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Agip

SERVIZIO STUDI GEOLOGICI
E LABORATORI

SOURCE ROCK EVALUATION OF THE WELL 33/6-1 (NORWAY OFFSHORE)

S Donato Milanese October, 1979

IL RESPONSABILE DEL SERVIZIO
Prof. L. Mattavelli

INTRODUCTION

At the request of Norsk Agip S/A (see letter ref 79/4/215/GRA/rio dated May 9, 1979) a source rock study has been made on the well 33/6-1. This report covers source rock analyses carried out on 41 cuttings, 26 sidewall cores and 1 bottom core at depths ranging from 1000 m to 3898 m.

The analytical methods followed and the significance of the data used for the source rock evaluation of the sediments are reviewed in the report "Petroleum Geochemistry Note No. 1 - Source Rocks".

EXPERIMENTAL

The results of the geochemical analyses are reported in the annexed data sheets 76 /Geoch/79 and 77 /Geoch/79 and graphically shown in the Annex 1. The results of the kerogen analyses and degree of organic maturity determinations are reported in the annexed data sheet 23 /MOR/79 and graphically shown in the Annex 2.

The formation temperatures are listed in Table 1, together with geothermal gradients.

DISCUSSION

Geochemical analyses

The samples of the Tertiary formations contain small amounts of organic carbon (average value 0.42%) and no hydrocarbons *. By high temperature pyrolysis of the kerogen they produce small amounts of hydrocarbons (270 ppm). The hydrogen content of the kerogen is fair/low (HK/OC ** = 6.4%).

The sample of the Cretaceous formations contain fair/low amounts of organic carbon (0.58%) but generally are devoid of hydrocarbons; only a few of them (cuttings of 2450 m, sidewall cores of 3257 m and 3525 m) contain significant amount of hydrocarbons (i.e. more than 50 ppm). By pyrolysis of the kerogen they produce small amounts of hydrocarbons (310 ppm). The hydrogen content of the kerogen is low (HK/OC = 5.4%).

The samples of the Upper and Middle Jurassic formations (Kimmeridge Clay, Heater and Brent formations) are very rich both in organic carbon (3.05%) and in hydrocarbons (440 ppm). By pyrolysis of the kerogen they produce very large amounts of hydrocarbons (4200 ppm). The hydrogen content of the kerogen is high (HK/OC = 13.7%). The ratio hydrocarbons present in the sample/organic carbon (HC/OC) is high (14.6‰), as it happens in mature and good source rocks. Also the ratio hydrocarbons present in the sample/hydrocarbons produced by pyrolysis of the kerogen (HC/HK), which gives a measurement of the petroleum potential already achieved ***, is high (10.6%). It is

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* The hydrocarbons shown by the thermovaporization of these samples are produced by partial pyrolysis of the organic matter.

** HK/OC = hydrocarbons produced by high temperature pyrolysis of the kerogen/organic carbon.

*** When the hydrocarbons present in the sample are indigenous, of course!

to be pointed out that the cuttings of the Brent formation are polluted by cavings coming from the Kimmeridge Clay and Heather formations *.

The samples of the Dunlin formation (Lower Jurassic) are rich both in organic carbon (1.82%) and in hydrocarbons (180 ppm). By pyrolysis of the kerogen they produce very large amounts of hydrocarbons (2400 ppm). The hydrogen content of the kerogen is high (HK/OC = 13.1%). Both the ratio HK/OC and the ratio HC/HK are high (10.1‰ and 7.7%, respectively). Cavings coming from Kimmeridge Clay and Heather formations are present also in the cuttings of this formation, but their influence is much smaller than in the Brent formation. **

The samples of the Statfjord and Cormorant formations (Lower Jurassic and Upper Triassic) contain very small amounts of organic carbon (0.15%) and no hydrocarbons. By pyrolysis of the kerogen they produce very small amounts of hydrocarbons (140 ppm). Palynological determinations show that also these samples are polluted by cavings coming from Kimmeridge Clay and Heather formation, but their influence on geochemical data is negligible.

