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ROBERTSON RESEARCH INTERNATIONAL LIMITED

REPORT NO. 6248/Ic

PETROLEUM GEOCHEMISTRY OF THE NORSK HYDRO 7321/8-1 BARENTS SEA WELL: MATURITY AND KEROGEN TYPE OF THE INTERVAL 580m TO 3450m

by

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PROJECT NO. RRPC/878/Ic/25564

NORSK HYDRO CONTRACT NO. K01497/OG-U & FoU

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JANUARY 1988

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2 INTRODUCTION

This report presents the results obtained from spore colouration, vitrinite reflectivity and visual kerogen type analysis of ditch cuttings, conventional core and sidewall core samples from the interval 580m to 3450m in the Barents Sea 7321/8-1 well. The work was submitted by Norsk Hydro, Harstad, under Contract No. K01497/0G-U & FoU. The analysis of one sample for total organic carbon and Rock-Eval pyrolysis was agreed with Norsk Hydro during the course of the project.

The group of samples comprised 23 unwashed, wet ditch cuttings, 5 pieces of conventional core and 47 sidewall cores, and were received at Robertson Research International's North Wales laboratories during the month of October, 1987. Preliminary results were sent to Norsk Hydro on 10th November (telex) and 2nd December, 1987 (facsimile message). The analyses carried out are as follows:

	No. of samples
Sample preparation	75
Kerogen preparation	73
Spore colouration	37
Vitrinite reflectivity	37
Visual kerogen typing	37
Total organic carbon	1
Rock-Eval pyrolysis	1

Insufficient sample material was available to carry out kerogen preparation on sidewall cores at 1915.3m and 2813m.

Robertson Research personnel involved in the study were:

Alan Collins	-	Project co-ordination, spore colour/kerogen microscopy and report writing
Jacqui Milner	-	Vitrinite microscopy
Neil Owen	-	Supervision of chemical analysis
Malcolm Jones	-	Supervision of kerogen preparation

COMPANY: NORSK HYDRO WELL: 7321/8-1 LOCATION: BARENTS 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
580	Swc	MDST, med-dk gy		.50(9) .26(1)L .67(3)R .85(20)R							
615	"	MDST, med-dk gy		.46(8) .22(6)L .69(17)R .97(9)R							
825	Ctgs	MDST, med-dk gy + 30% CMT		.58(10) .80(14)R 1.02(14)R 1.30(14)R							
905	"	SLTST, med-dk gy + 20% SST, v lt gy+ tr pyr		.59(5) .45(3)C .93(9)R 1.17(4)R							
920	"	SLTST, med-dk gy + 10% SST, v lt gy	6.5		15	75	10				
975	"	SLTST, med-dk gy + 20% SST, v lt gy+ tr pyr		.59(29) .46(4)L .74(8)R 1.04(13)R							
1020	"	SLTST, med-dk gy + 10% SST, v lt gy+ tr pyr		.62(15) .44(14)C .75(11)R							
1132	Swc	SLTST, med-dk gy + 10% SST, v lt gy		.65(41) .47(6)L .91(5)R 1.22(3)R							
1201	"	SLTST, med-dk gy		.74(18) .58(9)L .92(6)R 1.10(6)R							
1380	Ctgs	SLTST, med-dk gy + 10% SST, v lt gy+ mnr SLTST, gy-red	7.5		5	20	75				
1390	"	SLTST, dk gy+ 10% SST, v lt gy + mnr SLTST, gy-red	7.5		10	30	60				
1400	"	SLTST, dk gy+ mnr SST, v lt gy + mnr SLTST, gy-red	8.0		10	25	65				
1410	"	SLTST, dk gy+ tr LST, v lt gy	8.0		10	35	55				
1415	"	SLTST, dk gy+ tr SST	8.0		10	35	55				
1420	"	SLTST, dk gy+ tr SST	7.5 - 8.0		10	55	35				
1425	"	SLTST, dk gy+ tr SST	8.0		15	55	30				
1430	"	SLTST, dk gy+ tr SST	8.0		10	60	30				
1435	"	SLTST, dk gy+ tr SST		.77(24) .42(1)C .94(11)R 1.17(17)R							

Maturity and Kerogen Composition Data

TABLE 1A

COMPANY NORSK HYDRO WELL 7321/8-1 LOCATION BARENTS SEA

SAMPLE DEPTH (METRES)	SAMPLE TYPE	GENERALISED LITHOLOGY	SPORE COLOUR INDEX (1 10)	VITRINITE REFLECTIVITY R o/r av %	KEROGEN COMPOSITION (%) (by microscopic examination)			KEROGEN COMPOSITION (%) (by calculation from pyrolysis data)			
					INERTINITE	VITRINITE	SAPROPEL	INERTINITE	VITRINITE	ALGAL SAPROPEL	WAXY SAPROPEL
1470	Core	SLTST, dk gy		.77(8) .94(21)R 1.21(19)R							
1479	"	SST, dk gy+ 20% SST, yel-gy		.75(6) .59(3)L .98(20)R 1.32(24)R							
1481	"	SST, lt ol-gy+ 40% COAL	7.5 - 8.0	.69(22) 1.24(13)R 1.55(5)R 2.11(2)R	50	40	10				
	P	COAL		.68(8) 1.21(30)R 1.75(9)R 2.16(5)R							
1500	Core	SST, lt ol-gy+ 20% COAL+ tr pyr		.77(24) .67(3)L .92(26)R 1.21(2)R							
1527	"	SST, lt ol-gy+ tr SST, med gy		.92(17) .68(3)L 1.12(25)R 1.32(8)R							
1545.5	Swc	SND+ 10% CLYST, med gy		.90(11) .67(15)L 1.06(7)R 1.27(16)R							
1623	"	CLYST, med-dk gy		.97(1) 1.15(6)R 1.39(15)R							
1810	"	SST, v lt gy+ 10% CLYST, brn-gy		.93(3) .58(1)L 1.15(4)R 1.34(11)R							
1830.8	"	SLTST, med gy	8.0		60	35	5				
1850.9	"	SLTST, med-dk gy	8.0 - 8.5		40	60	Mnr				
1915.3	"	SLTST, lt ol-gy									
1942.3	"	COAL+ tr SST	7.5 - 8.0		10	90	Mnr				
2117.4	"	SLTST, dk gy	7.5 - 8.0		5	95	*				
2141.2	"	SLTST, dk gy	8.0 - 8.5		5	70	25				
2158.2	"	SH, dk gy	8.0 - 8.5		5	85	10				
2184.6	"	SH, dk gy	8.0		5	90	5				
2213.7	"	SLTST, med-dk gy		1.15(3) 1.35(9)R 1.63(19)R							
2229.1	"	SLTST, dk gy	8.5		Mnr	90	10				
2276.8	"	SLTST, dk gy+ tr SST	8.0		15	80	5				
2295	"	SLTST, dk gy		1.13(6) 1.31(8)R 1.55(16)R							
2429	"	SLTST, dk gy		1.09(1) 1.49(2)R							
2520	"	SST, lt ol-gy		1.23(13) .90(1)L 1.61(36)R							

Maturity and Kerogen Composition Data

TABLE 18

COMPANY NORSK HYDRO WELL: 7321/8-1 LOCATION. BARENTS 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
2520	Ctgs	SLTST, dk gy+ 20% SST, lt ol-gy		1.23(7) .83(2)L 1.53(10)R 1.97(25)R							
2582.5	Swc	SST+ 10% CLYST, med gy	8.5		20	75	5				
2600	Ctgs	SLTST, dk gy+ 40% SST, v lt gy		1.39(17) 1.08(4)C 1.68(23)R 1.97(5)R							
2634	Swc	SST, v lt gy+ mnr SLTST, dk gy	8.5		75	25	Mnr				
2650	"	SLTST, med-dk gy + mnr SST, v lt gy	8.0 - 8.5		35	65	Mnr				
2662	"	SLTST, dk gy	8.5		40	55	5				
2681.5	"	SST, v lt gy+ 10% SLTST, dk gy sndy	*		80	20	*				
2685	"	SLTST, dk gy+ 10% SST, v lt gy	8.0 - 8.5		70	20	10				
2690	"	SLTST, dk gy	8.5 - 9.0		30	65	5				
2700	Ctgs	SLTST, dk gy+ 20% SST, v lt gy		1.20(18) .92(7)C 1.63(28)R 2.18(2)R							
2719	Swc	SLTST, dk gy	8.5		50	45	5				
2750	Ctgs	SLTST, dk gy+ 30% SST, v lt gy		1.33(34) .90(7)L 1.86(12)R							
2759	Swc	SST, v lt gy+ 10% SLTST, dk gy	8.5		50	50	Mnr				
2778	"	SLTST, dk gy+ tr SST, v lt gy	8.5 - 9.0		15	75	10				
2800	Ctgs	SST, v lt gy+ 30% SLTST, dk gy		1.30(13) 1.08(3)L 1.63(32)R 2.02(6)R							
2813	Swc	SLTST, dk gy+ mnr SST, v lt gy									
2830	"	SLTST, dk gy+ tr SST, v lt gy	8.5 - 9.0		20	70	10				
2850	Ctgs	SST, v lt gy+ 30% SLTST, dk gy		1.32(27) .95(3)C 1.70(20)R 2.05(3)R							
2900	"	SLTST, dk gy+ 20% SST, v lt gy		1.43(19) 1.09(6)L 1.81(29)R 2.43(1)R							
2910	Swc	SLTST, dk gy+ 20% SST, v lt gy	8.5 - 9.0		25	70	5				
2950	"	SLTST, dk gy+ mnr SST, v lt gy		1.44(7) 1.09(3)L 1.80(25)R 2.35(20)R							

Maturity and Kerogen Composition Data

TABLE 1C

COMPANY. NORSK HYDRO WELL. 7321/8-1 LOCATION: BARENTS 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
3000	Swc	SLTST, dk gy+ mnr SST, v lt gy		1.39(8) 1.07(1)L 1.80(34)R 2.42(10)R							
3063	"	SLTST, dk gy+ mnr SST, v lt gy		1.68(6) 1.34(2)L 2.30(25)R 2.87(9)R							
3100	"	SLTST, dk gy+ mnr SST, v lt gy	9.0		25	65	10				
3150	"	SLTST, dk gy+ 10% SLTST, v lt gy, sndy		1.66(11) 1.16(1)L 2.05(28)R 2.47(15)R							
3200	"	SLTST, dk gy+ mnr SLTST, v lt gy, sndy		1.76(7) 1.28(12)L 2.23(27)R 2.71(9)R							
3269	"	SLTST, dk gy	9.0		Mnr	10	90				
3302	"	SLTST, dk gy	9.0		Mnr	10	90				
3351	"	SLTST, gy-blk+ tr SST		1.87(5) 1.36(2)L 2.66(18)R							
3366	"	SLTST, dk gy	9.0 - 9.5		5	10	85				
3373	"	SLTST, dk gy+ mnr SST, med gy	9.0		10	10	80				
3396	"	SLTST, dk gy+ tr SST, med gy	9.0 - 9.5		10	10	80				
3397	"	SLTST, dk gy+ 20% SLTST, med-lt gy, sndy		1.80(7) .85(1)L 2.22(12)R 2.78(6)R							
3400	Ccgs	SLTST, dk gy+ 10% SST, v lt gy		1.81(7) 2.80(8)R							
3450	"	DOL, blk+ 10% SLTST, dk gy+ 10% SST		1.77(7) 2.72(12)R 4.16(4)R							

Maturity and Kerogen Composition Data

TABLE 1D

Depth (metres)	Ro %	SCI	Palynomorphs	Vitrinite	Inertinite	Amorphous (liptinitic)	Amorphous (humic)	Cuticle	Reworked	Caved
580	0.50									
615	0.46									
825	0.58									
905	0.59									
920		6.5	10	30	15	Mar	45	Mnr	*	Mnr
975	0.59									
1020	0.62									
1132	0.65									
1201	0.74									
1380		7.5	Mnr	10	5	75	10	*	*	Mnr
1390		7.5	10	10	10	50	20	*	*	Mnr
1400		8	5	15	10	60	10	*	*	*
1410		8	5	15	10	50	20	*	*	*
1415		8	5	15	10	50	20	*	*	Mnr
1420		7.5-8	5	20	10	30	35	Mnr	*	*
1425		8	10	30	15	20	25	Mnr	*	*
1430		8	10	15	10	20	45	*	*	*
1435	0.77									
1470	0.77									
1479	0.75									
1481 (kgn)	0.69	7.5-8	10	40	50	*	*	*	Mnr	*
1481("coal")	0.68									
1500	0.77									
1527	0.92									
1545.5	0.90									
1623	0.97									
1810	0.93									
1830.8		8	5	35	60	*	*	*	*	*
1850.9		8-8.5	Mnr	60	40	*	*	*	*	*
1915.3	-	-	-	-	-	-	-	-	-	-
1942.3		7.5-8	Mnr	90	10	*	*	*	*	*
2117.4		7.5-8	*	95	5	*	*	*	*	*
2141.2		8-8.5	10	70	5	*	*	15	*	*
2158.2		8-8.5	10	70	5	*	15	*	*	*
2184.6		8	5	90	5	*	*	*	*	*
2213.7	1.15									
2229.1		8.5	10	75	Mnr	*	15	*	*	*
2276.8		8	5	70	15	*	10	*	*	*
2295	1.13									
2429	1.09									
2520(SWC)	1.23									
2520(ctgs)	1.23									
2582.5		8.5	5	75	20	*	*	*	*	*
2600	1.39									
2634		8.5	Mnr	25	75	*	*	*	*	*
2650		8-8.5	Mnr	65	35	*	*	*	*	*
2662		8.5	5	55	40	*	*	*	*	*
2681.5		*	*	20	80	*	*	*	*	*
2685		8-8.5	10	20	70	*	*	*	*	*
2690		8.5-9	5	65	35	*	*	*	*	*
2700	1.20									
2719		8.5	5	40	50	*	5	*	*	*
2750	1.33									
2759		8.5	Mnr	50	40	*	10	*	*	*
2778		8.5-9	10	75	15	*	*	*	*	*
2800	1.30									
2813	-	-	-	-	-	-	-	-	-	-
2830		8.5-9	10	70	20	*	*	*	*	*
2850	1.32									
2900	1.43									
2910		8.5-9	5	70	25	*	*	*	*	*
2950	1.44									
3000	1.39									
3063	1.68									
3100		9	10	65	25	*	*	*	*	*
3150	1.66									
3200	1.76									
3269		9	5	Mnr	Mnr	85	10	*	*	*
3302		9	5	5	Mnr	85	5	*	*	*
3351	1.87									
3366		9-9.5	Mnr	5	5	80	10	*	*	*
3373		9	Mnr	Mnr	10	80	10	*	*	*
3396		9-9.5	Mnr	Mnr	10	80	10	*	*	*
3397	1.80									
3400	1.81									
3450	1.77									

TABLE 2 Detailed Kerogen Composition Data

APPENDIX 1
ABBREVIATIONS USED IN ANALYTICAL DATA SHEETS

a/a	-	as above
Ac	-	acritarchs
ADD	-	mud additive
Al	-	algae
Am	-	amorphous
ang	-	angular
ANH	-	anhydrite
aren	-	arenaceous
arg	-	argillaceous
BAS	-	basalt
bd	-	bedded/bedding
B(IT)	-	bitumen/bituminous
bl	-	blue
bld	-	bleached
blk	-	black
bri	-	brilliant
brn	-	brown
calc	-	calcareous
CALT	-	calcite
carb	-	carbonaceous
CGL	-	conglomerate
CHK	-	chalk
CHT	-	chert
CLYST	-	claystone
CMT	-	cement
Comp	-	composite
crs	-	coarse
CSG	-	casing point/shoe
Ctgs	-	ditch cuttings
Cu	-	cuticle
C(vd)	-	caved
decarb	-	decarbonated
Di	-	dinocysts
dk	-	dark
DLT	-	dolerite
DOL/dol	-	dolomite/dolomitic
dsk	-	dusky
Ex	-	exinite
Exs	-	exsudatinite
extr	-	extracted
f	-	fine
fel	-	feldspathic
fer	-	ferruginous
flu	-	fluorescence
fm	-	formation
foss	-	fossils/fossiliferous
fr	-	friable
frac	-	fracture
frags	-	fragments
Fu	-	fusinite
GLC/glc	-	glauconite/glauconitic
gn	-	green
grd	-	graded/grading to
grns	-	grains
gy	-	grey
GYP	-	gypsum
HAL	-	halite
hd	-	hard
hor	-	horizontal
H(RV)	-	high reflecting vitrinite
i-	-	iso-
i/b	-	inter-bedded
IGN	-	igneous rocks
inc	-	including
Inert	-	inertinite
lam	-	laminae/laminated
LCM	-	lost circulation material
LIG/Lig	-	lignite/lignitic
lns	-	lens(es)
L(RV)	-	low reflecting vitrinite
LST	-	limestone
lt	-	light
mass	-	massive
MDST	-	mudstone
med	-	medium
MET	-	metamorphic rocks
mic	-	mica/micaceous
micr	-	micritic
min	-	mineral
mnr	-	minor
mod	-	moderate
mtl	-	mottled
n-	-	normal
NA	-	not available
nod	-	nodule/nodular
NS	-	no sample
occ	-	occasional
ol	-	olive
ool	-	oolitic
orng	-	orange
OS	-	oil stain
P	-	picked lithology
pal	-	pale
Ph	-	phytane
pnk	-	pink
por	-	porous/porosity
pp	-	purple
Pr	-	pristane
pred	-	predominantly
Prt	-	present
PYR/pyr	-	pyrite/pyritic
QTZ(T)	-	quartz(ite)
Re	-	resin
R(ew)	-	reworked
rnd	-	round(ed)
Sap	-	sapropel
sbng	-	subangular
sbrd	-	subrounded
SCI	-	spore colour index
Sf	-	semifusinite
sft	-	soft
SH	-	shale
shly	-	shaly
sil	-	siliceous
sks	-	slickenside surface
SLA	-	slate
SLT(ST)	-	silt(stone)
slty	-	silty
SND	-	sand
sndy	-	sandy
Sp	-	spores
SST	-	sandstone
st	-	stained
stks	-	streaks
suc	-	sucrosic
surf	-	surface
SWC	-	side wall core
TD	-	total depth
TOC	-	total organic carbon
tr	-	trace(s)
trns	-	transparent
v	-	very
vgt	-	variegated
Vit	-	vitrinite
vn	-	vein
VOLC	-	volcanic rocks
VR	-	vitrinite reflectivity
wht	-	white
xln	-	crystalline
yel	-	yellow
-	-	no analysis carried out
*	-	analysed but no data obtain
gy-gn	-	greyish green
gy/gn	-	grey-green (gradation)
gn-gy	-	greenish grey

Note: (Maturity data tables only). Number in brackets refers to number of reflectivity values averaged to give quoted result. Preferred values for indigenous phytoclasts are listed first.

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APPENDIX 2

ANALYTICAL PROCEDURES AND TECHNIQUES

This appendix summarises the main steps in the analyses carried out in the Robertson Research International Ltd. petroleum geochemistry laboratories. Analytical pathways are shown on the flow chart (Appendix Figure 1) and details of laboratory procedures and techniques are given in the text. These may in certain circumstances be adapted to suit particular samples or conditions. Interpretation guidelines are also defined.

1. Sample Preparation

General

Samples are received into the laboratories in the forms of well-site canned ditch cuttings, bagged ditch cuttings in various stages of preparation from wet, unwashed to dried, washed; sidewall cores, conventional cores, outcrop samples, crude oil samples and gas samples. Each sample is assigned a number which is entered into a computer system to monitor sample selection and progress. Preparation techniques are directed towards obtaining clean samples, free of drilling mud and mud additives, obvious caving contamination and indeterminate fine material. Washing with cold water is standard but further washing with solvent (dichloromethane, DCM) is carried out if oil-based mud is present, after which samples are dried, described and individual lithologies hand-picked where practicable. Samples are rough crushed to approximately pea-sized fragments for kerogen preparation or finely milled for chemical analysis.

Kerogen Preparation

Kerogen concentrates for microscopic examination and elemental analysis are prepared using standard palynological procedures but omitting oxidation or acetolysis. Acid maceration involves the use of hot hydrochloric acid (HCl) to remove carbonates and hot 60% hydrofluoric acid (HF) to remove or break down silicates. Mineral residues are separated from the kerogen by a combination of ultrasonic vibration and zinc bromide flotation. Kerogen samples for spore colour and kerogen typing are mounted on glass slides in glycerin jelly, those for vitrinite reflectivity are dried and mounted in epoxy resin. Kerogen residues are stored in methanol.

2. Maturity Evaluation

The techniques employed for interpreting maturity and thermal history in these laboratories are based mainly on spore colouration and vitrinite reflectivity measurement, supplemented by data obtained from airspace gas and gasoline analysis, pyrolysis Tmax, and hydrocarbon analysis including gas chromatography and gas chromatography-mass spectrometry.

Spore Colouration

Sporomorph colour is assessed using a >20μ sieved kerogen fraction viewed in transmitted light on a standard palynological microscope. Unusual hues are checked using incident blue/UV light fluorescence. Measurement is made by eye against reference sets of single grain spore mounts and trained operators achieve a high degree of accuracy and reproducibility. The 1 to 10 Spore Colour Index (SCI) scale was designed for linearity with increasing depth and temperature and correlates approximately with the following zones of oil generation: 1.0 to 3.5, immature; 3.5 to 5.0, early mature, generation of low gravity oils (28 to 35 °API); 5.0 to 7.0, middle mature, generation of medium gravity oils (35 to 42°API); 7.0 to 8.5, late mature, generation of light oils (>42°API) and condensates; 8.5 to 10, post mature, generation of condensate, wet gas and, ultimately, dry gas. Linearity of scale is of great value in prediction, by extrapolation, of the depth to any part of the oil generation sequence. The value of SCI measurement lies in the objective selection of measured grains, so minimising problems of caving and reworking, and in its more direct correlation against oil generation than vitrinite reflectivity measurement. Limitations in its use concern the difficulty of correlation against other colour scales and the insensitivity of the scale in the late to post mature region. Anomalous colours may result from bleaching or staining during deposition and diagenesis. The correlation of SCI against Thermal Alteration Index (TAI) given on the SCI versus depth plot in the reports was made by direct comparison of Staplin's standard slides with SCI standard slides.

Vitrinite Reflectivity

The majority of preparations examined under reflected light in these laboratories are made using >20μ sieved kerogen, mounted in resin blocks and polished with carborundum and alumina although total kerogen may be used when sample size is

limited. Picked coals, organic-rich shales or limestones containing solid bitumen are mounted directly in resin blocks and polished in the usual way. Measurement is made on a Leitz Orthoplan microscope fitted with an MPV Compact photometer which feeds values direct to a desk top computer for data processing from each sample. The system is calibrated against glass standards and reflectance values are expressed as arithmetic means of measurements taken in oil immersion (R_o or $R_{m\ oil}$). R_{max} and R_{min} may be measured and quoted in certain circumstances but the difference is insignificant below about R_o 1.0%. Some operator selection of particles during measurement is essential and obvious contaminants or non-vitrinitic material are noted but not necessarily quoted. The value quoted on data tables is that which is interpreted as most appropriate, but other possibilities may also be given. Plotted figures assume a logarithmic increase of reflectance with depth. R_o 0.5% is a widely accepted threshold value for the onset of oil generation, although as the kinetics of oil generation may not be identical to those of vitrinite reflectivity development this must be seen only as a general guide. The floor for oil generation is characterised by a reflectance value of about 1.3%. Wet gas generation peaks at a value of about 1% and ceases at the 2% level. Dry gas generation peaks at a reflectance of about 1.5% and ceases at the 3% to 4% level. Correlation of reflectance values with other maturity parameters may not be universal because of time-temperature factors and is best made on a local basis.

Reflectivity measurement is a widely used and versatile tool which may be readily calibrated against easily obtained standards. It is applicable over a wide range of maturity stages from immature to post mature (0.2% to 5% R_o). High surface intercepts on plotted figures and discordances at faults and unconformities can give realistic estimates of the amount of section missing. It is of limited value in Early Palaeozoic sections where land plant material is absent, although a general guide to maturity may be obtained from chitinous organic matter. Even a skilled operator may have difficulty in distinguishing indigenous vitrinite from some forms of inertinite, anomalously reflecting "pseudovitrinite", cavings and reworked fragments.

Airspace Gas Analysis

Wet cuttings are collected at the well site and sealed in partly full cans containing bactericide. In the laboratory, the airspace (headspace) gas is extracted using a can piercer fitted with a septum and analysed by gas chromatography. The proportions of methane, ethane, propane, iso- and n-butane are calculated from integrated peak areas by comparison with a standard mixture of these gases. Methane is the dominant gas in immature and post mature sediments, comprising 90-100% of total gas, falling to 30-70% in mature sediments. The onset of maturity for oil generation (SCI 3.5) is characteristically marked by an increase in wet gas (C_2-C_4) to between 10 and 20% with further increases in maturity indicated by a decrease in the ratio of iso- to n-butane. Ratios of >1.0 are typical for immature sediments and <0.5 are usual in mature sediments. Departures from composition versus depth trends may be useful in indicating migrant gas at faults, unconformities or reservoir rocks but limit the method as a reliable maturity indicator. Airspace gas analysis is an inexpensive and rapidly executed method of screening samples for further maturity and hydrocarbon content determinations.

Gasoline Analysis and Cuttings Gas Analysis

Cuttings samples received wet, preferably in sealed containers, are suitable for gasoline and cuttings gas analysis. A portion of the washed cuttings sample is retained wet, pulverised in a sealed shaker and warmed to expel the C_1 to C_7 hydrocarbon components into the shaker airspace. A sample of this airspace gas is then removed and analysed by gas chromatography either for cuttings gas (C_1 to C_4) or gasolines (C_4 to C_7). Up to 28 hydrocarbon components are identified in the C_4 to C_7 range and their relative proportions calculated from integrated peak areas with reference to standard mixtures. Immature source rocks yield low total abundances and limited numbers of components whereas mature source rocks usually contain a full complement of identified hydrocarbons with the onset of maturity indicated by a rapid rise in total gasoline abundances with depth. Anomalous amounts of gasolines may mark the presence of oil stain. Gasolines may be used in oil to oil or oil to source rock correlations but the concentration of some of the measured components is not only a function of source but also depends on maturity, migration and alteration in the reservoir. Using the most stable compounds, pairs with similar chemical structure and boiling points are reduced to pair ratios and compared with the same pair ratios in other oils or possible source rocks. Gasoline analysis is a valuable tool in that it measures directly the hydrocarbons being generated from a sediment but its sensitivity in detecting traces of oil places constraints on its use as a maturity indicator.

Rock-Eval Pyrolysis, Gas Chromatography (GC) and Gas Chromatography-Mass Spectrometry (GC-MS) in Maturity Analysis

These three analytical processes measure parameters which are functions of both maturity and kerogen type. Data from them may give a general guide to maturity but if the kerogen types are known, more specific conclusions may be drawn. From Rock-Eval data, the temperature of maximum rate of pyrolysis, Tmax, is the most useful datum; gas chromatograms of alkanes, separated from source rock extracts or oils, yield carbon preference indices (CPI) and isoprenoid ratios; GC-MS quantitative fragmentograms provide abundance ratios for specific compounds which are particularly useful in assessing the level of maturity at which source rock hydrocarbons or oils have been generated. All these supplementary data may be used to confirm results from visual analysis or supplant them if poor or unavailable.

3. Source Rock Evaluation

Total Organic Carbon Content (TOC)

Organic carbon values are obtained by treating 0.1g of crushed rock sample with hot, concentrated HCl to remove carbonates. The washed residue is filtered on to a glass fibre pad and ignited in a Leco carbon analyser. For screening purposes, samples are analysed singly but where further analyses, such as pyrolysis or solvent extraction are anticipated, a duplicate sample is run. Blanks and standards are run as routine and where values from duplicated samples do not concur within strict accuracy limits, they are rerun. Where samples are heavily stained with oil, either from natural deposits or drilling mud, TOC is repeated on the dried, solvent extracted sample.

TOC measurement is fundamental in assessing source rock quality since when combined with kerogen type and maturity, a full description of the potential to generate oil may be given. It is found in practice that sediments containing less than 0.3% TOC are unlikely to have any source potential, those containing between 0.3% and 1% may be marginal sources but the better quality sources contain in excess of 1% TOC. Screening by TOC is therefore an inexpensive and rapid method of selection of samples for further analysis in source potential evaluation.

Rock-Eval Pyrolysis

Pyrolysis data are obtained using the IFP-Fina Rock-Eval apparatus. 100 mg of crushed, whole rock either from bulk sample or picked lithology is weighed accurately into a crucible and introduced into a furnace at 250°C. Free hydrocarbons (roughly equivalent to solvent extractable hydrocarbons) are volatilised and quantified by flame ionisation detector (FID) to give Peak 1 (S_1, ppm). The furnace temperature is increased to 550°C at 25°C/minute and within this range, kerogens crack to give hydrocarbons, measured by FID to give Peak 2 (S_2, ppm) and carbon dioxide, measured by thermal conductivity detector (TCD) to give Peak 3 (S_3, ppm). The temperature at the maximum rate of evolution of cracked volatiles (Tmax) is measured automatically but can also be monitored visually. The instrument is calibrated daily using standards both at the beginning of the work period and at regular intervals thereafter and crucible blanks are run as routine. The tabulated data in reports comprise the following parameters:

Tmax °C - temperature of maximum rate of Peak 2 hydrocarbon evolution.

Hydrogen Index (HI) - S_2/TOC (mg/g) or ratio of released hydrocarbon to organic carbon content. This is a measure of the hydrocarbon generating potential remaining in the kerogen as opposed to that of the whole rock.

Oxygen Index (OI) - S_3/TOC (mg/g) or ratio of released carbon dioxide to organic carbon content.

Production Index (PI) - S_1/S_1+S_2, or ratio of the amount of hydrocarbons released in the first stage of heating to the total amount of hydrocarbons released and cracked during pyrolysis.

Potential Yield (PY) - S_2 (ppm) or total of hydrocarbons released during cracking of kerogen compared to original weight of rock.

Tmax, hydrogen index and oxygen index are each functions of both maturity and kerogen type. Using published and empirical data, it has been possible to assemble a model to show the relationships of these factors to maturity as measured by spore colouration and vitrinite reflectivity for a selection of pure kerogen types. The kerogen types used are algal sapropel (type I), waxy sapropel (type II), vitrinite (type IIIA) and inertinite (type IIIB) and a computer program has been devised by which the amounts of these components may be calculated from the HI, OI, Tmax and maturity

data for any sample. These are the values expressed in the "kerogen composition by calculation" columns tabulated in the reports.

The hydrogen index is a measure of the hydrocarbon generating potential of the kerogen and is analogous to the atomic H/C ratio. Immature, organically rich source rocks and oil shales give values above 500, mature oil source rocks give values between 200 and 550. For a given kerogen type, these values progressively diminish with increasing maturity.

