLEUM GEOCHEMISTRY RESULTS OF UK 16/23-1 WELL

SUMMARY

The analysed section, 10430' to 11810', is early mature. Organically rich dark grey shales, corresponding to a shale interval with a high gamma ray log response between 10677' and 11167', have good to very good oil source potential. The remaining parts of the analysed section have no oil source potential, but the coals occurring between 11270' and 11431' will have gas generating potential at a much elevated level of thermal maturity. Oil stain is present at various horizons between 11090' and 11810'.

GENERAL COMMENTS

Well status: Plugged and abandoned, dry hole.

Drilling data: Drilled with dextrid Q-Broxin based mud to 7345' and sea water/lignosulphonate mud to 12680' (T.D.). Casing points at 620' (30"), 1400' (20"), 3307" (13 $\frac{3}{8}$ "), 7604' (9 $\frac{7}{8}$ ").

Interval analysed: 10430' to 11810' (T.D. 12680').

Age of analysed interval: Late Triassic to Early Cretaceous.

Sample type and quality: 14 dried ditch cuttings samples of poor to adequate quality.

Maturation data quality: Adequate.

Source rock data quality: Adequate.

Gas chromatography run at: 11090'-11130', 11510'-11570', 11580'-11650', 11670'-11730'.

MATURATION (Table 1; Figures 1 and 2)

The spore colour indices of indigenous spores vary between 3.5 and 3.5-4 and the vitrinite reflectivities range from 0.37% to 0.42% in the analysed section, indicating early thermal maturity. Oil prone kerogen at this level of thermal maturity is beginning to generate hydrocarbons.

OIL SOURCE ROCKS (Tables 1 and 2)

Picked dark grey shale lithologies from between 11020' and 11810' are rich in organic matter and give high to very high pyrolysis potential yields ranging from 9100 ppm to 27200 ppm. The kerogens contain inertinite and vitrinite

together with sub-dominant quantities of waxy sapropel which has an anoxic character. These shales are attributed to the interval between 10677' and 11167' which has a high gamma ray log response. This interval could generate abundant oil at an elevated level of thermal maturity.

Pyrolysis production indices of around 0.1 and high hydrocarbon contents (from 1105 ppm to 1790 ppm) are noted in the interval 11090' to 11810'. Gas chromatography reveals a mature alkane distribution, indicating the presence of migrated oil. A mature equivalent of the interval between 10677' and 11167' could generate such an oil.

GEOCHEMICAL CHARACTERISTICS OF THE REMAINING SEDIMENTS

The shales in the interval 10430' to 10660' contain insufficient organic carbon to generate significant quantities of hydrocarbons. The sandstones between 11431' and 12680' (T.D.) similarly lack source potential; shales in samples from between these depths are caved. The coaly horizons occurring between 11270' and 11431' could generate gas at a much elevated level of thermal maturity.

SAMPLE DEPTH (FEET)	SAMPLE TYPE	GENERALISED LITHOLOGY	SPORE COLOUR INDEX (1-10)	VITRINITE REFLECTIVITY IN OIL, R av%	KEROGEN COMPOSITION (%) (by microscopic examination)			KEROGEN COMPOSITION (%) (by calculation from pyrolysis data)			
					INERTINITE	VITRINITE	SAPROPEL	INERTINITE	VITRINITE	ALGAL SAPROPEL	WAXY SAPROPEL
10430-490	Ctgs	SH, gn-gy+10% SH, med gy+10% SH, blk-red+mnr LST, wht+mnr SST, wht	*	0.32(7); 0.51(2)	40	30	30	20	80	*	*
	P	SH, med gy						20	80	*	*
10600-660	Ctgs	SH, blk-gy+40% SH, gn-gy						40	60	*	*
10680-800	"	SH, ol-gy+40% SH, a/a+10% SH, a/a	*	0.42(3)	20	20	60	15	70	*	15
	P	SH, blk-gy						30	70	*	*
10910-990	Ctgs	SH, blk-red+20% SH, ol-gy+20% SLTST, brn-blk						40	50	*	10
11020-080	"	SH, dk gy+30% SH, blk-red+10% SH, gn-gy	3.5	0.37(5); 0.30(16); 0.53(2); 0.82(1)	60	20	20				
	P	SH, dk gy						35	35	*	30
11090-130	Ctgs	SH, a/a+30% SH, blk-red+20% SH, gn-gy						30	60	*	10
11250-300	"	SH, a/a+30% SH, a/a+10% SH, a/a						50	45	*	5
11330-420	"	SH, a/a+20% SH, a/a+10% SH, a/a	3.5-4	0.41(1); 0.31(4); 0.59(6)	60	20	20				
	P	SH, dk gy						45	30	*	25
11430-490	Ctgs	SH, a/a+20% SH, blk-red+mnr SH, gn-gy						40	45	*	15
11510-570	"	SH, a/a+20% SH, a/a+10% SH, a/a +mnr SST, wht						30	60	*	10
	P	SH, dk gy						50	15	*	35
11580-650	Ctgs	SH, a/a+20% SH, blk-red+mnr SH, gn-gy+10% SST, a/a						25	70	*	5
	P	SH, dk gy						60	10	*	30
11670-730	Ctgs	SH, a/a+20% SH, blk-red+mnr SH, gn-gy+mnr SST, a/a						45	45	*	10
	P	SH, dk gy						65	5	*	30
11740-810	Ctgs	SH, a/a+20% SH, blk-red+mnr SH, gn-gy+mnr SST, a/a	3.5-4	0.32(5); 0.57(9)	60	20	20	25	65	*	10
	P	SH, dk gy						40	25	*	35