The average geothermal gradient is normal (2.6°C/100 m, uncorrected value). By taking into account that temperatures measured during log recording are lower than the true ones, this value is in quite good accordance with the average geothermal gradient (2.97°C/100 m) in North Sea basin calculated by Harper (M.L. Harper, Approximate Geothermal Gradients in the North Sea Basin, Nature, 1971, vol. 230, pp. 235 - 236).

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* As a matter of fact it results from the caliper log that the volume of caved borehole is about 0.8 m^3 in the Kimmeridge Clay formation and about 1.1 m^3 in the Heather formation, whereas the total volume of the cuttings of the Brent formation is about 1.6 m^3. The comparison between the geochemical data of the cuttings and those of the sidewall cores allows to evaluate the influence of caving.

** As a matter of fact the total volume of the cuttings of this formation is about 4.1 m^3. From the difference between the geochemical data of the cuttings and those of the sidewall cores it can be estimated that caving improves geochemical data by 10-30%.

Type of kerogen

In the whole studied section the composition of the organic content is rather uniform: continental organic matter constitutes the chief part of the kerogen (about 3/4) whereas phytoplankton and amorphous organic matter are less abundant.

In the Tertiary formations the amorphous organic matter (AOM) ranges from 5 to 25% (average value 12%), marine phytoplankton (MPh) from 5 to 30% (a.v. 16%), continental herbaceous fragments (CHF) from 15 to 45% (a.v. 33%) and continental woody fragments and fusinite debris (CWF) from 25 to 50% (a.v. 39%).

In the Cretaceous formations the quality of the organic matter is slightly worse: amorphous organic matter is very scarce (a.v. 5%), marine phytoplankton ranges from 5 to 25% (a.v. 19%), continental herbaceous fragments from 15 to 40% (a.v. 26%), continental woody fragments from 40 to 70% (a.v. 50%).

In the Upper and Middle Jurassic formations the type of the kerogen, on the whole, is very similar to that contained in the Tertiary formations.

In the Dunlin, Statfjord and Cormorant formations the kerogen is very poor in quality: as a matter of fact amorphous organic matter and marine phytoplankton are less than 10% of the total organic matter, whereas continental woody fragments constitutes more than 60% of it.

Both kerogen analyses and the ratio HK/OC show that the organic matter of the Tertiary and Cretaceous sediments is fair/poor in quality and that of Statfjord and Cormorant formations is poor in quality. But for the other formations there is a discrepancy: visual kerogen analyses indicate that the kerogen quality is fair in the Kimmeridge Clay and Heather formations and poor in the Brent and Dunlin formation, whereas the ratio HK/OC indicates a good quality for the whole interval. As the hydrogen content is a direct measurement of the kerogen quality, we can conclude that in these formations the organic matter is good in quality. Likely the discrepancy is due either to the fact that the correlation between the biological structure of the kerogen and its chemical composition could be not always simple and direct or to the fact that the sample used for kerogen analysis could be polluted by overlying sediments.

Degree of organic maturity

The maturity facies has been determined on the basis both of the Thermal Alteration Index (TAI) and of mean vitrinite reflectance (R_m). Unfortunately in most samples vitrinite is absent: only 8 samples out of 34 contain vitrinite and generally the number of vitrinite particles present in these samples is lower than 25, the minimum acceptable to yield reliable results.

The interval from 1000 m to 2000 m (Tertiary and Upper Cretaceous) is immature: TAI ranges from 1 to 1.5, vitrinite is absent. The organic matter is generally scarce and the TAI value has been determined on a few disaccate pollens.

The interval from 2000 m to 2300 m (Upper Cretaceous) is transitional: TAI is 1.5 - 2 and vitrinite is absent.

