

ROBERTSON RESEARCH INTERNATIONAL LIMITED

NORWEGIAN OFFSHORE AREA - PRELIMINARY REPORT NO. 2B

Project No. RRI/789/IIB/2676

PRELIMINARY RESULTS OF PETROLEUM GEOCHEMICAL STUDIES
OF THE AMOCO NORWAY 7/3-1 WELL.

9th JUNE, 1978

I

RECORDS
AND DATA
Location: NOCS 7/3-1 W 25
ID: 36693

INTRODUCTION

Petroleum geochemical studies have been carried out on samples received from the Amoco Norway 7/3-1 well. The samples were received at 30 feet intervals reducing to 20 and then 10 feet intervals from below the 36" casing shoe at 510 feet. Samples were selected for analysis below 2770 feet in the Middle - Lower Miocene by compositing at 60 feet intervals but dependant on lithological and log data. Samples were washed with cold water as necessary to remove drilling mud, and air dried at 50° C.

Relevant drilling information for this well is as follows:-

36" casing	-	480 feet below K. B.
20" casing	-	1220 feet below K. B.
13 ³ / ₈ " casing	-	5050 feet below K. B.

131

9⁵/₈" casing - 8886 feet below K. B.

T. D. - 15416 feet below K. B.

The well was drilled with a normal water-based mud to below the 9⁵/₈" casing where the mud was converted to an invert oil emulsion mud at 8975 feet to drill the thick salt section. Below the 20" casing small amounts of oil were used in the mud, ranging from 0% to 2%. A high mud weight was used in the salt interval and diamond drilling bits were used sporadically. Three cores were cut; core 1 at the base of the Zechstein and cores 2 and 3 in the Rotliegendes, and these consisted of reddened silty shales and sandstones/siltstones.

The samples selected were of good quality for geochemical analysis. The analytical procedures used include organic carbon analysis on all the samples between 2770 and 8950 feet and on individual lithologies where bulk samples contained more than one lithotype. Extractive source rock analysis has been carried out on samples containing more than 0.5% carbon at approximately 250 foot intervals and organic carbon contents have been determined both before and after extraction. Gas chromatography has been carried out on alkane fractions from samples containing more than 100 ppm of hydrocarbons. Pyrolysis source rock evaluation using the IFP/Fina ROCK-EVAL apparatus has been carried out on the same samples as have been used for extractive analysis and also on samples where insufficient material was available for extractive analysis and on samples of individual lithologies. Kerogen composition has been assessed on a semiquantitative basis by visual estimation of the kerogen components in unsieved, unoxidised, palynological preparations.

Maturity levels have been assessed in this study using principally spore colouration analysis on sieved, unoxidised, palynological preparations and vitrinite

reflectivity on kerogen concentrates. In assessing maturity level, reference may also be made to the temperatures of maximum pyrolysis rate.

II

RESULTS AND INTERPRETATION

The results of the various analyses carried on the 7/3-1 well are presented in Tables 1 to 3 and are represented graphically in Figures 1 to 4. Table 1 lists data on maturity level in the section along with the kerogen composition data for the same samples. The spore colouration and vitrinite reflectivity trends with depth are shown in Figures 1 and 2 respectively. Table 2 lists the organic carbon and extractive source rock evaluation data which pyrolysis data are presented in Table 3. Pyrolysis data are represented graphically against depth in Figures 3 and 4. A detailed graphic compilation of all the data will be presented later in the compilation report.

MATURITY DATA

Our assessment of the spore colouration data is that the Tertiary interval of the well is immature and an early stage of maturity is only reached below the Chalk in the Lower Cretaceous. Results in the Upper Jurassic interval are anomalous and it is considered that these sediments are also at an early stage of maturity. Samples analysed between 10180 and 10440 feet consisted of grey shales of Zechstein age within the salt section. The values obtained at spore colour index of 4 to 4.5, indicate a mature status for the interval. The one result obtained deeper in the well in the basal Zechstein at 13175 feet indicates a much higher level of maturity for this lower part of the section. No spores were observed in samples from the Rotliegendes or Carboniferous intervals.

Vitrinite reflectivity data give a trend rising from about 0.3% at about 2800 feet to about 0.45% at the base of the Tertiary at about 6000 feet. A value of 0.35%, which we consider can indicate the onset of maturity for oil generation in a Tertiary basin, is reached at about 4000 feet. The reflectivity level in the Lower Cretaceous/Upper Jurassic interval, is poorly defined as little clearly identified vitrinite was seen in this interval.

It is notable that the reflectivity values appear to indicate that a considerable thickness of later Tertiary section is missing above about 3000 feet.

HYDROCARBON SOURCE POTENTIAL EVALUATION

On the basis of the geochemical data obtained, the following breakdown of the analysed interval of the 7/3-1 well is made :-

Interval 2770 to 6160 feet - Organic carbon content in this interval is well above average for the most part with only the interval below 5800 feet having about average carbon contents. The organic matter is predominantly humic and in particular is vitrinitic. The interval is presently immature for significant hydrocarbon generation. However, both extractive and pyrolysis source rock evaluation have indicated the presence of minor amounts of contaminant hydrocarbons in this interval.