The temperature of maximum rate of pyrolysis depends partly on the kerogen type but the transition from immature to mature organic matter is marked by temperatures between 415° and 435°C. The maturity transition from oil and wet gas generation to dry gas generation is marked by temperatures between 455° and 460°C. In practice, greater variation than these ideal temperature ranges may be seen, but they are nevertheless useful as general guides to the level of maturity attained by the sediment.

The production index increases with maturity from values near zero for immature organic matter to maximum values of 0.15 during the late stages of oil generation. Anomalously high values indicate the presence of oil or contaminants. The potential yield is an indication of the predicted yield of hydrocarbons from the source rock at optimum maturity and is a measure of the quality of the source rock. For immature sediments, values of 0 to 2000 ppm of hydrocarbon characterise a poor source rock, 2000 to 6000 ppm fair, 6000 to 20 000 ppm good and above 20 000 ppm very good.

Pyrolysis techniques have in recent years provided a major advance in the assessment of source rock quality and generating potential. Hydrocarbon yields from immature source beds examined on-structure may be translated into actual oil productivity from the same beds in mature basinal, off-structure situations. Models relating maturity and kerogen type may be used to define original source rock quality grades which are of great value in mapping organic facies. Amorphous kerogen types, indistinguishable in microscopic preparations over a wide range of chemical properties, may be readily differentiated by pyrolysis. The problem of analysing bulk samples containing mixed kerogens has been largely overcome by the kerogen type/maturity model and anomalous results arising from the presence of caving contamination and drilling mud additives can usually be explained by inspection. High oxygen indices sometimes occur as a result of the presence of metastable carbonates and in such cases the sample is acid decarbonated and re-run.

Visual Examination of Kerogen Concentrates

All palynological preparations on which SCI determinations are made are also examined for kerogen type. Visual estimations of the relative abundance of the broad groups vitrinite, inertinite and sapropel are made on the total kerogen slide mount but reference is also made to the >20μ sieved fraction to assist in identification. The scheme of identification is shown in Appendix Table 1. Full use is made of incident blue or UV light in distinguishing immature or early mature oil-prone kerogen from gas-prone kerogen.

Extract Analysis

The soluble organic materials present in rocks can be extracted with organic solvents, fractionated and analysed. The type and amount of material extracted depends largely upon the nature of the contained kerogen and its maturity, although the presence of migrant oil or drilling contamination may be the determining factors.

A maximum of 40g of crushed sample is extracted for a minimum of 12 hours in a Soxhlet apparatus using laboratory redistilled DCM. The solvent and the more volatile components (approximately up to $\underline{n}$-C_{15}) are lost by evaporation in an air flow and the resulting total extract is weighed, dissolved in hexane and separated into alkane (saturate) hydrocarbon, aromatic hydrocarbon, resene and asphaltene (polar) fractions by silica adsorption chromatography in the Iatroscan process.

Larger fractions, suitable for further analysis, are obtained by column chromatography. The extract is run through a short glass column packed with silica and alumina and eluted with hexane (to give the saturate fraction), (3:1 hexane: toluene mixture (to give the aromatic fraction) and methanol (to give the polar, or resene and asphaltene, fraction). A small proportion of non-eluted polar compounds usually remains on the column.

The data tabulated in reports comprise the following parameters:

Total extract - soluble organic matter, heavier than about $\underline{n}$-C_{15+}, expressed as ppm of weight of rock.

Hydrocarbons - sum of alkane and aromatic hydrocarbons, expressed as ppm of weight of rock.

Extract % of organic carbon (EPOC) - $\frac{\text{total extract ppm}}{\text{TOC} \times 100}$; the extractability.

Hydrocarbons mg/g of organic carbon - total hydrocarbons normalised to 1g of organic carbon.

Hydrocarbons % extract - total hydrocarbons as a proportion of total extract.

Alkanes % hydrocarbons - the proportion of alkanes (saturates) in the total hydrocarbons. The proportion of aromatics is (100 minus this value) expressed as a percentage.

The extractability of oil-prone sapropelic organic matter increases rapidly in the oil generation zone and diminishes to very low values in post mature sediments. Overall the extractability of sapropelic organic matter is greater than that of gas-prone humic organic matter for similar levels of maturity. Samples with extractabilities of greater than 20% generally contain migrant oil or are contaminated with mud additives.

As maturation proceeds in the oil generation zone the proportion of hydrocarbons in the total extract increases from less than 20% to a maximum in the most productive horizons of around 60%. This trend is reversed as the oil-condensate zone is entered. The relative proportions of alkanes to aromatics can be used as a check for low levels of contamination. Fractions of the extract, separated by column chromatography are retained for further analysis by gas chromatography or for stable carbon isotope determination.

Capillary Gas Chromatography of C_{15+} Alkanes

A portion of the Soxhlet extract is eluted with hexane through a short silica column to yield the saturate hydrocarbon fraction. This fraction is evaporated in a stream of dry nitrogen at room temperature. A small portion of the fraction is then taken up in hexane and introduced into a 25 metre, wall-coated, open tubular glass capillary column coated with OV-1, or equivalent, mounted in a Carlo Erba gas chromatograph which is temperature programmed from 70°C to 270°C at 3°C/minute.

C_{15+} chromatograms are inspected for the distributions of $\underline{n}$-alkanes, and the presence and abundance of isoprenoids (particularly pristane and phytane), steranes and triterpanes and unresolved envelopes of naphthenic compounds. The ratios pristane:phytane and pristane:$\underline{n}$-C_{17} are calculated. Carbon Preference Index (CPI) values quoted are those as defined by Philippi as the ratio $2C_{29}$ to $(C_{28}+C_{30})$ unless otherwise stated. Chromatography may reveal information about the kerogen type of the source rock, its maturity and condition of deposition and, if migrant oil is present, whether this has been water-flushed or biodegraded. Contaminant drilling mud additives may be identified.

Capillary Gas Chromatography of Aromatic and Branched/Cyclic Alkanes

The aromatic portion of the Soxhlet extract is eluted from a short silica/alumina column by a hexane/toluene mixture. The dried fraction is taken up in DCM and introduced into a 25 metre, wall-coated, open tubular glass capillary column coated with OV-1, or equivalent, mounted in a Carlo Erba gas chromatograph which is temperature programmed from 70°C to 270°C at 3°C/ minute.

Branched chain alkanes are separated from normal alkanes by urea adduction and treated as for total alkanes.

Gas Chromatography-Mass Spectrometry

Mass spectrometry is a technique in which molecules are bombarded with high energy electrons causing ionisation and fragmentation of the molecules into ions of varying mass(m) and charge(z). The way in which a molecule fragments into ions of various m/z value is known as its fragmentation pattern, or mass spectrum and is unique. When linked to a gas chromatograph the mass spectrometer can be used in two different modes:

1. Full Scan Mode: A mass spectrum is obtained of each peak eluting from the gas chromatograph and a structural identification of the compound producing that peak can be made.

2. Multiple or Single Ion Monitoring Mode: The mass spectrometer is tuned to certain m/z values to detect whether a compound, eluting from the gas chromatograph, fragments to give an ion at that value. Certain fragmentations are indicative of specific compound types and the most commonly monitored fragment ions used in petroleum geochemistry are those with m/z values of 191, 217 and 259 which are the principal fragment ions obtained from groups of alkanes known as triterpanes, regular steranes and rearranged steranes respectively. These are compounds containing 27 to 35 carbon atoms arranged in a polycyclic, normally 4 or 5 ring, structure, occurring in the $\underline{n}$-C_{26} to $\underline{n}$-C_{35} region of a gas chromatogram. The basic molecular skeletons of these compounds are very similar to those of the original organic matter deposited in the sediment and so these 191, 217 and 259 distribution plots, known as mass fragmentograms or mass chromatograms, form a pattern characteristic of the source material. This technique of "fingerprinting" is also one of the more exact methods of correlating an oil to its source, or to another oil.

Carbon Isotope ($^{13}C/^{12}C$) Ratio Analysis

Carbon has two stable isotopes, the more abundant ^{12}C isotope and the heavier ^{13}C isotope, which in nature forms about 1% of carbon. Deviations from the $^{13}C/^{12}C$ ratio are extremely small and carbon isotope ratios, as measured by mass spectrometry, are expressed as deviations from a standard, the Pee Dee Belemnite carbonate (PDB standard) in parts per thousand (parts per mil; $^{o}/_{oo}$). Positive deviations indicate ^{13}C enrichment and conversely, negative deviations indicate ^{13}C impoverishment.

While the carbon isotope ratios of oils and rock extracts can range from -20 to -32 $^{o}/_{oo}$ depending on the source organic matter type, the difference between a specific oil and its source is small. Measurements are usually made on the C_{15+} alkane and aromatic hydrocarbon fractions separately and there should be no more than 1 $^{o}/_{oo}$ difference between the oil and its source for either fraction. If there is any doubt that the source rock extracts are not indigenous to the source rock kerogen, the carbon isotope ratio of the extracted source rock kerogen can be measured.

Pyrolysis-Gas Chromatography

The hydrocarbon pyrolysate derived from thermal, anhydrous cracking of kerogen is analysed by capillary gas chromatography. A few mg of rock, kerogen or asphaltene is heated to 600°C for 20 seconds in the injector of a gas chromatograph. The chromatograph oven is kept at -30°C during pyrolysis and then raised to 300°C at a programmed rate of 7.5°C/minute. Chromatograms produced this way are often very different from those of source rock extracts or oils in that branched and cyclic isomers are generated freely giving numerous, closely spaced peaks, along with unsaturated, alkene (olefin) hydrocarbons. The "doublet" peaks often observed in these chromatograms comprise alkene-alkane pairs, the first eluting, and usually smaller peak, being the alkene. The chromatograms range from C_1 to C_{30} or above and although variable, are broadly characteristic of source rock type. Gas-prone kerogen cracks to give a more limited molecular weight range of products, concentrated towards the light ends, whereas oil-prone kerogen gives more prominent alkene-alkane doublets in the C_{12} to C_{30} region. The largest peak from both types is usually methane.

Elemental Analysis

Total (unsieved) kerogen is prepared as described in Section 1. The dried material is combusted in oxygen in an elemental analyser and the oxides of carbon, hydrogen, nitrogen and sulphur are measured. The unburnt residue is the ash content. Oxygen is usually calculated by difference but can be determined separately if required. Results are quoted as percentage weights of C, H, O, N, S and Ash with the atomic ratio H/C and O/C calculated and plotted on the standard van Krevelen diagram. The relative amounts of C, H and O present in organic matter are dependent on both source and maturity. At known maturity levels, some measure of source quality may be determined. Limitations of the method in source rock assessment involve the difficulty of obtaining pure kerogen (in particular, free from pyrite) and the lack of a simple, direct determination of oxygen content.

4. Oil Analysis

RRI laboratories offer a wide range of oil analyses both for geochemical purposes and industrial use. Physical property determinations are based mainly on IP methods and are available for lubricating oils, fuels and greases as well as crudes. Frequently measured properties of crude oils presented in geochemistry reports include: API gravity, pour point, viscosity and contents of water, sulphur, wax, asphaltene, nickel, vanadium and other metals. Chemical analysis of oils involves the following:

Whole oil gas chromatography - using split syringe injection and a temperature programme from -20°C or -30°C up to 270°C at 4°C/minute.

Associated gas - if oil has high gas/oil ratio.

Gasoline analysis - as for gasolines in rock samples but a weighed quantity of oil is used.

Topping of the oil - this is equivalent to the removal of the fraction boiling below about 210°C and gives a more standardised product for comparison of gas chromatograms of the C_{15+} fraction.

Column chromatography and gas chromatography - as for solvent extracts. Analysis is carried out on topped oil.

5. Gas Analysis

The hydrocarbon gases, C_1 to C_4, may be collected from the airspace of sealed canned samples or may be received from well-site tests in a special sealed gas cylinder (gas mouse). Chromatographic separation of the C_1 to C_4 gases is effected as described under airspace gas analysis. In addition, the separated gas components may be analysed for stable carbon and hydrogen isotope composition which may provide valuable clues to the origin of the gas.

6. Solid Bitumen Analysis

In some oil fields, problems are encountered where bitumen developments form continuous or patchy layers within reservoirs, dividing the pay zones and acting as barriers to natural fluid movement or inhibiting enhanced oil recovery techniques. Integrated geochemical and sedimentological studies aim to produce geological models capable of predicting the occurrence of bitumen layers and their likely thickness and ability to act as permeability barriers. Of further concern are the past or present relationships between the bitumen and reservoired oil, their source rocks and the timing of bitumen formation.

Analysis schemes involve screening of samples by assessing the amount of bitumen in polished core pieces using reflected light microscopy, followed by solvent extraction of control samples to estimate the proportion of solvent soluble bitumen. Different phases of bitumen formation are differentiated by reflectance measurement as described for vitrinite reflectance measurement. Soluble extracts are fractionated to give alkane, aromatics, asphaltene and resene components. Separated bitumens may be subjected to elemental analysis.

Kerogen Typing Scheme for Transmitted White and Incident Blue/U.V. Light

General Properties	RRI Report Data Tables	Type *
Sapropelic (Oil-prone gas-prone at high maturity)	Algal Sapropel	Type I
	Waxy Sapropel	Type II
Humic (Gas-prone)	Vitrinite	Type IIIA
	Inertinite	Type IIIB

Amorphous		Structured	
Non-Fluorescent	Fluorescent	Non-fluorescent	Fluorescent
Type I/II at high maturity (SCI >7.5)	Type I Sapropel Type II (degraded spores) Soft bitumens	Vitrinite (Type IIIA) brown/black, woody tissue	Cuticle Spores Pollen Dinocysts (Type II)
Type IIIA/B		Inertinite (Type IIIB) very dark brown/black, woody tissue	Resinite Algae (Tasmanites, Botryococcus etc.)
Oil residues (bitumens) Mineral (undigested) Grease contamination Mud additives		Solid bitumen - brown/ black (oil residue) often with crystal imprints	(Type I)
		Microforaminifera, chitinozoa etc. (Not usually important)	
		Spores, cuticle etc. at high maturity levels	
		Mud Additives - walnut etc.	

* Types I, II, III approximately sensu Tissot et al but Type III subdivided into IIIA (vitrinite) and IIIB (inertinite)

APPENDIX TABLE 1

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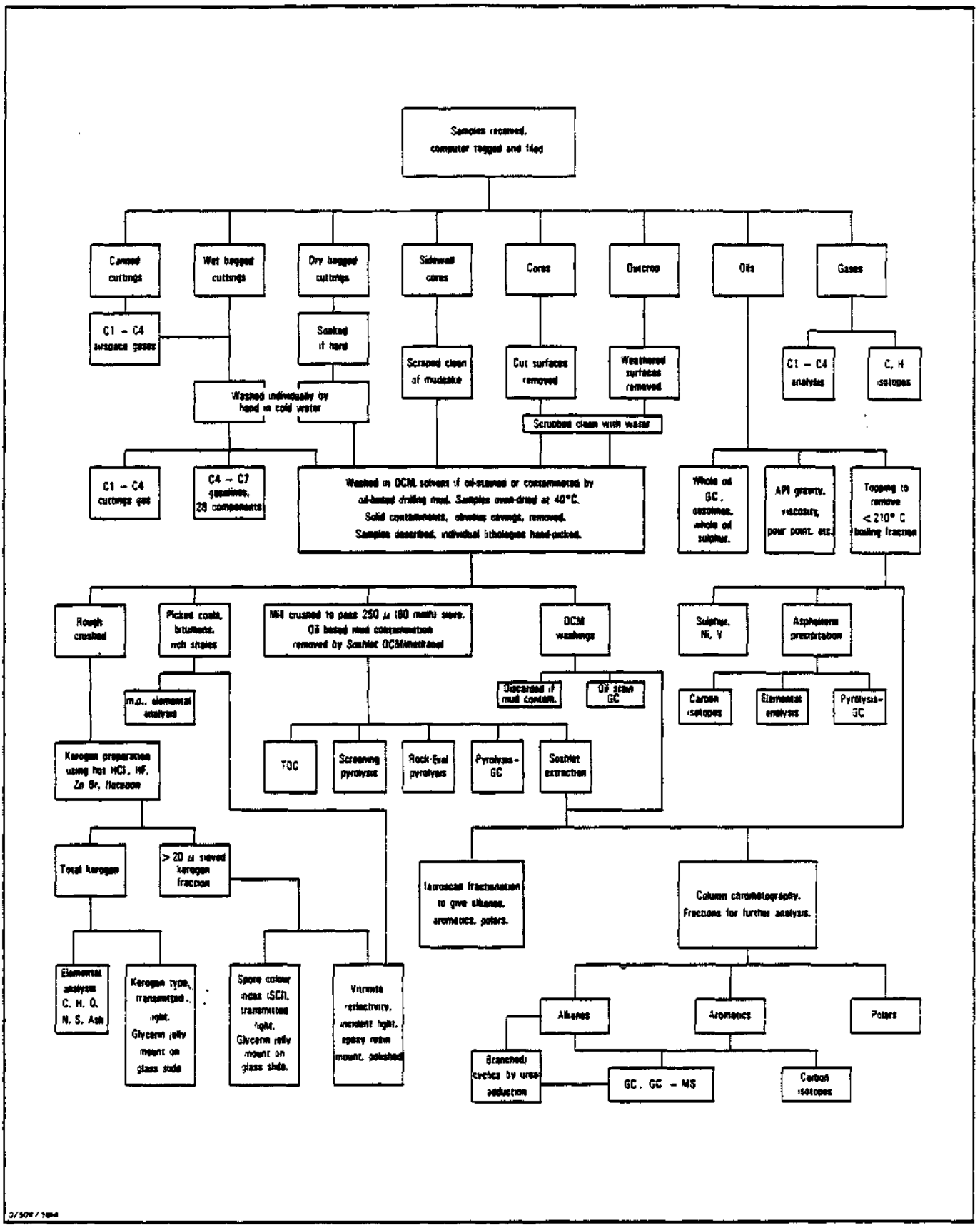
FLOW CHART FOR GEOCHEMICAL ANALYSIS



APPENDIX FIGURE 1

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TABLES

TABLE 1

STANDARD PYROLYSIS DATA @300 Deg.C/180 Secs

GEOCHEM SAMPLE NUMBER	DEPTH	ORGANIC CARBON	S0 (mg/g)	S1 (mg/g)	S2 (mg/g)	PRODUCTION INDEX	HYDROGEN INDEX	Tmax (Deg.C)
1606-001A	1383.0	2.42	0.10	0.65	1.91	0.25	78.9	442
1606-002A	1384.0	2.45	0.06	0.40	1.99	0.17	81.2	440
1606-003A	1385.0	2.09	0.00	0.80	2.85	0.22	136.4	441
1606-004A	1387.0	2.39	0.09	0.40	3.27	0.11	136.8	440
1606-005A	1388.0	1.76	0.08	0.21	1.15	0.15	65.3	440
1606-006A	1389.0	2.34	0.07	0.56	3.58	0.14	153.0	450
1606-007A	1391.0	2.34	0.12	0.51	3.38	0.13	144.4	444
1606-008A	1392.0	2.55	0.13	0.59	3.13	0.16	122.7	445
1606-009A	1395.0	2.63	0.05	0.17	2.64	0.06	100.4	452
1606-010A	1396.0	2.54	0.11	0.94	3.34	0.22	131.5	445
1606-011A	1398.0	2.46	0.00	0.18	2.40	0.07	97.6	448
1606-012A	1399.0	2.75	0.07	0.92	3.27	0.22	118.9	446
1606-013A	1401.0	3.67	0.10	1.03	5.18	0.17	141.1	447
1606-014A	1402.0	3.29	0.14	0.49	3.90	0.11	118.5	443
1606-015A	1404.0	3.99	0.14	0.35	4.60	0.07	115.3	444
1606-016A	1405.0	3.41	0.00	0.85	4.63	0.16	135.8	453
1606-017A	1406.0	3.52	0.05	1.26	6.11	0.17	173.6	442
1606-018A	1407.0	3.34	0.01	1.24	5.75	0.18	172.2	444
1606-019A	1408.0	3.12	0.16	1.06	2.20	0.33	70.5	453
1606-020A	1409.0	3.62	0.06	0.27	5.08	0.05	140.3	444
1606-021A	1410.0	4.59	0.14	0.39	8.44	0.04	183.9	444
1606-022A	1411.0	3.50	0.08	1.15	5.96	0.16	170.3	447
1606-023A	1412.0	3.76	0.03	1.74	6.33	0.22	168.4	444
1606-024A	1413.0	4.03	0.09	0.18	6.68	0.03	165.8	446
1606-025A	1414.0	3.44	0.13	0.80	1.94	0.29	56.4	443
1606-026A	1415.0	3.46	0.04	1.75	4.64	0.27	134.1	445
1606-027A	1416.0	3.09	0.09	0.76	3.44	0.18	111.3	448
1606-028A	1417.0	7.17	0.13	0.43	9.01	0.05	125.7	448
1606-029A	1418.2	0.83	0.11	0.26	0.69	0.27	83.1	440
1606-030A	1419.0	1.77	0.01	0.42	1.17	0.26	66.1	442
1606-031A	1420.0	1.63	0.01	0.35	0.72	0.33	44.2	439
1606-032A	1421.0	1.08	0.00	0.19	0.66	0.22	61.1	429
1606-033A	1422.0	1.22	0.00	0.18	0.60	0.23	49.2	439
1606-034A	1423.0	1.15	0.00	0.13	0.59	0.18	51.3	442
1606-035A	1424.0	0.62	0.05	0.28	0.67	0.29	108.1	442
1606-036A	1425.0	0.79	0.04	0.29	0.42	0.41	53.2	441
1606-037A	1426.0	0.66	0.00	0.12	0.36	0.25	54.5	433
1606-038A	1427.0	0.71	0.08	0.64	0.61	0.51	85.9	442
1606-039A	1428.0	0.67	0.07	0.29	0.28	0.51	41.8	441
1606-040A	1429.0	0.69	0.00	0.29	0.75	0.28	108.7	437
1606-041A	1430.0	0.66	0.00	0.28	0.85	0.25	128.8	441
1606-042A	1431.0	0.57	0.00	0.21	0.56	0.27	98.2	450
1606-043A	1432.0	0.45	0.00	0.21	0.63	0.25	140.0	434
1606-044A	1433.0	0.49	0.07	0.32	0.31	0.51	63.3	435
1606-045A	1434.0	0.57	0.00	0.12	0.48	0.20	84.2	441
1606-046A	1435.0	0.41	0.02	0.12	0.42	0.22	102.4	432
1606-047A	1436.0	0.55	0.03	0.15	0.44	0.25	80.0	441
1606-048A	1437.0	0.36	0.01	0.13	0.38	0.25	105.6	425

EXTRACTED SAMPLES

TABLE 2

STANDARD PYROLYSIS DATA @300 Deg.C/300 Secs

GEOCHEM SAMPLE NUMBER	DEPTH	ORGANIC CARBON	S0 (mg/g)	S1 (mg/g)	S2 (mg/g)	PRODUCTION INDEX	HYDROGEN INDEX	Tmax (Deg.C)
1606-001A	1383.0	2.42	0.09	0.26	2.18	0.11	90.1	447
1606-002A	1384.0	2.45	0.10	0.28	2.21	0.11	90.2	440
1606-003A	1385.0	2.09	0.04	0.97	3.67	0.21	175.6	442
1606-004A	1387.0	2.39	0.09	0.33	2.67	0.11	111.7	445
1606-005A	1388.0	1.76	0.08	0.31	1.17	0.21	66.5	431
1606-006A	1389.0	2.34	0.05	0.33	3.59	0.08	153.4	447
1606-007A	1391.0	2.34	0.07	0.31	2.72	0.10	116.2	436
1606-008A	1392.0	2.55	0.12	0.30	2.72	0.10	106.7	445
1606-009A	1395.0	2.63	0.09	0.26	2.82	0.08	107.2	431
1606-010A	1396.0	2.54	0.07	0.39	3.17	0.11	124.8	445
1606-011A	1398.0	2.46	0.08	0.42	2.47	0.15	100.4	451
1606-012A	1399.0	2.75	0.04	1.47	3.89	0.27	141.5	445
1606-013A	1401.0	3.67	0.03	1.43	5.50	0.21	149.9	433
1606-014A	1402.0	3.29	0.07	0.85	3.67	0.19	111.6	445
1606-015A	1404.0	3.99	0.09	0.60	4.64	0.11	116.3	450
1606-016A	1405.0	3.41	0.13	0.95	4.71	0.17	138.1	448
1606-017A	1406.0	3.52	0.09	1.37	6.71	0.17	190.6	444
1606-018A	1407.0	3.34	0.04	1.51	5.49	0.22	164.4	445
1606-019A	1408.0	3.12	0.15	0.51	2.47	0.17	79.2	448
1606-020A	1409.0	3.62	0.02	0.47	5.48	0.08	151.4	444
1606-021A	1410.0	4.59	0.09	0.37	8.13	0.04	177.1	444
1606-022A	1411.0	3.50	0.01	1.25	6.25	0.17	178.6	450
1606-023A	1412.0	3.76	0.16	1.55	5.03	0.24	133.8	451
1606-024A	1413.0	4.03	0.08	0.68	6.68	0.09	165.8	432
1606-025A	1414.0	3.44	0.02	0.36	2.66	0.12	77.3	437
1606-026A	1415.0	3.46	0.04	1.09	4.36	0.20	126.0	428
1606-027A	1416.0	3.09	0.08	0.51	3.34	0.13	108.1	442
1606-028A	1417.0	7.17	0.13	0.41	8.18	0.05	114.1	443
1606-029A	1418.2	0.83	0.01	0.16	0.48	0.25	57.8	438
1606-030A	1419.0	1.77	0.09	0.37	0.78	0.32	44.1	432
1606-031A	1420.0	1.63	0.21	0.39	0.51	0.43	31.3	442
1606-032A	1421.0	1.08	0.12	0.35	0.70	0.33	64.8	447
1606-033A	1422.0	1.22	0.07	0.19	0.58	0.25	47.5	436
1606-034A	1423.0	1.15	0.06	0.27	0.63	0.30	54.8	452
1606-035A	1424.0	0.62	0.05	0.22	0.53	0.29	85.5	439
1606-035R	1424.0	0.62	0.03	0.49	0.56	0.47	90.3	437
1606-036A	1425.0	0.79	0.01	0.15	0.36	0.29	45.6	441
1606-037A	1426.0	0.66	0.11	0.33	0.38	0.46	57.6	432
1606-038A	1427.0	0.71	0.10	0.39	0.70	0.36	98.6	437
1606-039A	1428.0	0.67	0.01	0.07	0.22	0.24	32.8	432
1606-040A	1429.0	0.69	0.07	0.32	0.35	0.48	50.7	437
1606-041A	1430.0	0.66	0.03	0.15	0.55	0.21	83.3	443
1606-042A	1431.0	0.57	0.08	0.18	0.38	0.32	66.7	441
1606-043A	1432.0	0.45	0.01	0.10	0.37	0.21	82.2	423
1606-044A	1433.0	0.49	0.04	0.16	0.27	0.37	55.1	434
1606-045A	1434.0	0.57	0.00	0.11	0.44	0.20	77.2	443
1606-046A	1435.0	0.41	0.03	0.10	0.46	0.18	112.2	443
1606-047A	1436.0	0.55	0.03	0.10	0.23	0.30	41.8	443
1606-048A	1437.0	0.36	0.03	0.14	0.18	0.44	50.0	429

EXTRACTED SAMPLES

TABLE 3

STANDARD PYROLYSIS DATA @340 Deg.C/300 Secs

GEOCHEM SAMPLE NUMBER	DEPTH	ORGANIC CARBON	S0 (mg/g)	S1 (mg/g)	S2 (mg/g)	PRODUCTION INDEX	HYDROGEN INDEX	Tmax (Deg.C)
1606-001A	1383.0	2.42	0.01	0.23	2.34	0.09	96.7	443
1606-002A	1384.0	2.45	0.00	0.22	2.52	0.08	102.9	442
1606-003A	1385.0	2.09	0.00	1.13	3.43	0.25	164.1	445
1606-004A	1387.0	2.39	0.00	0.34	2.89	0.11	120.9	448
1606-005A	1388.0	1.76	0.00	0.35	1.19	0.23	67.6	430
1606-006A	1389.0	2.34	0.03	0.33	3.25	0.09	138.9	449
1606-007A	1391.0	2.34	0.01	0.33	3.13	0.10	133.8	451
1606-008A	1392.0	2.55	0.05	0.32	2.76	0.10	108.2	446
1606-009A	1395.0	2.63	0.03	0.28	2.82	0.09	107.2	449
1606-010A	1396.0	2.54	0.06	0.32	3.14	0.09	123.6	448
1606-011A	1398.0	2.46	0.09	0.49	2.29	0.18	93.1	449
1606-012A	1399.0	2.75	0.02	1.37	3.88	0.26	141.1	447
1606-013A	1401.0	3.67	0.03	1.92	5.62	0.25	153.1	448
1606-014A	1402.0	3.29	0.02	1.46	4.19	0.26	127.4	449
1606-015A	1404.0	3.99	0.07	0.72	4.35	0.14	109.0	447
1606-016A	1405.0	3.41	0.04	1.01	5.20	0.16	152.5	448
1606-017A	1406.0	3.52	0.00	1.86	6.71	0.22	190.6	447
1606-018A	1407.0	3.34	0.01	1.34	5.10	0.21	152.7	443
1606-019A	1408.0	3.12	0.01	0.57	2.58	0.18	82.7	448
1606-020A	1409.0	3.62	0.01	1.09	5.75	0.16	158.8	446
1606-021A	1410.0	4.59	0.08	0.50	7.36	0.06	160.3	450
1606-022A	1411.0	3.50	0.00	1.98	7.10	0.22	202.9	446
1606-023A	1412.0	3.76	0.00	0.95	5.87	0.14	156.1	451
1606-024A	1413.0	4.03	0.06	0.50	6.81	0.07	169.0	447
1606-025A	1414.0	3.44	0.05	0.46	2.04	0.18	59.3	449
1606-026A	1415.0	3.46	0.07	0.92	4.24	0.18	122.5	445
1606-027A	1416.0	3.09	0.05	0.50	3.61	0.12	116.8	446
1606-028A	1417.0	7.17	0.13	0.61	8.73	0.07	121.8	448
1606-029A	1418.2	0.83	0.00	0.28	0.50	0.36	60.2	429
1606-030A	1419.0	1.77	0.04	0.40	0.68	0.37	38.4	430
1606-031A	1420.0	1.63	0.11	0.30	0.77	0.28	47.2	436
1606-032A	1421.0	1.08	0.06	0.24	0.65	0.27	60.2	437
1606-033A	1422.0	1.22	0.08	0.21	0.33	0.39	27.0	447
1606-034A	1423.0	1.15	0.04	0.24	0.61	0.28	53.0	433
1606-035A	1424.0	0.62	0.01	0.31	0.77	0.29	124.2	439
1606-036A	1425.0	0.79	0.03	0.23	0.54	0.30	68.4	431
1606-037A	1426.0	0.66	0.01	0.22	0.48	0.31	72.7	428
1606-038A	1427.0	0.71	0.04	0.35	0.76	0.32	107.0	424
1606-039A	1428.0	0.67	0.04	0.12	0.27	0.31	40.3	422
1606-040A	1429.0	0.69	0.03	0.11	0.31	0.26	44.9	443
1606-041A	1430.0	0.66	0.02	0.32	0.77	0.29	116.7	437
1606-042A	1431.0	0.57	0.00	0.20	0.44	0.31	77.2	444
1606-043A	1432.0	0.45	0.03	0.20	0.43	0.32	95.6	439
1606-044A	1433.0	0.49	0.02	0.14	0.32	0.30	65.3	437
1606-045A	1434.0	0.57	0.03	0.17	0.45	0.27	78.9	438
1606-046A	1435.0	0.41	0.04	0.12	0.50	0.19	122.0	424
1606-047A	1436.0	0.55	0.05	0.15	0.32	0.32	58.2	437
1606-048A	1437.0	0.36	0.00	0.15	0.25	0.38	69.4	423