The interval from 2300 m to the bottom (Upper and Lower Cretaceous, Jurassic and Upper Triassic) is mature: TAI increase from 2 at 2300 m to 2.5 at 3898 m while R_m increasly gradually from 0.52% to 0.71%.

According to the Connan's time-temperature relation (J. Connan, Time-temperature relation in oil genesis, AAPG Bull., v. 58, No. 1, December 1974, pp. 2516-2521), shown in Fig. 1, the top of the mature zone should be at a depth of 2800-2900 m; the slight discrepancy between this theoretical value and that obtained experimentally (2300 m) is due to the inaccuracy in temperature data and in time-temperature relation.

CONCLUSIONS

The Tertiary and Cretaceous formations up to 2300 m are not source rock of hydrocarbons because they are immature. At higher depths (i.e. temperatures) they should be poor source rocks.

The Cretaceous formations below 2300 m are poor source rocks, although they are mature: as a matter of fact they contain fair/low amounts of organic matter and generally no hydrocarbons, and the quality of the kerogen is fair/poor.

The Kimmeridge Clay, Heather and Brent formations, which are mature and contain very high amounts both of hydrocarbons and of organic matter rich in hydrogen, are very good source rocks.

The Dunlin formation, which is mature and contain high amounts both of hydrocarbons and of organic matter rich in hydrogen, is a good source rock.

The Statfjord and Cormorant formations, poor in organic matter and in hydrocarbons, are no source rocks although they are mature.

R. Cavaliere

U. Biffi

TABLE 1

FORMATION TEMPERATURES OF THE WELL 33/6-1

Depth m	Temperature °C	Average Geothermal Gradient °C/100 m
715	33*	
1974	38*	
3545	96	2.7
3901	103	2.6

BHT ihn korrigert
for sirkulasjon

* Data not reliable

N.B.: the temperatures have been measured by Schlumberger operators during log recording. The average geothermal gradients have been calculated by assuming that the temperature at the sea bottom (331 m below Rotary Table) is 10°C.

