ROBERTSON RESEARCH INTERNATIONAL LIMITED

REPORT No. 5082P/D

GEOCHEMICAL ANALYSES OF SAMPLES FROM THE 6407/1-2 WELL, HALTENBANK NORWEGIAN NORTH SEA

for

Statoil
P.O. Box 300
Forus
Stavanger
NORWAY

Project No. RRPS/834/D/25012

Statoil Contract No. T.4543

August, 1983

SUMMARY

Nine ditch cuttings samples from the interval 410m to 4400m in the 6407/1-2 Norwegian North Sea well have been analysed to determine total organic carbon content and maturity by spore colouration and vitrinite reflectivity. Tabulated data are presented.

I

INTRODUCTION

At the request of Dr Brian S. Cooper of B.S. Cooper and Associates acting on behalf of Statoil, Stavanger, Norway, total organic carbon, spore colouration

and vitrinite reflectivity analyses were carried out on ditch cuttings samples from the 6407/1-2, Haltenbank, Norwegian North Sea well. Samples were received into Robertson Research Limited, North Wales, laboratories on July 15th, 1983, and were washed, dried and described prior to analysis. Coal from the sample at 4400m was hand-picked for vitrinite reflectivity analysis and dark shale from 3900m for total organic carbon content determination. Preliminary maturity results were telephoned to B.S. Cooper on August 5th.

II

RESULTS

A. Spore Colouration (Tables 1 and 2, Figure 1)

Each of the nine samples was processed to isolate the kerogen for examination in transmitted light and sufficient residue was obtained for slide preparation although amounts were small from the samples at 410m and 2900m. The sample at 2402.5m contained mainly drilling additive. Results are summarised in Table 1 and analytical details given in Table 2. Kerogen composition by microscopic examination was determined from the spore colour preparation. Spore colouration results are plotted against depth in Figure 1. In the absence of stratigraphic data, no gradient has been drawn.

B. Vitrinite Reflectivity (Tables 1 and 3, Figure 2)

Processed kerogen residues, sieved through 20μ , were mounted in resin blocks and polished for examination in incident light. In addition, coal picked from the sample at 4400m was mounted directly in a resin block and polished to provide supplementary reflectivity and petrographic data. Results are summarised in Table 1 and analytical details of measured values and plotted histograms are shown in Table 3. Reflectivity values are plotted against depth in Figure 2, but in the absence of stratigraphic data, no gradient has been drawn.

C. Total Organic Carbon (Table 4)

Portions of selected samples and dark shale picked from the sample at 3900m were dried, crushed and analysed for organic carbon content. The results are listed in Table 4.

COMPANY: STATOIL **WELL:** 6407/1-2 **LOCATION:** NORWEGIAN NORTH SEA

SAMPLE DEPTH (METRES)	SAMPLE TYPE	GENERALISED LITHOLOGY	SPORE COLOUR INDEX (1 - 10)	VITRINITE REFLECTIVITY R oil av %	KEROGEN COMPOSITION (%) (by microscopic examination)			KEROGEN COMPOSITION (%) (by calculation from pyrolysis data)			
					INERTINITE	VITRINITE	SAPROPEL	INERTINITE	VITRINITE	ALGAL SAPROPEL	WAXY SAPROPEL
410	Ctgs	SST, lt gy, calc + 30% SST, yel-gy, calc	*	.26(2)	Prt	Prt	*				
900	"	MDST, ol-gy, calc+ 30% LCM	3.0	.33(38)	60	40	Mnr Incl Sp, Al				
1400	"	MDST, a/a + 40% LCM	3.0	.33(34)	60	40	Mnr				
1900	"	MDST, ol-gy+ 10% MDST, lt ol-gy+ mnr MDST, gy-orng	3.5	.31(20)	20	70?	10?				
2402.5	"	MDST, ol-gy+ 20% COAL+ 10% MDST, lt gn-gy+ 10% MDST, gy-red	3.5	.42(6)	40?	60?	Mnr				
2900	"	MDST, ol-blk+ tr MDST, lt gn-gy	*	.52(5)	Prt	Prt	*				
3400	"	SH, gy-blk+ tr MDST, lt gn-gy+ tr MDST, gy-red + tr SST, wht	4.5 - 5.0	.60(17)	90	10	*				
3900	"	SST, a/a + 20% SH, a/a	4.5 - 5.0	.52(35)	60	10	30 Incl Sp, Cu				
4400	"	COAL+ 30% SST, yel-gy+ 10% SH, a/a	7.0 5.0	.93(45)	30	70	Mnr Sp, Cu				
	P	COAL		.93(45)							