It is possibly of interest that some indications of the presence of sapropelic organic matter have been recorded in about the interval 3500 to 3800 feet. This interval is being investigated more fully at present.

- Interval 6160 to 7810 feet - Chalk - this interval is represented by chalk with widely varying amounts of caved lower Tertiary shales. The interval does not constitute a potential hydrocarbon source.
- Interval 7810 to 8530 feet - Organic carbon content in this interval of mottled marls and shales is well below average. Organic matter is predominantly humic and consists of both inertinitic and vitrinitic organic matter. Hydrocarbon generating potential in this interval is very poor but there is evidence of traces of contaminating migrant oil.
- Interval 8530 to 8830 feet - Lithologically this interval consists of dark grey shales and sands although the samples examined were contaminated by caved shales and limestones. Organic carbon content in the upper shale interval is well above average at about 6%. The organic matter is predominantly sapropelic but with significant amounts of humic material being seen in kerogen slides and confirmed by pyrolysis data and by gas chromatography of the alkane fractions.

The 200 feet thick shale down to about 8710 feet is believed to be at an early stage of maturity so that significant quantities of heavy to medium gravity oil may be sourced from the potentially good source rock interval. However the shales interbedded with sands below this depth seem to have poor source potential.

Interval 8830 to 8950 feet

- Samples in this interval consisted of predominantly dolomite and anhydrite with minor shales which are believed to be caved. The interval can have no hydrocarbon source potential.

Interval 8950 to 14455 feet

- this interval is predominantly Zechstein salt although there are several thin horizons of reddened shale present at about 10300 feet and also at the base of the Zechstein at around 14300 feet. This interval will have no significant source potential.

Interval 14455 to 15395 feet

- Rotliegendes shales and sands which have no hydrocarbon source potential.

Interval 15395 to 15416 feet

- Carboniferous - no hydrocarbon source potential.

TABLE 1a

MATURITY EVALUATION DATA

WELL: 7/3-1

LOCATION NORWEGIAN NORTH SEA

SAMPLE DEPTH (FEET)	SAMPLE TYPE	GENERALISED LITHOLOGY	SPORE COLOUR INDEX (I-M)	VITRINITE REFLECTIVITY IN OIL, R _{av} %	KEROGEN COMPOSITION (%)		
					INERTINITE	VITRINITE	SAPROPEL
2770-830	Ctgs	Dk gy sh	1.5	0.31(3)	15	85	*
2830-890	"	Ditto	-	*	-	-	-
3010-070	"	Ditto	-	0.34(30)	-	-	-
3130-190	"	Ditto	2	*	15	85	*
3370-430	"	Ditto	-	0.34(28)	-	-	-
3430-490	"	Ol-gy sh	2	*	15	85	*
3610-670	"	Ditto	-	0.32(19)	-	-	-
3730-790	"	Ditto	2.5	*	15	85	*
3850-910	"	Ditto	-	0.32(26)	-	-	-
4030-090	"	Ditto	2.5	*	15	85	*
4210-270	"	Ditto	-	0.35(31)	-	-	-
4330-390	"	Ditto	2.5	*	15	85	*
4510-570	"	Ditto	-	0.37(27)	-	-	-
4630-690	"	Ditto	2.5-3	*	15	85	*
4870-930	"	Ditto	3	*	15	85	*
4930-990	"	Ditto	-	0.42(25)	-	-	-
5110-170	"	Dk gy sh	2.5-3	0.44(5)	15	85	*
5410-470	"	Gn-gy sh	2.5	0.42(3)	15	85	*
5470-530	"	Med gy/ol-gy sh	-	0.42(27)	-	-	-
5650-710	"	Ditto	3	0.44(5)	15	85	*
5710-770	"	Ditto	-	0.41(7)	-	-	-
5890-950	"	Ol-gy sh	2.5-3	0.46(4)	15	85	*
6070-130	"	Ditto	3-3.5	0.51(3)?	15	85	*
7810-870	"	Bl-gy sh	3.5	0.40(3)?	15	85	*
8050-110	"	Red-brn marl+mtl sh	3.5-4	0.52(3)	50	50	*
8170-230	"	Ditto	-	*	-	-	-
8290-350	"	Med-dk gy sh	3.5-4	0.53(1)?	50	50	*