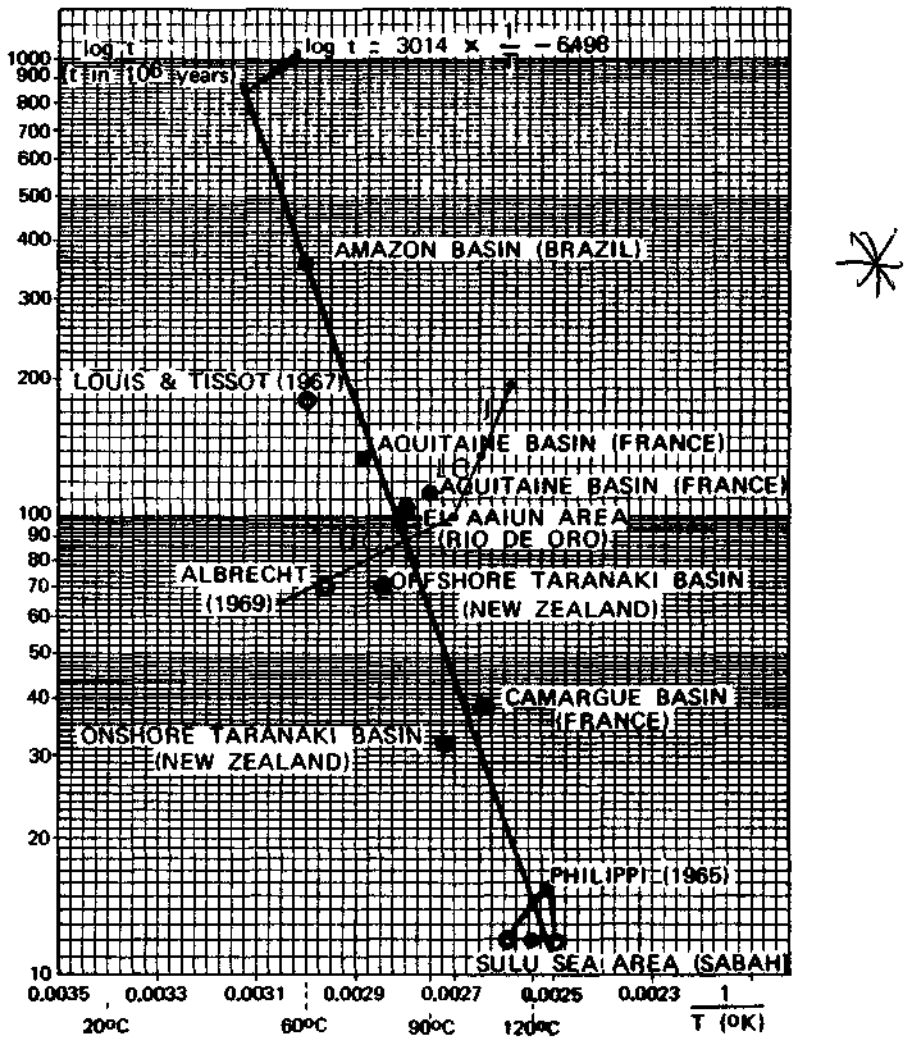

Fig. 1: Time-temperature relation according to Connan for the well 33/6-1 (UC = Upper Cretaceous, LC = Lower Cretaceous, J = Jurassic).

N.B.: Temperature values have been calculated from the average geothermal gradient of North Sea Basin calculated by Harper (2.97°C/100 m).
Ages are approximated.
The straight line shows the threshold of intense oil generation.

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Sample Sidewall cores of the well 33/6-1 (Norway Offshore)

ANALYTICAL DATA

Data sheet No. 76/Geoch

Depth m	Thermovaporization ppm – Natural sample – Gas	Natural sample – Cond.	Natural sample – Oil	Washed sample – Gas	Washed sample – Cond.	Washed sample – Oil	Organic Carbon %	Hydroc. produced by pyrolysis ppm	HK/OC %				Terrigenous Minerals % – Quartz	Albite	Orthocl.	Calcite	Dolomite	Clay	Clay minerals % – Montmor.	Illite	Chlorite	Kaolinite	Mix. layers
2110	81	12	–	15	–	–	0.51	222	4.3														
2130	43	6	–	–	–	–	0.55	164	3.0														
2221	34	2	–	–	–	–	0.48	121	2.5														
2325	62	6	–	19	–	–	0.63	257	4.1														
2630	37	2		–	–	–	0.38	109	2.9														
2730	33	2	–	–	–	–	0.66	186	2.8														
2870	30	2	–	–	–	–	0.61	185	3.0														
2950	49	3	–	–		–	0.21	228	10.9														
3215	52	5	–	–	–	–	0.66	372	5.6														
3257	136	14	–	24	–	–	0.78	330	4.2														
3300	55	5	–	–	–	–	0.78	217	2.8														
3368	51	2	–	–	–	–	0.65	265	4.1														
3403	70	8	–	–	–	–	0.71	417	5.9														
3437	40	3	–	–	–	–	0.61	242	4.0														
3468	59	9	–	–	–	–	0.78	471	6.0														
3525	94	7	1	20	–	–	0.36	285	7.9														
3542	50	750	118	47	23	–	3.29	6396	19.4														
3610	175	5	–	–	–	–	1.30	2645	20.3														
3674	50	67	2	–	–	–	1.27	827	6.4														
3730	50	182	14	7	5	–	1.27	1195	9.4														
3789	40	123	4	8	11	–	1.87	3564	19.0														
3814	23	4	1	–	–	–	0.20	235	11.7														
3835	28	1	–	–	–	–	0.16	131	8.2														
3871	26	–	–	–	–	–	0.12	125	10.4														