TABLE 1 Maturity and Kerogen Composition Data

COMPANY: STATOIL WELL: 6407/1-2 LOCATION: HALTENBANK
NORWEGIAN NORTH SEA

DEPTH (m)	COMMENTS
410	Poor sample. Fine orange-brown kerogen, non-fluorescent, probably humic. No measurable palynomorphs observed. Rare dinoflagellates pale yellow.
900	Humic kerogen. Inertinite dominant as small blocky to subangular fragments with poorly preserved, orange-brown vitrinite. Palynomorphs moderately abundant, particularly bisaccate pollen (occasionally thick/stained) small angiosperm pollen grains, pale colours.
1400	As above. Also minor amounts amorphous with spore and cuticle fragments, dull yellow-orange flecks of fluorescence.
1900	Amorphous kerogen dominant-yellow-orange/ yellow-brown, non-fluorescent, probably degraded humic.

TABLE 2A Spore Colouration - Analytical Details

COMPANY: STATOIL WELL: 6407/1-2 LOCATION: HALTENBANK
NORWEGIAN NORTH SEA

DEPTH (m)	COMMENTS
2402.5	Large, thick, opaque humic fragments, subrounded, probably additive. Subordinate degraded humic kerogen as 1900m. Occasional bisaccate pollen, rare spores.
2900	Poor sample. Pale brown aggregates fine amorphous kerogen. Non-fluorescent, probably degraded humic. No measurable palynomorphs.
3400	Large, subrounded humic fragments, probably additive as 2402.5m. Total kerogen dominated by fine inertinite. Spores rare, possibly brown stain, yellow-orange fluorescence.
3900	Humic kerogen with abundant exinite content. Inertinite laths, dark orange-brown telinite. Moderate amount orange-bown, resinous organic matter (? bitumen) with dull fluorescence. Moderately abundant spores and bisaccate pollen, rich yellow-orange/orange. Dull fluorescence this colour on palynomorphs and amorphous kerogen.
4400	Humic kerogen. Inertinite laths, thick, coaly vitrinite fragments. Spores, bisaccate pollen poorly preserved, rich orange-brown colours with similar fluorescence. Probable caved material at SCI 5.

TABLE 2B Spore Colouration - Analytical Details

Table 3

Vitrinite Reflectivity - Analytical Details

(4 sheets)

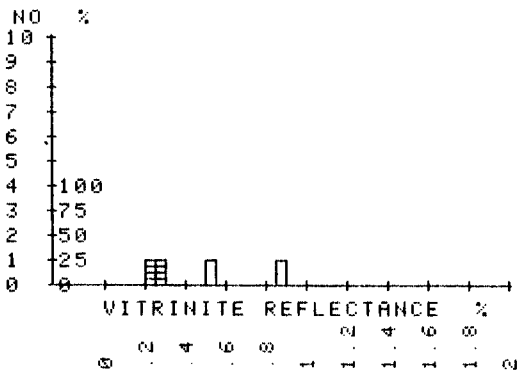
PROJECT NO. 25012
WELL:6407/1-2 BLOCKZ258

OPERATOR: PS DEPTH 410.0
DATE 5.8.83

I		+10	+20
1	0.24	0.00	0.00
2	0.28	0.00	0.00
3	0.54	0.00	0.00
4	0.85	0.00	0.00
5	0.00	0.00	0.00
6	0.00	0.00	0.00
7	0.00	0.00	0.00
8	0.00	0.00	0.00
9	0.00	0.00	0.00
10	0.00	0.00	0.00

STATISTICS ON SELECTED CLASS
Min: .20 Max: .30

No.of values 2
Mean .26
Std.Deviation .03



COMMENTS:
POOR SAMPLE.RARE FRAGMENTS DARK GREY ?VITRINITE Ro 0.2%,?REWKD. VITRINITE 0.5%,INERTINITE 1.5-2%.