MATURITY EVALUATION DATA

WELL: 7/3-1

LOCATION: NORWEGIAN NORTH SEA

SAMPLE DEPTH (FEET)	SAMPLE TYPE	GENERALISED LITHOLOGY	SPORE COLOUR INDEX (I-IX)	VITRINITE REFLECTIVITY IN OIL, R _{ov} %	KEROGEN COMPOSITION (%)		
					INERTINITE	VITRINITE	SAPROPEL
8530-590	Ctgs	Dk gy sh	4	0.50(1)?	20	20	60?
8650-710	"	Ditto	2.5-3	0.56(2)?	20	20	60?
8830-890	"	Dol+sh	2.5-3	*	20	20	60?
10180-210	"		4.5	*	70	30	*?
10380-440	"		4	0.53(2)?	70	30	*
13620-680	"		*	*	*	*	*
13860-920	"		*	*	*	*	*
14100-160	"		*	*	*	*	*
14280-340	"		*	*	*	*	*
14375-385	Core 1		7	0.52(2)?	80	15	5
14920-930	Core 3		*	*	100	*	*
15070-130	Ctgs		*	*	*	*	*
15370-410	"		*	0.67(1)?	*	*	*

SOURCE ROCK EVALUATION DATA

WELL: 7/3-1

LOCATION: NORWEGIAN 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
2770 -830	Ctgs	Med-dk gy/ol-gy/brn-gy slty sh	2.83					
2830- 890	"	Ditto	2.91					
2890- 950	"	Ditto (Extracted Rock)	4.72 4.84	3625	7.7	840	23	70
2950-3010	"	Gn-gy/brn-gy/ol-gy/ med-dk gy slty sh	3.77					
3010- 070	"	Ditto	4.33					
3070- 130	"	Ditto	4.22					
3130- 190	"	Dk gy/ol-blk slty sh (Extracted Rock)	5.75 5.46	5325	9.3	485	9	49
3190- 250	"	Ol-gy slty sh	3.68					
3250- 310	"	Dk gy slty sh	6.13					
3310- 370	"	Ol-gy/dk gy slty sh (Extracted Rock)	4.14 3.88	8815	21.0	2480	28	88
3370- 430	"	Ditto	3.56					
3430- 490	"	Ol-gy slty sh	3.34					
3490- 550	"	Ditto (Extracted Rock)	4.06 3.50	9140	22.0	3200	35	87
3550- 610	"	Ditto	2.97					
3610- 670	"	Ditto	3.24					
3670- 730	"	Ditto	3.33					
3730- 790	"	Ditto	4.10					
3790- 850	"	Ditto (Extracted Rock)	3.63 3.26	11515	32.0	3885	34	81
3850- 910	"	Ditto	3.23					
3910- 940	"	Ditto	2.31					
3940- 970	"	Ditto	2.78					
3970-4030	"	Ditto	2.51					

SOURCE ROCK EVALUATION DATA

WELL: 7/3-1

LOCATION: NORWEGIAN NORTH SEA

SAMPLE DEPTH (FEET) OR NOTATION	SAMPLE TYPE	ANALYSED LITHOLOGY	ORGANIC CARBON % OF ROCK	TOTAL EXTRACT PPM	EXTRACT % OF ORGANIC CARBON	HYDRO- CARBONS P.P.M. OF ROCK	HYDRO- CARBONS % OF EXTRACT	TOTAL ALKANES % HYDRO- CARBONS
4030- 090	Ctgs	Ol-gy slty sh (Extracted Rock)	3.04 2.52	11555	38.0	3800	33	89
4090- 150	"	Ditto	2.80					
4150- 210	"	Ditto	3.17					
4210- 270	"	Ditto	2.41					
4270- 330	"	Ditto	2.52					
4330- 390	"	Ditto	3.72					
4390- 450	"	Ditto	3.57					
4450- 510	"	Ditto	3.58					
4510- 570	"	Ditto	3.66					
4570- 630	"	Ditto (Extracted Rock)	3.94 3.68	4240	11.0	1300	31	86
4630- 690	"	Ditto	4.28					
4690- 750	"	Ditto	3.26					
4750- 810	"	Ditto	4.14					
4810- 870	"	Ditto (Extracted Rock)	4.95 4.77	6850	14.0	2050	30	72
4870- 930	"	Ditto	5.26					
4930- 990	"	Ditto	5.06					
4990-5050	"	Ditto	5.32					
5050- 110	"	Ditto	5.53					
5110- 170	"	Dk gy sl slty sh + mmr ol-gy slty sh	5.77					
5170- 230	"	Med-dk gy sl slty sh + mmr ol-gy/dk gy sh + mmr med brn lst	3.84					
5230- 290	"	V lt gy marl/med brn lst + mmr ol-gy/dk gy sh	2.01					