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Sample Sidewall cores of the well 33/6-1 (Norway Offshore)

ANALYTICAL DATA

Data sheet No. 76/Geoch

Depth m	Thermovaporization ppm Natural sample Gas	Natural sample Cond.	Natural sample Oil	Meshed sample Gas	Meshed sample Cond.	Meshed sample Oil	Organic Carbon %	Hydrocarb. produced by pyrolysis ppm	HI mg HC/g OC			Terrigenous Minerals % Quartz	Albite	Orthocl.	Calcite	Dolomite	Clay	Clay minerals % Montmor.	Illite	Chlorite	Kaolinite	Mix. layers
3883	46	-	-	-	-	-	0.10	67	6.7													
3895	40	2	-	-	-	-	0.16	129	8.0													

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Sample Cuttings of the well 33/6 -1(Norway Offshore)

S. Donato Milanese 22/10/79

ANALYTICAL DATA

Data sheet No. 77/Geoch

Cuttings	Thermovaporization ppm: Natural sample – Gas	Natural sample – Cond.	Natural sample – Oil	Washed sample – Gas	Washed sample – Cond.	Washed sample – Oil	Organic Carbon %	Hydroc. produced by pyrolysis ppm	HC/OC %
1000 *	29	-	-				0.21	139	6.6
1100 *	29	-	-				0.30	179	6.0
1200 *	185	6	-	113	6		0.91	1151	12.6
1300	23	-	-				0.41	152	3.7
1400 *	38	2	-				0.46	214	4.6
1510 *	21	-	-				0.35	142	4.0
1600 *	21	1	-				0.34	108	3.2
1700 *	18	-	-				0.49	235	4.8
1800 *	14	-	-				0.28	101	3.6
1900 *	25	-	-				0.35	137	3.9
2000 *	25	-	-				0.44	169	3.8
2300	42	6	-				0.60	428	7.1
2350	31	1	-				0.51	254	5.0
2400	26	1	-		-	-	0.44	241	5.5
2450	77	29	10	38	-	-	0.75	736	9.5
2500	50	43	4	-	-	-	0.59	503	8.5
2505 *	42	-	-				0.50	314	6.3
2550	38	10	-				0.58	587	8.6
2600	69	10	-				0.69	601	8.7
2605 *	22	20	-		-	-	0.36	237	6.6
2650	86	10	-	26	-	-	0.67	402	6.0
2700	18	1	-	-	-	-	0.61	215	3.5
2705 *	27	1	-	-	-	-	0.53	188	3.5
2750	25	-	-	-	-	-	0.54	289	5.3

Terrigenous Minerals %: Quartz, Albite, Orthocl., Calcite, Dolomite, Clay — Clay minerals %: Montmor., Illite, Chlorite, Kaolinite, Mix.layers (no values entered)

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Sample Cuttings of the well 33/6-1 (Norway Offshore)

ANALYTICAL DATA

Data sheet No. 77/Geoch

Cuttings	Thermovaporization ppm Natural sample Gas	Natural sample Cond.	Natural sample Oil	Washed sample Gas	Washed sample Cond.	Washed sample Oil	Organic Carbon %	Hydrac. produced by pyrolysis ppm	HK S1/S2				Terrigenous Minerals % Quartz	Albite	Orthocl.	Calcite	Dolomite	Clay	Clay minerals % Montmor.	Illite	Chlorite	Kaolinite	Mix. layers
2800	58	10	-				0.69	416	6.0														
2805*	62	2	-				0.42	221	5.3														
2850	33	1	-				0.63	312	4.9														
2905*	34	4	-				0.48	225	4.7														
3005*	34	1	-				1.20	746	6.2														
3506	69	10	9				0.96	1939	20.2														
3565*	50	287	132	18	36	1	4.05	5061	12.5														
3592*	50	185	29	26	1		3.19	2228	7.0														
3604*	50	303	8				2.79	2419	8.7														
3622*	50	735	41	48	1	-	4.85	6617	13.6														
3628*	50	331	15				4.19	5192	12.4														
3634*	50	568	29	13	24	-	3.26	4865	14.9														
3640*	50	636	62				3.01	4811	16.0														
3646*	50	395	14	26	3	-	2.63	3733	14.2														
3652*	50	22	4				2.87	3918	13.6														

* These samples have been dried on the rig by heating. The others have been dried in the laboratory at room temperature.