TABLE 1 Maturity and Kerogen Data

GENERAL DATA			CHEMICAL ANALYSIS DATA											
SAMPLE DEPTH (FEET)	SAMPLE TYPE	ANALYSED LITHOLOGY	ORGANIC CARBON % OF ROCK	PYROLYSIS					SOLVENT EXTRACTION					
				TEMP - ERATURE °C	HYDROGEN INDEX	OXYGEN INDEX	PRODUCTION INDEX	POTENTIAL YIELD (ppm)	TOTAL EXTRACT (ppm)	HYDRO- CARBONS (ppm)	EXTRACT % OF ORGANIC CARBON	HYDROCARBONS		ALKANES % OF HYDRO- CARBONS
												mg/g OF ORGANIC CARBON	% OF EXTRACT	
10430-490	Ctgs	SH, gn-gy+10% SH, med gy+10% SH, blk-red+mnr LST, wht+mnr SST, wht	0.42	438	111	174	0.1	500						
	P	SH, gn-gy	0.35											
	P	SH, med gy	1.04	436	124	48	0.1	1300						
10500-570	Ctgs	SH, blk-gy+30% SH, gn-gy	0.26											
10600-660	"	SH, a/a+40% SH, a/a	0.56	438	68	139	0.03	400						
10680-800	"	SH, ol-gy+40% SH, blk-gy+10% SH, gn-gy	1.93	436	207	43	0.1	4000						
	P	SH, blk-gy	1.66	438	136	44	0.1	2300						
10910-990	Ctgs	SH, blk-red+20% SH, ol-gy+20% SLTST, brn-blk	1.38	438	132	77	0.1	1800						
11020-080	"	SH, dk gy+30% SH, blk-red+10% SH, gn-gy	-											
	P	SH, dk gy	4.10	440	276	19	0.1	11300						
11090-130	Ctgs	SH, a/a+30% SH, blk-red+20% SH, gn-gy	3.02	437	165	32	0.2	5000	3065	1570	10.2	52	51	55
11250-300	"	SH, a/a+30% SH, a/a+10% SH, a/a	4.61	441	111	24	0.1	5100						
11330-420	"	SH, a/a+20% SH, a/a+10% SH, a/a	-											
	P	SH, dk gy	4.73	440	232	16	0.1	11000						
11430-490	Ctgs	SH, a/a+20% SH, blk-red+mnr SH, gn-gy	3.38	442	177	24	0.1	6000						
11510-570	"	SH, a/a+20% SH, a/a+10% SH, a/a+mnr SST, wht	3.66	435	198	32	0.1	7300	3285	1790	9.0	49	55	68
	P	SH, dk gy	5.22	441	271	11	0.1	14100						
11580-650	Ctgs	SH, a/a+20% SH, blk-red+mnr SH, gn-gy+10% SST, a/a	2.65	434	178	35	0.2	4700	2450	1365	9.2	92	56	72
	P	SH, dk gy	8.79	443	203	8	0.1	17800						
11670-730	Ctgs	SH, a/a+20% SH, blk-red+mnr SH, gn-gy+mnr SST, a/a	3.65	434	177	24	0.1	6500	3445	1655	9.5	94	48	58
	P	SH, dk gy	13.90	444	196	5	0.04	27200						
11740-810	Ctgs	SH, a/a+20% SH, blk-red+mnr SH, gn-gy+mnr SST, a/a	2.42	437	189	33	0.2	4600	2600	1105	10.7	46	43	71
	P	SH, dk gy	3.58	443	255	14	0.1	9100						