EXTRACTED SAMPLES

TABLE 4
ROCKEVAL PYROLYSIS DATA

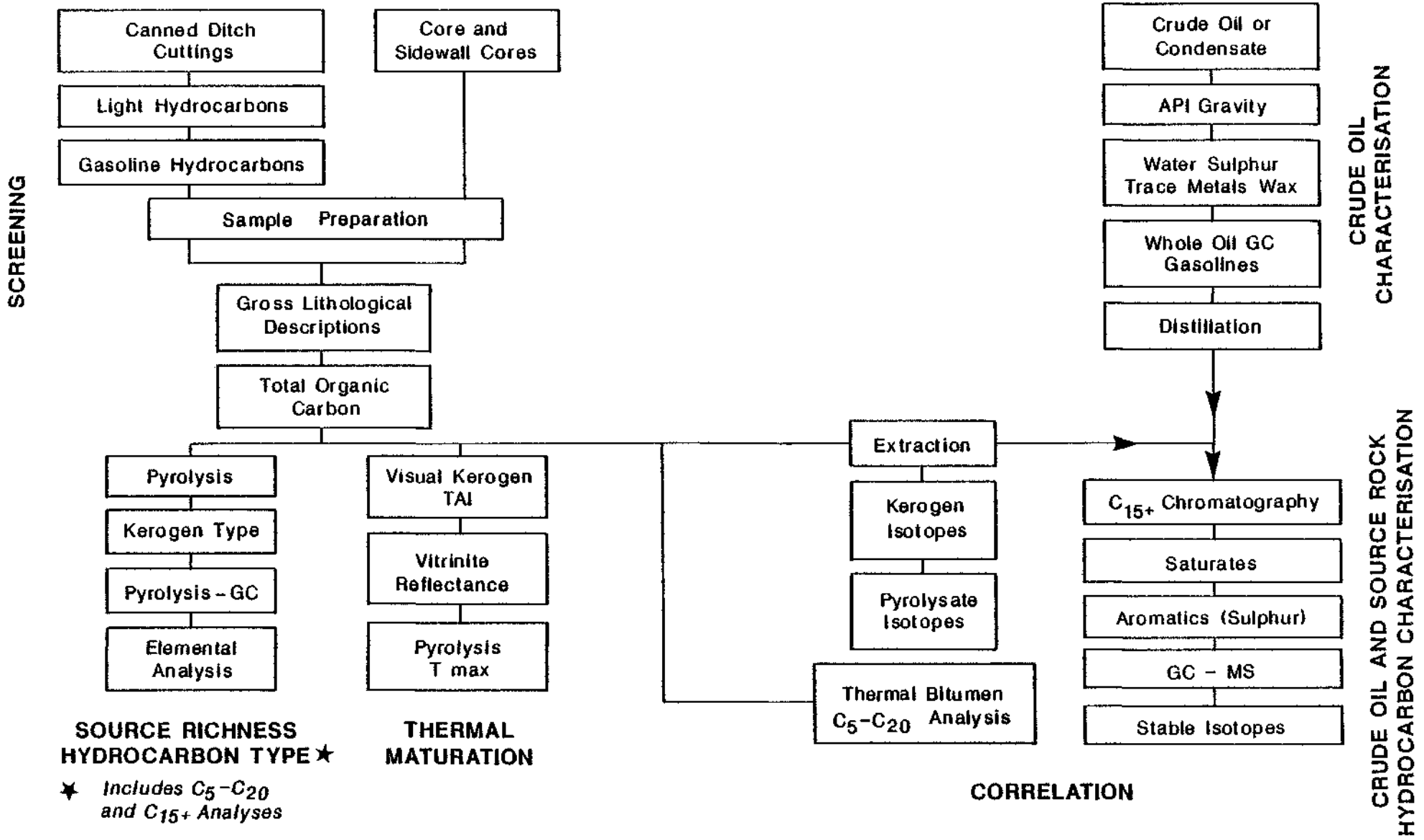
GEOCHEM SAMPLE NUMBER	DEPTH	TOC (%)	S1 (mg/g)	S2 (mg/g)	S3 (mg/g)	PRODUCTION INDEX	HYDROGEN INDEX	OXYGEN INDEX	TMAX (°C)
WELL: 7321/8-1									
1606-001A	1383m	2.42	1.46	3.08	1.09	0.32	127.3	45.0	434
1606-002A	1384m	2.45	1.15	2.80	0.49	0.29	114.3	20.0	443
1606-003A	1385m	2.09	1.03	2.81	0.40	0.27	134.4	19.1	442
1606-004A	1387m	2.39	1.12	3.50	0.69	0.24	146.4	28.9	443
1606-004R	1387m	2.39	1.09	3.37	0.37	0.24	141.0	15.5	440
1606-005A	1388m	1.76	0.46	1.24	0.36	0.27	70.5	20.5	438
1606-006A	1389m	2.34	1.03	3.61	0.62	0.22	154.3	26.5	441
1606-007A	1391m	2.34	0.69	1.98	0.55	0.26	84.6	23.5	450
1606-008A	1392m	2.55	1.00	3.24	0.26	0.24	127.1	10.2	443
1606-009A	1395m	2.63	1.25	4.84	0.44	0.21	184.0	16.7	443
1606-009R	1395m	2.63	1.15	4.55	0.42	0.20	173.0	16.0	440
1606-010A	1396m	2.54	0.92	3.23	0.50	0.22	127.2	19.7	446
1606-011A	1398m	2.46	0.34	2.15	0.30	0.14	87.4	12.2	450
1606-012A	1399m	2.75	1.00	3.20	0.48	0.24	116.4	17.5	446
1606-013A	1401m	3.67	1.69	4.98	0.45	0.25	135.7	12.3	448
1606-014A	1402m	3.29	1.55	3.47	0.28	0.31	105.5	8.5	446
1606-014R	1402m	3.29	1.53	3.67	0.25	0.29	111.6	7.6	446
1606-015A	1404m	3.99	1.66	4.22	0.24	0.28	105.8	6.0	447
1606-016A	1405m	3.41	1.13	5.29	0.60	0.18	155.1	17.6	446
1606-017A	1406m	3.52	1.47	5.54	0.69	0.21	157.4	19.6	446
1606-018A	1407m	3.34	1.61	5.69	1.16	0.22	170.4	34.7	444
1606-018R	1407m	3.34	1.71	5.32	1.01	0.24	159.3	30.2	444
1606-019A	1408m	3.12	3.18	6.30	3.49	0.34	201.9	111.9	445
1606-020A	1409m	3.62	1.52	5.72	0.69	0.21	158.0	19.1	445
1606-020R	1409m	3.62	1.57	5.62	0.62	0.22	155.2	17.1	444
1606-021A	1410m	4.59	1.52	6.31	0.40	0.19	137.5	8.7	450
1606-022A	1411m	3.50	1.50	5.77	0.51	0.21	164.9	14.6	448
1606-023A	1412m	3.76	1.91	4.57	0.39	0.29	121.5	10.4	450
1606-024A	1413m	4.03	1.77	6.12	0.30	0.22	151.9	7.4	448
1606-025A	1414m	3.44	1.07	4.02	0.95	0.21	116.9	27.6	442
1606-026A	1415m	3.46	1.75	4.79	0.84	0.27	138.4	24.3	443
1606-027A	1416m	3.09	1.40	3.51	1.01	0.29	113.6	32.7	447
1606-027R	1416m	3.09	1.46	3.49	0.55	0.29	112.9	17.8	446
1606-028A	1417m	7.17	0.89	9.70	0.39	0.08	135.3	5.4	451
1606-029A	1418m	0.83	0.28	0.52	0.31	0.35	62.7	37.3	432
1606-030A	1419m	1.77	0.73	1.18	0.51	0.38	66.7	28.8	439
1606-031A	1420m	1.63	0.74	1.03	0.72	0.42	63.2	44.2	443
1606-032A	1421m	1.08	0.37	0.39	0.22	0.49	36.1	20.4	428
1606-034A	1423m	1.15	0.73	1.07	0.37	0.41	93.0	32.2	444
1606-035A	1424m	0.62	0.28	0.49	0.36	0.36	79.0	58.1	432
1606-036A	1425m	0.79	0.41	0.70	0.79	0.37	88.6	100.0	429
1606-037A	1426m	0.66	0.48	0.71	0.44	0.40	107.6	66.7	449
1606-038A	1427m	0.71	0.33	0.71	0.39	0.32	100.0	54.9	430
1606-039A	1428m	0.67	0.35	0.54	0.22	0.39	80.6	32.8	433
1606-040A	1429m	0.69	0.27	0.60	0.28	0.31	87.0	40.6	439
1606-041A	1430m	0.66	0.33	0.59	0.21	0.36	89.4	31.8	438
1606-042A	1431m	0.57	0.56	1.21	0.40	0.32	212.3	70.2	426
1606-043A	1432m	0.45	0.30	0.66	0.37	0.31	146.7	82.2	428
1606-044A	1433m	0.49	0.23	0.40	0.15	0.37	81.6	30.6	425
1606-045A	1434m	0.57	0.26	0.40	0.20	0.39	70.2	35.1	429
1606-046A	1435m	0.41	0.30	0.61	0.46	0.33	148.8	112.2	423
1606-047A	1436m	0.55	0.30	0.35	0.28	0.46	63.6	50.9	441
1606-048A	1437m	0.36	0.15	0.19	0.26	0.44	52.8	72.2	439

PRODUCTION INDEX = S1 / (S1 + S2) HYDROGEN INDEX = 100 x S2 / TOC
OXYGEN INDEX = 100 x S3 / TOC

BRIEF DESCRIPTION

OF ANALYSES

GEOCHEM ANALYSIS SCHEME



BRIEF DESCRIPTION OF ANALYSES PERFORMED BY GEOCHEM

Analyses described in this section include industry standard methods and techniques resulting from more than thirteen years of development by Geochem Laboratories. Analytical methodology arising from collaboration with individual clients or groups of clients (e.g. the Norwegian oil companies) is not necessarily included in these descriptions.

The flowchart illustrates a typical sequence of analyses and their functional relationships.

These analyses may be grouped as follows :

- A source rock screening
- B source richness and hydrocarbon type
- C source rock thermal maturity
- D source rock hydrocarbon characterisation
- E crude oil characterisation
- F gas characterisation
- G correlation

A. SOURCE ROCK SCREENING

A-1 C_1-C_7 LIGHT HYDROCARBONS ANALYSIS

The abundance and composition of the C_1-C_7 hydrocarbons in sediments reflects their source richness, maturity and the character of the hydrocarbons they can yield. Most importantly, it is extremely sensitive to the presence of migrated hydrocarbons and is an excellent method for their detection. As it provides the information on most of the critical parameters and is also economical, this analysis is recommended for screening samples to decide which of them merit further analysis.

During the time which elapses between the collection of the sample at the wellsite and its analysis in the laboratory, a variable fraction of the total gas passes from the rock to the air space at the top of the can. For this reason, both the air space and the cuttings are analysed. To minimise loss of air space gases, cans fitted with pressfit lids are stored in the inverted position.

A sample of the headspace gases is withdrawn from the can using a syringe and then analysed by gas chromatography. The can is opened and the head space volume measured. A small portion of the cuttings is homogenised in a sealed blender and the released cuttings gases are analysed by the method used for the headspace gases.

Concentrations of the individual C_1-C_4 gases, plus the total C_{5+} hydrocarbons for both headspace and cuttings gases, are determined by means of a gas chromatograph equipped with flame detector and calibrated with a standard gas mixture. These data are reported in ppm by volume or in µl/Kg(dry) rock - for the headspace and cuttings gas and for the combined headspace and cuttings gas.

A-2 DETAILED GASOLINE RANGE (C_4-C_7) HYDROCARBONS ANALYSIS

The abundance and composition of the C_4-C_7 hydrocarbons in sediments reflects their source quality, level of thermal maturity and kerogen type or, if they are reservoir facies, the strength and nature of hydrocarbon shows. This analysis is particularly useful in evaluating the reservoir history of crude oils and in oil to oil correlation studies.

Selected lithologies are heated and crushed in a sealed blender in order to liberate the C_4-C_7 hydrocarbons from the rock matrix. A sample of these hydrocarbons is withdrawn by syringe and analysed by capillary gas chromatography to identify the individual hydrocarbons. With crude oils, a sample of the oil is injected directly into the chromatograph.

The gross composition, selected ratios and normalised composition of the individual C_4-C_7 hydrocarbons (including toluene) are tabulated and plotted against depth.

A-3 SAMPLE PREPARATION

All of the analyses described in subsequent sections are run on washed and hand picked samples.

Cuttings are washed to remove the drilling mud, care being taken not to remove soft clays and fine sand during the washing procedure. The lithology of each facies is then described and the presence of caved material noted. Sidewall core material is liberated from any associated drilling mud and then

described. Using the C_1-C_7 hydrocarbon and the organic carbon profiles of the well, electric logs (if supplied) and the lithology and appearance of the cuttings, sidewall cores and cores under the binocular microscope, samples are selected to represent the lithological and geochemical zones penetrated by the well. These samples are then carefully hand picked and it is these samples which are submitted for further analysis.

Sample material remaining after analysis is retained for six months. Unless instructions are received to the contrary, Geochem Laboratories may then destroy the samples.

Our reports incorporate a gross lithological description of all the samples which have been analysed and litho percentage logs. As screen analyses are recommended at narrow intervals, a complete lithological profile is obtained.

A-4 ORGANIC CARBON ANALYSIS

The organic carbon content of a rock is a measure of its total organic richness. Combined with the visual kerogen, C_1-C_7, C_4-C_7, pyrolysis and C_{15+} analyses, the organic carbon content is used to evaluate the potential (not necessarily actual) hydrocarbon source richness of the sediment. This analysis is an integral part of any evaluation and is also used as an economical screen analysis for dry samples (when the C_1-C_7 analysis cannot be employed).

Hand picked samples are dried, crushed and then acidised to remove the inorganic calcium and magnesium carbonates. The actual analysis involves combustion in a Leco CS244 carbon/sulphur analyser. Blanks, standards and duplicates are run routinely for purposes of quality control at no extra cost to the client. Sulphur contents are also measured but are not reported routinely.

The organic carbon data are tabulated and presented diagramatically in our reports in a manner which facilitates comparison with the gross lithology of the samples.

B. SOURCE RICHNESS AND HYDROCARBON TYPE

B-1 PYROLYSIS

The thermal maturation process is simulated in the laboratory by the pyrolysis analysis. This involves heating the source rock under controlled conditions to produce firstly, a distillate (thermal bitumen) and secondly, a pyrolysate (from the breakdown of the kerogen). The thermal bitumen (S1) content is related to the present potential of a source rock (plus any non-indigenous hydrocarbons) whilst the pyrolysate yield (S2) is a measure of ultimate source potential.

Industry standard machines made by Leco (Thermolytic Hydrocarbons Analyser, THA) and by Delsi (Rockeval II) are used to automatically measure S1 and S2 and to ascertain the temperature, Tmax, at which maximum S2 evolution occurs. In addition, the Rockeval machine measures S3 - the proportion of oxygen containing species in the kerogen. This latter value is used to calculate the oxygen index (S3/TOC) which, together with the hydrogen index (S2/TOC), is used to identify kerogen types on the van Krevelen diagram. Care must be used in the interpretation of S3 data since they are influenced by inorganic carbonates.

S1, S2 and where applicable S3, values (in mg/g rock) are reported, with production indices [S1/(S1 + S2)], hydrogen indices, oxygen indices and Tmax values for all prospective source units. The pyrolysate yield (S2) is preferred to organic carbon contents as an unambiguous measure of potential source richness.

B-2 KEROGEN TYPE

Kerogen is the insoluble organic matter in rocks. Visual examination of the kerogen ("Visual Kerogen" analysis) directly assesses the composition of the organic matter (organic facies) and indicates the source quality of the sediment - which is confirmed using the pyrolysis, pyrolysis-GC and C_{15+} analyses. Thermal maturity is also evaluated from the colour of the spore-pollen material (see below).

The type of hydrocarbons (oil or gas) generated by a source rock is a function of its level of thermal maturation and of the composition of its organic

matter. Both of these parameters are measured directly by this visual kerogen method. Kerogen is separated from the inorganic rock matrix by acid digestion and flotation methods which avoid oxidation of the organic matter. It is then mounted on a glass slide and examined at high and low magnifications with a Leitz microscope. Chemical methods measure the total kerogen population but, with this technique, individual particles can be selected for examination and spurious material identified and avoided. This is particularly valuable in reworked, contaminated and turbodrilled sediments.

The following data are generated: the types of the organic matter present and their relative abundances, an estimate of the proportion of reworked material, the preservation state and the thermal maturity (see below, C-1) of the non-reworked organic matter using the spore colouration technique.

A total of fourteen types of organic matter are sought based upon the major categories of algal, amorphous, herbaceous (spore, pollen, cuticle), wood, inertinite and resin. This detail is essential for a proper understanding of hydrocarbon source potential as the different sub-groups within each category have different properties.

Upon completion of the study, the kerogen slides are sent to the client.

B-3 PYROLYSIS-GC

The nature of potential hydrocarbon products is deduced from gas chromatograms of the pyrolysate material (S2, see above). These 'pyrograms' resemble the hydrocarbons generated by the source rock at peak maturity. Thus, for oil prone sediments the chromatograms display a methane peak followed by a series of alkene-alkane double peaks which extend out to C_{25}-C_{30}, whereas these doublets are absent in gas-prone source rocks. The gas-oil index (% C_1-C_5/total pyrolysate) provides a digital representation of the pyrogram and predicts the hydrocarbon product : oil prone sediments have values of less than 20%, 20-35% corresponds to a potential for oil and gas, 35-50% to condensate and values greater than 50% to gas.

Small (1-2 mg) samples of solvent-extracted rock powder are heated by one of two methods to produce a pyrolysate (S2) which is subsequently analysed by capillary gas chromatography. The two methods differ only in the pyrolysate generation mode. In the first 'instantaneous' method a pyroprobe rapidly (10

seconds) generates the pyrolysis products whereas in the second, the pyrolysate is generated over a period of several minutes by programmed pyrolysis. These two methods are referred to as flash and programmed pyrolysis-GC respectively. The actual pyrolysis temperature range is comparable in each case and both methods give similar results, although the light ends are relatively enhanced by flash pyrolysis-GC.

B-4 ELEMENTAL ANALYSIS OF KEROGEN

Kerogen isolated from prospective source rocks is analysed in a Carlo Erba 1106 Elemental Analyser. Carbon, hydrogen, nitrogen, oxygen and sulphur are measured directly by this machine. Hydrogen : carbon ratios have been traditionally used by the oil industry to assess the oil potential of organic matter in source rocks and, in conjunction with the oxygen : carbon ratio permit the use of the Van Krevelen diagram. This assigns the gross organic matter population to Types I, II or III and gives an indication of its ability to generate oil or gas. It is employed in association with the visual kerogen, pyrolysis and pyrolysis-GC analyses.

C. SOURCE ROCK THERMAL MATURITY

C-1 SPORE COLOURATION THERMAL ALTERATION INDEX (TAI)

Organic matter darkens with increasing thermal maturity. The increasing colouration of the spore and pollen material, as observed microscopically using kerogen concentrates, accurately reflects the hydrocarbon generation process and is used to assess thermal maturity. As with the vitrinite reflectance analysis, core and sidewall core material is preferred for this "Visual Kerogen" analysis when available.

Our maturation scale has been developed to digitise small but recognisable changes in organic matter colouration resulting from increasing maturity and to place particular emphasis upon the immature to mature transition. In the absence of a universal colouration scale, the most significant points on our scale have been calibrated against equivalent vitrinite reflectance values.

The following maturation stages are recognised, the values referring to the top of each maturity zone:-

	Marginally Mature	Mature	Top Oil Window	Gas Condensate	Dry Gas
TAI Scale	2-	2	2 to 2+	3	3+
1-10 Scale	3	4	5	7	8
Vitrinite Reflectance (% Ro)	0.45	0.55	0.72	1.3	2.0
Tmax (°C)	[430]	[435]	[440]	[460]	

The top of the condensate zone corresponds to the base of the oil window.

C-2 VITRINITE REFLECTANCE

Vitrinite reflectance is an alternative/confirmatory method for evaluating thermal maturation which is used in conjunction with the visual kerogen analysis. The reflectivity of vitrinite macerals increases in response to thermal alteration and is used to define maturation levels and, by projection, to predict maturity at depth or the thicknesses of section removed by erosion.

Measurements are made upon carefully polished blocks either of kerogen concentrates or of whole rocks depending upon the organic richness of the samples and the preference of the client. In general, this analysis is performed upon the same samples as the visual kerogen analysis, thus facilitating a direct comparison of the two sets of results.

If possible, forty to fifty measurements are taken per sample, although this may not be possible if the sediments are organically lean or vitrinite is sparse. The data are processed using an interactive computer program which allows the operator to select, calculate and plot populations and mean reflectances. Indigenous vitrinite is thus distinguished from possible

reworked or caved material. Comments upon exinite fluorescence (if relevant) and upon the character of the phytoclasts are noted on the histograms. The reports contain the tabulated data, histograms and the reflectivities plotted against depth.

The vitrinite and visual kerogen techniques provide mutually complementary information upon maturity, organic matter type and diagenesis.

C-3 PYROLYSIS TMAX

This is an empirical parameter which can produce a depth related maturity trend. Tmax is also affected by gross kerogen composition, the amount of reworked material etc and must therefore, be used with caution in the assessment of thermal maturity.

The measurement of Tmax has been described under the 'Pyrolysis' analysis (B-1).

D. SOURCE ROCK HYDROCARBON CHARACTERISATION

C_2+ hydrocarbons in source rocks reflect in situ generation, diffusion of migrated hydrocarbons (via microfractures or sand bodies) or contamination from the mud-system. It is important, therefore to identify these hydrocarbons because their abundance is diagnostic of source richness, maturity or, if migrated species, of show strength. Any hydrocarbons detected in reservoir facies merit further investigation. The gasoline range analysis has been discussed above (A-2).

D-1 C_{15+} HYDROCARBON EXTRACTION, DEASPHALTENING AND CHROMATOGRAPHIC SEPARATION

Hand picked rock samples are ground and then extracted in a Soxtec machine - a modern version of the soxhlet extractor - employing solvents such as dichloro methane and methanol. Pre-extracted cellulose extraction thimbles are used in conjunction with selected pure solvents to minimise the introduction of extraneous material by the extraction process. The procedures have been designed to avoid loss of the lighter hydrocarbons and to ensure quantitative recovery of the heavy ends.

Asphaltenes are precipitated from the total extract using standard methods (e.g. IP143) and the soluble material is then separated into fractions by liquid chromatography. These fractions comprise the saturated hydrocarbons (paraffin-naphthenes), aromatic hydrocarbons, eluted NSO's (nitrogen, sulphur and oxygen species) and non-eluted NSO's.

Traditional column chromatographic methods, for the separation of source rock extract and crude oil components, have largely been replaced by high performance liquid chromatography (HPLC). This technique gives an optimal separation of the saturated and aromatic hydrocarbon fractions which is important for subsequent GC-MS analyses.

Quantification of the C_{15+} hydrocarbons and non-hydrocarbons is achieved by means of the Iatrascan equipment, in which rods coated with silica are used to separate the fractions by thin layer liquid chromatography. The resolved hydrocarbons are measured by passing the rods through a flame ionisation detector.

Analyses of the C_{15+} fractions are reported either in parts per million (ppm) by weight of rock or as mg/g TOC, as normalised % composition of the C_{15+} fraction and as selected diagnostic ratios. These data are also plotted to facilitate the evaluation of depth-related trends.

Oils and condensates are distilled or 'topped' to give a C_{15+} (210°C+) fraction which is then analysed in the same way as the total soluble extract from source rocks.

D-2 ANALYSIS OF C_{15+} SATURATED HYDROCARBONS

The distribution of C_{15+} saturated hydrocarbons - n-alkanes, iso-alkanes (including the principal acyclic isoprenoids) and cyclo alkanes (naphthenes) - is affected by changes in organic facies, maturity and source rock geochemistry, and by the presence of shows. Of most value are the n-alkane configuration which defines crude oil type (waxiness, maturity, gravity etc), the ratios of the odd to even carbon number n-alkanes (CPI) - which approach unity with increasing maturity - and the ratios of the isoprenoids (e.g. pristane and phytane) to the adjacent alkanes, which are affected by source depositional environment.

Saturated hydrocarbons, isolated from the source rock extracts or from crude oils by C_{15+} liquid chromatography, are injected into a high resolution gas chromatograph. The individual hydrocarbons separated by the capillary column in this instrument are detected by a flame ionisation detector and quantified (by reference to standard hydrocarbons) using a computerised laboratory data processor. Care is taken to ensure that all of the alkanes including those heavier than C_{30} are quantitatively recorded. Concentrations of each n-alkane in the C_{15} - C_{35} range are reported as normalised percentage of total alkanes or in parts per million of total extract. The principal C_{15} - C_{20} isoprenoids plus the total n-alkanes, isoprenoids and naphthenes are also tabulated.

Ratios reported include:

$$\text{CPI (1)} = 1/2\left[\frac{(C_{21} + C_{23} + C_{25} + C_{27})}{(C_{20} + C_{22} + C_{24} + C_{26})} + \frac{(C_{21} + C_{23} + C_{25} + C_{27})}{(C_{22} + C_{24} + C_{26} + C_{28})}\right]$$

$$\text{CPI (2)} = 1/2\left[\frac{(C_{25} + C_{27} + C_{29} + C_{31})}{(C_{24} + C_{26} + C_{28} + C_{30})} + \frac{(C_{25} + C_{27} + C_{29} + C_{31})}{(C_{26} + C_{28} + C_{30} + C_{32})}\right]$$

$$\text{CPI (3)} = \frac{2 \times C_{27}}{\left(\frac{}{C_{26} + C_{28}}\right)}$$

Pristane : Phytane Pristane : nC_{17}

Phytane : nC_{18}

D-3 ANALYSIS OF C_{15+} AROMATIC HYDROCARBONS

The C_{15+} aromatic hydrocarbons are relatively more resistant to alteration in the reservoir by biodegradation than the corresponding saturates. They are, therefore, of value in correlation studies. Furthermore, ratios of selected methyl-phenanthrenes and of phenanthrene (MPI) are used to ascertain the maturation levels of (inferred) hydrocarbon source rocks.

C_{15+} aromatic hydrocarbons are analysed by methods analagous to those used for the saturated hydrocarbons. The gas chromatogram displays the naphthalenes, methyl substituted naphthalenes, phenanthrene, the methyl phenanthrenes and the heavier aromatics. Methyl phenanthrene indices are calculated and included in the reports:

$$\text{MPI (1)} = \frac{1.5 \times (2\text{-MP} + 3\text{-MP})}{\text{P} + 1\text{-MP} + 9\text{-MP}}$$

$$\text{MPI (2)} = \frac{3 \times (2\text{-MP})}{\text{P} + 1\text{-MP} + 9\text{-MP}}$$

P = phenanthrene MP = methyl phenanthrene

Note : Calculated mean reflectance (Rc)

$$Rc = 0.6\ \text{MPI (1)} + 0.40 \quad (Ro < 1.35\%)$$
$$Rc = -0.6\ \text{MPI (1)} + 2.30 \quad (Ro > 1.35\%)$$

(M. Radke & D.H. Welte, 1981)

Under certain conditions dibenzothiophenes co-elute with the methyl phenanthrenes (for example 3-MP coelutes with methyldibenzothiophene) and hence GC-MS data are preferred, although the MPI(2) ratio calculated from the gas chromatograms is reliable.

D-4 ANALYSIS OF C_{15+} SULPHUR AROMATIC HYDROCARBONS

These compounds are present in the C_{15+} aromatic hydrocarbons fraction and, by substituting a flame photometric detector for the more normal flame ionisation detector in the GC, are detected and measured in the same way as the aromatic hydrocarbons. The sulphur aromatic hydrocarbons produce a characteristic chromatogram which is principally used in correlation studies.

D-5 NORMAL AND BRANCHED/CYCLIC SATURATES CHROMATOGRAMS

By using clathrating agents, such as urea or molecular sieves, the C_{15+} saturates fraction is separated into normal (straight chain) and branched/cyclic alkane fractions. These fractions are then analysed by the same techniques as those used for the total saturates fractions.

D-6 THERMAL BITUMEN (C_5-C_{20}) ANALYSIS

Powdered rock samples are heated in a thermal desorption cold trap injector and the evolved hydrocarbons are analysed by gas-chromatography. This technique enables us to examine the C_{15-} hydrocarbons which are normally lost and requires only milligram quantities of rock. The resulting chromatogram for the sediment is comparable to the whole oil trace.

A small quantity of powdered rock is heated to approximately 350°C in a helium gas stream and the desorbed hydrocarbons are collected on-column in a cold trap at -130°C. After a pre-determined time interval the furnace is cooled, the cold trap heated and the liberated hydrocarbons are analysed by capillary column gas-chromatography in the usual manner. The high resolution chromatogram displays a full range of hydrocarbons and non-hydrocarbons from C_4 to C_{25+} but is not quantitative beyond C_{20}. This analysis is invaluable for the evaluation of source rocks, for show detection, for correlation purposes and for volumetric yield calculations. Total abundances are reported together with the normalised distribution of the C_5-C_{20} n-alkanes.

D-7 ANALYSIS OF SATURATED AND AROMATIC HYDROCARBON BIOMARKERS BY GC-MS

Hydrocarbons representing the skeletal remains of the original biolipids in plant and animal debris survive to advanced levels of thermal maturity and are not seriously affected by normal biodegradation. These 'biomarker' hydrocarbons are therefore invaluable in correlation studies because they are diagnostic of the facies, depositional environment and maturity of the source.