Agip SpA	BULLETIN	23/79 MOR	COUNTRY	WELL 33/6 no. 1
SGEL Materia Organica Riflettometria	SLIDE	21244-65; 21322-23; 26-27; 21270-73	NORWAY	SECTION

AGE		FORM.	SAMPLE	DEPTH	KEROGEN %				TAI	VITRINITE $\bar{R}o$ %	FACIES	REMARKS
					AOM	MPh	CHF	CWF				
NEOGENE	MM		ds	1000	/	/	/	/	/	VA		Organic matter absent
	LM		ds	1100	15	10	25	50	1	VA	IMMATURE	TAI measured on 3 disaccate pollens
PALEOGENE	OLIGOCENE		ds	1200	25	30	15	30	1 - 1,5	VA	IMMATURE	TAI measured on disaccate pollens
			ds	1300	15	30	15	40	1 - 1,5	VA	IMMATURE	TAI measured on 2 disaccate pollens - Organic matter very scarce
			ds	1400	5	5	40	50	/	VA		Organic matter very scarce No pollens
	EOCENE		ds	1510	5	10	40	45	1,5	VA	IMMATURE	Organic matter very scarce TAI measured on one pollen
			ds	1600	15	10	35	40	1,5	VA	IMMATURE	Organic matter very scarce TAI measured on 2 disaccate pollens
	L. Eo.		ds	1700	10	20	45	25	1,5	VA	IMMATURE	Organic matter very scarce TAI measured on 6 pollens
	Pal.	SELE FORMATION	ds	1800	5	15	45	35	1,5	VA	IMMATURE	
UPPER CRETACEOUS	MAASTRICHTIAN	SHETLAND GROUP	ds	1900	5	/	40	55	/	VA		Organic matter very scarce No pollens
			ds	2000	5	25	15	55	1,5 - 2	VA	TRANSITIONAL	
			swc	2110	5	20	20	55	1,5 - 2	VA	TRANSITIONAL	
	CAMPANIAN		swc	2221	5	20	15	60	1,5 - 2	VA	TRANSITIONAL	
			ds	2300	5	20	30	45	2	0,52	MATURE	$\bar{R}o$ measured on 15 points
			ds	2400	5	20	30	45	2	VA	MATURE	
			ds	2475	5	25	25	45	2	VA	MATURE	
			ds	2505	5	25	20	50	2	0,53	MATURE	$\bar{R}o$ measured on 15 points
			ds	2605	5	20	25	50	2	0,55	MATURE	$\bar{R}o$ measured on 20 points

DATE		OPERATOR	

Agip SpA	BULLETIN	23/79 MOR	COUNTRY	WELL 33/6 no. 1
SGEL Materia Organica Riflettometria	SLIDE	21244-65; 21322-23; 26-27; 21270-73	NORWAY	SECTION