SOURCE ROCK EVALUATION DATA

WELL: 7/3-1

LOCATION: NORWEGIAN NORTH SEA

SAMPLE DEPTH (FEET) OR NOTATION	SAMPLE TYPE	ANALYSED LITHOLOGY	ORGANIC CARBON % OF ROCK	TOTAL EXTRACT P.P.M.	EXTRACT % OF ORGANIC CARBON	HYDRO- CARBONS P.P.M. OF ROCK	HYDRO- CARBONS % OF EXTRACT	TOTAL ALKANES % HYDRO- CARBONS
5290- 350	Ctgs	V lt gy marl/med brn lst + mnr ol-gy/dk gy sh	2.19					
5350- 410	"	Ditto + ditto	1.60					
5410- 470	"	Lt gn-gy marl/med brn lst + mnr med gy sh	1.95					
5470- 530	"	Med gy sl slty sh/ol- gy slty sh + mnr gn-gy marl/med brn lst	3.07					
5530- 590	"	Gn-gy/red-brn marl + dk gy/gn gy/gy-blk slty sh + mnr chk	3.16					
5590- 650	"	Gn-gy/red-brn marl+ dk gy/red-brn/lt gn slty sh	3.29					
5650- 710	"	Gn-gy marl + gn-gn slty sh/dk gy sh + mnr red-brn/ol-gy sh	3.09					
5710- 770	"	Med gy/ol-gy sh + mnr gn-gy/red-brn sh/med brn lst	2.44					
5770- 800	"	Ol-gy sh + mnr gn-gy sh/med brn lst	3.98					
5800- 830	"	Ol-gy sh	1.09					
5830- 890	"	Ditto	1.14					
5890- 950	"	Ditto	1.22					
5950-6010	"	Ditto	0.75					
6010- 070	"	Ditto	1.72					
6070- 130	"	Ditto	1.51					
6130- 160	"	Ditto	0.89					
6160- 220	"	Wht chk + mnr mtl gy/ gy-red sh + mnr med brn lst	0.33					

SOURCE ROCK EVALUATION DATA

WELL 7/3-1

LOCATION: NORWEGIAN 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
6220- 280	Ctgs	Wht chk + mmr mt1 gy/ gy-red sh gy-brn sh	0.30					
6280- 340	"	Ditto + ditto	0.35					
6340- 400	"	Wht chk + 20% bl-gy sh	0.28					
6400- 460	"	Ditto + 15% ditto + mmr ol-gy/lt gn-gy/red- brn sh	0.23					
6460- 520	"	Ditto + ditto + ditto	0.22					
6520- 580	"	Ditto + 10% ditto	0.13					
6580- 640	"	Ditto + 10% ditto mmr red/ol-gy sh	0.20					
6640- 700	"	Ditto + ditto + ditto (Extracted Rock)	0.30 0.32	930	31.0	145	16	82
6700- 760	"	Bl-gy sh + 15% wht chk + mmr ol-gy/gn-gy sh	0.29					
6760- 820	"	Ditto + ditto + ditto	0.49					
6820- 880	"	Wht chk + 40% bl-gy/ ol-gy/red-brn/med-dk gy sh (Extracted Rock)	0.65 0.63	1350	21.0	110	8	61
6880- 940	"	Wht/pnk-gy chk + mmr bl-gy/med gy/lt gn-gy/ ol-gy sh	0.16					
6940-7000	"	Ditto + 10% ditto	0.24					
7000- 060	"	Ditto + mmr pale red marl + mmr bl-gy/ol- gy/med gy sh	0.41					
7060- 100	"	Ditto + ditto	0.24					
7130- 190	"	Ditto + ditto	0.34					
7190- 250	"	Ditto + ditto	0.30					
7250- 310	"	Ditto + mmr mt1 gy-red /bl-gy calc sh/marl	0.68					

SOURCE ROCK EVALUATION DATA

WELL 7/3-1

LOCATION NORWEGIAN 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
7310- 370	Ctgs	Bl-gy sh + 30% wht/pnk -gy chk + mmr gn-gy/ ol-gy sh	0.73					
7370- 450	"	Bl-gy/gn-gy/ol-gy sh + 15% wht/pnk-gy chk + mmr pale red marl (Extracted Rock)	0.88 0.76	1290	15.0	135	11	68
7450- 510	"	Ditto + 25% ditto + ditto	0.67					
7510- 570	"	Ditto + 30% ditto + ditto	0.68					
7570- 630	"	Ditto + 40% ditto + ditto	0.41					
7630- 690	"	Wht/pnk-gy chk + 40% bl-gy/gn-gy/ol-gy sh	0.26					
7690- 750	"	Ditto + ditto	0.30					
7750- 810	"	Ditto + ditto	0.29					
7810- 870	"	Bl-gy/gn-gy/ol-gy sh + mmr wht/pnk-gy chk + mmr pale brn marl	0.98					
7870- 930	"	Ditto + ditto	0.53					
7930- 990	"	Ditto + ditto	1.42					
7990-8050	"	Pale brn marl+red-brn /ol-gy/med-dk gy sh + mmr pnk-gy chk	0.88					
8050- 110	"	Pale red-brn marl + mtl red-brn/bl-gy/ med gy sh	1.27					
8110- 170	"	Ditto + calc ditto	0.68					
8170- 230	"	Dk gn-gy/red-brn calc sh + mmr ol-gy/dk gy sh + mmr chk	0.34					
8230- 290	"	Ditto + ditto	0.42					
8290- 350	"	Med-dk gy/dk gn-gy calc sh + mmr gn-gy sh + mmr chk	0.52					