PROJECT NO. 25012
WELL:6407/1-2 BLOCKZ259

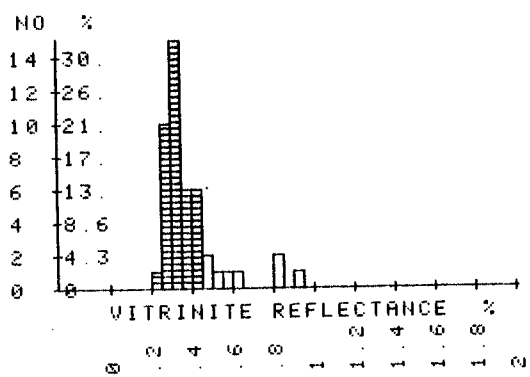
OPERATOR: PS DEPTH 900.0
DATE 5.8.83

I		+10	+20
1	0.24	0.30	0.34
2	0.25	0.30	0.34
3	0.25	0.31	0.34
4	0.26	0.31	0.34
5	0.26	0.32	0.34
6	0.26	0.32	0.35
7	0.27	0.32	0.35
8	0.28	0.33	0.35
9	0.28	0.33	0.36
10	0.29	0.33	0.37

I	+10	+20	+30
31	0.37	0.54	0.00
32	0.39	0.55	0.00
33	0.40	0.62	0.00
34	0.40	0.85	0.00
35	0.41	0.85	0.00
36	0.41	0.91	0.00
37	0.42	0.00	
38	0.42	0.00	
39	0.46	0.00	
40	0.47	0.00	

STATISTICS ON SELECTED CLASS
Min: .20 Max: .45

No.of values 38
Mean .33
Std.Deviation .05



COMMENTS:
HUMIC ABUNDANT INERTINITE Ro 1%+ SCLEROTINITE 0.5%.VITRINITE VARIABLE,STRINGERS/IRREGULAR FRAGS. AT Ro 0.25-0.35%,BLOCKY 0.3-0.4% SUBROUNDED ?REWKD. 0.45%+. MOD. YELLOW-ORANGE/ORANGE FLUORESCENCE ON SPORES/BISACCATES.

PROJECT NO. 25012
WELL:6407/1-2 BLOCKZ260

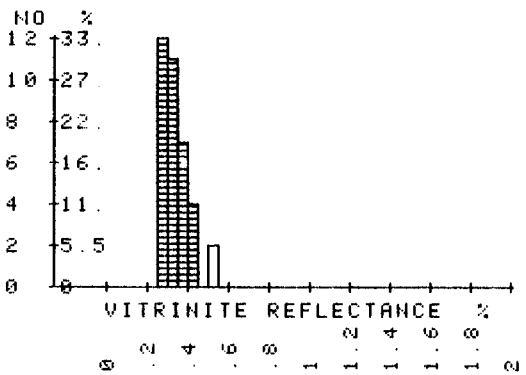
OPERATOR: PS DEPTH 1400.0
DATE 5.8.83

I		+10	+20
1	0.27	0.30	0.34
2	0.27	0.30	0.34
3	0.27	0.30	0.35
4	0.27	0.30	0.35
5	0.28	0.31	0.37
6	0.28	0.32	0.37
7	0.29	0.32	0.37
8	0.29	0.32	0.37
9	0.29	0.33	0.39
10	0.29	0.33	0.40

I	+10	+20	+30
31	0.41	0.00	0.00
32	0.41	0.00	0.00
33	0.44	0.00	0.00
34	0.45	0.00	0.00
35	0.54	0.00	0.00
36	0.55	0.00	0.00
37	0.00	0.00	
38	0.00	0.00	
39	0.00	0.00	
40	0.00	0.00	

STATISTICS ON SELECTED CLASS
Min: .25 Max: .45

No.of values 34
Mean .33
Std.Deviation .05



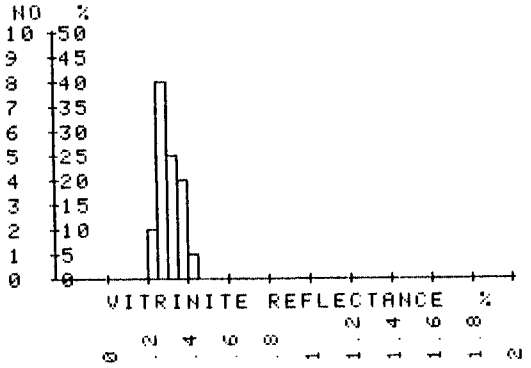
COMMENTS:
ABUNDANT HUMIC OM AS 900M.SOME NON-FLUORESCENT AMORPHOUS,POOR FLUORESCENCE ON PALYNOMORPHS.