C_{15+} saturated and aromatic hydrocarbons from crude oils or source rock extracts are separated on a Hewlett Packard 5890 capillary gas chromatograph. The molecular fragments associated with specific biomarkers are monitored as they emerge from the capillary column by a V.G. TS250 double focussing mass spectrometer, coupled to a V.G. 11250 data system. In conjunction with the associated mass-spectra library, this system permits the quantitative identification of all biomarkers. Mass fragmentograms of the steranes (at m/z 217, 218, 231 and 259) and of triterpanes (at m/z 177, 191 and 205) are routinely reported with eleven biomarker ratios plus, if required, peak area data. Similarly, for the aromatic hydrocarbons, the mono- and tri-aromatic steranes (at m/z 253 and m/z 231 respectively) together with the phenanthrene series (m/z 178, 192 and 206) and dibenzothiophenes (m/z 184, 198 and 212) fragmentograms are reproduced in the report. Other fragment ions can be monitored at the client's request. Peak area data from the aromatic steranes and phenanthrenes are used to evaluate thermal maturity and for correlation purposes. The saturates are employed for correlation, maturity and source facies evaluations.

Considerable enhancements in sensitivity and selectivity in biomarker analysis can now be provided by the selective metastable ion monitoring (SMIM) mass spectroscopic technique. This new technique (also known as metastable reaction monitoring, MRM) produces less complex fragmentograms, avoids co-elution problems and permits the detailed investigation of the C_{30} steranes.

D-8 CARBON ISOTOPE RATIOS

The ratio of the stable ^{13}C and ^{12}C atoms in living organic matter is controlled by biosynthetic pathways and by environment. Thus, plants and animals which develop in fresh-water have different isotopic ratios to similar species growing in seawater. The geothermal history of the sedimentary organic matter has a secondary influence on the isotope values. The principal application of stable carbon isotopic ratios is therefore, in oil-oil and oil-source rock correlation studies, since the generated hydrocarbons retain the isotopic signature of the source kerogen.

Carbon isotope ratios are measured on hydrocarbons and non-hydrocarbons isolated from crude oils and source rocks, from source rock kerogens and from kerogen pyrolysates. The hydrocarbon fraction or kerogen is combusted under controlled conditions (to avoid isotopic fractionation) and the resulting carbon dioxide is analysed by a mass spectrometer. This is a specialised spectrometer (a modified VG 602) fitted with dual collector and micro processor controlled ratio measurement device.

^{13}C is approximately 1% of the total carbon in organic matter and the changes in composition are, therefore, only a few parts per million. For this reason the absolute ratios are compared to those of an international standard (the Peedee belemnite, PDB). In practice, a secondary standard (NBS 22 oil) is used in routine measurements and the results expressed as a deviation (δ) in parts per thousand from the PDB standard.

$$^{13}C = \left[\frac{^{13}C/^{12}C)\ \text{sample}}{^{13}C/^{12}C)\ \text{standard}} - 1 \right] \times 1000$$

The δ values for hydrocarbons, non-hydrocarbons, pyrolysates and kerogens are tabulated and plotted as X-Y or Galimov plots.

Oil to source rock correlation studies should involve the analysis of the whole oil, each of the four C_{15+} fractions and of the kerogen and kerogen pyrolysate material. Carbon isotopes are essential in correlation studies involving gases, when each hydrocarbon which is sufficiently abundant is separated for individual analysis.

E. CRUDE OIL CHARACTERISATION

Crude oils and condensates are, if necessary, dehydrated before measuring their bulk properties. Typical analyses by industry standard methods (ASTM, IP) include API gravity, viscosity, sulphur content, wax content, trace metal content, nitrogen content, pour point, flash point, water, sediment and salt contents, total acid content and total base number.

Large liquid samples are distilled, generally to give a 210°C+ fraction, whilst small samples are topped by evaporating under controlled conditions, to give a comparable fraction.

Capillary gas chromatographic analyses of the whole oil and of the gasoline fraction (A-2) provide detailed fingerprints and quantitative data for correlation studies. Crude oils and condensates are further characterised by analyses which are analagous to those performed on source rock extracts (D-1 through D-5, D-7, D-8).

F. HYDROCARBON GAS ANALYSIS

Hydrocarbons and non-hydrocarbons are measured by gas chromatography. Methane and, if possible, the individual C_2-C_4 hydrocarbons are separated by gas chromatography prior to determining their carbon isotope ratios. These data are used to evaluate the nature of the hydrocarbon source rock and its thermal maturity.

G. CORRELATION

Analyses (referred to above) of the gasolines, whole oil, C_{15+} saturates and aromatics by GC and by GC-MS, and of the carbon isotope ratios of the C_{15+} fractions, are performed upon crude oils/condensates and source rock extracts. Correlations between oils and between oils and source rocks are investigated by comparing the two sets of data.

See A-2, D-1 through D-8.

G-1 STABLE LIGHT ISOTOPES ANALYSES

Stable isotope ratio measurements not only of carbon but also of oxygen, sulphur, nitrogen and hydrogen (deuterium) are used in correlation studies. Carbon and sulphur isotope ratios are applied to the study of kerogen diagenesis whereas oxygen and carbon isotope data are used to investigate carbonate diagenesis. Hydrogen : deuterium and carbon isotope ratios of methane and the heavier gaseous hydrocarbons are sensitive to changes in source type and maturity and are therefore, used in hydrocarbon migration studies. Biosynthetic processes are often accompanied by isotopic fractionation and isotope ratio techniques have therefore a wide application in the field of environmental analysis.

Preparative techniques, determined by the nature of the sample and by the element under investigation, are designed to avoid fractionation. Combustion techniques are generally used for carbon and sulphur whilst chemical methods of isolation are employed for oxygen and hydrogen/deuterium. Measurement of isotopic ratios of these elements is by means of a Sigma 7X mass spectrometer. This fully computer controlled machine uses automatic freeze down for small samples, dual collectors for hydrogen and deuterium and triple collectors for the heavier elements such as carbon, oxygen, sulphur and nitrogen.

Results are reported as delta values by reference to the appropriate international standard.

H-1 INTERPRETATION

Interpretation of the geochemical data obtained from the analytical specification agreed with the client is undertaken by a team of experienced geochemists. In addition to an extensive knowledge of petroleum geochemistry the members of this team are also specialists in areas such as organic petrography, mass spectrometry or data processing and statistical analysis. When required, data from related disciplines such as biostratigraphy are incorporated into the interpretation. Reports are specifically designed to aid the explorationist in prospect evaluation and to solve any particular problems raised by the client. They contain detailed evaluations of the lithological succession, source facies and hydrocarbon potential and source rock maturity in addition to show detection and the characterisation of the shows. Integration of these topics gives the source rock and show character of each formation/interval. The report also contains a concise executive summary for the benefit of senior management.

I-1 COMPUTER DATA FILES

Tabulated geochemical data can be supplied on one of several standard magnetic media, including ½ inch 9 track tapes at 1600 BPI, 5.1/4" IBM compatible diskettes or on TK50 DEC tapes. The content and file structure is usually agreed between the client and Geochem.

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ROBERTSON RESEARCH INTERNATIONAL LIMITED

REPORT NO. 6257/Ic

MATURITY AND KEROGEN TYPE OF 48 SIDEWALL CORE SAMPLES FROM THE NORSK HYDRO 7321/8-1 BARENTS SEA WELL: INTERVAL 1383m TO 1437m

by

A.G. COLLINS

PROJECT NO. RRPC/878/Ic/25564

NORSK HYDRO CONTRACT NO. K01898-00/UP-U003330

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JANUARY 1988

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1 SUMMARY

Prepared kerogen slides from 48 sidewall cores from 1383m to 1437m have been examined for spore colour and kerogen type. The data are presented in tabular form, with brief text summaries. No geological interpretation has been attempted.

2 INTRODUCTION

This report presents the results obtained from spore colouration and visual kerogen type analysis of 48 sidewall cores samples from the interval 1383m to 1437m in the Barents Sea 7321/8-1 well.
The work was submitted by Norsk Hydro, Harstad, under Contract No. K01898-00/UP-U003330.

The samples comprised 48 prepared kerogen slides, coded 1A to 48A, and were collected on 3rd December, 1987, from Geochem Laboratories of Chester, England, where they had been processed. Preliminary results were sent to Norsk Hydro on 8th January, 1988, by facsimile message.

Our contact at Norsk Hydro throughout the project has been Jan Augustson who provided the list of sample depths and the outline stratigraphy used in the report.

COMPANY NORSK HYDRO WELL. 7321/8-1 LOCATION BARENTS 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
1383	Swc		7.0 - 7.5		25	20	55				
1384	"		7.0 - 7.5		35	35	30				
1385	"		7.5		35	40	25				
1387	"		7.5		35	40	25				
1388	"		7.5		35	40	25				
1389	"		7.5		15	20	65				
1391	"		7.5		40	40	20				
1392	"		7.5		15	15	70				
1395	"		7.5		40	40	20				
1396	"		7.5		10	35	55				
1398	"		7.0 - 7.5		40	40	20				
1399	"		7.0 - 7.5		50	30	20				
1401	"		7.5		10	10	80				
1402	"		7.5		30	45	25				
1404	"		7.5		20	45	35				
1405	"		7.5		10	20	70				
1406	"		7.5		10	10	80				
1407	"		7.5		5	15	80				
1408	"		7.5		10	50	40				
1409	"		7.5		15	20	65				
1410	"		7.5		15	20	65				
1411	"		7.5		25	35	40				
1412	"		7.5		15	30	55				
1413	"		7.5 - 8.0		15	15	70				
1414	"		7.5 - 8.0		10	25	65				
1415	"		7.5 - 8.0		15	15	70				
1416	"		7.5 - 8.0		10	25	65				
1417	"		7.5		15	30	55				
1418.2	"		7.5		40	50	10				
1419	"		7.5		40	50	10				
1420	"		7.5		25	40	35				
1421	"		7.0 - 7.5		55	30	15				
1422	"		7.5		40	55	5				
1423	"		7.5		35	25	40				
1424	"		7.5 - 8.0		35	60	5				
1425	"		7.5 - 8.0		85	10	5				
1426	"		7.5 - 8.0		30	10	60				
1427	"		7.5		40	60	Mnr				
1428	"		7.5 - 8.0		35	60	5				
1429	"		7.5		65	30	5				

Maturity and Kerogen Composition Data

TABLE 1A

COMPANY: NORSK HYDRO WELL: 7321/8-1 LOCATION: BARENTS 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
1430	Swc		7.5 - 8.0		60	40	Mnr				
1431	"		7.5		65	35	Mnr				
1432	"		7.5 - 8.0		50	50	Mnr				
1433	"		7.5 - 8.0		50	50	Mnr				
1434	"		7.5 - 8.0		60	40	Mnr				
1435	"		7.5 - 8.0		60	40	Mnr				
1436	"		8.0		50	50	Mnr				
1437	"		8.0		65	30	5				

Maturity and Kerogen Composition Data

TABLE 1B

Depth (metres)	SCI	Palynomorphs	Vitrinite	Inertinite	Amorphous (liptinitic)	Amorphous (humic)	Cuticle	Reworked	Caved
1383	7-7.5	5 sp	10	25	50	10	-	-	-
1384	7-7.5	10 sp	25	35	20	10	-	-	-
1385	7.5	10 sp	25	40	15	10	-	-	-
1387	7.5	10 sp	25	40	15	10	-	-	-
1388	7.5	10 sp	35	40	10	5	-	-	-
1389	7.5	Mnr sp	10	15	65	?10	-	-	-
1391	7.5	5 sp	25	40	15	15	-	-	-
1392	7.5	Mnr sp	5	15	70	?10	-	-	-
1395	7.5	5 sp	30	40	15	?10	-	-	-
1396	7.5	Mnr sp	10	10	55	25	-	-	-
1398	7-7.5	5 sp	30	40	15	?10	-	-	-
1399	7-7.5	10 sp	20	50	?10	?10	-	-	-
1401	7.5	-	10	10	80	-	-	-	-
1402	7.5	5 sp	25	30	20	?20	-	-	-
1404	7.5	Mnr sp	15	20	35	?30	-	-	-
1405	7.5	-	10	10	70	?10	-	-	-
1406	7.5	-	10	10	80	-	-	-	-
1407	7.5	-	15	5	80	-	-	-	-
1408	7.5	5 sp	40	10	35	?10	-	-	-
1409	7.5	-	10	15	65	?10	-	-	-
1410	7.5	-	10	15	65	?10	-	-	-
1411	7.5	Mnr sp	20	25	40	?15	-	-	-
1412	7.5	Mnr sp	10	15	55	?20	-	-	-
1413	7.5-8	Mnr sp	5	10	70	?15	-	-	-
1414	7.5-8	5 sp	10	10	60	?15	-	-	-
1415	7.5-8	Mnr sp	10	5	70	?15	-	-	-
1416	7.5-8	Mnr sp	15	10	65	?10	-	-	-
1417	7.5	Mnr sp	20	15	55	?10	-	-	-
1418.2	7.5	10 sp	50	40	-	-	-	-	-
1419	7.5	10 sp	30	40	-	?20	-	-	-
1420	7.5	5 sp	15	25	?30	?25	-	-	-
1421	7-7.5	15 sp	30	55	-	-	-	-	-
1422	7.5	5 sp	15	20	-	?60	-	-	-
1423	7.5	40 sp	20	35	-	?5	-	-	-
1424	7.5-8	5 sp	10	30	-	?55	-	-	-
1425	7.5-8	5 sp	10	85	-	-	-	-	-
1426	7.5-8	5 sp	5	25	-	?65	-	-	-
1427	7.5	Mnr sp	10	20	-	?70	-	-	-
1428	7.5-8	5 sp	15	25	-	?55	-	-	-
1429	7.5	5 sp	30	65	-	-	-	-	-
1430	7.5-8	Mnr sp	20	60	-	?20	-	-	-
1431	7.5	Mnr sp	25	65	-	?10	-	-	-
1432	7.5-8	Mnr sp	20	40	-	?40	-	-	-
1433	7.5-8	Mnr sp	20	40	-	?40	-	-	-
1434	7.5-8	Mnr sp	30	50	-	?20	-	-	-
1435	7.5-8	Mnr sp	40	60	-	-	-	-	-
1436	8	Mnr sp	30	50	-	?20	-	-	-
1437	8	5 sp	30	65	-	-	-	-	-

sp = spores

TABLE 2 Detailed Kerogen Composition Data

U-552

3

87.19522 -- 1

GEOCHEMICAL REPORT

NORSK HYDRO

NORWAY

7321/8-1

EXPLORATION LOGGING SERVICES

P.O. Box 72,

Kokstadevien 29,

5061 Kokstad,

Norway.

INTRODUCTION

Geochemical screening using the Oil Shows Analyser was performed on 796 cuttings samples and 128 core samples. The cuttings samples were washed and air dried. The argillaceous lithologies were then selected with the use of a binocular microscope. The selected cuttings were then ground to a fine powder prior to analysis. The core samples were cleaned and also ground prior to analysis.

Five metre composite samples were analysed from 825m to 1400m, two and three metre composite samples from 1400m to 3090m and five or ten metre composite samples from 3090m to 3482m.

APPENDIX A

SAMPLE PREPARATION

SAMPLE CONTAMINATION

DESCRIPTION OF ANALYTICAL EQUIPMENT

PRESENTATION OF RESULTS

INTERPRETATION OF OSA DERIVED PARAMETERS

SAMPLE PREPARATION

Small samples of ditch cuttings are taken and thoroughly washed in cold water through a 2.36mm sieve and collected in a 180 micron sieve to remove cavings. Any large quantities of contaminants such as lost circulation material are removed at this stage. The washed material is then examined under a binocular microscope and any further contaminants removed. The samples are then air dried at room temperature to prevent the loss of 'free hydrocarbons' and then ground to a homogenous powder in preparation for pyrolysis.

SAMPLE CONTAMINATION

The effects of contamination, if unrecognized, can lead to misleading geochemical data. The major contaminants usually encountered at the wellsite include paint chips, lost circulation material (mica, nuthulls, etc.), steel fragments, and pipe dope. In the 7321/8-1 well these were removed by picking from the dried sample.

Organic mud additives, especially those used for water loss control, can also cause serious contamination problems.

Another source of contamination to be aware of is caused by migrated hydrocarbons. The presence of migrated oil or bitumen in a rock can give a major response in the vicinity of 300 degrees centigrade on the pyrogram (S1) while solid bitumen and the 'heavy end' fraction of petroleum has been found to produce a measurable response in the region 300-550 degrees centigrade. This is the same temperature range in which kerogen is cracked releasing hydrocarbons during pyrolysis. Thus large quantities of bitumen or migrated petroleum in rocks can affect the size and maximum temperature (Tmax) of the (S2) peak and cause non-source rocks to be falsely identified as source rocks as reported by Clementz (1979)*.

The problems encountered as a result of hydrocarbon contamination may be overcome by solvent extraction using a 50:50 solution of trichloroethane and acetone. As a guideline, samples with high S1 values (greater than 1.0 mgHC/g rock) are solvent extracted and reanalysed to obtain more valid values for S2 and Tmax. The S1 value obtained in the first analysis remains a useful indicator of oil accumulations, and degree of contamination.

* Clementz, D. 1979, 'Effect of Oil and Bitumen Saturation on Source Rock Pyrolysis', A.A.P.G. Bull., Vol 62 (12).

DESCRIPTION OF ANALYTICAL EQUIPMENT

Principle of Operation

Small quantities of sample (approx. 100 mg) are analysed by programmed pyrolysis in an inert Helium atmostphere. Any evolved hydrocarbons are detected by a Flame Ionisation Detector. The output from this sensor provides the peak data for the S0, S1 and S2 indices. In addition, the temperature, Tmax, for maximum generation of cracked hydrocarbons is measured by a probe monitoring oven temperature.

On completion of the pyrolysis cycle the sample is transferred to a second oven. The sample is heated in air and any carbonaceous material remaining is converted to carbon dioxide, this is detected by a thermal conductivity detector (TCD), the output of which is the S4 peak. The Oil Shows Analyser thus derives the Total Organic Carbon content from the sum of the pyrolysed carbon (S0+S1+S2) and the residual carbon (S4).

The Oil Shows Analyser used the following analytical cycle:-

Pyrolysis:

Carrier gas	:	Helium
Initial Isotherm	:	90 deg. C
Isothermal Hold	:	2 minutes
Second Isotherm	:	300 Deg. C
Isothermal Hold	:	2 minutes
Temperature Ramp	:	30 deg/min
Final Temperature	:	600 deg. C

Oxidation:

Oxidation Gas	:	Air (after removal of CO2)
Oven Temperature	:	600 deg. C
Oxidation Time	:	5 minutes

The equipment was calibrated using a standard supplied by Exploration Logging Overseas, Inc. A quality control sample was run routinely every ten unknown samples, or every 24 hours if less than ten samples were analysed during this period.

PRESENTATION OF RESULTS

The processed data is expressed in terms of:-

SO	:	Low temperature gas yield (mgHC/g rock)
S1	:	Low temperature oil yield (mgHC/g rock).
S2	:	High temperature hydrocarbon yield (mgHC/g rock).
Tmax	:	Temperature at which maximum emission of hydrocarbons occurs.
T.O.C.	:	Total Organic Carbon (weight percent of whole rock) comprised of S4 (residual organic carbon) plus 82% of the quantity SO+S1+S2.
T.P.I.	:	Total Production Index (SO+S1/SO+S1+S2).
H.I.	:	Hydrogen Index (S2/TOC).

APPENDIX B

TABULATION OF ANALYTICAL DATA

EXPLORATION LOGGING GEOCHEMICAL DATA PRINT

FOR : NORSK HYDRO A/S
WELL : 7321/8-1

Printed at : 15:20
: 9 Sep 1987
Format : 5

825.0 m TO 1030.0 m

		SOURCE BED EVALUATION				FREE HYDROCARBS		
LITHOLOGY	DEPTH m	TOC %wt	S2 mg/g	TMAX degC	S2/TOC HI	S0 mg/g	S1 mg/g	TPI
Cuttings Samples								
	825.00	.60	.42	439	70	0.00	.17	.29
	830.00	.72	.55	430	76	0.00	.23	.29
	835.00	.79	.75	428	95	0.00	.34	.31
	840.00	.67	.51	431	76	0.00	.28	.35
	845.00	.76	.53	432	70	0.00	.34	.39
	850.00	.70	.30	432	43	0.00	.37	.55
	855.00	.66	.43	428	65	0.00	.29	.40
	860.00	.82	.57	435	70	0.00	.39	.41
	865.00	.56	.21	427	38	0.00	.24	.53
	870.00	.58	.22	427	38	0.00	.29	.57
L	875.00	.45	.17	430	38	0.00	.17	.50
	880.00	.92	.81	428	88	0.00	.58	.42
	885.00	.94	1.14	433	121	0.00	.71	.38
	890.00	1.06	1.57	432	148	0.00	.95	.38
	895.00	1.41	3.00	433	213	0.00	1.61	.35
	900.00	1.27	2.73	434	215	0.00	2.19	.45
,,,,,,,,,	905.00	1.24	2.62	431	211	0.00	2.12	.45
,,,,,,,,,,	910.00	1.30	2.81	435	216	0.00	1.88	.40
,,,,,,,,,,	915.00	1.47	3.55	433	241	0.00	3.45	.49
,,,,,,,,,,	920.00	1.46	3.54	430	242	0.00	3.75	.51
,,,,,,,,,,	925.00	1.35	3.35	430	248	0.00	2.88	.46
,,,,,,,,,,	930.00	1.38	3.15	432	228	0.00	3.01	.49
,,,,	935.00	1.88	2.49	437	132	0.00	1.03	.29
,,,	940.00	1.59	2.60	437	164	0.00	1.18	.31
,,	945.00	1.57	2.81	439	179	0.00	1.19	.30
,,	950.00	1.43	2.84	437	199	0.00	1.47	.34
,,,	955.00	1.35	2.38	437	176	0.00	.93	.28
,,,	960.00	1.52	2.67	438	176	0.00	1.12	.30
,,,,	965.00	1.53	2.78	437	182	0.00	1.14	.29
,,,,	970.00	1.55	2.96	438	191	0.00	1.40	.32
,,,	975.00	1.71	3.10	438	181	0.00	1.39	.31
,,,	980.00	1.58	3.07	436	194	0.00	1.76	.36
,,	985.00	1.56	2.80	436	179	0.00	1.39	.33
,	990.00	1.68	2.91	440	173	0.00	1.21	.29
,	1000.00	1.59	2.62	436	165	0.00	1.25	.32
,	1005.00	1.67	3.03	438	181	0.00	1.47	.33
,	1010.00	1.69	2.89	439	171	0.00	1.38	.32
,,,	1015.00	1.31	2.35	438	179	0.00	1.48	.39
,,	1020.00	1.23	2.32	439	189	0.00	1.10	.32
,,,	1025.00	1.37	2.54	437	185	0.00	1.51	.37
,	1030.00	1.48	2.54	437	172	0.00	1.25	.33

EXPLORATION LOGGING GEOCHEMICAL DATA PRINT

FOR : NORSK HYDRO A/S
WELL : 7321/8-1

Printed at : 15:24
: 9 Sep 1987
Format : 5

1035.0 m TO 1235.0 m

		SOURCE BED EVALUATION				FREE HYDROCARBS		
LITHOLOGY	DEPTH m	TOC %wt	S2 mg/g	TMAX degC	S2/TOC HI	S0 mg/g	S1 mg/g	TPI
Cuttings Samples								
,	1035.00	1.70	3.32	439	195	0.00	1.38	.29
	1040.00	1.51	2.89	438	191	0.00	1.26	.30
	1045.00	1.63	2.50	434	153	0.00	1.29	.34
,	1050.00	1.58	2.89	439	183	0.00	1.06	.27
	1055.00	1.50	2.65	438	177	0.00	1.22	.32
	1060.00	1.41	2.44	440	173	0.00	1.26	.34
	1065.00	1.36	2.33	439	171	0.00	1.11	.32
	1070.00	1.47	2.53	440	172	0.00	1.03	.29
	1075.00	1.19	1.95	440	164	0.00	.89	.31
,,,	1080.00	1.33	2.06	441	155	0.00	1.10	.35
,,,	1085.00	1.56	2.59	441	166	0.00	1.04	.29
,,,	1090.00	1.50	2.45	442	163	0.00	.97	.28
,	1095.00	1.55	2.76	441	178	0.00	1.16	.30
,,	1100.00	1.62	2.59	441	160	0.00	.99	.28
,	1105.00	1.64	3.12	439	190	0.00	1.71	.35
,,	1110.00	1.65	2.84	442	172	0.00	1.18	.29
,,	1115.00	1.60	2.66	442	166	0.00	.97	.27
,,	1120.00	1.57	2.66	442	169	0.00	.94	.26
,,	1125.00	1.45	2.29	442	158	0.00	.75	.25
,,,	1130.00	1.59	2.49	444	157	0.00	.82	.25
	1135.00	1.62	2.47	443	152	0.00	.81	.25
,,,,,,	1140.00	1.59	2.72	441	171	0.00	.90	.25
	1145.00	1.16	1.94	442	167	0.00	.91	.32
,,,	1150.00	1.38	2.39	440	173	0.00	.92	.28
,,	1160.00	1.21	2.03	443	168	0.00	.94	.32
,	1165.00	1.28	2.08	443	163	0.00	.71	.25
,	1170.00	1.22	1.75	442	143	0.00	.80	.31
,,,	1175.00	1.25	1.83	442	146	0.00	.69	.27
,,	1180.00	1.02	1.55	443	152	0.00	.87	.36
,	1185.00	1.19	2.99	439	251	0.00	1.03	.26
,,,	1190.00	1.17	1.14	443	97	0.00	.49	.30
,,	1195.00	1.12	1.52	442	136	0.00	.65	.30
,,	1200.00	1.10	1.47	444	134	0.00	.61	.29
,	1205.00	1.15	1.55	443	135	0.00	.61	.28
,,	1210.00	1.01	1.31	444	130	0.00	.56	.30
,,	1215.00	.99	1.18	445	119	0.00	.50	.30
,	1220.00	1.10	1.39	443	126	0.00	.62	.31
	1225.00	1.04	1.40	443	135	0.00	.63	.31
	1230.00	1.01	1.25	444	124	0.00	.53	.30
	1235.00	1.25	1.53	444	122	0.00	.68	.31

EXPLORATION LOGGING GEOCHEMICAL DATA PRINT

FOR : NORSK HYDRO A/S
WELL : 7321/8-1

Printed at : 15:27
: 9 Sep 1987
Format : 5

1240.0 m TO 1417.0 m

		SOURCE BED EVALUATION				FREE HYDROCARBS		
LITHOLOGY	DEPTH m	TOC %wt	S2 mg/g	TMAX degC	S2/TOC HI	S0 mg/g	S1 mg/g	TPI
Cuttings Samples								
	1240.00	1.18	1.36	445	115	0.00	.64	.32
	1245.00	1.14	1.42	442	125	0.00	.59	.29
	1250.00	1.27	1.55	444	122	0.00	.71	.31
,	1255.00	.83	.66	438	80	0.00	.56	.46
,,	1260.00	1.10	1.25	444	114	0.00	.65	.34
	1265.00	1.35	1.49	445	110	0.00	.71	.32
	1270.00	1.12	1.22	448	109	0.00	.64	.34
	1275.00	1.65	2.05	442	124	0.00	1.04	.34
	1280.00	1.74	2.12	447	122	0.00	1.10	.34
	1285.00	1.00	1.87	445	187	0.00	1.18	.39
	1287.00	1.46	1.55	443	106	0.00	.85	.35
,	1290.00	1.46	2.11	446	145	0.00	.81	.28
,,,,	1295.00	1.57	1.93	446	123	0.00	.90	.32
,,,	1300.00	1.85	2.55	448	138	0.00	1.16	.31
,,,	1305.00	1.81	3.01	449	166	0.00	1.23	.29
,,,,	1310.00	2.38	2.82	449	118	0.00	1.44	.34
,,,,:	1315.00	2.16	2.83	449	131	0.00	1.57	.36
,:::::	1320.00	2.04	2.82	447	138	0.00	1.33	.32
,,:	1325.00	1.80	2.77	451	154	0.00	1.26	.31
,,,,:	1330.00	2.01	2.52	449	125	0.00	1.23	.33
	1335.00	1.68	2.73	445	163	0.00	1.19	.30
	1340.00	2.55	3.26	450	128	0.00	1.33	.29
:	1345.00	2.00	2.99	447	149	0.00	1.26	.30
,,	1350.00	2.78	3.54	450	127	0.00	1.21	.25
	1355.00	3.10	4.09	450	132	0.00	1.24	.23
Z	1360.00	2.23	3.55	449	159	0.00	1.06	.23
	1365.00	2.30	2.80	453	122	0.00	.91	.25
	1370.00	.92	.22	451	24	0.00	.10	.31
	1375.00	.37	.07	450	19	0.00	.09	.56
	1380.00	1.08	.14	450	13	0.00	.12	.46
	1385.00	1.70	1.76	448	104	0.00	1.29	.42
	1390.00	2.04	3.01	447	148	0.00	1.77	.37
	1395.00	2.50	4.37	449	175	0.00	2.54	.37
	1400.00	2.27	4.88	446	215	.04	3.02	.39
	1402.00	2.64	5.20	443	197	0.00	3.62	.41
	1405.00	3.04	5.37	445	177	.07	3.60	.41
	1407.00	2.69	5.71	446	212	.06	3.54	.39
	1410.00	2.63	6.78	447	258	.07	3.82	.36
	1412.00	2.57	6.02	450	234	.08	3.68	.38
	1415.00	3.17	6.82	448	215	0.00	3.89	.36
	1417.00	3.56	8.02	449	225	0.00	3.73	.32