TABLE 2 Chemical Analysis Data

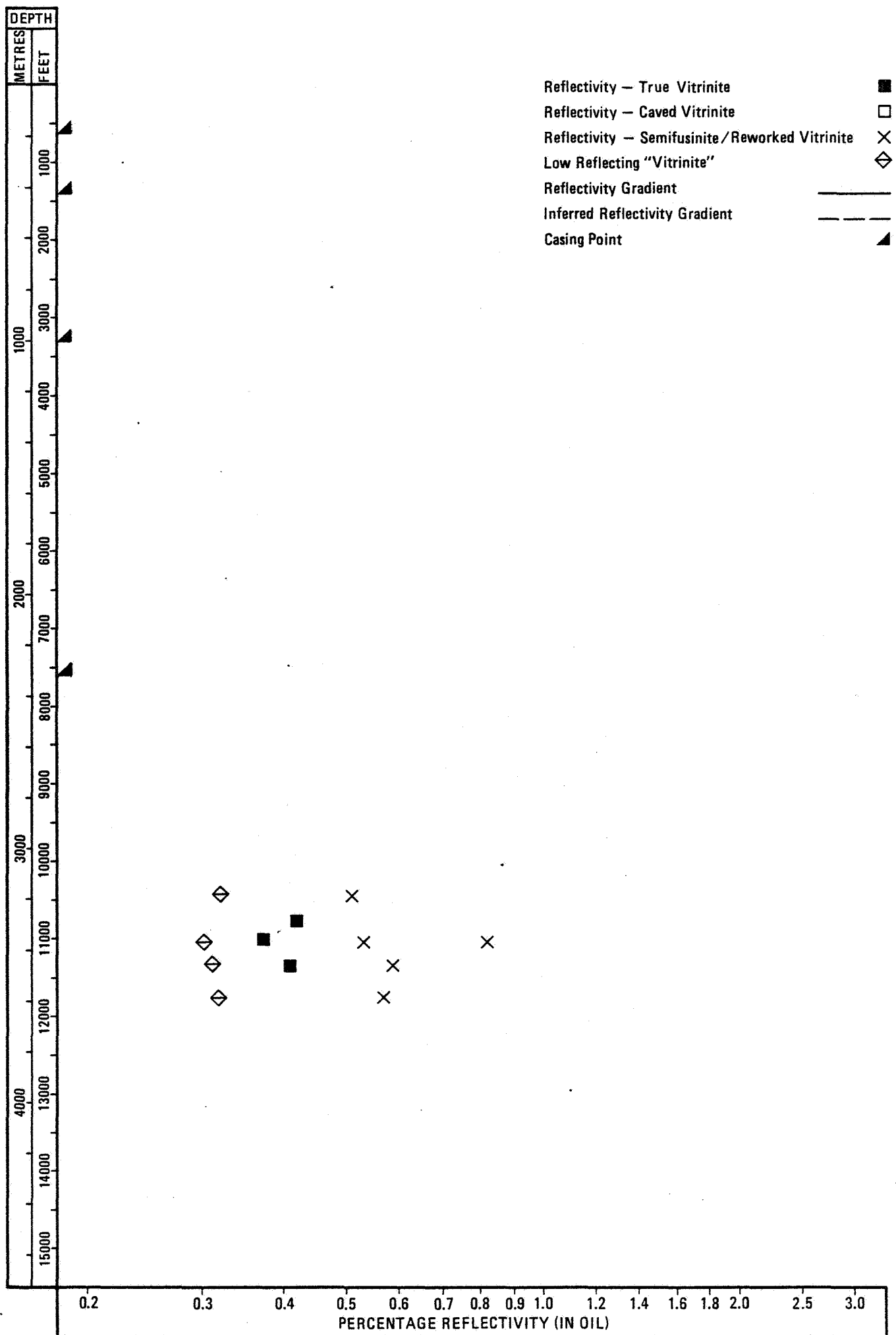


FIGURE 2 Vitrinite Reflectivity against Depth

ROBERTSON RESEARCH INTERNATIONAL LIMITED

Project No. RRPS/8182/B/2043

NORWAY II STUDY - PRELIMINARY REPORT G31 (9/6/81)

PRELIMINARY PETROLEUM GEOCHEMISTRY RESULTS OF UK 30/24-4 WELL

SUMMARY

The analysed section, 9120' to 9840', is immature to early mature, but no oil source rocks have been identified. Oil shows were logged at 9220'-9270' and 9470'-9540' and shales from between 9120' and 9540' are stained with a light oil from a late mature source.