PROJECT NO. 25012
WELL:6407/1-2 BLOCKZ261

OPERATOR: PS DEPTH 1900.0
DATE 5.8.83

I		+10	+20
1	0.23	0.30	0.00
2	0.24	0.31	0.00
3	0.27	0.31	0.00
4	0.27	0.31	0.00
5	0.27	0.32	0.00
6	0.28	0.35	0.00
7	0.29	0.35	0.00
8	0.29	0.37	0.00
9	0.29	0.38	0.00
10	0.30	0.44	0.00

No.of values	20
Mean	.31
Std.Deviation	.05



COMMENTS:
SPARSE SAMPLE.SMALL STRINGERS
?LOW Ro VITRINITE 0.3%. LOW GREY
EXINITE & AMORPHOUS WITH DULL
YELLOW-ORANGE/ORANGE FLUORESC-
ENCE.

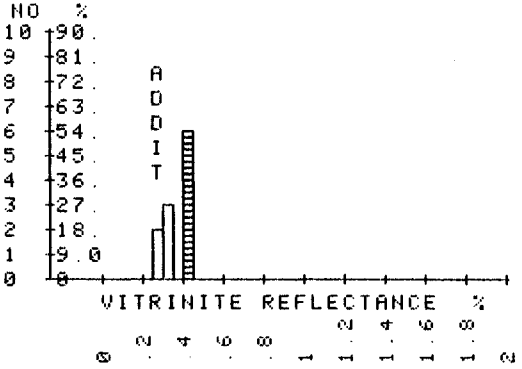
PROJECT NO. 25012
WELL:6407/1-2 BLOCKZ262

OPERATOR: PS DEPTH 2402.5
DATE 5.8.83

I		+10	+20
1	0.29	0.43	0.00
2	0.30	0.00	0.00
3	0.30	0.00	0.00
4	0.31	0.00	0.00
5	0.34	0.00	0.00
6	0.41	0.00	0.00
7	0.41	0.00	0.00
8	0.42	0.00	0.00
9	0.42	0.00	0.00
10	0.42	0.00	0.00

STATISTICS ON SELECTED CLASS
Min: .40 Max: .45

No.of values	6
Mean	.42
Std.Deviation	.01



COMMENTS:
MAINLY LARGE,IRREGULAR/BLOCKY
LIGNITIC OM Ro 0.3% OR LESS.
PROBABLY ADDITIVE.RARE SMALL
VITRINITE STRINGERS 0.4%.

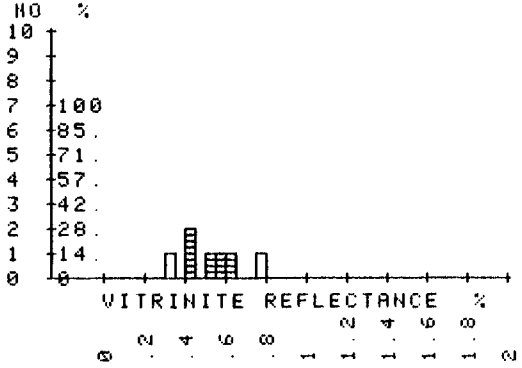
PROJECT NO. 25012
WELL:6407/1-2 BLOCKZ263

OPERATOR: PS DEPTH 2900.0
DATE 5.8.83

I		+10	+20
1	0.35	0.00	0.00
2	0.40	0.00	0.00
3	0.43	0.00	0.00
4	0.54	0.00	0.00
5	0.57	0.00	0.00
6	0.64	0.00	0.00
7	0.78	0.00	0.00
8	0.00	0.00	0.00
9	0.00	0.00	0.00
10	0.00	0.00	0.00

STATISTICS ON SELECTED CLASS
Min: .40 Max: .65

No.of values	5
Mean	.52
Std.Deviation	.10



COMMENTS:
FINE PYRITIC MASS WITH SMALL
HUMIC FRAGMENTS.ADDITIVE AS
2402M.RARE SMALL STRINGERS 0.4-
0.5%.LIMITED AMOUNT FLUORESCENCE
DULL YELLOW-ORANGE/ORANGE SPORES
CUTICLE,BRIGHT YELLOW-GREEN DROP
LETS OILY MATERIAL.