SOURCE ROCK EVALUATION DATA

WELL: 7/3-1

LOCATION NORWEGIAN 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
8350- 410	Ctgs	Med-dk gy/dk gn-gy calc sh + mnr gn-gy sh + mnr chk	0.67					
8410- 470	"	Gy-red calc sh + mnr med-dk gy/gn-gy sh	0.50					
8470- 530	"	Ditto + mnr lt ol-gy/ med gy calc sh (Extracted Rock)	0.86 0.62	1035	12.0	290	28	61
8530- 590	"	Dk gy sh + 10% gy-red calc sh + mnr lt ol- gy lst (Extracted Rock)	3.15 2.73	1880	6.0	215	11	68
8590- 650	"	Ditto + ditto + ditto (Extracted Rock)	3.49 2.95	2240	6.4	460	21	76
8650- 710	"	Ditto + ditto + ditto (Extracted Rock)	6.46 5.52	6185	9.5	1235	20	65
8710- 770	"	Ditto + 40% gy-red calc sh+lt ol-gy glauc sst	2.87					
8770- 830	"	Dk gy sh + gy-red calc sh+lt ol-gy glauc sst	1.99					
8830- 890	"	Wht/pnk-gy dol/ anhydrite + mnr med- dk gy/red-brn calc sh (Extracted Rock)	1.82 1.73	855	4.7	385	45	53
8890- 950	"	Ditto + 30% dk gy/gn- gy/red-brn calc sh (Extracted Rock)	1.62 1.52	747	4.6	115	15	52

TABLE 2g

SOURCE ROCK EVALUATION DATA

WELL 7/3-1

LOCATION NORWEGIAN 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
		PICKED LITHOLOGIES						
3010- 070	Ctgs	Med-dk gy sh	4.98					
3070- 130	"	Ditto	4.70					
3130- 190	"	Dk gy sh	3.93					
3250- 310	"	Ditto	5.93					
5110- 170	"	Ditto	5.88					
5170- 230	"	Ditto	4.03					
5470- 530	"	Ol-gy slty sh	3.79					
5470- 530	"	Med gy slty sh	2.16					
5530- 410	"	Dk gy sh	4.80					
5530- 410	"	Chk	0.99					
6160- 220	"	Bl-gy sh	0.82					
6220- 280	"	Ditto	0.79					
6220- 280	"	Chk	0.14					
6340- 400	"	Bl-gy sh	0.62					
6340- 400	"	Chk	0.11					
6580- 640	"	Bl-gy sh	1.76					
6640- 700	"	Ditto	0.81					
6700- 760	"	Ditto	0.66					
6760- 820	"	Ditto	0.66					
6760- 820	"	Gn-gy sh	5.36					
7000- 060	"	Ol-gy sh	0.61					
7060- 100	"	Ditto	0.64					
7250- 310	"	Bl-gy sh	0.79					
7370- 450	"	Ditto	0.91					
7810- 870	"	Ditto	1.29					

SOURCE ROCK EVALUATION DATA

WELL 7/3-1

LOCATION NORWEGIAN 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
		PICKED LITHOLOGIES						
7810- 870	Ctgs	Chk	0.20					
8350- 410	"	Gn-gy sh	0.53					
8530- 590	"	Dk gy sh	2.96					
8530- 590	"	Gy-red sh	0.29					
8590- 650	"	Dk gy sh	3.51					
8650- 710	"	Ditto	6.22					
8710- 770	"	Ditto	6.74					
8830- 890	"	Ditto	4.73					
8890- 950	"	Ditto	5.15					