GENERAL COMMENTS

Well status: Plugged and abandoned, oil well.

Drilling data: Drilled with lime and water based muds to 10090' (T.D.).
Casing points at 441' (30"), 1315' (20"), 5988' (13 $\frac{3}{8}$ ").
BHT 188°F at 10090' (T.D.).

Interval analysed: 9120' to 9840' (T.D. 10090').

Age of analysed interval: Permian to Late Cretaceous.

Sample type and quality: 8 dried ditch cuttings samples of adequate quality.

Maturation data quality: Fair.

Source rock data quality: Fair.

Gas chromatography run at: 9210'-9270', 9480'-9540'.

MATURATION (Table 1; Figures 1 and 2)

The analysed interval has spore colour indices ranging from 3-3.5 to 3.5-4 and vitrinite reflectivities from 0.38% to 0.40%. These data are in reasonable accord with the BHT of 188°F at 10090' (T.D.) and indicate that the section is transitional from an immature to early mature state.

OIL SOURCE ROCKS (Tables 1 and 2)

No oil source rocks have been identified in the analysed section of this well.

GEOCHEMICAL CHARACTERISTICS OF THE SEDIMENTS

The analysed interval generally contains below average contents of organic matter, which is mostly inertinitic. Shales at 9120'-9180', 9290'-9360' and 9480'-9540' contain about 1% of organic carbon, but hydrogen indices of less

than 75 confirm their inertinitic nature.

Production indices of between 0.8 and 0.9 suggest the presence of migrated oil and solvent extraction, followed by gas chromatography, of two visually oil-stained samples shows a mature oil-like alkane distribution, indicating derivation from a source at a high level of maturity. This oil stain may be equated with the oil shows recorded at 9220'-9270' and 9470'-9540' on the mud log.

WELL: UK 30/24-4

SAMPLE DEPTH (FEET)	SAMPLE TYPE	GENERALISED LITHOLOGY	SPORE COLOUR INDEX (1 - 10)	VITRINITE REFLECTIVITY IN OIL, R _{av} %	KEROGEN COMPOSITION (%) (by microscopic examination)			KEROGEN COMPOSITION (%) (by calculation from pyrolysis data)			
					INERTINITE	VITRINITE	SAPROPEL	INERTINITE	VITRINITE	ALGAL SAPROPEL	WAXY SAPROPEL
9120-180	Ctgs	CHK+30% SH, ol-gy +10% SH, dk gy+ mnr SH, gy-red	3-3.5	$\frac{0.38}{0.51}$ (7) (4)	20	60	20	85	10	mnr	mnr
9290-360	"	CHK+30% SH, a/a +30% SH, a/a+10% SH, a/a	3-3.5	$\frac{0.40}{0.53}$ (7) (3)	20	60	20				
	P	SH, dk gy						70	30	*	*
9390-450	Ctgs	CHK+40% SH, ol- gy+20% SH, a/a+ mnr SH, gy-red	3.5	$\frac{0.40}{0.54}$ (6) (4)	80	20	mnr				
9420-450	"	A/a	3.5		20	80	*				
9480-540	"	SH, a/a+10% SH, a/a+10% CHK						75	25	*	*
9540-570	"	A/a	3-3.5		*	*	*				
9660-690	"	A/a	3-3.5		*	*	*				
9690-750	"	SH, a/a+mnr SH, a/a+10% CHK	3.5-4	*	60	20	20				