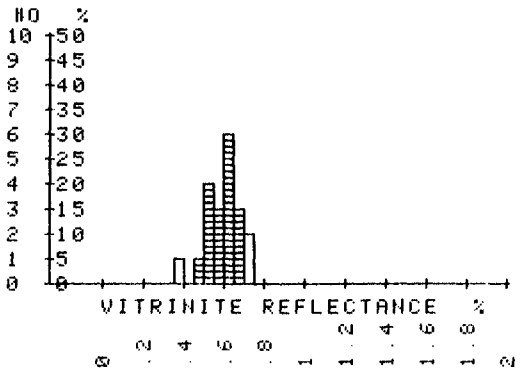
PROJECT NO. 25012
WELL:6407/1-2 BLOCKZ264

OPERATOR: PS DEPTH 3400.0
DATE 5.8.83

I		+10	+20
1	0.39	0.63	0.00
2	0.48	0.64	0.00
3	0.53	0.64	0.00
4	0.53	0.65	0.00
5	0.55	0.65	0.00
6	0.55	0.66	0.00
7	0.57	0.67	0.00
8	0.58	0.69	0.00
9	0.59	0.71	0.00
10	0.62	0.72	0.00

STATISTICS ON SELECTED CLASS
Min: .45 Max: .70

No.of values 17
Mean .60
Std.Deviation .06



COMMENTS:
MODERATELY ABUNDANT INERTINITE SEMIFUSINITE Ro 0.7-0.9%.SMALL VITRINITE STRINGERS & FRAGMENTS 0.5-0.6%,TENDING TO HIGH Ro VITRINITE AT 0.65-0.7%.ADDITIVE AS 2402.5M.DULL YELLOW-ORANGE/ ORANGE EXINITE FLUORESCENCE.

PROJECT NO. 25012
WELL:6407/1-2 BLOCKZ265

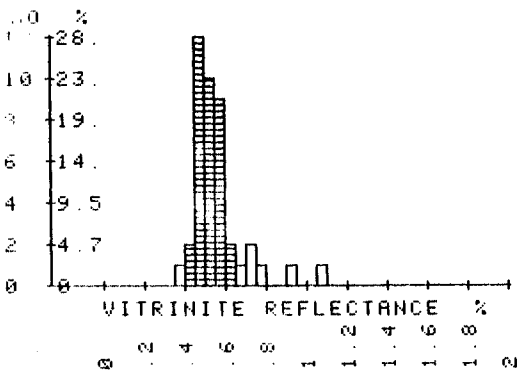
OPERATOR: PS DEPTH 3900.0
DATE 5 8.83

I		+10	+20
1	0.38	0.48	0.53
2	0.44	0.49	0.53
3	0.44	0.49	0.53
4	0.45	0.49	0.53
5	0.46	0.50	0 54
6	0.46	0.50	0.56
7	0 47	0.51	0.57
8	0.48	0.51	0.57
9	0.48	0.52	0.57
10	0.48	0.52	0.57

I	+10	+20	+30
31	0 58	0.91	0.00
32	0.59	1.06	0.00
33	0.59	0.00	0.00
34	0 60	0.00	0.00
35	0 64	0.00	0.00
36	0.64	0.00	0.00
37	0.69	0.00	
38	0.72	0.00	
39	0.75	0.00	
40	0 78	0.00	