EXPLORATION LOGGING GEOCHEMICAL DATA PRINT

FOR : NORSK HYDRO A/S
WELL : 7321/8-1

Printed at : 15:30
: 9 Sep 1987
Format : 5

1420.0 m TO 1620.0 m

		SOURCE BED EVALUATION				FREE HYDROCARBS		
LITHOLOGY	DEPTH m	TOC %wt	S2 mg/g	TMAX degC	S2/TOC HI	S0 mg/g	S1 mg/g	TPI
Cuttings Samples								
	1420.00	3.52	7.01	447	199	.10	3.72	.35
	1422.00	3.11	7.71	449	248	.07	3.82	.34
	1425.00	3.54	6.70	448	189	.08	3.36	.34
	1427.00	3.65	9.13	449	250	.20	4.50	.34
	1430.00	3.40	6.40	449	188	.23	3.47	.37
	1432.00	3.10	9.15	451	295	.20	4.29	.33
	1435.00	2.93	7.64	449	261	.15	4.13	.36
::	1437.00	2.56	4.75	448	186	.10	2.60	.36
::::	1440.00	2.25	4.64	451	206	.08	2.61	.37
::::::	1442.00	2.25	6.78	448	301	.19	3.78	.37
::::::::::	1545.00	2.89	9.14	447	316	0.00	3.09	.25
::::::::::	1547.00	2.58	3.10	450	120	0.00	1.40	.31
:::::::::	1550.00	2.32	4.74	447	204	0.00	2.38	.33
:::::::::	1552.00	1.98	5.04	448	255	0.00	2.28	.31
:::::::::	1555.00	2.62	3.75	444	143	0.00	1.84	.33
:::::::::	1557.00	2.62	5.17	452	197	0.00	2.68	.34
:::::::::	1560.00	1.65	2.60	445	158	0.00	1.20	.32
:::::::::	1562.00	2.07	3.32	450	160	0.00	1.57	.32
:::::::::	1565.00	1.81	2.67	452	148	0.00	1.52	.36
:::::::::	1567.00	1.54	2.19	448	142	0.00	1.28	.37
:::::::::	1570.00	2.59	4.54	450	175	0.00	2.15	.32
:::::::::	1572.00	2.53	2.92	446	115	0.00	1.72	.37
:::::::::	1575.00	1.04	2.30	446	221	0.00	1.76	.43
,,:::::::	1577.00	1.25	1.53	445	122	0.00	1.16	.43
,,,,,::::	1580.00	2.19	2.10	450	96	0.00	1.04	.33
,,,,,::::	1582.00	.60	.48	448	80	0.00	.33	.41
,,,,,,:::	1585.00	1.35	1.65	454	122	0.00	.89	.35
,,,,,,:::	1587.00	.73	.50	450	68	0.00	.37	.43
,,,,,,::	1590.00	.77	.64	441	83	0.00	.48	.43
,,,,::	1592.00	1.31	1.62	442	124	0.00	.76	.32
,,,,::	1595.00	.83	.74	445	89	0.00	.52	.41
,,,,::	1597.00	.87	.81	440	93	0.00	.73	.47
,,,,,::	1600.00	1.35	1.17	451	87	0.00	.57	.33
,,,,,	1602.00	.94	.81	440	86	0.00	.38	.32
,,:	1605.00	1.23	1.14	454	93	0.00	.50	.30
,:	1607.00	1.31	1.06	456	81	0.00	.50	.32
,:	1610.00	1.02	.65	449	64	0.00	.44	.40
,:	1612.00	.92	.78	451	85	0.00	.51	.40
,,	1615.00	.77	.54	456	70	0.00	.35	.39
,,	1617.00	.84	.56	453	67	0.00	.33	.37
	1620.00	.79	.52	456	66	0.00	.35	.40

EXPLORATION LOGGING GEOCHEMICAL DATA PRINT

FOR : NORSK HYDRO A/S
WELL : 7321/8-1

Printed at : 15:34
: 9 Sep 1987
Format : 5

1622.0 m TO 1722.0 m

		SOURCE BED EVALUATION				FREE HYDROCARBS		
LITHOLOGY	DEPTH m	TOC %wt	S2 mg/g	TMAX degC	S2/TOC HI	S0 mg/g	S1 mg/g	TPI
Cuttings Samples								
	1622.00	.83	.59	454	71	0.00	.31	.34
	1625.00	1.55	.68	453	44	0.00	.46	.40
::::	1627.00	.79	.49	455	62	0.00	.26	.35
::::::	1630.00	1.02	.68	453	67	0.00	.37	.35
,,::::::	1632.00	.93	.49	455	53	0.00	.20	.29
:::::::	1635.00	.86	.51	457	59	0.00	.21	.29
:::::::	1637.00	.88	.65	452	74	0.00	.24	.27
:::::::	1640.00	.76	.44	451	58	0.00	.19	.30
,,,,::::	1642.00	.94	.55	457	59	0.00	.22	.29
,:	1645.00	.87	.47	455	54	0.00	.17	.27
,:::	1647.00	.88	.58	453	66	0.00	.18	.24
:::::::	1650.00	.98	.52	458	53	0.00	.20	.28
:::::::	1652.00	.95	.53	454	56	0.00	.21	.28
,,,::::	1655.00	1.00	.54	456	54	0.00	.27	.33
:::::	1657.00	.85	.63	458	74	0.00	.23	.27
::::	1660.00	1.00	.50	462	50	0.00	.20	.29
::::	1662.00	1.02	.65	462	64	0.00	.24	.27
,,,::	1665.00	1.42	1.04	446	73	0.00	.47	.31
,,,::	1667.00	.71	.54	451	76	0.00	.37	.41
,,,,:	1670.00	.76	.80	446	105	0.00	.48	.38
,,::::	1672.00	.91	.65	448	71	0.00	.49	.43
,,,::::	1675.00	1.22	1.39	442	114	0.00	.67	.33
,,::::::	1677.00	1.32	1.50	449	114	0.00	.59	.28
,,::::::	1680.00	1.41	1.21	456	86	0.00	.45	.27
,,::::::::	1682.00	1.08	.88	455	81	0.00	.31	.26
::::::::	1685.00	1.01	.97	454	96	0.00	.45	.32
,::::::::	1687.00	.35	.50	445	143	0.00	.32	.39
,::::::::	1690.00	1.39	1.49	451	107	0.00	1.28	.46
,:::::::::	1692.00	1.24	1.18	452	95	0.00	.46	.28
,:::::::::	1695.00	1.03	1.19	454	116	0.00	.39	.25
,::::::	1697.00	1.18	1.06	455	90	0.00	.42	.28
,,::::::	1700.00	1.27	1.70	453	134	0.00	1.04	.38
,,::::::	1702.00	1.11	.84	454	76	0.00	.42	.33
,,,::::::	1705.00	.99	.98	453	99	0.00	.53	.35
,,,::::::	1707.00	1.08	.83	448	77	0.00	.51	.38
,,,,:::	1710.00	1.04	1.03	455	99	0.00	.52	.34
,,,::::::	1712.00	.75	.73	454	97	0.00	.39	.35
,,::::	1715.00	1.40	1.93	453	138	0.00	.68	.26
,,,::::	1717.00	.88	.84	453	95	0.00	.47	.36
,,,,:::	1720.00	.93	.81	455	87	0.00	.41	.34
,,,:::::	1722.00	1.05	1.03	450	98	0.00	.50	.33

EXPLORATION LOGGING GEOCHEMICAL DATA PRINT

FOR : NORSK HYDRO A/S
WELL : 7321/8-1

Printed at : 15:37
: 9 Sep 1987
Format : 5

1725.0 m TO 1825.0 m

		SOURCE BED EVALUATION				FREE HYDROCARBS		
LITHOLOGY	DEPTH m	TOC %wt	S2 mg/g	TMAX degC	S2/TOC HI	S0 mg/g	S1 mg/g	TPI
Cuttings Samples								
,,,,,,:::	1725.00	.66	.63	456	95	0.00	.27	.30
,,,,,::	1727.00	.73	.57	452	78	0.00	.27	.32
,,,,:::	1730.00	.57	.49	449	86	0.00	.27	.36
,,,,,:	1732.00	.93	.58	452	62	0.00	.20	.26
,,,,,,:	1735.00	.56	.41	454	73	0.00	.33	.45
,,,,,,:	1737.00	.53	.31	461	58	0.00	.17	.35
,,,,,	1740.00	.54	.43	454	80	0.00	.15	.26
,,,	1742.00	.38	.22	460	58	0.00	.09	.29
,	1745.00	.49	.23	460	47	0.00	.13	.36
,	1747.00	.35	.18	0	51	0.00	.06	.25
,	1750.00	.36	.18	0	50	0.00	.06	.25
,	1752.00	.30	.21	461	70	0.00	.06	.22
,	1755.00	.41	.21	462	51	0.00	.09	.30
,:	1757.00	.41	.25	458	61	0.00	.08	.24
,,,:	1760.00	.42	.22	455	52	0.00	.07	.24
,,:	1762.00	.41	.15	0	37	0.00	.05	.25
,:	1765.00	.30	.13	0	43	0.00	.08	.38
	1767.00	.36	.14	0	39	0.00	.05	.26
	1770.00	.44	.23	455	52	0.00	.10	.30
,:	1772.00	.45	.19	0	42	0.00	.09	.32
,,	1775.00	.39	.19	0	49	0.00	.10	.34
,,::	1777.00	.39	.12	0	31	0.00	.07	.37
,,,::	1780.00	.33	.17	0	52	0.00	.12	.41
,,::	1782.00	.33	.22	449	67	0.00	.11	.33
,,,:::::	1785.00	.48	.19	0	40	0.00	.12	.39
,,:	1787.00	.46	.24	440	52	0.00	.13	.35
,,::	1790.00	.28	.16	0	57	0.00	.08	.33
,,::	1792.00	.40	.65	444	163	0.00	.26	.29
,,,:	1795.00	.29	.40	433	138	0.00	.25	.38
,,,:	1797.00	.68	.96	427	141	0.00	.45	.32
,,,::	1800.00	.49	.53	438	108	0.00	.39	.42
,,,::	1802.00	.28	.25	445	89	0.00	.16	.39
,,,	1805.00	.30	.16	0	53	0.00	.09	.36
,,	1807.00	.35	.24	453	69	0.00	.15	.38
,,,,,,,	1810.00	.19	.11	0	58	0.00	.05	.31
:::::::::	1812.00	.84	.83	0	99	0.00	.81	.49
,,::::	1815.00	.52	.48	437	92	0.00	.35	.42
:::::::	1817.00	.53	.56	437	106	0.00	.53	.49
:::::::	1820.00	.49	.45	448	92	0.00	.17	.27
::::::	1822.00	.66	.62	442	94	0.00	.28	.31
::::::::	1825.00	.96	.69	458	72	0.00	.18	.21

EXPLORATION LOGGING GEOCHEMICAL DATA PRINT

FOR : NORSK HYDRO A/S
WELL : 7321/8-1

Printed at : 15:41
: 9 Sep 1987
Format : 5

1827.0 m TO 1927.0 m

		SOURCE BED EVALUATION				FREE HYDROCARBS		
LITHOLOGY	DEPTH m	TOC %wt	S2 mg/g	TMAX degC	S2/TOC HI	S0 mg/g	S1 mg/g	TPI
Cuttings Samples								
,::::::	1827.00	.81	.69	429	85	0.00	.50	.42
::::::	1830.00	.71	.55	462	77	0.00	.33	.37
,:::	1832.00	1.70	3.32	460	195	0.00	.51	.13
,,:::::::	1835.00	.81	.41	461	51	0.00	.07	.15
,:	1837.00	.53	.40	452	75	0.00	.12	.23
,,:	1840.00	.51	.33	457	65	0.00	.12	.27
,::	1842.00	2.07	2.91	460	141	0.00	.28	.09
,::	1845.00	1.58	1.02	462	65	0.00	.17	.14
,,::	1847.00	.88	.66	461	75	0.00	.09	.12
,,,::::	1850.00	2.10	2.58	465	123	0.00	.33	.11
,,,,:::	1852.00	1.99	4.76	460	239	0.00	.68	.13
,,,:::	1855.00	3.71	3.54	463	95	0.00	.52	.13
,,,:::	1857.00	2.11	3.08	462	146	0.00	.55	.15
,,,,:::	1860.00	2.82	4.32	463	153	0.00	.61	.12
,,,::	1862.00	2.84	3.07	465	108	0.00	.48	.14
,,,	1865.00	3.10	3.58	461	115	0.00	.54	.13
,,,::	1867.00	2.26	1.83	464	81	0.00	.28	.13
,,,:::	1870.00	1.96	1.13	463	58	0.00	.18	.14
,::	1872.00	1.80	1.60	465	89	0.00	.22	.12
,::::::	1875.00	1.02	.68	460	67	0.00	.11	.14
,:::	1877.00	.79	.61	467	77	0.00	.10	.14
,:::::::	1880.00	.96	.67	464	70	0.00	.10	.13
,,:::::::	1882.00	.69	.38	464	55	0.00	.06	.14
,,:::::::	1885.00	.93	.91	468	98	0.00	.20	.18
,:::	1887.00	.63	.15	0	24	0.00	.06	.29
,,:::	1890.00	.43	.26	459	60	0.00	.07	.21
,,:::	1892.00	.42	.19	0	45	0.00	.08	.30
,,:	1895.00	.50	.58	463	116	0.00	.11	.16
,:	1897.00	.89	.57	465	64	0.00	.13	.19
:	1900.00	.55	.42	460	76	0.00	.17	.29
:	1902.00	.38	.18	0	47	0.00	.12	.40
:	1905.00	.45	.27	466	60	0.00	.12	.31
:	1907.00	.48	.38	516	79	0.00	.12	.24
::	1910.00	.60	.54	454	90	0.00	.27	.33
::	1912.00	.58	.38	463	66	0.00	.14	.27
:::	1915.00	1.16	.91	464	78	0.00	.29	.24
:::	1917.00	1.22	.90	463	74	0.00	.32	.26
::	1920.00	1.43	1.18	467	83	0.00	.31	.21
:::	1922.00	.99	.75	467	76	0.00	.19	.20
::	1925.00	1.20	.97	464	81	0.00	.24	.20
:::	1927.00	1.02	.66	467	65	0.00	.17	.20

EXPLORATION LOGGING GEOCHEMICAL DATA PRINT

FOR : NORSK HYDRO A/S
WELL : 7321/8-1

Printed at : 15:44
: 9 Sep 1987
Format : 5

1930.0 m TO 2030.0 m

		SOURCE BED EVALUATION				FREE HYDROCARBS		
LITHOLOGY	DEPTH m	TOC %wt	S2 mg/g	TMAX degC	S2/TOC HI	S0 mg/g	S1 mg/g	TPI
Cuttings Samples								
::::	1930.00	1.32	.99	466	75	0.00	.32	.24
::::	1932.00	.65	.38	464	58	0.00	.21	.36
:::	1935.00	.66	.42	465	64	0.00	.15	.26
:	1937.00	.71	.40	468	56	0.00	.14	.26
::::	1940.00	.59	.35	464	59	0.00	.11	.24
:::	1942.00	3.81	5.15	464	135	0.00	1.10	.18
::	1945.00	2.56	2.22	462	87	0.00	.57	.20
::	1947.00	3.17	3.52	461	111	0.00	.78	.18
::	1950.00	3.04	2.55	460	84	0.00	.76	.23
:::	1952.00	3.66	3.49	462	95	0.00	.88	.20
::::	1955.00	3.36	2.94	461	88	0.00	.88	.23
:::::	1957.00	3.49	4.12	463	118	0.00	1.01	.20
::::::	1960.00	2.83	2.29	461	81	0.00	.59	.20
::::::	1962.00	2.92	2.50	459	86	0.00	.75	.23
::::::	1965.00	1.46	1.33	463	91	0.00	.44	.25
:::::::	1967.00	2.54	1.91	463	75	0.00	.63	.25
:::	1970.00	1.32	.87	465	66	0.00	.46	.35
:::::::	1972.00	1.37	.97	466	71	0.00	.46	.32
:::::	1975.00	1.74	1.38	466	79	0.00	.46	.25
:::::::	1977.00	1.46	1.07	464	73	0.00	.56	.34
:::::::	1980.00	1.13	.98	462	87	0.00	.48	.33
::::::::	1982.00	1.23	1.04	467	85	0.00	.45	.30
::::::::	1985.00	1.15	.91	467	79	0.00	.31	.25
:::::::	1987.00	.91	.53	471	58	0.00	.26	.33
:::::::	1990.00	1.66	1.41	468	85	0.00	.45	.24
::::::	1992.00	2.68	2.85	465	106	0.00	.79	.22
::::::::	1995.00	1.74	1.38	466	79	0.00	.46	.25
:::::::	1997.00	2.27	1.97	464	87	0.00	.67	.25
:::::	2000.00	2.46	3.04	463	124	0.00	.78	.20
:::::::	2002.00	2.12	2.44	463	115	0.00	.83	.25
:::::::	2005.00	4.73	7.27	462	154	0.00	1.47	.17
:::::	2007.00	4.07	5.04	466	124	0.00	1.23	.20
:::::::	2010.00	6.84	19.84	462	290	0.00	2.82	.12
::::::	2012.00	6.51	14.56	464	224	0.00	2.41	.14
:::::	2015.00	3.73	3.80	467	102	0.00	.86	.18
:::::	2017.00	3.73	4.81	467	129	0.00	1.04	.18
:::	2020.00	3.08	2.60	468	84	0.00	.63	.20
::::	2022.00	1.56	1.06	468	68	0.00	.37	.26
:::	2025.00	3.69	3.65	465	99	0.00	1.01	.22
:::::	2027.00	3.20	3.05	465	95	0.00	.78	.20
::::::	2030.00	2.70	2.39	467	89	0.00	.69	.22

EXPLORATION LOGGING GEOCHEMICAL DATA PRINT

FOR : NORSK HYDRO A/S
WELL : 7321/8-1

Printed at : 15:48
: 9 Sep 1987
Format : 5

2032.0 m TO 2132.0 m

		SOURCE BED EVALUATION				FREE HYDROCARBS		
LITHOLOGY	DEPTH m	TOC %wt	S2 mg/g	TMAX degC	S2/TOC HI	SO mg/g	S1 mg/g	TPI
Cuttings Samples								
:::::::	2032.00	2.94	2.94	466	100	0.00	.82	.22
:::::::	2035.00	1.77	1.55	469	88	0.00	.41	.21
::::::::	2037.00	2.50	2.37	468	95	0.00	.62	.21
::::::::	2040.00	1.84	1.34	467	73	0.00	.43	.24
::::::	2042.00	3.94	6.32	460	160	0.00	2.40	.28
::::::	2045.00	2.72	3.94	463	145	0.00	.88	.18
::	2047.00	1.23	.82	462	67	0.00	.23	.22
:::	2050.00	1.39	1.44	460	104	0.00	.34	.19
:::::::	2052.00	1.56	1.45	463	93	0.00	.38	.21
::::::	2055.00	1.86	1.72	465	92	0.00	.46	.21
:::::	2057.00	1.60	1.65	468	103	0.00	.52	.24
:::::	2060.00	1.55	1.25	473	81	0.00	.35	.22
::::::	2062.00	1.94	1.65	467	85	0.00	.44	.21
::::	2065.00	1.39	.95	469	68	0.00	.33	.26
:::	2067.00	.82	.55	467	67	0.00	.21	.28
::	2070.00	.98	.70	471	71	0.00	.25	.26
L ::	2072.00	.97	.63	460	65	0.00	.38	.38
L ::	2075.00	.72	.40	474	56	0.00	.18	.31
L ::	2077.00	.80	.48	474	60	0.00	.19	.28
::	2080.00	.69	.39	473	57	0.00	.18	.32
:	2082.00	.63	.37	473	59	0.00	.14	.27
::	2085.00	.85	.58	470	68	0.00	.21	.27
:	2087.00	.97	.65	473	67	0.00	.21	.24
:	2090.00	3.01	3.62	471	120	0.00	.80	.18
:	2092.00	2.80	2.65	470	95	0.00	.63	.19
:	2095.00	3.40	3.61	469	106	0.00	.94	.21
:	2097.00	2.46	3.03	470	123	0.00	1.03	.25
:	2100.00	4.70	8.56	468	182	0.00	1.70	.17
:	2102.00	4.37	6.97	469	159	0.00	1.38	.17
::	2105.00	3.74	6.34	471	170	0.00	1.20	.16
:::	2107.00	2.04	3.74	471	183	0.00	.83	.18
:::	2110.00	2.81	2.90	475	103	0.00	.66	.19
:::::	2112.00	2.02	1.63	466	81	0.00	.42	.20
:::	2115.00	4.73	7.87	471	166	0.00	1.31	.14
:::	2117.00	4.25	8.88	471	209	0.00	1.54	.15
::::::	2120.00	4.47	12.07	471	270	0.00	1.80	.13
:::::::	2122.00	2.77	3.43	474	124	0.00	.69	.17
:::	2125.00	4.33	4.92	473	114	.01	1.02	.17
::	2127.00	4.61	6.69	471	145	0.00	1.06	.14
:::	2130.00	2.27	1.63	474	72	0.00	.41	.20
::	2132.00	2.23	.86	472	39	0.00	.30	.26

EXPLORATION LOGGING GEOCHEMICAL DATA PRINT

FOR : NORSK HYDRO A/S
WELL : 7321/8-1

Printed at : 15:56
: 9 Sep 1987
Format : 5

2135.0 m TO 2237.0 m

		SOURCE BED EVALUATION				FREE HYDROCARBS		
LITHOLOGY	DEPTH m	TOC %wt	S2 mg/g	TMAX degC	S2/TOC HI	S0 mg/g	S1 mg/g	TPI
Cuttings Samples								
L :	2135.00	2.15	1.65	472	77	0.00	.40	.20
L :	2137.00	3.13	2.69	473	86	0.00	.59	.18
L :::	2140.00	3.03	2.53	475	83	0.00	.57	.18
L :::::	2142.00	4.65	12.70	472	273	.01	1.50	.11
L :::	2147.00	3.52	2.25	471	64	0.00	.54	.19
L ::	2150.00	4.28	4.01	471	94	.01	1.01	.20
L ::	2152.00	1.59	1.00	473	63	0.00	.30	.23
L :	2155.00	2.28	1.30	473	57	0.00	.34	.21
L ::	2157.00	2.80	2.01	471	72	0.00	.47	.19
L ::	2160.00	4.05	4.13	470	102	0.00	.97	.19
L ::	2162.00	2.45	2.78	471	113	0.00	.68	.20
L ::	2165.00	2.40	1.64	473	68	0.00	.49	.23
L ::	2167.00	2.71	1.77	473	65	0.00	.48	.21
LLL :	2170.00	2.75	1.76	470	64	0.00	.50	.22
LLL :	2172.00	2.17	1.51	471	70	0.00	.40	.21
LLL ::	2175.00	1.31	.81	471	62	0.00	.30	.27
LLL ::	2177.00	1.08	.66	471	61	0.00	.25	.27
LL ::::	2180.00	1.25	.59	471	47	0.00	.23	.28
LL :::	2182.00	2.79	3.07	471	110	0.00	.56	.15
LL	2185.00	2.56	4.08	449	159	0.00	3.96	.49
L	2187.00	1.73	2.17	447	125	0.00	1.05	.33
:	2190.00	1.30	.64	448	49	0.00	.44	.41
::	2192.00	1.18	.70	452	59	0.00	.53	.43
:	2195.00	1.11	.74	463	67	0.00	.38	.34
L ::	2197.00	.91	.40	459	44	0.00	.30	.43
L :	2200.00	.85	.34	441	40	0.00	.31	.48
L	2202.00	.97	.34	461	35	0.00	.33	.49
L ::	2205.00	.87	.37	461	43	0.00	.25	.40
L ::	2207.00	.95	.35	463	37	0.00	.26	.43
LLLL ::	2210.00	.68	.18	463	26	0.00	.17	.49
LLLL ::	2212.00	.85	.31	468	36	0.00	.19	.38
LLLL ::	2215.00	.93	.45	473	48	0.00	.21	.32
LLLL :	2217.00	2.49	1.52	474	61	0.00	.42	.22
LLL ::::	2220.00	1.28	.84	474	66	0.00	.26	.24
LL :::	2222.00	1.20	.80	475	67	0.00	.21	.21
LL ::	2225.00	2.67	1.69	479	63	0.00	.46	.21
LL ::::	2227.00	2.82	2.10	473	74	0.00	.42	.17
LL :::	2230.00	4.56	4.86	473	107	0.00	.82	.14
L :::	2232.00	4.31	5.83	475	135	.04	.85	.13
L :::::	2235.00	2.48	1.51	478	61	0.00	.32	.17
::::	2237.00	3.40	3.54	479	104	.02	.55	.14

EXPLORATION LOGGING GEOCHEMICAL DATA PRINT

FOR : NORSK HYDRO A/S
WELL : 7321/8-1

Printed at : 16:01
: 9 Sep 1987
Format : 5

2240.0 m TO 2337.0 m

			SOURCE BED EVALUATION				FREE HYDROCARBS		
LITHOLOGY		DEPTH m	TOC %wt	S2 mg/g	TMAX degC	S2/TOC HI	S0 mg/g	S1 mg/g	TPI
Cuttings Samples									
L	:::	2240.00	3.19	2.22	478	70	.01	.50	.19
	:::	2242.00	1.89	1.61	478	85	0.00	.34	.17
	::::::	2245.00	2.21	1.48	478	67	.01	.31	.18
	::::::	2247.00	1.14	.62	483	54	0.00	.17	.22
	:::::	2250.00	1.23	.73	475	59	0.00	.23	.24
L	::::::	2252.00	1.61	1.26	477	78	0.00	.34	.21
L	::::	2255.00	1.47	.91	479	62	0.00	.23	.20
L	::::	2257.00	1.03	.28	479	27	0.00	.13	.32
L	:::	2260.00	.50	.11	0	22	0.00	.08	.42
LL	:::	2262.00	.86	.45	484	52	0.00	.15	.25
ZZ	:::	2265.00	.51	.11	0	22	0.00	.09	.45
ZZ	::	2267.00	1.11	.79	472	71	0.00	.24	.23
Z	::	2270.00	1.31	.51	479	39	0.00	.14	.22
Z	::	2272.00	1.55	.64	478	41	0.00	.19	.23
ZZ	:	2275.00	2.43	1.75	446	72	0.00	.41	.19
ZZ	::	2277.00	2.30	1.41	479	61	0.00	.28	.17
ZZ	:::	2280.00	1.57	.73	481	46	0.00	.26	.26
Z	::	2282.00	1.16	.55	478	47	0.00	.21	.28
ZZ	::	2285.00	.76	.24	459	32	0.00	.20	.45
LL	::	2287.00	1.05	.42	448	40	0.00	.24	.36
Z	::	2290.00	1.27	1.04	443	82	0.00	.49	.32
	:::	2292.00	.80	.44	464	55	0.00	.17	.28
	::::	2295.00	1.11	.77	474	69	0.00	.21	.21
	::::::	2297.00	.86	.53	464	62	0.00	.17	.24
	::	2300.00	.77	.37	479	48	0.00	.13	.26
Z	:	2302.00	.92	.47	483	51	0.00	.14	.23
	:::::::	2305.00	1.12	.58	477	52	0.00	.16	.22
	::::::	2307.00	1.08	.75	477	69	0.00	.16	.18
	::::::	2310.00	1.31	1.07	473	82	0.00	.18	.14
	:::::::	2312.00	.79	.45	486	57	0.00	.10	.18
	:::	2315.00	.68	.22	492	32	0.00	.07	.24
	::::	2317.00	.79	.28	489	35	0.00	.08	.22
	:::	2320.00	.74	.24	490	32	0.00	.09	.27
	:::	2322.00	.74	.38	476	51	0.00	.14	.27
	:::	2325.00	.84	.47	465	56	0.00	.28	.37
	::::	2327.00	.74	.26	493	35	0.00	.08	.24
	::::	2330.00	.73	.26	487	36	0.00	.10	.28
	::::	2332.00	.67	.28	489	42	0.00	.16	.36
	::	2335.00	.59	.20	496	34	0.00	.13	.39
	:::::::	2337.00	.59	.21	448	36	0.00	.11	.34

EXPLORATION LOGGING GEOCHEMICAL DATA PRINT

FOR : NORSK HYDRO A/S
WELL : 7321/8-1

Printed at : 16:04
: 9 Sep 1987
Format : 5

2340.0 m TO 2442.0 m

		SOURCE BED EVALUATION				FREE HYDROCARBS		
LITHOLOGY	DEPTH m	TOC %wt	S2 mg/g	TMAX degC	S2/TOC HI	S0 mg/g	S1 mg/g	TPI
Cuttings Samples								
::::	2340.00	.96	.58	478	60	0.00	.15	.21
:::::	2342.00	.55	.18	0	33	0.00	.09	.33
:::::::	2345.00	.41	.13	0	32	0.00	.06	.32
:::::::	2347.00	.45	.16	0	36	0.00	.08	.33
:::::	2350.00	.52	.17	0	33	0.00	.07	.29
:::::	2352.00	.52	.15	0	29	0.00	.05	.25
::	2355.00	.64	.27	477	42	0.00	.12	.31
::	2357.00	.70	.22	490	31	0.00	.12	.35
:::	2360.00	1.10	.35	487	32	0.00	.11	.24
::	2362.00	.76	.25	488	33	0.00	.11	.31
:	2365.00	.97	.38	477	39	0.00	.16	.30
:::	2367.00	.67	.22	490	33	0.00	.11	.33
:	2370.00	1.27	1.00	416	79	0.00	1.00	.50
::	2372.00	1.04	.87	423	84	0.00	.51	.37
::	2375.00	1.14	.58	480	51	0.00	.27	.32
::	2377.00	.96	.69	430	72	0.00	.49	.42
::	2380.00	1.45	1.14	421	79	0.00	1.03	.47
:	2382.00	1.50	1.26	422	84	0.00	1.01	.44
	2385.00	.93	.54	443	58	0.00	.19	.26
:	2387.00	.97	.54	438	56	0.00	.26	.33
:	2390.00	.95	.46	445	48	0.00	.16	.26
:	2392.00	.87	.33	494	38	0.00	.11	.25
:	2395.00	.79	.31	452	39	0.00	.13	.30
::	2397.00	1.09	.47	485	43	0.00	.15	.24
::	2400.00	.95	.41	480	43	0.00	.13	.24
::	2402.00	.87	.31	495	36	0.00	.12	.28
::::	2405.00	.73	.19	0	26	0.00	.07	.27
::	2407.00	.88	.32	501	36	0.00	.06	.16
:	2410.00	.78	.25	508	32	0.00	.07	.22
::	2412.00	.88	.26	486	30	0.00	.09	.26
:	2415.00	.71	.24	478	34	0.00	.11	.31
:	2417.00	.76	.24	497	32	0.00	.09	.27
:	2420.00	.81	.29	486	36	0.00	.07	.19
::	2422.00	.80	.26	488	33	0.00	.07	.21
	2425.00	.83	.16	0	19	0.00	.07	.30
	2427.00	.89	.34	527	38	0.00	.09	.21
::	2430.00	.81	.23	502	28	0.00	.07	.23
:	2432.00	.73	.23	501	32	0.00	.09	.28
::	2435.00	.60	.16	0	27	0.00	.05	.24
;;;::	2437.00	.78	.24	503	31	0.00	.08	.25
;;;::	2440.00	.80	.24	501	30	0.00	.25	.51
;;::	2442.00	.62	.17	0	27	0.00	.04	.19