TABLE 3a

ROCK - EVAL. PYROLYSIS DATA

WELL: 7/3-1

LOCATION: NORWEGIAN NORTH SEA

SAMPLE DEPTH (FEET) OR NOTATION	GENERALISED LITHOLOGY	ORGANIC CARBON (%)	TEMPERATURE (°C)	HYDROGEN INDEX	OXYGEN INDEX	PRODUCTION INDEX	POTENTIAL YIELD (PPM)
2770- 830	Med-dk gy sh	2.83	421	25	45	0.04	800
2890- 950	Ditto	4.72	421	41	35	0.03	1900
3130- 190	Dk gy slty sh	5.75	403	24	22	0.16	1400
3310- 370	Ditto	4.14	416	39	19	0.84	1600
3490- 550	Ol-gy slty sh	4.06	416	45	19	0.83	1800
3790- 850	Ditto	3.63	421	48	37	0.82	1800
4030- 090	Ditto	3.04	420	45	21	0.91	1400
4330- 390	Ditto	3.72	431	30	14	0.83	1100
4570- 630	Ditto	3.94	425	50	14	0.72	2000
4810- 870	Ditto	4.95	429	55	16	0.57	2700
5050- 110	Ditto	5.53	428	46	28	0.64	2500
5290- 350	Lt gy marl+mmr dk gy sh	2.19	431	22	47	0.33	700
5530- 590	Gn-gy marl + dk gy sh	3.16	425	207	*	0.03	6000
5770- 800	Ol-gy sh	3.98	429	10	42	0.89	300
6010- 070	Ditto	1.72	429	4	54	0.75	100
6160- 220	Wht chk + mmr sh	0.33	413	5	79	*	*
6640- 700	Ditto + mmr sh	0.07	413	53	167	*	*
6820- 880	Ditto + 40% dk gy sh	0.65	431	53	85	*	300
7370- 450	Ol-gy sh + 15% chk	0.88	431	20	68	*	200
7810- 870	Ditto + mmr chk	0.98	425	23	75	*	200
8050- 110	Red-brn marl +mmr gy sh	1.27	438	30	142	0.06	500
8470- 530	Gy-red sh + mmr gy sh	0.86	425	26	112	0.09	200
8530- 590	Dk gy sh + 10% gy-red sh	3.15	428	146	67	0.04	4600
8590- 650	Ditto	3.49	425	176	58	0.04	6200

TEMPERATURE (°C) = TEMPERATURE AT MAXIMUM RATE OF PYROLYSIS
 PRODUCTION INDEX = AN ESTIMATE OF PRESENT HYDROCARBON GENERATING POTENTIAL
 COMPARED TO THAT AT OPTIMUM MATURITY
 POTENTIAL YIELD = AN ESTIMATE OF HYDROCARBON PRODUCTION AT OPTIMUM MATURITY

TABLE 3b

ROCK - EVAL. PYROLYSIS DATA

WELL: 7/3-1

LOCATION: NORWEGIAN NORTH SEA

SAMPLE DEPTH (FEET) OR NOTATION	GENERALISED LITHOLOGY	ORGANIC CARBON (%)	TEMPERATURE (°C)	HYDROGEN INDEX	OXYGEN INDEX	PRODUCTION INDEX	POTENTIAL YIELD (PPM)
8650- 710	Dk gy sh	6.46	419	208	56	0.04	13500
8710- 770	Ditto + 40% gy- red sh	2.87	428	160	86	0.06	5200
8770- 830	Ditto + ditto	1.99	416	14	64	*	300
8830- 890	Wht lstn/dol + mmr dk gy sh	1.82	*	*	210	*	*
8890- 950	Ditto + 30% dk gy sh	1.62	*	*	333	*	*
REPEAT ANALYSIS: EXTRACTED RESIDUES							
2890- 950	Med-dk gy sh	4.84	413	23	87	*	1100
3130- 190	Dk gy slty sh	5.46	401	17	83	*	900
3310- 870	Ditto	3.88	412	29	75	*	1100
3490- 550	Ol-gy slty sh	3.50	410	37	77	*	1300
3790- 850	Ditto	3.26	418	45	74	*	1500
4030- 090	Ditto	2.52	*	43	75	*	1100
4570- 630	Ditto	3.68	425	37	52	*	1400
4810- 870	Ditto	4.77	413	40	53	*	1900
6640- 700	Wht chk + mmr sh	0.32	421	18	105	*	< 100
6820- 880	Ditto + 40% sh	0.63	423	22	78	*	100
7370- 450	Ol-gy sh + 15% chk	0.76	422	22	82	*	200
8470- 530	Gy-red sh + mmr gy sh	0.62	423	40	41	*	300
8530- 590	Dk gy sh	2.73	420	222	88	*	6100
8590- 650	Ditto	2.95	429	257	67	*	7600
8650- 710	Ditto	5.52	415	264	65	*	14600
8830- 890	Wht lstn + mmr dk gy sh	3.35	426	62	99	*	2100

TEMPERATURE (°C) = TEMPERATURE AT MAXIMUM RATE OF PYROLYSIS
 PRODUCTION INDEX = AN ESTIMATE OF PRESENT HYDROCARBON GENERATING POTENTIAL
 COMPARED TO THAT AT OPTIMUM MATURITY
 POTENTIAL YIELD = AN ESTIMATE OF HYDROCARBON PRODUCTION AT OPTIMUM MATURITY