STATISTICS ON SELECTED CLASS
Min: .40 Max: .65

No.of values 35
Mean .52
Std.Deviation .05



COMMENTS:
INERTINITE DOMINANT.VITRINITE & EXINITE AS 3400M.BITUMEN,LARGE, IRREGULAR FRAGMENTS Ro 0.4-0.45%

PROJECT NO. 25012
WELL:6407/1-2 BLOCKZ266

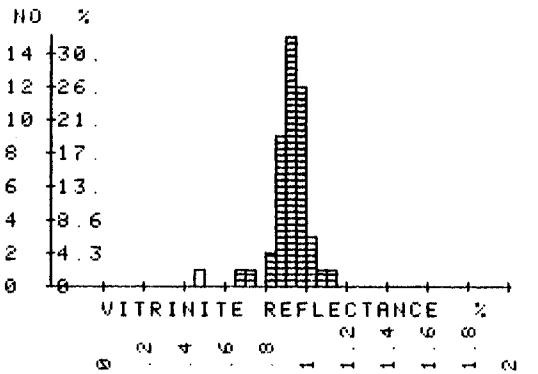
OPERATOR: PS DEPTH 4400.0
DATE 5.8.83

I		+10	+20
1	0.48	0.88	0.93
2	0.70	0.88	0.93
3	0.70	0.89	0.93
4	0.84	0.90	0.94
5	0.85	0.91	0.94
6	0.85	0.91	0.94
7	0.86	0.91	0.94
8	0.86	0.91	0.94
9	0 87	0.92	0.95
10	0.88	0.92	0.95

I	+10	+20	+30
31	0.95	1.00	0.00
32	0.96	1.01	0.00
33	0.97	1.02	0.00
34	0.97	1.02	0.00
35	0.98	1.09	0.00
36	0.98	1.11	0.00
37	0.98	0.00	
38	0.99	0.00	
39	0.99	0.00	
40	0.99	0.00	

STATISTICS ON SELECTED CLASS
Min: .65 Max: 1.15

No.of values 45
Mean .93
Std.Deviation .08



COMMENTS:
LARGE STRINGERS,BLOCKY,COALY FRAGMENTS VITRINITE.SHARPLY ANGULAR HIGH Ro VITRINITE AT 1-1.05 %.SPORES,CUTICLE 0.8%,DULL ORANGE-BROWN FLUORESCENCE.

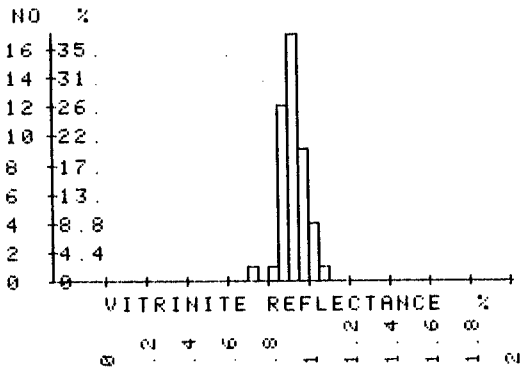
PROJECT NO. 25012
WELL:6407/1-2 BLOCK2213

OPERATOR: PS DEPTH 4400.0
DATE 2.8.83

I		+10	+20
1	0.74	0.89	0.92
2	0.80	0.89	0.92
3	0.85	0.89	0.92
4	0.86	0.90	0.93
5	0.86	0.90	0.93
6	0.87	0.91	0.93
7	0.87	0.91	0.94
8	0.87	0.92	0.94
9	0.88	0.92	0.94
10	0.88	0.92	0.95

I	+10	+20	+30
31	0.95	1.02	0.00
32	0.95	1.03	0.00
33	0.95	1.03	0.00
34	0.96	1.03	0.00
35	0.96	1.07	0.00
36	0.96	0.00	0.00
37	0.97	0.00	
38	0.97	0.00	
39	1.00	0.00	
40	1.00	0.00	

No.of values 45
Mean .93
Std.Deviation .06



COMMENTS:
POLISHED COAL FRAGMENTS.
VITRINITE DOMINANT OTHERWISE. AS KEROGEN.

COMPANY: STATOIL **WELL:** 6407/1-2 **LOCATION:** NORWEGIAN NORTH SEA

GENERAL DATA			CHEMICAL ANALYSIS DATA												
				PYROLYSIS					SOLVENT EXTRACTION						
SAMPLE DEPTH (METRES)	SAMPLE TYPE	ANALYSED LITHOLOGY	ORGANIC CARBON % OF ROCK	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	HYDROCARBONS % OF EXTRACT	ALKANES % OF HYDRO– CARBONS
410	Ctgs	SST, lt gy, calc+ 30% SST, yel-gy, calc	.19											
900	"	MDST, ol-gy, calc+ 30% LCM	.19											
1400	"	MDST, a/a + 40% LCM	.23											
1900	"	MDST, a/a + 10% MDST, lt ol-gy + mnr MDST, gy-orng	1.27											
2402.5	"	MDST, ol-gy+ 20% COAL+ 10% MDST, lt gn-gy+ 10% MDST, gy-red	7.37											
2900	"	MDST, ol-blk+ tr MDST, lt gn-gy	1.60											
3400	"	SH, gy-blk+ tr MDST, lt gn-gy + tr MDST, gy-red+ tr SST, wht	1.40											
3900	"	SST, a/a + 20% SH, a/a	-											
	P	SH, gy-blk	2.63											
4400	Ctgs	COAL+ 30% SST, yel-gy+ 10% SH, a/a	-											
	P	COAL	-											