TABLE 1 Maturity and Kerogen Data

GENERAL DATA			CHEMICAL ANALYSIS DATA												
SAMPLE DEPTH (FEET)	SAMPLE TYPE	ANALYSED LITHOLOGY	ORGANIC CARBON % OF ROCK	PYROLYSIS					SOLVENT EXTRACTION						
				TEMP - ERATURE °C	HYDROGEN INDEX	OXYGEN INDEX	PRODUCTION INDEX	POTENTIAL YIELD (ppm)	TOTAL EXTRACT (ppm)	HYDRO- CARBONS (ppm)	EXTRACT % OF ORGANIC CARBON	HYDROCARBONS		ALKANES % OF HYDRO- CARBONS	
9120-180	Ctgs	CHK+30% SH, ol-gy+10%SH, dk gy+mnr SH, gy-red	1.00	440	44	144	0.8	400							
9210-270	"	CHK+40% SH, a/a+20% SH, a/a+ mnr SH, a/a	0.77												
9290-360	"	CHK+30% SH, a/a+30% SH, a/a+ 10% SH, a/a	0.75												
	P	SH, dk gy	1.17	442	73	88	0.8	900							
9390-450	Ctgs	CHK+40% SH, ol-gy+20% SH, a/a +mnr SH, gy-red	0.65												
	P	SH, dk gy	0.70												
9480-540	Ctgs	SH, ol-gy+10% SH, a/a+tr SH, gy-red+10% CHK+tr SND	1.01	441	58	209	0.9	600							
9570-660	"	SH, a/a+mnr SH, a/a+mnr SH, a/a+20% CHK+tr SND	0.67												
9690-750	"	SH, a/a+mnr SH, a/a+mnr SH, a/a+10% CHK+mnr SND	0.54												
9780-840	"	SND+30% SH, a/a+mnr SH, a/a +mnr SH, a/a+tr CHK	0.31												