TABLE 3c

ROCK - EVAL. PYROLYSIS DATA

WELL: 7/3-1

LOCATION: NORWEGIAN NORTH SEA

SAMPLE DEPTH (FEET) OR NOTATION	GENERALISED LITHOLOGY	ORGANIC CARBON (%)	TEMPERATURE (°C)	HYDROGEN INDEX	OXYGEN INDEX	PRODUCTION INDEX	POTENTIAL YIELD (PPM)
8890- 950	Wht lstn + mmr dk gy sh + 30% gy sh	3.30	413	20	168	*	700
PICKED LITHOLOGIES							
3010- 070	Med-dk gy sh	4.98	413	36	123	*	1800
3130- 190	Dk gy sh	3.93	425	58	96	0.5	2300
5110- 170	Ditto	5.88	425	143	116	0.6	8400
5470- 530	Ol-gy slty sh	3.79	429	77	107	0.7	3900
5530- 590	Dk gy sh	4.80	438	80	136	0.7	3400
6580- 640	Bl-gy sh	1.79	431	28	121	*	500
6760- 820	Gn-gy sh	5.36	431	75	103	*	4000
7250- 310	Bl-gy sh	0.79	431	20	209	*	200
7810- 870	Ditto	1.29	419	40	128	*	500
8530- 590	Dk gy sh	2.96	433	305	76	0.02	9000
8590- 650	Ditto	3.51	427	340	142	0.01	4900
8650- 710	Ditto	6.22	420	457	55	0.06	28400
8710- 770	Ditto	6.74	431	458	47	0.05	30500
8830- 890	Ditto	4.73	430	208	89	0.06	9800
8890- 950	Ditto	5.15	426	472	84	0.03	24300

TEMPERATURE (°C) = TEMPERATURE AT MAXIMUM RATE OF PYROLYSIS
 PRODUCTION INDEX = AN ESTIMATE OF PRESENT HYDROCARBON GENERATING POTENTIAL
 COMPARED TO THAT AT OPTIMUM MATURITY
 POTENTIAL YIELD = AN ESTIMATE OF HYDROCARBON PRODUCTION AT OPTIMUM MATURITY