TABLE 4 Chemical Analysis Data

COMPANY: STATOIL WELL: 6407/1-2 LOCATION: NORWEGIAN NORTH SEA

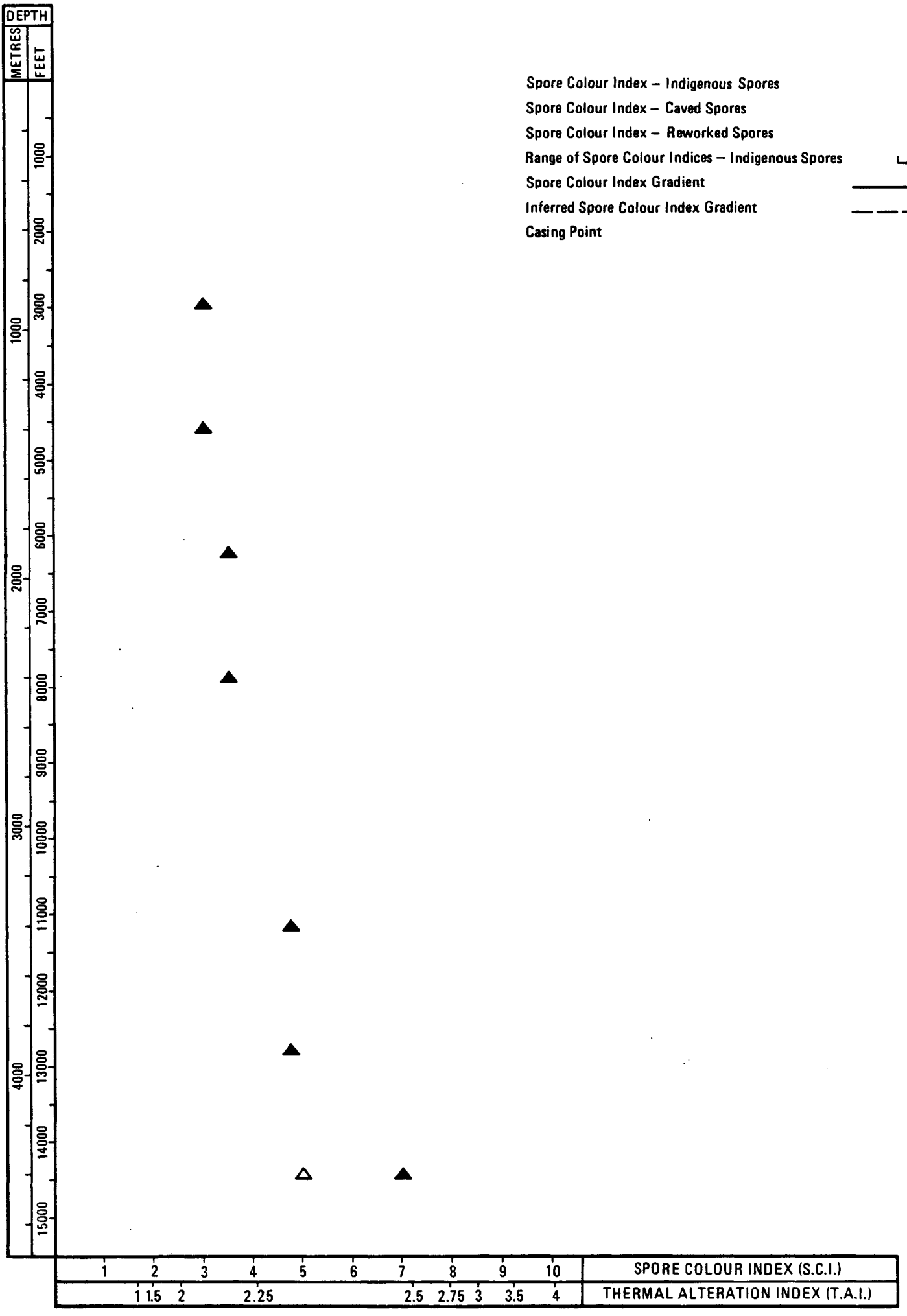