EXPLORATION LOGGING GEOCHEMICAL DATA PRINT

FOR : NORSK HYDRO A/S
WELL : 7321/8-1

Printed at : 16:08
: 9 Sep 1987
Format : 5

2445.0 m TO 2545.0 m

		SOURCE BED EVALUATION				FREE HYDROCARBS		
LITHOLOGY	DEPTH m	TOC %wt	S2 mg/g	TMAX degC	S2/TOC HI	S0 mg/g	S1 mg/g	TPI
Cuttings Samples								
;;::::	2445.00	.70	.17	0	24	0.00	.03	.15
;;::::	2447.00	.62	.14	0	23	0.00	.05	.26
;;::::	2450.00	.61	.16	0	26	0.00	.04	.20
;;::::	2452.00	.70	.16	0	23	0.00	.04	.20
;;::::	2455.00	.83	.24	506	29	0.00	.06	.20
;;;::::	2457.00	.79	.30	496	38	0.00	.06	.17
;;;::::	2460.00	.72	.90	434	125	0.00	.23	.20
;;;::::	2462.00	.57	.42	439	74	0.00	.15	.26
;;;::::	2465.00	.60	.61	436	102	0.00	.22	.27
;;::::	2467.00	.53	.36	437	68	0.00	.17	.32
;;::::	2470.00	.59	.69	427	117	0.00	.25	.27
;;;::::	2472.00	.87	.47	441	54	0.00	.18	.28
;;::::	2475.00	1.09	.81	442	74	0.00	.31	.28
;::::::	2477.00	1.09	.77	444	71	0.00	.28	.27
::::::::	2480.00	.78	.45	459	58	0.00	.20	.31
::::::::	2482.00	.96	.45	458	47	0.00	.15	.25
;::::::	2485.00	.79	.35	443	44	0.00	.14	.29
;::::::	2487.00	.83	.46	442	55	0.00	.21	.31
;::::::	2490.00	.42	.12	0	29	0.00	.07	.37
;;::::	2492.00	.57	.16	0	28	0.00	.10	.38
;;::::	2495.00	.57	.11	0	19	0.00	.07	.39
,,,::::	2497.00	.87	.22	504	25	0.00	.11	.33
;;::::	2500.00	.78	.24	497	31	0.00	.06	.20
;;::::	2502.00	.59	.14	0	24	0.00	.07	.33
;;::::	2505.00	.55	.16	0	29	0.00	.08	.33
;;;;::	2507.00	.72	.14	0	19	0.00	.09	.39
;;::::	2510.00	.55	.11	0	20	0.00	.05	.31
;;;;::	2512.00	1.11	.46	480	41	0.00	.21	.31
;;;::	2515.00	.64	.18	0	28	0.00	.09	.33
;;;;:	2517.00	.50	.11	0	22	0.00	.07	.39
;;;;:	2520.00	.59	.10	0	17	0.00	.07	.41
;;;:	2522.00	1.02	.42	483	41	0.00	.17	.29
;;;:	2525.00	.78	.21	491	27	0.00	.13	.38
;;:	2527.00	.74	.22	474	30	0.00	.10	.31
;;;	2530.00	.63	.22	451	35	0.00	.11	.33
,,	2532.00	1.06	1.32	438	125	0.00	.60	.31
,,	2535.00	1.21	1.17	437	97	0.00	.49	.30
,:	2537.00	1.26	.82	443	65	0.00	.28	.25
:	2540.00	.99	.78	438	79	0.00	.21	.21
:	2542.00	1.05	.67	445	64	0.00	.21	.24
:	2545.00	.66	.23	444	35	0.00	.08	.26

EXPLORATION LOGGING GEOCHEMICAL DATA PRINT

FOR : NORSK HYDRO A/S
WELL : 7321/8-1

Printed at : 16:12
: 9 Sep 1987
Format : 5

2547.0 m TO 2652.0 m

		SOURCE BED EVALUATION				FREE HYDROCARBS		
LITHOLOGY	DEPTH m	TOC %wt	S2 mg/g	TMAX degC	S2/TOC HI	SO mg/g	S1 mg/g	TPI
Cuttings Samples								
:	2547.00	.60	.21	441	35	0.00	.09	.30
::	2550.00	.64	.24	448	38	0.00	.09	.27
::	2552.00	.68	.19	0	28	0.00	.05	.21
:	2555.00	.64	.13	0	20	0.00	.05	.28
,::	2557.00	.57	.11	0	19	0.00	.06	.35
,	2560.00	.70	.15	0	21	0.00	.02	.12
,	2562.00	.68	.12	0	18	0.00	.02	.14
,,	2565.00	.49	.13	0	27	0.00	.04	.24
,,,,,:	2567.00	.68	.15	0	22	0.00	.09	.38
,,::::::	2570.00	.67	.22	462	33	0.00	.16	.42
,,,::::::	2572.00	.63	.18	0	29	0.00	.09	.33
,,::::::	2575.00	.61	.13	0	21	0.00	.11	.46
,,::::::	2577.00	.68	.18	0	26	0.00	.10	.36
::::::	2580.00	.95	.15	0	16	0.00	.07	.32
::::::	2582.00	1.09	.21	524	19	0.00	.07	.25
:::::*	2585.00	4.06	2.19	496	54	0.00	.15	.06
::::::	2587.00	1.59	.27	519	17	0.00	.04	.13
::::*	2590.00	3.09	1.11	503	36	0.00	.12	.10
::::	2592.00	3.44	1.46	501	42	0.00	.28	.16
:::::	2595.00	3.46	1.16	504	34	0.00	.08	.06
,,::::::*	2597.00	4.37	5.12	493	117	0.00	.35	.06
,:::::::::	2600.00	2.35	.66	502	28	0.00	.20	.23
,:::::::::	2602.00	1.48	.37	511	25	0.00	.05	.12
::::::::::	2605.00	1.98	.50	513	25	0.00	.11	.18
::::::::::	2607.00	2.42	.79	507	33	0.00	.09	.10
::::::::::	2610.00	.85	.19	0	22	0.00	.05	.21
::::::::::	2612.00	1.18	.26	515	22	0.00	.05	.16
::::::::::	2617.00	.88	.16	0	18	0.00	.04	.20
,:::::::::	2620.00	.95	.26	526	27	0.00	.06	.19
::::::::::	2622.00	.81	.15	0	19	0.00	.04	.21
::::::::::	2625.00	1.26	.31	523	25	0.00	.04	.11
L:::::::::	2627.00	1.77	.40	519	23	0.00	.02	.05
L:::::::::	2630.00	1.54	.36	522	23	0.00	.02	.05
,:::::::::	2632.00	1.36	.31	524	23	0.00	.04	.11
,:::::::::	2635.00	2.36	.63	516	27	0.00	.02	.03
,,,,,::::	2637.00	2.15	.65	509	30	0.00	.05	.07
,,,::::*	2640.00	3.13	1.20	507	38	0.00	.10	.08
,,:::	2642.00	2.34	.68	508	29	0.00	.05	.07
,::::*	2645.00	3.02	.88	504	29	0.00	.09	.09
,::::*	2647.00	2.95	.95	508	32	0.00	.09	.09
:::::	2650.00	2.36	.72	511	31	0.00	.06	.08
:::::	2652.00	2.32	.65	509	28	0.00	.04	.06

EXPLORATION LOGGING GEOCHEMICAL DATA PRINT

FOR : NORSK HYDRO A/S
WELL : 7321/8-1

Printed at : 16:16
: 9 Sep 1987
Format : 5

2655.0 m TO 2762.0 m

		SOURCE BED EVALUATION				FREE HYDROCARBS		
LITHOLOGY	DEPTH m	TOC %wt	S2 mg/g	TMAX degC	S2/TOC HI	S0 mg/g	S1 mg/g	TPI
Cuttings Samples								
::::	2655.00	1.75	.43	511	25	0.00	.04	.09
:::::	2657.00	1.13	.19	0	17	0.00	.01	.05
::::	2660.00	1.39	.28	519	20	0.00	.02	.07
::::	2662.00	1.65	.38	517	23	0.00	.01	.03
,:::*	2665.00	3.09	1.47	503	48	0.00	.11	.07
,::::	2667.00	1.54	.24	523	16	0.00	.04	.14
,:::::	2670.00	2.07	1.22	503	59	0.00	.18	.13
,,,,,,,	2680.00	1.06	.42	462	40	0.00	.19	.31
:::::*	2682.00	5.12	8.46	497	165	.06	.90	.10
,,,,,:::*	2685.00	5.60	4.02	503	72	.12	.48	.13
,,,,,,::	2687.00	2.40	1.36	514	57	.01	.14	.10
,,,,,,:	2690.00	2.37	.58	519	24	0.00	.05	.08
,,,,,	2692.00	2.82	.77	517	27	0.00	.06	.07
,,,,,,,:	2695.00	1.70	.26	530	15	0.00	.01	.04
,,,,,,,,:	2697.00	1.34	.26	531	19	0.00	0.00	0.00
,,,,,,:	2700.00	1.21	.20	533	17	0.00	.01	.05
::::::::::	2702.00	1.11	.19	0	17	0.00	.01	.05
,,,,,,,	2705.00	1.72	.21	527	12	0.00	.02	.09
::::::	2707.00	3.30	1.67	502	51	0.00	.08	.05
,,:::	2710.00	1.48	.40	509	27	0.00	.04	.09
,,:::	2712.00	3.21	1.14	507	36	0.00	.09	.07
,,,::::	2715.00	1.97	1.50	501	76	0.00	.15	.09
,,::::	2717.00	2.21	.89	504	40	0.00	.11	.11
,,::::	2720.00	4.40	2.22	494	50	0.00	.18	.08
,,:::	2722.00	2.04	.52	509	25	0.00	.03	.05
,,:::	2725.00	2.44	1.32	499	54	0.00	.13	.09
,::::	2727.00	1.37	.23	522	17	0.00	.01	.04
,::::	2730.00	1.26	.23	522	18	0.00	.01	.04
,::::	2732.00	1.19	.24	526	20	0.00	0.00	0.00
,:::	2735.00	1.13	.18	0	16	0.00	.01	.05
,::	2737.00	1.02	.14	0	14	0.00	.02	.13
,::	2740.00	1.21	.25	517	21	0.00	.03	.11
,:	2742.00	1.08	.20	519	19	0.00	.02	.09
,:	2745.00	.72	.08	0	11	0.00	.05	.38
,,::::	2747.00	1.14	.23	525	20	0.00	.02	.08
,,,::	2750.00	.75	.11	0	15	0.00	.02	.15
,::::::	2752.00	.85	.17	0	20	0.00	.05	.23
::::::::	2755.00	.72	.09	0	13	0.00	.04	.31
,::::::	2757.00	.90	.13	0	14	0.00	.02	.13
,::::::	2760.00	1.06	.16	0	15	0.00	.07	.30
,,:::::	2762.00	.83	.10	0	12	0.00	.04	.29

EXPLORATION LOGGING GEOCHEMICAL DATA PRINT

FOR : NORSK HYDRO A/S
WELL : 7321/8-1

Printed at : 16:20
: 9 Sep 1987
Format : 5

2765.0 m TO 2870.0 m

		SOURCE BED EVALUATION				FREE HYDROCARBS		
LITHOLOGY	DEPTH m	TOC %wt	S2 mg/g	TMAX degC	S2/TOC HI	S0 mg/g	S1 mg/g	TPI
Cuttings Samples								
,::::::	2765.00	.84	.12	0	14	0.00	.04	.25
,,,,,:::	2767.00	.87	.13	0	15	0.00	.04	.24
,,,,::::	2770.00	1.00	.16	0	16	0.00	.02	.11
,,,,:::	2772.00	.93	.14	0	15	0.00	.01	.07
,,,,,,::	2775.00	.93	.17	0	18	0.00	.02	.11
,,,,,,,:	2777.00	.95	.13	0	14	0.00	.01	.07
,,,,::::::	2780.00	1.03	.14	0	14	0.00	.03	.18
,,,,,::::	2782.00	.75	.07	0	9	0.00	0.00	0.00
,,,,::::::	2785.00	1.30	.24	531	18	0.00	.09	.27
L,,,,,::::	2787.00	.94	.12	0	13	0.00	.01	.08
,,,,:::	2790.00	.99	.18	0	18	0.00	.03	.14
,,,,:::::	2792.00	1.33	.15	0	11	0.00	.07	.32
,,,,::::::	2795.00	.88	.11	0	13	0.00	.01	.08
,,,::::::::	2797.00	.61	.12	0	20	0.00	.01	.08
::::::::	2800.00	.71	.12	0	17	0.00	.01	.08
,,,::::::	2802.00	1.00	.22	527	22	0.00	.03	.12
,,::::::	2805.00	.72	.08	0	11	0.00	.01	.11
,,::::::	2807.00	.57	.13	0	23	0.00	.02	.13
,,,,::::	2810.00	2.36	.56	524	24	0.00	.07	.11
,,,,::::	2812.00	1.87	.33	536	18	0.00	.03	.08
,,,,:::	2815.00	1.40	.32	531	23	0.00	.02	.06
,,,,,:::	2817.00	1.06	.11	0	10	0.00	0.00	0.00
,,,,:::	2820.00	1.20	.13	0	11	0.00	.02	.13
,,,:::	2822.00	.92	.12	0	13	0.00	.06	.33
,,::	2825.00	1.05	.12	0	11	0.00	.01	.08
,,:	2827.00	1.16	.16	0	14	0.00	.03	.16
,,:	2830.00	1.06	.18	0	17	0.00	.07	.28
,::	2832.00	.97	.14	0	14	0.00	.03	.18
,::::	2835.00	.93	.12	0	13	0.00	.03	.20
::::::	2837.00	.93	.09	0	10	0.00	.02	.18
::::::	2840.00	.93	.11	0	12	0.00	.02	.15
:::::::	2847.00	1.03	.16	0	16	0.00	.09	.36
:::::::	2850.00	.73	.21	425	29	0.00	.09	.30
,,::::::	2852.00	2.27	1.68	415	74	0.00	1.20	.42
,,,::::::	2855.00	1.82	.60	535	33	0.00	.05	.08
,,::::::::	2857.00	1.52	.20	543	13	0.00	.01	.05
,::::::::	2860.00	1.34	.21	543	16	0.00	.03	.13
,::::::::	2862.00	1.42	.20	546	14	0.00	.01	.05
,,::::::	2865.00	1.14	.15	0	13	0.00	0.00	0.00
,:::::::	2867.00	1.59	.45	518	28	0.00	.05	.10
,::::::::	2870.00	1.30	.21	544	16	0.00	.02	.09

EXPLORATION LOGGING GEOCHEMICAL DATA PRINT

FOR : NORSK HYDRO A/S
WELL : 7321/8-1

Printed at : 16:24
: 9 Sep 1987
Format : 5

2872.0 m TO 2970.0 m

		SOURCE BED EVALUATION				FREE HYDROCARBS		
LITHOLOGY	DEPTH m	TOC %wt	S2 mg/g	TMAX degC	S2/TOC HI	S0 mg/g	S1 mg/g	TPI
Cuttings Samples								
,::::::::::	2872.00	1.40	.17	0	12	0.00	.04	.19
,::::::::::	2875.00	1.05	.14	0	13	0.00	.01	.07
,::::::::::	2877.00	1.41	.32	522	23	0.00	.04	.11
,:::::::::	2880.00	1.29	.17	0	13	0.00	0.00	0.00
,::::::::::	2882.00	1.25	.16	0	13	0.00	.01	.06
,::::::::::	2885.00	1.20	.15	0	13	0.00	0.00	0.00
::::::::::	2887.00	1.26	.16	0	13	0.00	.01	.06
,,,,::::::	2890.00	.90	.12	0	13	0.00	.03	.20
,,,,,:::::	2892.00	.74	.08	0	11	0.00	0.00	0.00
,,,,,,::::	2895.00	.93	.10	0	11	0.00	.02	.17
,,,,,,,:::	2897.00	1.00	.14	0	14	0.00	.01	.07
,,,::::	2900.00	1.26	.14	0	11	0.00	0.00	0.00
,,,:	2902.00	1.25	.14	0	11	0.00	0.00	0.00
,,:	2905.00	1.16	.12	0	10	0.00	0.00	0.00
,,:	2907.00	1.27	.14	0	11	0.00	.01	.07
,:	2910.00	1.06	.14	0	13	0.00	.02	.13
,,,,:	2912.00	.96	.11	0	11	0.00	.01	.08
,,,,,,::	2915.00	1.04	.01	0	1	0.00	.01	.43
,,,,,,::	2917.00	1.21	.13	0	11	0.00	.01	.07
,,,,,,::	2920.00	1.02	.14	0	14	0.00	.04	.22
,,,,,::	2922.00	1.21	.13	0	11	0.00	.03	.19
,,,,,:	2925.00	1.22	.16	0	13	0.00	.02	.11
,,,,,:	2927.00	1.30	.15	0	12	0.00	.01	.06
,,,,,,:	2930.00	1.11	.19	0	17	0.00	0.00	0.00
,,,:	2932.00	1.12	.13	0	12	0.00	.02	.13
,,,,:	2935.00	1.12	.17	0	15	0.00	.04	.19
,,,,	2937.00	1.14	.14	0	12	0.00	.03	.18
,,,,:	2940.00	1.07	.12	0	11	0.00	.03	.20
,,,,	2942.00	1.30	.16	0	12	0.00	0.00	0.00
,,,	2945.00	1.31	.17	0	13	0.00	.04	.19
,,,	2947.00	1.19	.15	0	13	0.00	.02	.12
,,,	2950.00	1.18	.13	0	11	0.00	.02	.13
,,,,	2952.00	1.11	.12	0	11	0.00	.01	.08
,,,	2955.00	1.16	.16	0	14	0.00	.02	.11
,,:	2957.00	1.18	.11	0	9	0.00	0.00	0.00
,,,	2960.00	1.19	.15	0	13	0.00	.01	.06
,,	2962.00	1.19	.15	0	13	0.00	.03	.17
,,	2965.00	1.29	.15	0	12	0.00	.03	.17
,,	2967.00	1.25	.14	0	11	0.00	.02	.13
,	2970.00	1.17	.12	0	10	0.00	.03	.20

EXPLORATION LOGGING GEOCHEMICAL DATA PRINT

FOR : NORSK HYDRO
WELL : 7381/8-1

Printed at : 17:08
: 9 Sep 1987
Format : 5

2972.0 m TO 3072.0 m

		SOURCE BED EVALUATION				FREE HYDROCARBS		
LITHOLOGY	DEPTH m	TOC %wt	S2 mg/g	TMAX degC	S2/TOC HI	S0 mg/g	S1 mg/g	TPI
Cuttings Samples								
,	2972.00	1.39	.16	0	12	0.00	.07	.30
,,	2975.00	1.28	.13	0	10	0.00	.02	.13
,,	2977.00	1.33	.17	0	13	0.00	.09	.35
	2980.00	1.26	.13	0	10	0.00	.03	.19
	2982.00	1.33	.14	0	11	0.00	.03	.18
	2985.00	1.26	.13	0	10	0.00	.02	.13
	2987.00	1.26	.14	0	11	0.00	.02	.13
	2990.00	1.22	.13	0	11	0.00	.01	.07
	2992.00	1.29	.14	0	11	0.00	.01	.07
	2995.00	1.24	.14	0	11	0.00	.01	.07
,	2997.00	1.25	.12	0	10	0.00	.06	.33
	3000.00	1.18	.12	0	10	0.00	.01	.08
	3002.00	1.23	.13	0	11	0.00	0.00	0.00
	3005.00	1.24	.12	0	10	0.00	0.00	0.00
	3007.00	1.28	.13	0	10	0.00	.02	.13
	3010.00	1.19	.15	0	13	0.00	.02	.12
	3012.00	1.26	.16	0	13	0.00	.01	.06
	3015.00	1.26	.14	0	11	0.00	.01	.07
,	3017.00	1.18	.13	0	11	0.00	0.00	0.00
	3020.00	1.17	.16	0	14	0.00	.01	.06
	3022.00	1.12	.16	0	14	0.00	.01	.06
	3025.00	1.24	.13	0	10	0.00	0.00	0.00
	3027.00	1.13	.10	0	9	0.00	0.00	0.00
	3030.00	1.12	.11	0	10	0.00	0.00	0.00
,:	3032.00	1.03	.11	0	11	0.00	0.00	0.00
,,::	3035.00	1.13	.10	0	9	0.00	0.00	0.00
,,:::	3037.00	1.05	.10	0	10	0.00	0.00	0.00
,,:::	3040.00	1.07	.12	0	11	0.00	.01	.08
,,,:	3042.00	1.02	.13	0	13	0.00	.02	.13
,,,	3045.00	1.01	.12	0	12	0.00	0.00	0.00
,,	3047.00	1.17	.12	0	10	0.00	0.00	0.00
,	3050.00	1.01	.12	0	12	0.00	.01	.08
,	3052.00	1.01	.12	0	12	0.00	.01	.08
,::	3055.00	1.11	.09	0	8	0.00	0.00	0.00
,:	3057.00	1.40	.12	0	9	0.00	0.00	0.00
,::	3060.00	1.34	.11	0	8	0.00	.01	.08
,::	3062.00	1.36	.12	0	9	0.00	0.00	0.00
L ::	3065.00	.99	.09	0	9	0.00	0.00	0.00
,:	3067.00	1.01	.18	0	18	0.00	.13	.42
::	3070.00	.89	.07	0	8	0.00	.01	.13
,::	3072.00	1.01	.10	0	10	0.00	.02	.17

EXPLORATION LOGGING GEOCHEMICAL DATA PRINT

FOR : NORSK HYDRO
WELL : 7381/8-1

Printed at : 17:11
: 9 Sep 1987
Format : 5

3075.0 m TO 3315.0 m

		SOURCE BED EVALUATION				FREE HYDROCARBS		
LITHOLOGY	DEPTH m	TOC %wt	S2 mg/g	TMAX degC	S2/TOC HI	S0 mg/g	S1 mg/g	TPI
Cuttings Samples								
,::	3075.00	1.02	.13	0	13	0.00	.02	.13
::	3077.00	.96	.08	0	8	0.00	.02	.20
:::	3080.00	.79	.05	0	6	0.00	0.00	0.00
,:	3082.00	1.05	.16	0	15	0.00	.01	.06
,:	3085.00	1.05	.09	0	9	0.00	.01	.10
,:	3087.00	.93	.09	0	10	0.00	.01	.10
,:	3090.00	1.18	.20	466	17	0.00	.03	.13
:	3095.00	1.19	.14	0	12	0.00	.01	.07
,:	3100.00	1.19	.14	0	12	0.00	.01	.07
,:	3115.00	1.56	.22	563	14	0.00	.03	.12
::::::	3120.00	1.21	.13	0	11	0.00	.01	.07
,:	3125.00	1.15	.15	0	13	0.00	.01	.06
:::::	3130.00	1.32	.13	0	10	0.00	.01	.07
,::::	3135.00	1.26	.36	427	29	0.00	.08	.18
,::::::	3140.00	1.46	.14	0	10	0.00	.02	.13
:::::::	3145.00	1.61	.73	418	45	0.00	.51	.41
::	3150.00	1.28	.09	0	7	0.00	.05	.36
::::	3155.00	1.36	.12	0	9	0.00	.03	.20
:::	3160.00	1.23	.16	0	13	0.00	.03	.16
:::	3165.00	1.15	.16	0	14	0.00	.03	.16
:	3170.00	1.28	.12	0	9	0.00	.02	.14
:	3175.00	1.32	.12	0	9	0.00	.02	.14
:	3180.00	1.43	.12	0	8	0.00	.02	.14
:	3185.00	1.24	.10	0	8	0.00	.01	.09
::	3190.00	1.22	.09	0	7	0.00	0.00	0.00
:	3195.00	1.25	.15	0	12	0.00	.06	.29
:	3200.00	1.14	.09	0	8	0.00	.02	.18
:	3205.00	1.13	.09	0	8	0.00	.03	.25
	3210.00	.95	.13	0	14	0.00	.05	.28
	3215.00	1.08	.11	0	10	0.00	.05	.31
	3220.00	1.10	.08	0	7	0.00	.04	.33
	3225.00	.98	.07	0	7	0.00	.02	.22
	3230.00	.92	.07	0	8	0.00	.05	.42
	3245.00	.97	.09	0	9	0.00	.05	.36
	3255.00	.99	.07	0	7	0.00	.06	.46
	3265.00	.93	.08	0	9	0.00	.05	.38
	3275.00	.93	.08	0	9	0.00	.05	.38
	3285.00	1.03	.09	0	9	0.00	.04	.31
	3295.00	.98	.05	0	5	0.00	.01	.17
	3305.00	1.05	.07	0	7	0.00	.03	.30
	3315.00	.98	.07	0	7	0.00	.05	.42

EXPLORATION LOGGING GEOCHEMICAL DATA PRINT

FOR : NORSK HYDRO
WELL : 7381/8-1

Printed at : 17:16
: 9 Sep 1987
Format : 5

3325.0 m TO 3482.0 m

		SOURCE BED EVALUATION				FREE HYDROCARBS		
LITHOLOGY	DEPTH m	TOC %wt	S2 mg/g	TMAX degC	S2/TOC HI	S0 mg/g	S1 mg/g	TPI
Cuttings Samples								
	3325.00	1.10	.05	0	5	0.00	.03	.38
	3335.00	1.20	.05	0	4	0.00	.04	.44
	3345.00	1.25	.05	0	4	0.00	.01	.17
	3355.00	1.38	.03	0	2	0.00	.04	.57
	3365.00	1.25	.01	0	1	0.00	.01	.50
	3375.00	1.50	.24	0	16	0.00	.10	.29
	3385.00	1.65	.04	0	2	0.00	.04	.50
	3395.00	.99	.01	0	1	0.00	.05	.83
	3405.00	.95	.02	0	2	0.00	.02	.50
	3415.00	.65	0.00	0	0	0.00	0.00	0.00
	3425.00	.47	0.00	0	0	0.00	0.00	0.00
^^	3435.00	.26	.02	0	8	0.00	.09	.82
^^	3445.00	.29	.04	0	14	0.00	.11	.73
	3455.00	.23	.05	0	22	0.00	.04	.44
^	3465.00	.18	.09	0	50	0.00	.02	.18
	3475.00	.16	.01	0	6	0.00	.01	.50
^	3482.00	.14	0.00	0	0	0.00	0.00	0.00

EXPLORATION LOGGING GEOCHEMICAL DATA PRINT

FOR : NORSK HYDRO A/S
WELL : 7321/8-1

Printed at : 16:28
: 9 Sep 1987
Format : 5

1443.0 m TO 1484.0 m

		SOURCE BED EVALUATION				FREE HYDROCARBS		
LITHOLOGY	DEPTH m	TOC %wt	S2 mg/g	TMAX degC	S2/TOC HI	S0 mg/g	S1 mg/g	TPI
Core Samples								
::::::::::	1443.50	0.00	.04	0	0	0.00	.15	.79
::::::::::	1444.50	0.00	.08	0	0	0.00	.34	.81
::::::::::	1445.50	.37	.70	0	189	0.00	.39	.36
::::::::::	1446.50	0.00	.06	0	0	0.00	.18	.75
::::::::::	1447.50	0.00	.08	0	0	0.00	.39	.83
::::::::::	1448.50	0.00	.05	0	0	0.00	.26	.84
::::::::::	1449.50	.70	.90	445	129	0.00	.73	.45
::::::::::	1450.50	0.00	.07	0	0	0.00	.32	.82
::::::::::	1451.50	0.00	.21	0	0	0.00	.29	.58
::::::::::	1452.50	0.00	0.00	0	0	0.00	.09	1.00
::::::::::	1453.50	0.00	0.00	0	0	0.00	.08	1.00
::::::::::	1454.50	0.00	.04	0	0	0.00	.59	.94
::::::::::	1455.50	.49	.22	0	45	0.00	.14	.39
:::::	1456.50	.84	1.45	452	173	0.00	.60	.29
:::::	1458.50	.94	2.40	447	255	0.00	.78	.25
::::::::::	1459.50	0.00	.16	0	0	0.00	.12	.43
::::::::::	1460.50	0.00	.07	0	0	0.00	.15	.68
::::::::::	1461.50	0.00	0.00	0	0	0.00	.05	1.00
::::::::::	1462.50	0.00	0.00	0	0	0.00	.10	1.00
:::::	1463.50	.95	1.86	453	196	0.00	.71	.28
::::::::::	1464.50	0.00	.27	0	0	0.00	.18	.40
::::::::::	1465.50	0.00	.14	0	0	0.00	.06	.30
::::::::::	1466.00	0.00	0.00	0	0	0.00	.12	1.00
::::::::::	1467.00	0.00	0.00	0	0	0.00	.05	1.00
::::::::::	1468.00	.70	1.10	459	157	0.00	.51	.32
==========	1469.00	.57	.29	463	51	0.00	.23	.44
::::::::	1470.00	1.03	1.64	457	159	0.00	.83	.34
::::::::::	1471.00	.74	.91	458	123	0.00	.70	.43
:::::	1472.00	.90	1.17	456	130	0.00	.68	.37
::::::::::	1473.00	.79	1.09	457	138	0.00	.54	.33
::::::::::	1474.00	.61	.81	464	133	0.00	.57	.41
::::::::::	1475.00	0.00	.22	0	0	0.00	.23	.51
::::::::::	1476.00	0.00	.31	0	0	0.00	.20	.39
::::::::::	1477.00	0.00	.27	0	0	0.00	.27	.50
::::::::::	1478.00	0.00	0.00	0	0	0.00	.19	1.00
,,,,,:::::	1479.00	.41	.43	456	105	0.00	.78	.64
::::::::::	1480.00	0.00	.19	0	0	0.00	.08	.30
	1481.00	.58	.84	456	145	0.00	.47	.36
==========	1482.00	4.33	20.17	458	466	.03	7.11	.26
::::::::::	1483.00	0.00	.10	0	0	0.00	.38	.79
::::::::::	1484.00	.77	.84	459	109	0.00	.60	.42

EXPLORATION LOGGING GEOCHEMICAL DATA PRINT

FOR : NORSK HYDRO A/S
WELL : 7321/8-1

Printed at : 16:32
: 9 Sep 1987
Format : 5

1485.0 m TO 1523.0 m

		SOURCE BED EVALUATION				FREE HYDROCARBS		
LITHOLOGY	DEPTH m	TOC %wt	S2 mg/g	TMAX degC	S2/TOC HI	S0 mg/g	S1 mg/g	TPI
Core Samples								
:::::::::	1485.00	2.57	4.02	457	156	0.00	1.85	.32
	1486.00	2.09	3.81	460	182	0.00	1.66	.30
::	1487.00	2.14	1.70	460	79	0.00	.93	.35
::::::::::	1488.00	0.00	.04	0	0	0.00	.35	.90
	1489.00	1.63	1.53	457	94	0.00	.71	.32
::::::::::	1490.00	.59	.63	467	107	0.00	.36	.36
::::::::::	1491.00	.26	.31	0	119	0.00	1.17	.79
	1492.00	0.00	.42	0	0	0.00	1.40	.77
	1493.00	0.00	.17	0	0	0.00	.79	.82
::::::::::	1494.00	0.00	.27	0	0	0.00	1.18	.81
::::::::::	1495.00	.61	.80	459	131	0.00	1.36	.63
::::::::::	1496.00	0.00	.11	0	0	0.00	.78	.88
::::::::::	1497.00	0.00	.13	0	0	0.00	1.03	.89
::::::::::	1498.00	0.00	.05	0	0	0.00	.71	.93
::::::::::	1499.00	0.00	.18	0	0	0.00	.74	.80
:::::::	1500.00	3.99	16.70	453	419	0.00	6.74	.29
::::::::::	1501.00	0.00	.09	0	0	0.00	.52	.85
::::::::::	1502.00	.72	.95	462	132	0.00	.75	.44
::::::::::	1503.00	0.00	.04	0	0	0.00	.53	.93
::::::::::	1504.00	0.00	.04	0	0	0.00	.49	.92
::::::::::	1505.00	0.00	.09	0	0	0.00	.62	.87
::::::::::	1506.00	0.00	.05	0	0	0.00	.78	.94
::::::::::	1507.00	0.00	.03	0	0	0.00	.69	.96
::::::::::	1508.00	.29	.17	0	59	0.00	1.12	.87
::::::::::	1509.00	0.00	.11	0	0	0.00	1.12	.91
::::::::::	1510.00	0.00	.16	0	0	0.00	.98	.86
::::::::::	1511.00	0.00	.09	0	0	0.00	.70	.89
::::::::::	1512.00	0.00	.06	0	0	0.00	.80	.93
::::::::::	1513.00	0.00	.05	0	0	0.00	.81	.94
::::::::::	1514.00	0.00	.03	0	0	0.00	.90	.97
::::::::::	1515.00	0.00	.04	0	0	0.00	.93	.96
::::::::::	1516.00	0.00	.03	0	0	0.00	.86	.97
::::::::::	1516.40	0.00	.07	0	0	0.00	.99	.93
::::::::::	1517.00	0.00	.01	0	0	0.00	.86	.99
::::::::::	1518.00	0.00	.05	0	0	0.00	.94	.95
::::::::::	1519.00	0.00	.04	0	0	0.00	.84	.95
::::::::::	1520.00	0.00	.11	0	0	0.00	.96	.90
,,,,,,,,,,	1521.00	1.59	2.12	461	133	0.00	1.09	.34
::::::::::	1522.00	0.00	.10	0	0	0.00	.85	.89
::::::::::	1523.00	0.00	.12	0	0	0.00	.95	.89