AGE		FORM.	SAMPLE	DEPTH	KEROGEN %				TAI	VITRINITE $\bar{R}o$ %	FACIES	REMARKS
					AOM	MPh	CHF	CWF				
UPPER CRETACEOUS	SANTONIAN	SHETLAND GROUP	swc	2730	5	15	30	50	2	VA	MATURE	
			ds	2805	5	15	20	60	2	VA	MATURE	
	CON.		ds	2905	5	15	10	70	2	0,55	MATURE	$\bar{R}o$ measured on 16 points
	TURONIAN		swc	3005	5	15	15	65	2	VA	MATURE	
			ds	3100	5	15	20	60	2	0,56	MATURE	$\bar{R}o$ measured on 15 points
	CEN.		swc	3215	5	20	20	55	2	VA	MATURE	
LOWER CRETACEOUS	ALBIAN	CROMER KNOLL GROUP	swc	3300	10	20	20	50	2	VA	MATURE	
			swc	3403	5	25	20	50	2	VA	MATURE	
			swc	3468	5	20	35	40	2	VA	MATURE	
UPPER JURASSIC	L.OXF.? - KIMMERIDG.-? VOLG.	KIMMERIDGE CLAY FORMATION	swc	3542	15	5	30	50	2	VA	MATURE	
			ds	3545	20	10	20	50	2	VA	MATURE	
			ds	3553	10	5	20	65	2	VA	MATURE	
			ds	3557	10	5	30	55	2	VA	MATURE	
			ds	3562	40	5	10	45	2	VA	MATURE	
	E.OXF.	HEATHER FORMATION	ds	3586	10	10	40	40	2	VA	MATURE	
MIDD. JURA.	BATH.	BRENT FORMATION	c-	3607 - 16	10	/	50	40	2	VA	MATURE	
LOWER JURASSIC	PLIENSBACH.	DUNLIN FORMATION	swc	3674	5	5	30	60	2	0,58	MATURE	$\bar{R}o$ measured on 18 points
			swc	3730	5	/	30	65	2	0,50	MATURE	$\bar{R}o$ measured on 15 points

DATE		OPERATOR	

Agip SpA

SGEL Materia Organica Riflettometria

BULLETIN	23/79 MOR	COUNTRY NORWAY	WELL 33/6 no. 1
SLIDE	21244-65; 21322-23; 26-27; 21270-73		SECTION

AGE	FORM.	SAMPLE	DEPTH	KEROGEN %				TAI	VITRINITE $\bar{R}o$ %	FACIES	REMARKS
				AOM	MPh	CHF	CWF				
LOW. JURAS SINEM	STATFJORD FORMATION	ds	3826	5	5	20	70	2 - 2,5	VA	MATURE	
UPP. TRIAS RHAETS	CORMORANT FORMATION	ds	3898	5	/	25	70	2,5	0,71	MATURE	$\bar{R}o$ measured on 25 points

DATE ...tober 1979 OPERATOR U. Biffi

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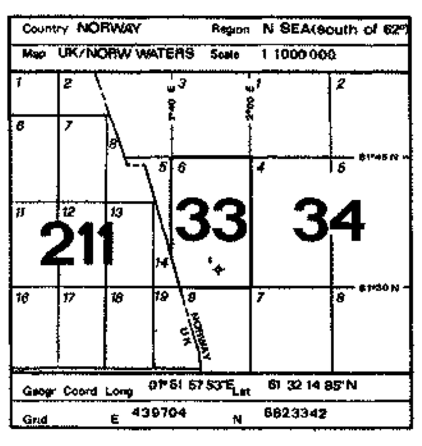
GEOCHEMICAL ANALYSES OF THE WELL 33/6-1 (NORWAY OFFSHORE)

Drawing N°	Up to date	Enclosure to	Encl N°
1888		SOURCE ROCK EVALUATION OF THE WELL 33/6-1 (NORWAY OFFSHORE)	1
Scale 12500	Date OCTOBER 1979	Compiled by R. CAVALIERE	Drawn by F. GARIBOLDI

Other missing symbols are reported in the "Standard Legend" AGIP Direzione Mineraria Servizio Geologico (1972)

Country NORWAY — Region N SEA (south of 62°)
Map UK/NORW WATERS — Scale 1:1000000