FIGURE 1 Spore Colour Indices against Depth

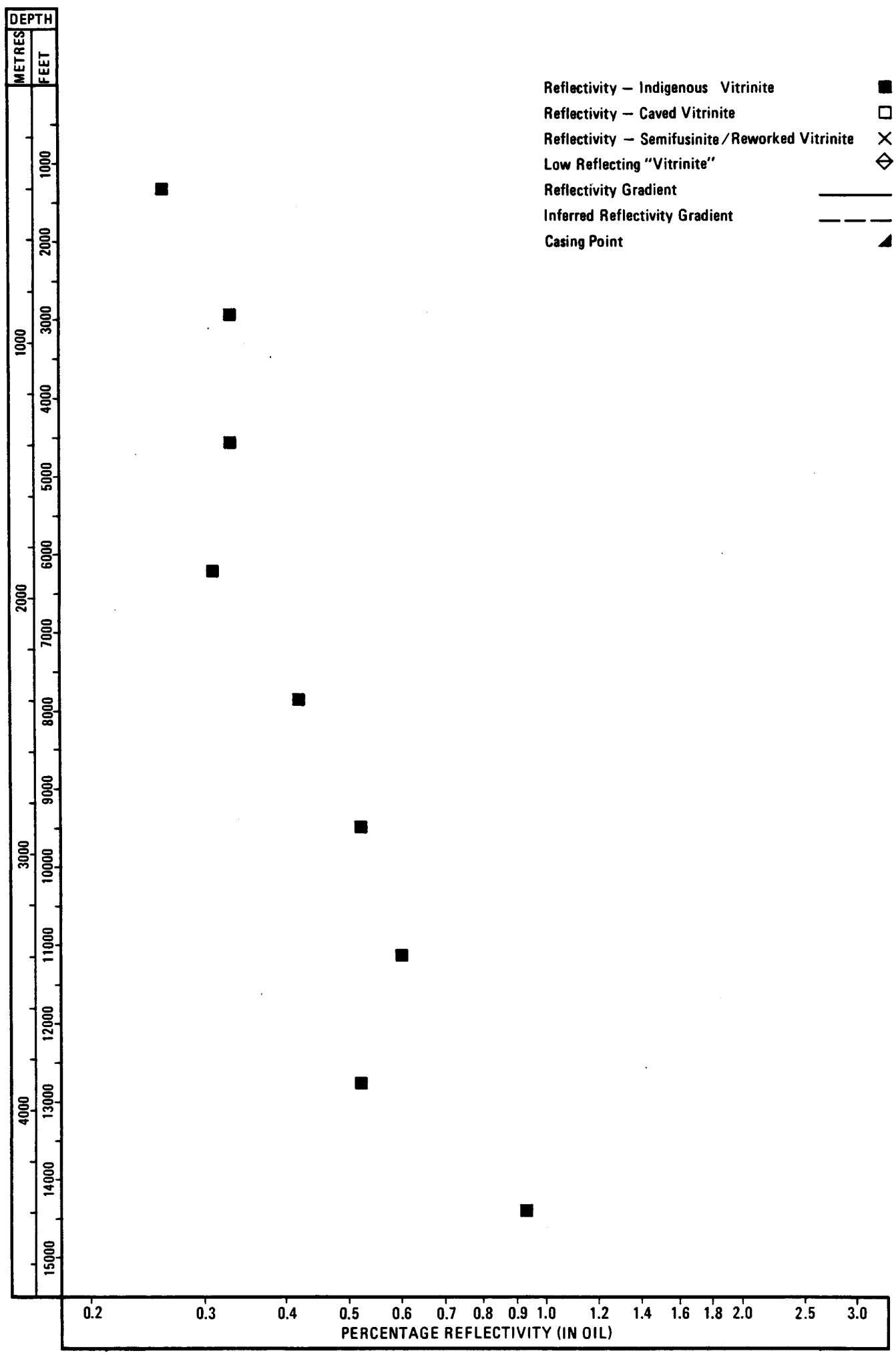


FIGURE 2 Vitrinite Reflectivity against Depth