EXPLORATION LOGGING GEOCHEMICAL DATA PRINT

FOR : NORSK HYDRO A/S
WELL : 7321/8-1

Printed at : 17:24
: 9 Sep 1987
Format : 5

1524.0 m TO 2846.2 m

		SOURCE BED EVALUATION				FREE HYDROCARBS		
LITHOLOGY	DEPTH m	TOC %wt	S2 mg/g	TMAX degC	S2/TOC HI	S0 mg/g	S1 mg/g	TPI
Core Samples								
::::::::::	1524.00	0.00	.03	0	0	0.00	.75	.96
::::::::::	1525.00	0.00	.10	0	0	0.00	.78	.89
::::::::::	1526.00	0.00	.20	0	0	0.00	1.01	.83
,,,,::::::	1527.00	.58	.73	454	126	0.00	1.12	.61
,,,,,,,,,,	1528.00	1.21	1.65	460	136	0.00	.82	.33
::::::::::	1529.00	0.00	.10	0	0	0.00	.97	.91
::::::::::	1530.00	0.00	.07	0	0	0.00	.65	.90
::::::::::	1531.00	0.00	.18	0	0	0.00	.74	.80
::::::::::	1532.00	0.00	.02	0	0	0.00	.72	.97
::::::::::	1533.00	0.00	.04	0	0	0.00	.82	.95
::::::::::	1534.00	0.00	.06	0	0	0.00	.80	.93
::::::::::	1535.00	0.00	.08	0	0	0.00	1.02	.93
::::::::::	1536.00	0.00	.14	0	0	0.00	1.19	.89
::::::::::	1537.00	0.00	.24	0	0	0.00	1.08	.82
::::::::::	1538.00	0.00	.07	0	0	0.00	1.00	.93
::::::::::	1539.00	.54	.80	445	148	0.00	1.39	.63
::::::::::	1540.00	.35	.36	455	103	0.00	1.01	.74
::::::::::	1541.00	0.00	.01	0	0	0.00	.73	.99
::::::::::	1542.00	.77	1.00	457	130	0.00	1.33	.57
	1543.00	0.00	.04	0	0	0.00	1.00	.96
::::::::::	1544.00	0.00	0.00	0	0	0.00	1.06	1.00
::::::	1544.70	.99	1.04	458	105	0.00	1.23	.54
,,,,,,,,,,	2670.75	1.15	.17	0	15	0.00	.02	.11
,,,,,,,,,,	2671.00	1.57	.30	528	19	0.00	.01	.03
,,,,,,,,,,	2672.00	3.46	.98	507	28	0.00	.05	.05
,,,,,,,,,,	2673.00	1.46	.22	531	15	0.00	.01	.04
,,,,,,,,,,	2674.00	1.21	.22	526	18	0.00	.03	.12
,,,,,,,,,,	2675.00	.99	.15	0	15	0.00	.01	.06
,,,,,,,,,,	2676.00	.99	.16	0	16	0.00	.02	.11
,,,,,,,,,,	2677.00	.96	.17	0	18	0.00	.02	.11
,,,,,,,,,,	2677.90	.15	0.00	0	0	0.00	0.00	0.00
::::::::::	2840.00	.11	.01	0	9	0.00	.04	.80
::::::::::	2841.00	.16	.01	0	6	0.00	.08	.89
::::::::::	2842.50	.10	.05	0	50	0.00	.03	.38
==========	2843.43	3.09	.50	543	16	0.00	.02	.04
::::::::::	2844.00	.05	.03	0	60	0.00	.06	.67
==========	2845.50	2.20	.43	539	20	0.00	.06	.12
======::::	2846.23	1.06	.14	0	13	0.00	.01	.07

EXPLORATION LOGGING GEOCHEMICAL DATA PRINT

FOR : NORSK HYDRO
WELL : 7381/8-1

Printed at : 17:20
: 9 Sep 1987
Format : 5

3430.0 m TO 3431.4 m

		SOURCE BED EVALUATION				FREE HYDROCARBS		
LITHOLOGY	DEPTH m	TOC %wt	S2 mg/g	TMAX degC	S2/TOC HI	S0 mg/g	S1 mg/g	TPI
Core Samples								
^^	3430.00	.16	.07	0	44	0.00	.08	.53
^^	3430.17	.47	.04	0	9	0.00	.05	.56
^^	3430.70	.16	.04	0	25	0.00	.07	.64
^^	3431.10	1.31	.15	0	11	0.00	.24	.62
^^	3431.40	.20	.01	0	5	0.00	.05	.83

EXPLORATION LOGGING GEOCHEMICAL DATA PRINT

FOR : NORSK HYDRO
WELL : 7321/8-1 (CHECKS)

Printed at : 15:58
: 22 Sep 1987

WINDSOR LABORATORY
QUALITY CONTROL CHECKS

	SOURCE BED EVALUATION							FREE HYDROCARBS	
DEPTH m	TOC %wt	S2 mg/g	T Max deg C	S2/S3 H:O	S2/TOC HI	S3/TOC OI	S3 mg/g	S1 mg/g	S1/(S1+S2)
Cuttings Samples									
825.0	0.00	.87	421	.5	0	0	1.66	.53	.38
895.0	0.00	3.03	430	3.2	0	0	.94	1.67	.36
945.0	0.00	2.29	436	.8	0	0	2.73	1.17	.34
1000.0	0.00	2.43	436	.9	0	0	2.70	1.35	.36
1055.0	0.00	2.30	436	.8	0	0	2.92	1.37	.37
1105.0	0.00	3.10	432	.9	0	0	3.34	1.21	.28
1145.0	0.00	1.86	438	.8	0	0	2.32	.91	.33
1210.0	0.00	1.15	440	1.0	0	0	1.19	.73	.39
1260.0	0.00	1.27	435	.7	0	0	1.91	.87	.41
1295.0	0.00	1.76	444	.7	0	0	2.65	1.22	.41
1345.0	0.00	2.75	445	4.7	0	0	.59	1.44	.34
1395.0	0.00	4.43	444	12.0	0	0	.37	2.07	.32
1420.0	0.00	6.91	445	30.0	0	0	.23	3.23	.32
1570.0	0.00	5.46	443	5.7	0	0	.96	2.50	.31
1592.0	0.00	1.98	435	1.2	0	0	1.72	1.09	.36
1617.0	0.00	.77	437	1.1	0	0	.68	.47	.38
1645.0	0.00	.98	435	3.5	0	0	.28	.86	.47
1675.0	0.00	1.33	440	1.0	0	0	1.31	.59	.31
1700.0	0.00	1.52	441	2.3	0	0	.65	.59	.28
1725.0	0.00	1.06	433	1.5	0	0	.73	.56	.35
1750.0	.51	.18	431	.2	35	152	.78	.13	.42
1775.0	.45	.29	426	.7	65	92	.41	.26	.47
1800.0	.63	.86	432	1.5	138	94	.59	.45	.34
1825.0	0.00	.96	436	1.7	0	0	.57	.34	.26
1852.0	0.00	4.56	457	7.0	0	0	.65	.94	.17
1877.0	0.00	1.08	436	1.6	0	0	.68	.49	.31
1900.0	.72	.51	440	.4	70	169	1.22	.29	.36
1925.0	0.00	1.02	452	1.8	0	0	.57	.38	.27
1952.0	0.00	2.45	461	3.1	0	0	.79	.66	.21
1977.0	0.00	1.15	446	2.2	0	0	.52	.42	.27
2000.0	0.00	2.70	462	4.2	0	0	.65	.88	.25
2025.0	0.00	2.80	464	2.8	0	0	1.00	.78	.22
2050.0	1.70	1.56	443	2.9	92	31	.53	.62	.28
2077.0	.91	.59	438	.7	65	99	.90	.30	.34
2560.0	0.00	.56	415	.8	0	0	.71	.18	.24
2587.0	0.00	.76	421	2.3	0	0	.33	.20	.21
2625.0	0.00	.63	429	1.8	0	0	.35	.16	.20

INSUFFICIENT SAMPLE MATERIAL WAS AVAILABLE TO TOC
ALL SAMPLES

EXPLORATION LOGGING GEOCHEMICAL DATA PRINT

FOR : NORSK HYDRO
WELL : 7321/8-1 (CHECKS)

Printed at : 16:25
: 22 Sep 1987

WINDSOR LABORATORY
QUALITY CONTROL CHECKS

	SOURCE BED EVALUATION							FREE HYDROCARBS	
DEPTH m	TOC %wt	S2 mg/g	T Max deg C	S2/S3 H:O	S2/TOC HI	S3/TOC OI	S3 mg/g	S1 mg/g	S1/(S1+S2)
Cuttings Samples									
2650.0	0.00	.70	507	4.4	0	0	.16	.16	.19
2695.0	0.00	.59	423	2.8	0	0	.21	.16	.21
2717.0	0.00	.95	504	19.0	0	0	.05	.16	.14
2745.0	0.00	.23	0	4.6	0	0	.05	.13	.36
2777.0	0.00	.68	420	2.1	0	0	.32	.21	.24
2810.0	0.00	.59	511	6.6	0	0	.09	.14	.19
2837.0	0.00	.46	400	.6	0	0	.72	.28	.38
2865.0	0.00	.50	423	3.6	0	0	.14	.19	.28
2922.0	0.00	.50	424	1.9	0	0	.27	.21	.30
2947.0	0.00	.28	409	.6	0	0	.45	.16	.36
2975.0	0.00	.52	416	.9	0	0	.59	.29	.36
3002.0	1.23	.37	409	1.5	30	20	.24	.23	.38
3030.0	0.00	.42	0	.8	0	0	.54	.28	.40
3060.0	0.00	.65	414	3.0	0	0	.22	.25	.28
3087.0	1.06	.52	400	1.2	49	42	.44	.29	.36
3115.0	0.00	.59	416	.9	0	0	.64	.25	.30

INSUFFICIENT SAMPLE MATERIAL WAS AVAILABLE TO TOC
ALL SAMPLES

EXPLORATION LOGGING GEOCHEMICAL DATA PRINT

FOR : NORSK HYDRO
WELL : 7321/8-1 (CHECKS)

Printed at : 16:28
: 22 Sep 1987

WINDSOR LABORATORY
QUALITY CONTROL CHECKS

	SOURCE BED EVALUATION							FREE HYDROCARBS	
DEPTH m	TOC %wt	S2 mg/g	T Max deg C	S2/S3 H:O	S2/TOC HI	S3/TOC OI	S3 mg/g	S1 mg/g	S1/(S1+S2)
Core Samples									
1448.5	0.00	.24	407	3.4	0	0	.07	.22	.48
1460.5	0.00	.16	436	.5	0	0	.35	.13	.45
1471.0	.75	1.06	454	21.2	142	7	.05	.56	.35
1485.0	3.15	3.03	458	1.1	96	87	2.75	1.44	.32
1503.0	.13	.06	422	.2	45	188	.25	.08	.57
1510.0	.14	.25	0	.6	185	311	.42	.15	.37
1521.0	1.83	1.84	456	.4	100	227	4.16	.97	.35
1528.0	1.40	1.38	456	.3	98	292	4.09	.73	.35
1542.0	.85	.90	448	1.1	106	99	.84	.53	.37
2673.0	0.00	.41	419	3.2	0	0	.13	.16	.28

INSUFFICIENT SAMPLE MATERIAL WAS AVAILABLE TO TOC
ALL SAMPLES

APPENDIX E

LITHOLOGY DATA SHEETS

EXLOG®

GEOCHEMICAL ANALYSIS SAMPLE LITHOLOGY DATA
NORSK HYDRO A/S WELL # 7321/8-1

DEPTH	PRE-PICKED LITH				ANALYSED LITH	ANALYSED LITHOLOGY DESCRIPTION
			SLTST	CLYST		
820					100 % CMT	NO ANALYSIS
825				100%	CLAYSTONE	DK GRY, FRM - HD, BLKY, NON CALC
830				100%	CLAYSTONE	A/A
835				100%	CLAYSTONE	A/A
840				100%	CLAYSTONE	DK - M/LT GY, OCC GRN GY, SFT-FRM
845				100%	CLAYSTONE	A/A
850				100%	CLAYSTONE	A/A
855				100%	CLAYSTONE	A/A
860				100%	CLAYSTONE	A/A BCMG CALC
865				100%	CLAYSTONE	A/A
870				100%	CLAYSTONE	A/A PRED M LT GY
875			TR	100%	CLAYSTONE	A/A, OCC SLTY, TR BRN STN
880			100%	TR	SILTSTONE	M BRN GY, MICROMIC, OCC SHOWS
885			100%	TR	SILTSTONE	A/A
890			50	50	SILTSTONE/CLAYSTONE	A/A
895			100%	TR	SILTSTONE	A/A
900			100%	TR	SILTSTONE	A/A
920			100%		SILTSTONE	A/A
925			100%		SILTSTONE	A/A
930			100%		SILTSTONE	LT - M BRN, OCC BRN GY, BLKY, MICROMIC
935			40	60	SILTSTONE/CLAYSTONE	A/A
940			30	70	SILTSTONE/CLAYSTONE	A/A
945			20	80	SILTSTONE/CLAYSTONE	A/A
950			20	80	SILTSTONE/CLAYSTONE	A/A
955			30	70	SILTSTONE/CLAYSTONE	A/A
960			30	70	SILTSTONE/CLAYSTONE	CLYST - BRN GY, DSKY BRN, SFT-FRM, BLKY, V SLTY, GRDG TO SLTST
965			40	60	SILTSTONE/CLAYSTONE	A/A
970			40	60	SILTSTONE/CLAYSTONE	A/A
975			30	70	SILTSTONE/CLAYSTONE	A/A

EXLOG

GEOCHEMICAL ANALYSIS SAMPLE LITHOLOGY DATA
NORSK HYDRO A/S WELL # 7321/8-1

DEPTH	PRE-PICKED LITH				ANALYSED LITH	ANALYSED LITHOLOGY DESCRIPTION
			SLTST	CLYST		
905			100%		SILTSTONE	A/A
910			100%		SILTSTONE	A/A
915			100%		SILTSTONE	A/A
980			30	70	SILTY CLAYSTONE	A/A
985			20	80	SILTY CLAYSTONE	A/A
990			10	90	CLAYSTONE	BRN GY - OLV GY, SFT, BLKY, LOC SLTY & MICROMIC NON CALC
995			10	90	CLAYSTONE	A/A
1000			10	90	CLAYSTONE	A/A
1005			10	90	CLAYSTONE	A/A
1010			10	90	CLAYSTONE	A/A
1015			30	70	SILTY CLAYSTONE	LT-MGY, OCC M BRN, FRM, SUBFISS, SLTY.
1020			20	80	SILTY CLAYSTONE	A/A
1025			30	70	SILTY CLAYSTONE	A/A
1030			10	90	SILTY CLAYSTONE	A/A
1035			10	90	SILTY CLAYSTONE	A/A
1040				100%	CLAYSTONE	A/A LOC SLTY
1045				100%	CLAYSTONE	A/A
1050				100%	CLAYSTONE	DUSKY YEL BRN - BRN BLK, LOC DUSKY YEL BRN - OLV GY, SFT-MOD HD, TR CARB
1055				100%	CLAYSTONE	A/A
1060				100%	CLAYSTONE	A/A
1065				100%	CLAYSTONE	A/A
1070				100%	CLAYSTONE	A/A
1075				100%	CLAYSTONE	A/A
1080				100%	CLAYSTONE	A/A.
1085			30	70	SILTY CLAYSTONE	A/A
1090			30	70	SILTY CLAYSTONE	CLYST, GY BRN - DUSKY YEL BRN, V SLTY, SL CALC.
1095			30	70	SILTY CLAYSTONE	SLTST, DK - M GY, FM - HD, BLKY, MICROMIC, SI CARB.
1100			20	80	SILTY CLAYSTONE	A/A
1105			10	90	SILTY CLAYSTONE	A/A

EXLOG

GEOCHEMICAL ANALYSIS SAMPLE LITHOLOGY DATA
NORSK HYDRO A/S WELL # 7321/8-1

DEPTH	PRE-PICKED LITH				ANALYSED LITH	ANALYSED LITHOLOGY DESCRIPTION
			SLTST	CLYST		
1110			20	80	SILTY CLAYSTONE	A/A
1115			20	80	SILTY CLAYSTONE	A/A
1120			20	80	SILTY CLAYSTONE	A/A
1125			20	80	SILTY CLAYSTONE	CLYST BCMG V SLTY
1130			70	30	SILTY CLAYSTONE	V CALC IN PTS
1135			60	40	SILTY CLAYSTONE	A/A
1140			40	60	SILTY CLAYSTONE	A/A
1145			30	70	SILTY CLAYSTONE	A/A
1150			30	70	SILTY CLAYSTONE	A/A
1155					LAGGED AFTER TRIP - NO ANALYSIS	
1160			20	80	SILTY CLAYSTONE	DK GY, FRM-HD, BLKY, MOD CALC
1165			10	90	SILTY CLAYSTONE	A/A
1170			10	90	SILTY CLAYSTONE	A/A
1175			30	70	SILTY CLAYSTONE	A/A
1180			20	80	SILTY CLAYSTONE	SLTST - DK GY, FRM-MOD HD,
1185			10	90	CLAYSTONE	PA BRN - PA GY, SFT, SL CALC
1190			30	70	SILTY CLAYSTONE	A/A
1195			20	80	SILTY CLAYSTONE	A/A
1200			20	80	SILTY CLAYSTONE	A/A
1205			10	90	SILTY CLAYSTONE	A/A
1210			20	80	SILTY CLAYSTONE	A/A
1215			20	80	SILTY CLAYSTONE	A/A
1220			10	90	SILTY CLAYSTONE	A/A
1225				100	CLAYSTONE	A/A
1230				100	CLAYSTONE	OLV GY - DUSKY YEL BRN, SFT-FRM, MICROMIC, TR CARB.
1235				100	CLAYSTONE	A/A
1240				100	CLAYSTONE	A/A
1245				100	CLAYSTONE	A/A
1250				100	CLAYSTONE	A/A

EXLOG

GEOCHEMICAL ANALYSIS SAMPLE LITHOLOGY DATA
NORSK HYDRO A/S WELL # 7321/8-1

DEPTH	PRE-PICKED LITH				ANALYSED LITH	ANALYSED LITHOLOGY DESCRIPTION
	MARL	SST	SLTST	CLYST		
1255			10	90	SILTY CLAYSTONE	CLYST - M GY BRN - DUSKY YEL BRN, AMOR - BLKY, LOC GRDG TO SLTST.
1260			20	80	SILTY CLAYSTONE	SLTST DK GY - DUSKY YEL BRN, BLKY FRM-HD, CARB, V MICROMIC, V CALC IN PTS.
1265				100	CLAYSTONE	A/A
1270				100	CLAYSTONE	A/A
1275			10	90	CLAYSTONE	A/A
1280				100	CLAYSTONE	A/A
1285				100	CLAYSTONE	A/A
1287				100	CLAYSTONE	A/A
1290			10	90	SILTY CLAYSTONE	A/A
1295			40	60	SILTY CLAYSTONE	A/A
1300			30	70	SILTY CLAYSTONE	A/A
1305			30	70	SILTY CLAYSTONE	A/A
1310			40	60	SILTY CLAYSTONE	A/A
1315		10	40	50	SILTY CLAYSTONE	A/A
1320		10	40	50	SILTY CLAYSTONE	A/A
1325		10	40	50	SILTY CLAYSTONE	A/A
1330		10	40	50	SILTY CLAYSTONE	A/A
1335				100	CLAYSTONE	M - DK GY, FRM - HD, ARG - BLKY, SL MICROMIC, NON CALC
1340				100	CLAYSTONE	A/A
1345		10		90	CLAYSTONE	A/A
1350		20		80	CLAYSTONE	DK GRY - GY BLK, OCC DK BRN BLK SUBFISS, NON CALC
1355				100	CLAYSTONE	A/A
1360		10		90	CLAYSTONE	A/A
1365	20			80	CLAYSTONE	A/A
1370	40			60	CLAYSTONE	RD BRN, V SFT, RNDED CTNS, SL SLTY, MOD CALC
1375	10			90	CLAYSTONE	A/A
1380	80			20	CLAYSTONE	DK GY - GY BLK - GEN A/A.
1385	30			70	CLAYSTONE	A/A
1390	40			60	CLAYSTONE	A/A

EXLOG

GEOCHEMICAL ANALYSIS SAMPLE LITHOLOGY DATA
NORSK HYDRO A/S WELL # 7321/8-1

DEPTH	PRE-PICKED LITH				ANALYSED LITH	ANALYSED LITHOLOGY DESCRIPTION
		SST	SLTST	CLYST		
1395				100	CLAYSTONE	GY BLK – BRN BLK, FISS, SL CALC, MICROMIC, OCC GREASY,
1400				100	CLAYSTONE	A/A
14 02				100	CLAYSTONE	A/A
1405				100	CLAYSTONE	A/A
14 07				100	CLAYSTONE	A/A
1410				100	CLAYSTONE	A/A
1412				100	CLAYSTONE	A/A
1415				100	CLAYSTONE	A/A
1417				100	CLAYSTONE	A/A
1420				100	CLAYSTONE	A/A
1422				100	CLAYSTONE	A/A
1425				100	CLAYSTONE	A/A
1427				100	CLAYSTONE	A/A
1430				100	CLAYSTONE	OLV BLK – GY BLK, FRM, PLATY, NON SUBFISS, MICROMIC, SILTY IN PTS/CALC
1432				100	CLAYSTONE	A/A
1435				100	CLAYSTONE	A/A
1437				100	CLAYSTONE	A/A
1440		40		60	CLAYSTONE	A/A
1442		50		50	CLAYSTONE	A/A
	CORE # 1			CUT 1443.5 –		1485.58 100% RECOVERY
1443.5		100			SANDSTONE	LT OLV GY, LT GY, VF-F, HD-V HD SILIC CMT, MICROMIC, NO-V SL SHOWS
1444.5		100			SANDSTONE	A/A
1445.5		100			SANDSTONE	A/A
1446.5		100			SANDSTONE	A/A
1447.5		100			SANDSTONE	A/A
1448.5		100			SANDSTONE	A/A
1449.5		90		10	CLAYSTONE	BLK – DR GY, MICROMIC, LAM
1450.5		100			SANDSTONE	A/A
1451.5		100			SANDSTONE	A/A

EXLOG

GEOCHEMICAL ANALYSIS SAMPLE LITHOLOGY DATA
NORSK HYDRO A/S WELL # 7321/8-1

DEPTH	PRE-PICKED LITH				ANALYSED LITH	ANALYSED LITHOLOGY DESCRIPTION
	SHALE	SST	SLTST	CLYST		
1452.5		100			SANDSTONE	GEN A/A CALC CMT, NO SHOWS
1453.5		100			SANDSTONE	A/A
1454.5		100			SANDSTONE	A/A
1455.5		100			SANDSTONE	A/A OCC BNDED W/ BIOTITE
1456.5		50		50	CLAYSTONE	BRN BLK - BRN GY, MICROMIC, SL SLTY, NON CALC
1458.5		50		50	CLAYSTONE	A/A
1459.5		90		10	CLAYSTONE	BRN BLK - BLK, CARB, MICROMIC, INTERBED W/ SD.
1460.5		100			SANDSTONE	A/A
1461.5		100			SANDSTONE	A/A
1462.5		100			SANDSTONE	A/A F-M, TR KAOL, SLO STRMG DULL BL WH CUT, WH YEL FLU RESID.
1463.5		50		50	SANDSTONE WITH CLAYSTONE LAM.	A/A
1464.5		100			SANDSTONE	A/A W/ OCC CLAY LAM
1465.5		100			SANDSTONE	A/A
1466		CORE # 2 100			CUT 1465.58 - 1493.7 REC 98.9 % SANDSTONE	A/A
1467		100			SANDSTONE	LT BRN, VF, HD, SILIC CMT, MIC,
1468		100			SANDSTONE	SLTY SST W/ BRN BLK CLYST LAM & MIC BNDS.
1469	100				SHALE	DK GY SH W/ SD FILLED BURROWS
1470		20		80	CLAYSTONE	BRN BLK, MOD HD, FISS, CARB, MIC, SLTY, W/ THIN SD LAM.
1471		90		10	SANDSTONE	A/A W/ THIN SD LAM
1472		50		50	INTERLAMINATED SANDSTONE & CLAYSTONE	A/A
1473		100			SANDSTONE	A/A W/ THIN SH LAM
1474		100			SANDSTONE	A/A
1475		100			SANDSTONE	LT BRN, F, HD, SILIC CMT, MIC, TR CARB, TR KAO, GEN CLEAN. SL SHOWS
1476		100			SANDSTONE	A/A
1477		100			SANDSTONE	A/A
1478		100			SANDSTONE	A/A
1479			50	50	BANDED SILTY CLAYSTONE.	A/A
1480		100			SANDSTONE	A/A
1481				100	CLAYSTONE	A/A

EXLOG

GEOCHEMICAL ANALYSIS SAMPLE LITHOLOGY DATA
NORSK HYDRO A/S WELL # 7321/8-1

DEPTH	PRE-PICKED LITH				ANALYSED LITH	ANALYSED LITHOLOGY DESCRIPTION
	SHALE	CLYST		SST		
1482	100				SHALE	BLK, V hd, BRIT, MICROXLN, FISS, CARB.
1483				100	SANDSTONE	LT OLV GY, F, UHD, W CMTD, CLEAN.
1484				100	SANDSTONE	GEN A/A - V SLTY & CARB LAM
1485		10		0	SANDSTONE	A/A W/ CARB LAM & FRAGS
1486		100			CLAYSTONE	BRN BLK - DK GY, MIC, SLTY, FISS
1487		80		20	CLAYSTONE	A/A W/ OCC SD LAM, LENT BED
1488				100	SANDSTONE	SD - A/A RR CARB LAM
1490				100	SANDSTONE	A/A
1491				100	SANDSTONE	A/A SPOTTY DULL YEL WH FLU
1492				100	SANDSTONE	A/A
1493				100	SANDSTONE	A/A MOD SHOWS
1489		100			CLAYSTONE	BRN BLK, BLKY, MOD HD, MICROMIC,
CORE # 3			CUT		1493.7 - 1516.6	RECOVERY 99.1%
1494				100	SANDSTONE	BRN GY, HD, VF-F, CARB BLK GRS, SILIC CMT, V WEAK CUT
1495				100	SANDSTONE	A/A W/ BLK CARB LAM
1496				100	SANDSTONE	A/A
1497				100	SANDSTONE	A/A
1498				100	SANDSTONE	A/A CALC CMT
1499				100	SANDSTONE	A/A CALC CMT
1500		30		70	SANDSTONE WITH CLAYSTONE LAM	SST A/A W/ BLK CARB CLYST LAM
1501				100	SANDSTONE	F - M, CALC CMT, TR SPOT SHOWS
1502				100	SANDSTONE	A/A ABUND CARB MAT
1503				100	SANDSTONE	A/A
1504				100	SANDSTONE	A/A } TR SPOTTY YEL WH FLU
1505				100	SANDSTONE	A/A } WK SLOW BL WH CUT
1506				100	SANDSTONE	A/A }
1507				100	SANDSTONE	A/A
1508				100	SANDSTONE	A/A } SHOWS A/A
1509				100	SANDSTONE	A/A }

EXLOG

GEOCHEMICAL ANALYSIS SAMPLE LITHOLOGY DATA
NORSK HYDRO A/S WELL # 7321/8-1

DEPTH	PRE-PICKED LITH				ANALYSED LITH	ANALYSED LITHOLOGY DESCRIPTION
			SLTST	SST		
1510				100	SANDSTONE	A/A
1511				100	SANDSTONE	A/A SHOWS A/A
1512				100	SANDSTONE	A/A
1513				100	SANDSTONE	A/A
1514				100	SANDSTONE	A/A SPOTTY SHOWS A/A
1515				100	SANDSTONE	A/A
1516				100	SANDSTONE	A/A
1516.4				100	SANDSTONE	A/A
			CORE		# 4 CUT 1516.6 - 1544.8	RECOVERY 100%
1517				100	SANDSTONE	LT BRN-OLV GY, F-M, MD, SILIC CMT, TR CARB, TR MIC, WK PET ODOUR, POOR FLU
1518				100	SANDSTONE	A/A
1519				100	SANDSTONE	A/A OCC CARB FRAGS.
1520				100	SANDSTONE	A/A NO SHOWS
1521			100		SILTSTONE	BRN BLK, OLV BLK, MOD HD, NON CALC TR CARB, MIC, NO SHOWS
1522				100	SANDSTONE	A/A
1523				100	SANDSTONE	A/A
1524				100	SANDSTONE	A/A
1525				100	SANDSTONE	A/A
1526				100	SANDSTONE	A/A
1527			40	60	SANDSTONE & SILTSTONE	SST, GEN A/A LT BRN, MOD PET ODOUR SLT A/A
1528			100		SILTSTONE	A/A
1529				100	SANDSTONE	A/A - TR CARB FRAGS
1530				100	SANDSTONE	A/A
1531				100	SANDSTONE	A/A
1532				100	SANDSTONE	A/A
1533				100	SANDSTONE	A/A
1534				100	SANDSTONE	A/A
1535				100	SANDSTONE	GEN VF-F, MOD PET ODOUR
1536				100	SANDSTONE	A/A