FIGURE 1 SPORE COLOURATION INDICES AGAINST DEPTH

WELL: 7/3-1

LOCATION: NORWEGIAN NORTH SEA

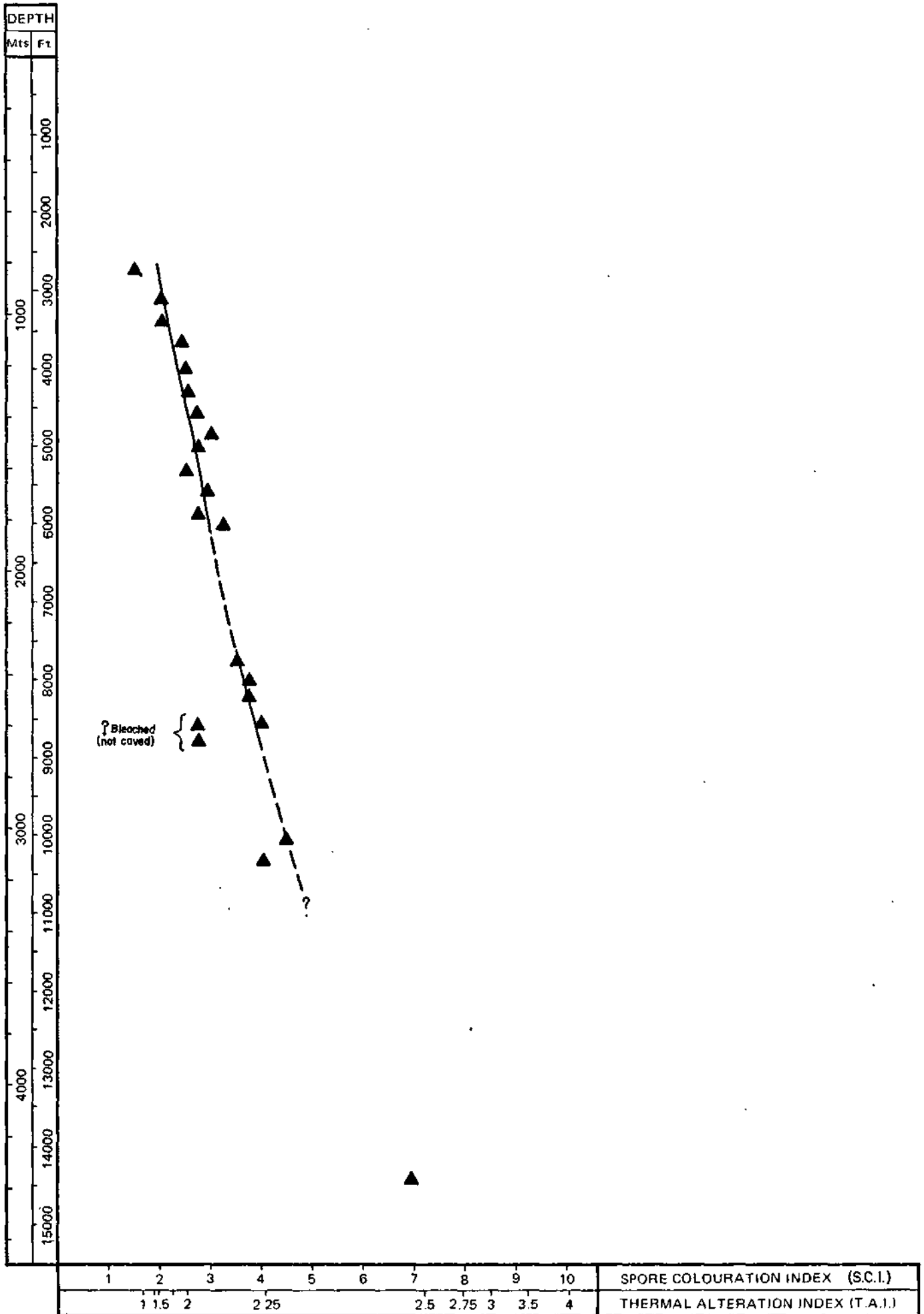


FIGURE 2 VITRINITE REFLECTIVITY AGAINST DEPTH

WELL: 7/3-1

LOCATION: NORWEGIAN NORTH SEA

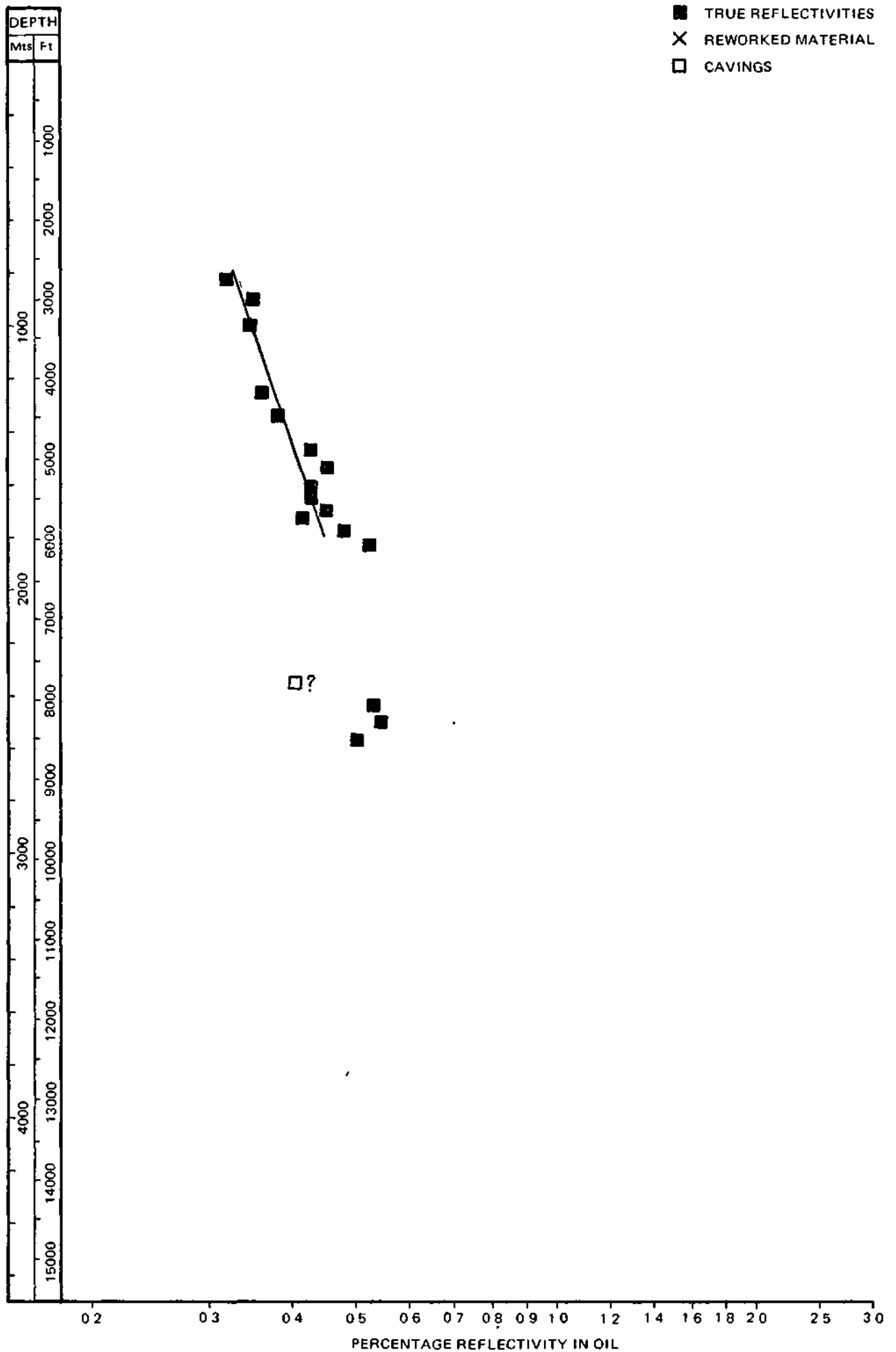


FIGURE 3

PYROLYSIS DATA SUMMARY CHART

WELL: 7/3-1

LOCATION: NORWEGIAN NORTH SEA