TABLE 2 Chemical Analysis Data

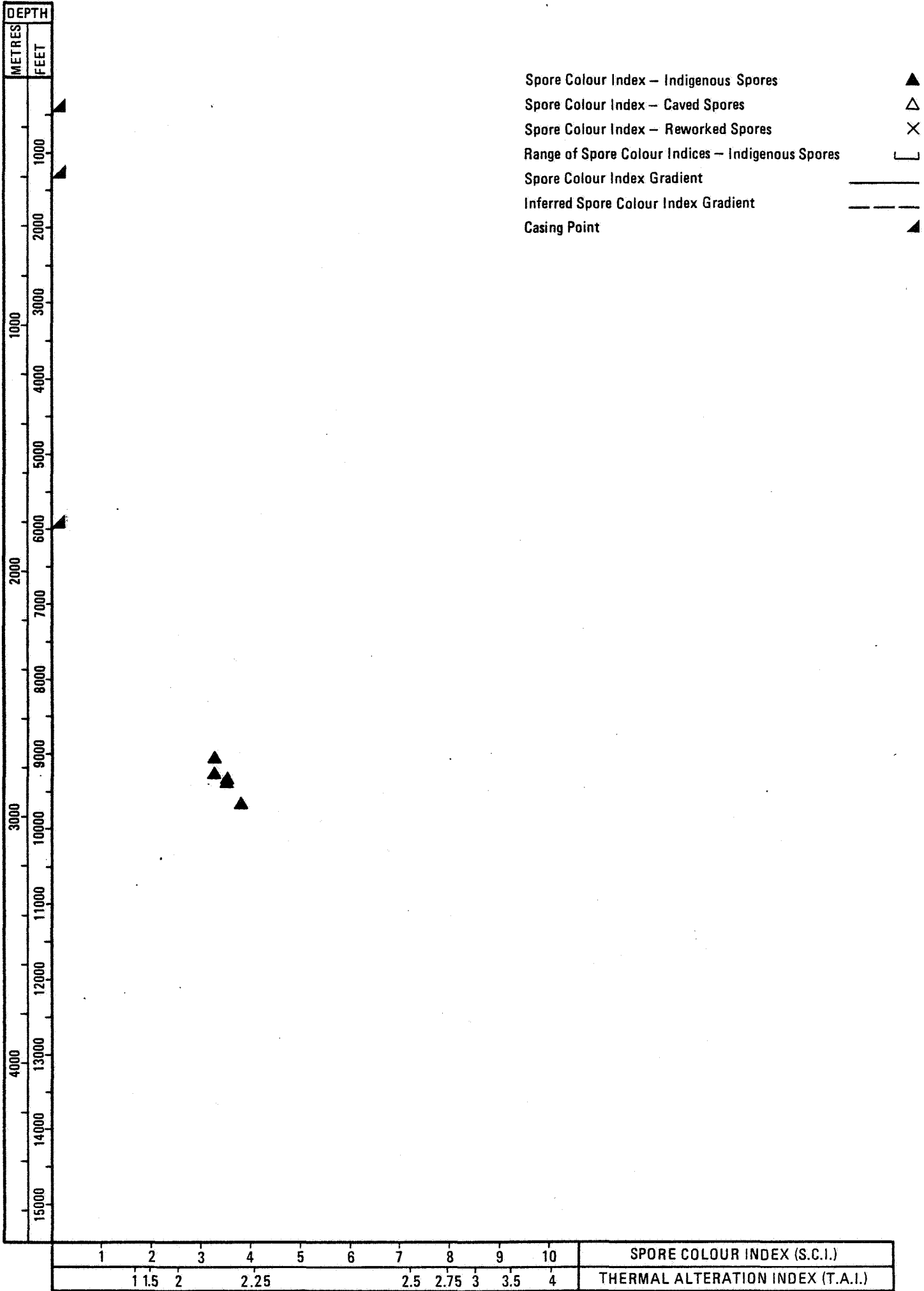


FIGURE 1 . Spore Colour Indices against Depth

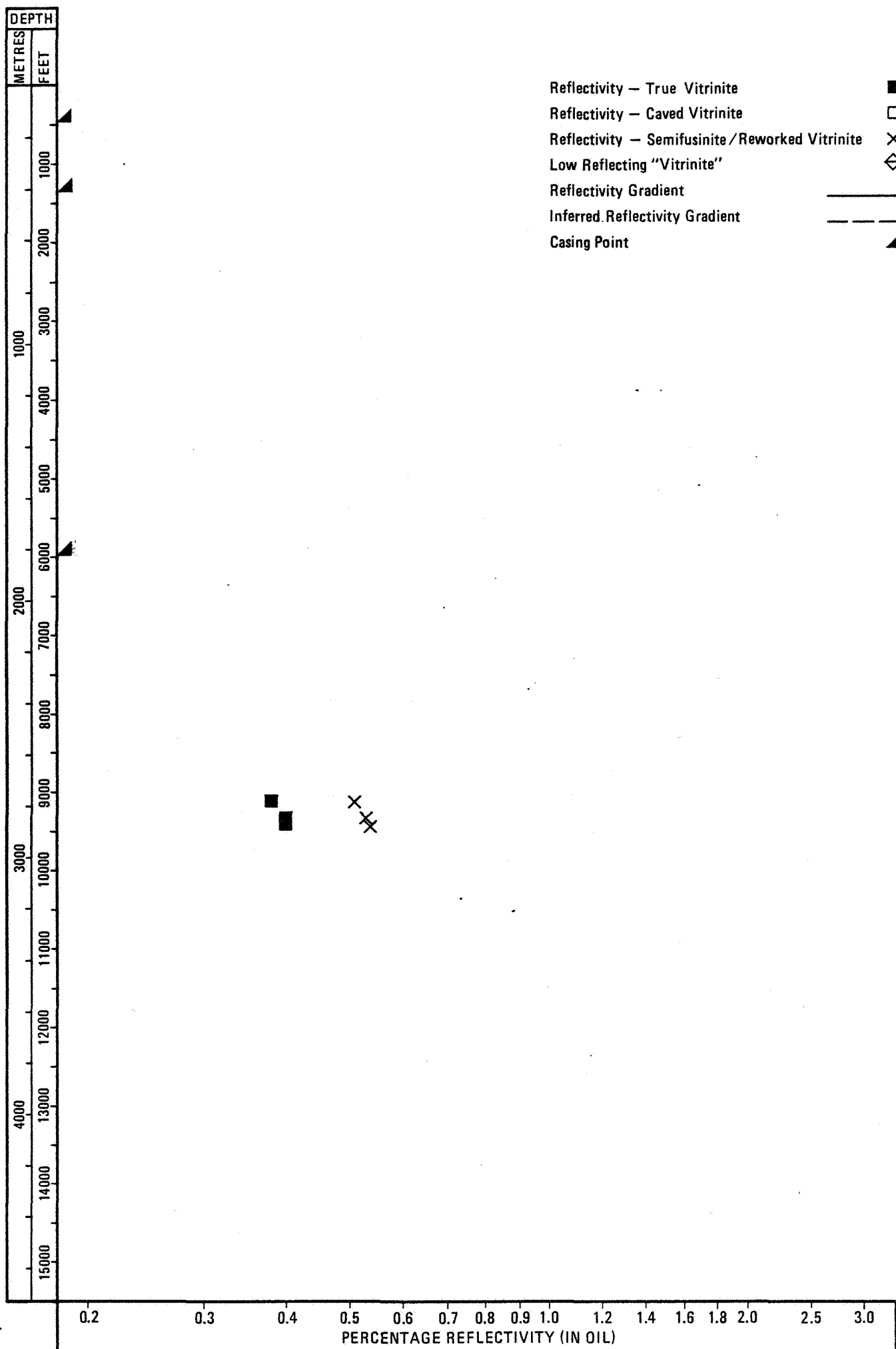


FIGURE 2 Vitrinite Reflectivity against Depth