Geogr. Coord. Long 01°51'57.53"E Lat 61 32 14.85"N
Grid E 439704 N 6823342

TERRIGENOUS ROCKS
CARBONATE ROCKS
IGNEOUS AND METAMORPHIC ROCKS
SEDIMENTARY AND DIAGENETIC STRUCTURES
FORMATION FLUIDS
SPECIAL SYMBOLS FOR PETROGRAPHIC LOG
PARTICLES AND FOSSILS
CEMENTS
OTHER ROCKS
SHOWS
OTHER SYMBOLS
POROSITY TYPES
AGE
FORMATION
ENVIRONMENT
DEPTH
LITHOLOGIC COLUMN
SAMPLES
HK/OC
THERMOVAPORIZATION
TEMPERATURE
HIGH TEMPERATURE PYROLISIS
ORGANIC CARBON
HC/OC
HC/HK
SIDERITE
U. TERTIARY
L. MIOCENE
OLIGOCENE
EOCENE
L. EOCENE
PALEOCENE
LISTA
BALDER FORMATION
OUTER SHELF
BATHYAL to OUTER SHELF
MAASTRICHTIAN
CAMPANIAN
SANTONIAN
CONIACIAN
TURONIAN
CENOMANIAN
Upper CRETACEOUS
Lower CRETACEOUS
ALBIAN
CROMER KNOLL GROUP
Lower JURASSIC
TD m 3900


KEROGEN ANALYSIS
33/6-1 WELL
NORWAY
AGIP S.p.A.
SGEL PALEO
Drawing N° 8-2
Enclosure to SOURCE ROCK EVALUATION OF THE WELL 33/6-1 (NORWAY OFFSHORE)
Encl. N° 2
Scale 1:2500
Date OCTOBER 1979
Compiled by U. BIFFI
Drawn by F. GARIBOLDI
Other missing symbols are reported in the "Standard Legend" AGIP Direzione Mineraria Servizio Geologico (1972)
Country NORWAY
Region N. SEA (south of 62°)
Map U.K. NORW. WATERS Scale 1:1000 000
211
33
34
Geogr. Coord. Long. 01°51'57.53" E Lat. 61°32'14.65" N
Grid E 439704 N 6823342
TERRIGENOUS ROCKS
CARBONATE ROCKS
IGNEOUS AND METAMORPHIC ROCKS
SEDIMENTARY AND DIAGENETIC STRUCTURES
FORMATION FLUIDS
SPECIAL SYMBOLS FOR KEROGEN LOG
Amorphous organic matter
Algae marine phytoplankton
Terrestrial herbaceous debris leaf cuticle spores pollen
Terrestrial wood fragments fusinite debris
PARTICLES AND FOSSILS
CEMENTS
OTHER ROCKS
POROSITY TYPES
SHOWS
OTHER SYMBOLS
AGE
FORMATION
ENVIRONMENT
DEPTH
LITHOLOGIC COLUMN
SAMPLES
SCHLUMBERGER LOGS
KEROGEN COMPOSITION %
THERMAL INDEX
VITRINITE REFLECTANCE
% R oil $N_D^{23°C}$ = 1,5150
MATURATION FACIES
U. TERTIARY
L. MIOCENE
LOWER TERTIARY
OLIGOCENE
EOCENE
PALEOCENE
LISTA
UPPER CRETACEOUS
MAASTRICHTIAN
CAMPANIAN
SANTONIAN
CONIACIAN
TURONIAN
CENOMANIAN
Lower CRETACEOUS
ALBIAN
CROMER KNOLL GROUP
Lower JURASSIC
OUTER SHELF
BATHYAL to OUTER SHELF
UPPER BATHYAL to OUTER SHELF
VITRINITE ABSENT
Ro = 0,52
Ro = 0,53
Ro = 0,55
Ro = 0,55
Ro = 0,58
Ro = 0,58
Ro = 0,59
Ro = 0,71
KEROGEN COMPOSITION DETAIL KIMMERIDGE CLAY Fm.
IMMATURE
TRANSITIONAL
MATURE
TD = 3900