EXLOG

GEOCHEMICAL ANALYSIS SAMPLE LITHOLOGY DATA
NORSK HYDRO A/S WELL # 7321/8-1

DEPTH	PRE-PICKED LITH				ANALYSED LITH	ANALYSED LITHOLOGY DESCRIPTION
		CLYST	SLTST	SST		
1537				100	SANDSTONE	A/A
1538				100	SANDSTONE	A/A
1539		10		90	SANDSTONE W/ V THIN CLYST LAM	SST, VF, V HD W/ THIN CARB, MIC, CLYST LAM.
1540		10		90	SANDSTONE	A/A - LESS CLYST LAM
1541				100	SANDSTONE	A/A TR SPTY WH YEL FLU
1542		10		90	SANDSTONE W/ THIN CLYST LAM	A/A
1543				100	SANDSTONE	V.F., V.HD, CALC CMT
1544				100	SANDSTONE	GEN A/A NO CALC CMT, OCC CARB LAM.
1544.7		40		60	INTERLAMINATED SANDSTONE/CLAYSTONE	CLYST - DK GY, LAM, V MIC, SLTY
1545				100	100% SST	NO ANALYSIS
1547				100	100% SST	NO ANALYSIS
1550		10		90	CLAYSTONE	A/A
1552		10		90	a/a	A/A
1555		10		90	a/a	A/A
1557		10		90	a/a	A/A
1560		10		90	a/a	A/A NO SHOWS
1562		10		90	a/a	MLT - M GY, OLV GY, HD, BLKY - OCC FISS, MIC, CARB, NON CALC
1565		10		90	a/a	A/A
1567		10		90	a/a	A/A
1570		10		90	a/a	A/A
1572		10		90	a/a	A/A BCMG SLTY
1575		10		90	a/a	A/A
1577		10	20	70	SILT/CLAYSTONE	SLTST OLV GY - GY BRN, MICROMIC, V CARB IN PTS, GROG TO SST
1580		10	50	40	SILT/CLAYSTONE	A/A
1582		10	50	40	a/a	A/A
1585		10	60	30	a/a	A/A
1587		10	70	30	SILT W/CLAYSTONE	A/A
1590		20	50	30	a/a	A/A
1592		40	40	20	a/a	A/A

EXLOG

GEOCHEMICAL ANALYSIS SAMPLE LITHOLOGY DATA
NORSK HYDRO A/S WELL # 7321/8-1

DEPTH	PRE-PICKED LITH				ANALYSED LITH	ANALYSED LITHOLOGY DESCRIPTION
		SLTST	CLYST	SST		
1595		40	40	20		A/A
1597		40	40	20		A/A
1600		50	30	20		A/A
1602		50	50			A/A
1605		20	70	10		CLYST MOD BRN - DSKY YELBRN, NON CALC, CARB,
1607		10	80	10		A/A
1610		10	80	10		A/A
1612		10	80	10		A/A
1615		20	80			A/A
1617		20	80			A/A
1620			100		CLAYSTONE	a/a
1622			100		a/a	a/a
1625			100		a/a	a/a
1627			60	40	a/a	a/a
1630			40	60	a/a	a/a
1632		20	20	60	SLT/CLAYSTONE	SLTST- m gry, frm-v hd, blky, arg, wh mat cmt, non calc.
1635		10	20	70	a/a	a/a.
1637			30	70	CLAYSTONE	CLYST- pred dk gry, m dk gry, slt-frm, stky, blky-plty, s/ slty, tr micromic.
1640			30	70	a/a	a/a
1642		20	40	40	SILT/CLAYSTONE	SLTST- V. calc, lt-v lt gry, fri, arg.
1645		10	80	10	CLAYSTONE	a/a
1647		10	60	30	a/a w/ SILT	a/a
1650			30	70	CLAYSTONE	a/a
1652			20	80	a/a	a/a
1655		30	20	50	SILT/CLAYSTONE	a/a
1657			50	50	CLAYSTONE	a/a
1660			60	40	a/a	a/a
1662			60	40	a/a	a/a
1665		30	50	20	SILT/CLAYSTONE	a/a

EXLOG

GEOCHEMICAL ANALYSIS SAMPLE LITHOLOGY DATA
NORSK HYDRO A/S WELL # 7321/8-1

DEPTH	PRE-PICKED LITH				ANALYSED LITH	ANALYSED LITHOLOGY DESCRIPTION
		SLTST	CLYST	SST		
1667		30	50	20	SILT/CLAYSTONE	SLTST - m dk gry - brn, gry - olv gry, blky, frm - mod hd, occ grdng sst, non calc v. ang.
1670		40	50	10	a/a	
1672		20	40	40	a/a	CLYST - brn blk - olv blk, occ off wh, v. sft, sol, amor, stcky, occ bndd, non calc
1675		20	30	50	a/a	a/a
1677		20	20	60	a/a	a/a
1680		20	20	60	a/a	a/a
1682		20	TR	80	a/a	a/a
1685		20	Tr.	80	a/a	a/a
1687		10	10	80	a/a	a/a
1690		10	10	80	a/a	a/a
1692		10		90	a/a	a/a
1695		10	10	80	a/a	a/a
1697		10	30	60	a/a	a/a
1700		20	20	60	a/a	a/a
1702		20	20	60	a/a	a/a
1705		20	20	50	a/a	a/a
1707		30	20	50	a/a	a/a
1710		40	40	20	a/a	a/a
1712		30	20	50	a/a	a/a
1715		20	40	40	a/a	a/a
1717		30	30	40	a/a	a/a
1720		30	40	30	a/a	a/a
1722		30	20	50	a/a	a/a
1725		30	50	30	a/a	SLTST - m gry, mod - v. hd, blky, hompg, ang interlam, w/lt gry clyst, grdng v. f. sd in prt.
1727		40	30	30	a/a	CLYST - (Tr?) kaolinite, v. sft, stky, amor; non calc, wh.
1730		50	40	10	a/a	CLYST - m gy - lt gy, frm - sft, stky, amor; rnd chgs, occ w/ blk spots, non calc, gen non stky
1732		50	40	10	a/a	a/a
1735		60	30	10	a/a	a/a
1737		60	30	10	a/a	a/a

EXLOG

GEOCHEMICAL ANALYSIS SAMPLE LITHOLOGY DATA
NORSK HYDRO A/S WELL # 7321/8-1

DEPTH	PRE-PICKED LITH				ANALYSED LITH	ANALYSED LITHOLOGY DESCRIPTION
	MARL	CLYST	SLTST	SST		
1740		50	50		CLAYSTONE/SILTSTONE	CLYST - lt gry, ang, v. frm, brt ip.
1742		70	30		a/a.	SLTST - m gry m-vhd, blky, homog, ang, non calc.
1745		90	10		CLAYSTONE W TR SILT.	a/a
1747		90	10		a/a	a/a
1750		90	10		a/a	CLYST - m gry, lt gry, v. sft, stky, amor, rnd cfgs, non-sl slty, loc sl calc.
1752		90	10		a/a	a/a
1755		90	10		a/a	a/a
1757		80	10	10	a/a	a/a
1760		60	30	10	a/a	SLTST - lt gry, mod hd - fri, blky, homog, occ w/ blk specs, mod ang, non calc.
1762		70	20	10	a/a	a/a
1765		60	30	10	a/a	a/a
1767		70	20	10	a/a	CLYST - varicol: mdk gry, lt-v lt gry, m gry pred v. sft, stky, sol, occ mod frm
1770		100			CLAYSTONE	subblky, plty, non-sl slty, specs blk mat non - mod calc.
1772		80	10	10	CLAYSTONE W TR SILT	a/a
1775		80	20		CLAYSTONE W TR SILT.	a/a
1777	10	50	20	20	CLYST W TR SILT + MARL	MARL - wh, v. sft, amor, stky, tr kaolinite.
1780	10	50	20	20	a/a	a/a
1782		60	20	20	CLAYSTONE W TR SILT	a/a
1785		20	30	50	CLAYSTONE + SILTSTONE	a/a
1787		70	20	10	CLAYSTONE W SILT	a/a
1790		60	20	20	a/a	a/a
1792		60	20	20	a/a	CLYST - pred lt ol gry, brn blk, sft, plas, stky, amor, slty, sdy, non calc.
1795		60	30	10	a/a	a/a
1797		60	30	10	a/a	a/a
1800		60	20	20	a/a	a/a
1802		50	30	20	a/a	a/a
1805		70	30	TR	a/a	CLYST - pred lt gry - m lt gry, v. sft, stky, mdd cuttings, homog, non slty, non calc
1807		80	20		a/a	a/a
1810		30		70	CLAYSTONE	a/a

EXLOG

GEOCHEMICAL ANALYSIS SAMPLE LITHOLOGY DATA
NORSK HYDRO A/S WELL # 7321/8-1

DEPTH	PRE-PICKED LITH				ANALYSED LITH	ANALYSED LITHOLOGY DESCRIPTION
		CLYST	SLTST	SST		
1812		10		90	CLAYSTONE	CLYST - v. lt gry - m gry, v. sft, stky, amor, non-slty, non-mod calc, carb specs in prt.
1815		40	20	40	CLAYSTONE W/SILTSTONE	a/a
1817		30	Tr	70	CLAYSTONE	a/a
1820		30		70	a/a	a/a
1822		30		70	a/a	a/a
1825		40		60	a/a	a/a
1827		20		80	a/a	a/a
1830		40	Tr	60	a/a	a/a.
1832		60	10	30	CLAYSTONE W/SILTSTONE	SLTST. - olv blk, frm-hd, occ blk lams. CLYST - a/a
1835		20	20	60	a/a	a/a
1837		80	10	10	a/a	a/a
1840		70	20	10	a/a	a/a
1842		70	10	20	a/a	a/a
1845		70	10	20	a/a	a/a
1847		60	20	20	a/a	a/a
1850		30	30	40	a/a	a/a
1852		30	40	30	a/a	a/a
1855		40	30	30	a/a	a/a
1857		40	30	30	a/a	a/a
1860		30	40	30	a/a	a/a
1862		50	30	20	a/a	a/a
1865		70	30	Tr.	a/a	CLYST - dk olv gry, sft stky, amor, slty, non calc.
1867		50	30	20	a/a	a/a
1870		40	30	30	a/a	a/a
1872		70	10	20	a/a	a/a
1875		30	10	60	a/a	a/a
1877		60	10	30	a/a	a/a
1880		20	10	70	a/a	a/a
1882		20	20	60	a/a	a/a

EXLOG

GEOCHEMICAL ANALYSIS SAMPLE LITHOLOGY DATA
NORSK HYDRO A/S WELL # 7321/8-1

DEPTH	PRE-PICKED LITH				ANALYSED LITH	ANALYSED LITHOLOGY DESCRIPTION
	CLYST	SLTST	SST			
1885	20	20	60		CLYST/W SILTSTONE	SLTST - dv gry, frm-hd, occ w/ blk lams, occ sdy grading v.f sst., non calc
1887	60	10	30		a/a	CLYST - m-ltgry, frm, blky, occ subfiss
1890	50	20	30		a/a	a/a
1892	50	20	30		a/a	a/a
1895	70	20	10		a/a	a/a
1897	80	10	10		a/a	a/a
1900	90	TR	10		CLAYSTONE	a/a
1902	90	TR	10		a/a	a/a
1905	90	TR	10		a/a	a/a
1907	90	TR	10		a/a	a/a
1910	80	TR	20		a/a	a/a
1912	80	TR	20		a/a	a/a
1915	70	TR	30		a/a	a/a
1917	80	TR	20		a/a	a/a
1920	70	TR	30		a/a	CLYST - olv blk, frm, blky, v. slty, non calc.
1922	80	TR	20		a/a	a/a
1925	80	TR	20		a/a	a/a
1927	70	TR	30		a/a	a/a
1930	60	TR	40		a/a	a/a
1932	60	TR	40		a/a	a/a
1935	70	TR	30		a/a	a/a
1937	90	TR	10		a/a	a/a
1940	60	TR	40		a/a	a/a
1942	70	TR	30		a/a	a/a
1945	80		20		a/a	a/a
1947	80		20		a/a	a/a
1950	80		20		a/a	a/a
1952	70		30		a/a	a/a
1955	60		40		a/a.	a/a

EXLOG

GEOCHEMICAL ANALYSIS SAMPLE LITHOLOGY DATA
NORSK HYDRO A/S WELL # 7321/8-1

DEPTH	PRE-PICKED LITH				ANALYSED LITH	ANALYSED LITHOLOGY DESCRIPTION
		CLYST	SLTST	SST		
1957		40		60	CLAYSTONE	CLYST - brn blk, occ olv blk, frm, blky, v. slty, non calc.
1960		40		60	a/a	a/a
1962		40		60	a/a	a/a
1965		40		60	a/a	a/a
1967		30		70	a/a	CLYST - brn blk, occ dk gny, sft-frm, slky, hydrated, bndd, non calc
1970		30		70	a/a	a/a
1972		30		70	a/a	a/a
1975		50		50	a/a	a/a
1977		30		70	a/a	a/a
1980		30		70	a/a	a/a
1982		20		80	a/a	a/a
1985		20		80	a/a	a/a
1987		30		70	a/a	a/a
1990		30		70	a/a	a/a
1992		40		60	a/a	CLYST - dk olv gny, amor-blky, sft, plas, non calc
1995		20		80	a/a	a/a
1997		30		70	a/a	a/a
2000		50		50	a/a	a/a
2002		30		70	a/a	a/a
2005		30		70	a/a	a/a
2007		50	Tr	50	CLAYSTONE WITH TR coaly claystone.	CLYST - brn blk, blky, ang, coal like. coal - blk, vit, sl frm, crmbly, blky.
2010		30	Tr	70	a/a (coaly CLAYSTONE)	a/a
2012		40	Tr	60	a/a	CLYST - brn blk blky, ang, crmbly, non calc, (coal like.)
2015		60	Tr	40	a/a	a/a
2017		50	Tr	50	a/a	a/a
2020		70	Tr.	30	a/a	a/a
2022		60	Tr	40	a/a	a/a
2025		70	Tr	30	a/a	a/a
2027		50	Tr	50	a/a	a/a

EXLOG

GEOCHEMICAL ANALYSIS SAMPLE LITHOLOGY DATA
NORSK HYDRO A/S WELL # 7321/8-1

DEPTH	PRE-PICKED LITH				ANALYSED LITH	ANALYSED LITHOLOGY DESCRIPTION
	CALC DOL	CLYST	SLTST	CLYST		
2030		40	Tr	60	CLAYSTONE	CLAYSTONE - brn blk, sl frm, blky, occ ang, crumbly, non calc.
2032		30	Tr.	70	a/a	a/a
2035		20		80	a/a	a/a
2037		20		80	a/a	a/a
2040	Tr	20	Tr	80	a/a	a/a
2042	Tr	40	Tr	60	a/a	a/a
2045	Tr	80	Tr	20	a/a	a/a
2047	Tr	80	Tr	20	a/a	a/a
2050	Tr	70	Tr	30	a/a	CLAYSTONE - brn blk, olv blk, frm-hd, blky, slty, non calc
2052	Tr	30	Tr	70	a/a	a/a
2055	Tr	40		60	a/a	a/a
2057	Tr	50	Tr	50	a/a	a/a
2060	Tr	50	Tr	50	a/a	a/a
2062	Tr	40	Tr	60	a/a	a/a
2065	Tr	50	Tr	50	a/a	a/a
2067	Tr.	60	Tr	40	a/a	a/a
2070	Tr	70	Tr	30	a/a	a/a
2072	Tr	80	Tr	20	a/a	a/a
2075	Tr	70		20	a/a	a/a
2077	Tr	70		20	a/a	a/a
2080	Tr	80		20	a/a	a/a
2082	Tr	90		10	a/a	a/a
2085	Tr	80		20	a/a	a/a
2087	Tr	90		10	a/a	a/a
2090	Tr	90		10	a/a	CLYST - dk gry/grn, spltty, v. frm-mod hd.
2092	Tr	90		10	a/a	a/a
2095		90		10	a/a	a/a
2097		90		10	a/a	a/a
2100		90		10	a/a	a/a

EXLOG

GEOCHEMICAL ANALYSIS SAMPLE LITHOLOGY DATA
NORSK HYDRO A/S WELL # 7321/8-1

DEPTH	PRE-PICKED LITH				ANALYSED LITH	ANALYSED LITHOLOGY DESCRIPTION
	CALC DOL.	COAL	CLYST	SST		
2102		Tr	90	10	CLAYSTONE W/Tr coal.	CLAYSTONE - olv blk, frm, blky, slty, non calc, coal like. coal, v:f, blk, dng, non calc.
2105		Tr	80	20	a/a	a/a
2107		Tr	70	30	a/a	a/a
2110		Tr	60	40	a/a	a/a
2112	Tr	Tr	50	50	a/a	a/a
2115		Tr	50	50	a/a	a/a
2117		Tr	70	30	a/a	a/a
2120	Tr	Tr	40	60	CLAYSTONE W/good Tr coal.	a/a
2122	Tr	Tr	30	70	CLAYSTONE W/TR coal	a/a
2125		Tr	70	30	a/a	a/a
2127		Tr	80	20	a/a	a/a
2130	Tr		70	30	CLAYSTONE	a/a
2132	Tr		80	20	a/a	a/a
2135	10		80	10	a/a	a/a
2137	10	Tr	70	20	CLAYSTONE W/TR coal	a/a
2140	10	Tr	60	30	CLAYSTONE W/ TR coal.	a/a
2142	10	Tr	40	50	a/a w/good Tr coal	a/a
2145	10	Tr	50	40		a/a
2147	10	Tr	60	30	CLAYSTONE W/ TR coal.	a/a
2150	10	Tr	70	20	a/a	a/a
2152	10	Tr	70	20	CLAYSTONE	a/a
2155	10	Tr	80	10	a/a	a/a.
2157	10	Tr	70	20	a/a	CLAYSTONE - lt brn, hd, blky, slty, non calc.
2160	10	Tr	70	20	a/a bec. coal like.	a/a
2162	10	Tr	60	30	CLAYSTONE	a/a
2165	10	Tr	70	20	a/a	a/a
2167	20	Tr	60	20	a/a	CLAYSTONE - dk gry, frm-hd, blky, splty, sub [illegible]s.
2170	30	Tr	60	10	a/a	a/a
2172	30	Tr	60	10	a/a	a/a

EXLOG

GEOCHEMICAL ANALYSIS SAMPLE LITHOLOGY DATA
NORSK HYDRO A/S WELL # 7321/8-1

DEPTH	PRE-PICKED LITH				ANALYSED LITH	ANALYSED LITHOLOGY DESCRIPTION
	CALC DOL.	COAL	CLYST	SD.		
2175	30		50	20	CLAYSTONE	CLYST. - dk gny, frm - mod hd, blky, non calc.
2177	30		50	20	a/a	a/a
2180	20		40	40	a/a	a/a
2182	20	TR	50	30	CLAYSTONE w/TR coal.	a/a
2185	20	TR	80	TR	a/a	a/a
2187	10	TR	90	TR.	a/a	CLYST- m dk gny, frm, blky, sl calc.
2190	TR		90	10	CLAYSTONE	a/a.
2192	TR		80	20	a/a	a/a
2195	TR		90	10	a/a	a/a
2197	10		70	20	a/a	a/a
2200	10		80	10	a/a	a/a
2202	10		90	TR	a/a	a/a
2205	10		70	20	a/a	a/a
2207	10		70	20	a/a	a/a
2210	40		40	20	a/a	a/a
2212	40		40	20	a/a	a/a
2215	40		40	20	a/a	a/a
2217	40		50	10	a/a	CLYST- olv blk, brn blk, blky, plas, non calc.
2220	30		30	40	a/a	a/a
2222	20		50	30	a/a	a/a
2225	20	TR	60	20	a/a w pr TR coal.	a/a
2227	20		40	40	a/a	a/a
2230	20	TR	50	30	a/a w good tr coal.	a/a
2232	10	TR	60	30	a/a.	a/a
2235	10	TR	40	50	CLAYSTONE (coal like)	a/a
2237	TR	TR	60	40	a/a.	a/a
2240	10	TR	60	30	a/a	a/a
2242	TR	TR	70	30	CLAYSTONE	a/a
2245	TR	TR	40	60	a/a.	a/a

EXLOG

GEOCHEMICAL ANALYSIS SAMPLE LITHOLOGY DATA
NORSK HYDRO A/S WELL # 7321/8-1

DEPTH	PRE-PICKED LITH				ANALYSED LITH	ANALYSED LITHOLOGY DESCRIPTION
	CALC. DOL.	COAL	CLYST	SST.		
2247	Tr		40	60	CLAYSTONE	CLYST - dk brn gy, occ blk, blky, hd, grdg to marl in prt, mod calc
2250	Tr		50	50	a/a	a/a
2252	10	Tr	30	60	a/a w pr Tr coal	a/a
2255	10	Tr	50	40	a/a	a/a
2257	10		50	40	CLAYSTONE	a/a
2260	10		60	30	a/a	a/a
2262	20		50	30	a/a	a/a
2265	DOL. 20		50	30	a/a	a/a
2267	20		60	20	a/a	a/a
2270	10		70	20	a/a	a/a
2272	10		70	20	a/a	a/a
2275	20		70	10	a/a	a/a
2277	20		60	20	a/a	a/a
2280	20		50	30	a/a	a/a
2282	10		70	20	a/a	a/a
2285	20		60	20	a/a	a/a.
2287	20		60	20	a/a	a/a
2290	10		60	30	a/a	a/a
2292	Tr		70	30	a/a	a/a
2295	Tr		60	40	a/a	a/a
2297			40	60	a/a	a/a
2300	10		80	10	a/a	a/a
2302	10		80	10	a/a	CLYST - m gy, olv brn, v sft, hydrtd, amor, sl slty, non-sli calc
2305	Tr		30	70	a/a	a/a
2307	Tr		40	60	a/a	a/a
2310	Tr		40	60	a/a	a/a
2312	Tr		30	70	a/a	a/a
2315	Tr		70	30	a/a	a/a
2317	Tr		60	40	a/a	a/a

EXLOG

GEOCHEMICAL ANALYSIS SAMPLE LITHOLOGY DATA
NORSK HYDRO A/S WELL # 7321/8-1

DEPTH	PRE-PICKED LITH				ANALYSED LITH	ANALYSED LITHOLOGY DESCRIPTION
	CALC DOL	COAL	CLYST	SST		
2320	Tr		70	30	a/a	a/a
2322	Tr		70	30	a/a	a/a
2325	Tr		70	30	a/a	CLYST. m gy - olv gy, occ lt gy, v sft, hydrtd, amor, sl slty, non calc.
2327	Tr		60	40	a/a	a/a
2330	Tr		50	50	a/a	a/a
2332	Tr		60	40	a/a	a/a
2335	Tr		30	70	a/a	a/a
2337	Tr		30	70	a/a	a/a
2340	Tr		60	40	a/a	a/a
2342	Tr		50	50	a/a	a/a
2345	Tr		30	70	a/a	a/a
2347			30	70	a/a	a/a
2350	Tr		50	50	a/a	a/a
2352	Tr		50	50	a/a	a/a
2355	Tr		80	20	a/a	CLYST. m gy - olv gy, occ lt gy, v sft - v frm, splty, hydtd, amor, v slty
2357	Tr		80	20	a/a	a/a
2360	Tr		70	30	a/a	a/a
2362	Tr		80	20	a/a	a/a
2365	Tr		90	10	a/a	a/a
2367	Tr		70	30	a/a	a/a
2370	Tr		90	10	a/a	a/a
2372	Tr		80	20	a/a	a/a
2375	Tr		80	20	a/a	a/a
2377	Tr		80	20	a/a	a/a
2380			80	20	a/a	a/a
2382			90	10	a/a	a/a
2385			100	Tr	a/a	a/a
2387			90	10	a/a	a/a occ grdg sltst.
2390			90	10	a/a	a/a

EXLOG

GEOCHEMICAL ANALYSIS SAMPLE LITHOLOGY DATA
NORSK HYDRO A/S WELL # 7321/8-1

DEPTH	PRE-PICKED LITH				ANALYSED LITH	ANALYSED LITHOLOGY DESCRIPTION
	CALC OOL	COAL	CLYST	SD		
2392	Tr		90	10	CLAYSTONE	CLYST, m dk gy, occ lt gy, occ dk gy, amor-blky, occ plty non calc
2395	Tr		90	10	a/a	a/a
2397			80	20	a/a	a/a
2400			80	20	a/a	a/a
2402			80	20	a/a	a/a
2405			60	40	a/a	a/a
2407		Tr	80	20	a/a	a/a w tr coal
2410		Tr	90	10	a/a	a/a
2412		Tr	80	20	a/a	a/a
2415			90	10	a/a	a/a
2417			90	10	a/a	a/a
2420			80	20	a/a	a/a
2422			90	10	a/a	a/a
2425			100	Tr	a/a	a/a
2427			100	Tr	a/a	a/a
2430			80	20	a/a	a/a
2432			90	10	a/a	a/a
2435		SLTST	80	20	a/a	a/a
2437		30	50	20	CLAYSTONE/SILTSTONE	SLTST, m dk gy, frm-hd, blky, v arg.
2440		30	50	20	a/a	CLYST. gy, brn, sft-frm, blky, amor, slt. sbtis, plty, non calc
2442		20	60	20	a/a	a/a
2445		20	60	20	a/a	a/a
2447		20	50	30	a/a	a/a
2450		20	60	20	a/a	a/a
2452		20	60	20	a/a	a/a
2455		20	50	30	a/a	a/a
2457		30	40	30	a/a	a/a.
2460		40	30	30	a/a	a/a
2462		40	30	30	a/a	a/a

EXLOG®

GEOCHEMICAL ANALYSIS SAMPLE LITHOLOGY DATA
NORSK HYDRO A/S WELL # 7321/8-1

DEPTH	PRE-PICKED LITH				ANALYSED LITH	ANALYSED LITHOLOGY DESCRIPTION
		CLY	SLT	SS		
2465		40	30	30	a/a	a/a
2467		50	20	30	a/a	a/a
2470		50	20	30	a/a	a/a
2472		40	30	30	a/a	a/a
2475		40	20	40	a/a	a/a
2477		20	10	70	a/a	a/a
2480		10	Tr	90	a/a	a/a
2482		10		90	a/a	a/a
2485		10	10	80	a/a	a/a
2487		10	10	80	a/a	a/a
2490		30	20	50	CLAYSTONE/SILTSTONE	SLTST. gy - blk, frm, occ v hd, blky, sucr, occ v arg, grdg v ↓ ss
2492		30	20	50	a/a	CLYST. gy - brn, sft - frm, amor, blky,
2495		20	20	60	a/a	a/a
2497		20	30	50	a/a	a/a
2500		20	20	60	a/a	a/a
2502		20	20	60	a/a	a/a
2505		30	20	50	a/a	a/a
2507		40	50	10	a/a	a/a
2510		40	50	10	a/a	a/a
2512		20	50	30	a/a	a/a
2515		50	30	20	a/a	a/a
2517		50	40	10	a/a	a/a
2520		50	40	10	a/a	a/a
2522		60	30	10	a/a	a/a
2525		60	30	10	a/a	a/a
2527		70	20	10	a/a	a/a
2530		70	30	–	a/a	a/a
2532		70	30		a/a	a/a
2535		70	30		a/a	a/a

EXLOG

GEOCHEMICAL ANALYSIS SAMPLE LITHOLOGY DATA
NORSK HYDRO A/S WELL # 7321/8-1

DEPTH	PRE-PICKED LITH				ANALYSED LITH	ANALYSED LITHOLOGY DESCRIPTION
	COAL	CLYST	SLTST	SST		
2537		80	20	Tr	CLAYSTONE	CLYST - M-DK GY, occ DK GY OLV, SFF, GEN FRM, LOC MOD HD, SL-VSLTY in prt.
2540		80	10	10	a/a	a/a
2542		90	Tr	10	a/a	a/a
2545		90	Tr	10	a/a	a/a
2547		90	Tr	10	a/a	CLYST - a/a, grdng to sltst in prt.
2550		80	Tr	20	a/a	a/a
2552		80	Tr	20	a/a	a/a
2555		90	Tr	10	a/a	a/a
2557		70	10	20	a/a	a/a
2560		90	10	Tr	a/a	a/a
2562		90	10	Tr.	a/a	a/a
2565		80	20	Tr	a/a	a/a
2567		40	50	10	CLAYSTONE/SILTSTONE	CLYSTONE - gy blk, hd, blky, ang, sb liss ip, sf slty, non calc.
2570		30	20	50	a/a	SLTSTONE - med gy, hd, blky, ang
2572		20	30	50	a/a	a/a
2575		30	20	50	a/a	a/a
2577		30	20	50	a/a	a/a
2580		40	Tr	60	CLAYSTONE	
2582	Tr	40	Tr	60	a/a	
2585	Tr	40	Tr	60	CLAYSTONE w/COAL	CLAYSTONE - gy blk, rr dk brn blk, mod hd, occ frm, occ hd, blky,
2587	Tr	40	Tr	60	CLAYSTONE	a/a
2590	Tr	50	Tr	50	CLAYSTONE w/COAL	COAL - blk, hd, blky, ang, vit lustre.
2592	·	60	Tr	40	a/a	a/a
2595		60	Tr	40	a/a	a/a
2597	Tr	10	20	70	CLAYSTONE w/COAL	a/a
2600	Tr	10	10	80	CLAYSTONE/SILTSTONE	CLYST - bec more slty
2602	Tr	Tr	10	90	a/a	a/a
2605		Tr	Tr	100	CLAYSTONE/SILTSTONE	a/a
2607		Tr	Tr	100	a/a	a/a

EXLOG

GEOCHEMICAL ANALYSIS SAMPLE LITHOLOGY DATA
NORSK HYDRO A/S WELL # 7321/8-1

DEPTH	PRE-PICKED LITH				ANALYSED LITH	ANALYSED LITHOLOGY DESCRIPTION
	COAL	CLYST	SLTST	SST		
2610	-		Tr	100	SILTSTONE	SILTSTONE - m-dk gy, hd, blky, ang
2612	-		Tr	100	a/a	a/a
2615	.	Tr	10	90	a/a	a/a
2617	.		Tr	100	a/a	a/a
2620	-		10	90	a/a	a/a
2622	-		Tr	100	a/a	a/a
2625	..	LST 10	Tr	90	a/a	a/a
2627	Tr.	10	Tr	90	a/a w Tr COAL	a/a
2630	Tr	CLYST 10	10	80	CLAYSTONE / SILTSTONE	CLAYSTONE - gry brn, gy blk, hd-v hd, v. carb in prt.
2632	Tr	10	10	80	a/a	a/a
2635	Tr	10	10	80	a/a	a/a
2637	Tr	10	50	40	SILTSTONE.	a/a.
2640	10	30	20	40	SILTSTONE w COAL.	SLTST- gy blk, brn blk, occ dk olv gy, mod hd-hd, blky, grd clyst in prt.
2642		20	50	30	CLAYSTONE / SILTSTONE	a/a.
2645		30	10	60	CLAYSTONE	a/a
2647		40	10	50	a/a	a/a
2650		50	Tr	50	a/a	a/a
2652		50	Tr	50	a/a	a/a
2655		60	Tr	40	a/a	a/a
2657		50	Tr	50	a/a	a/a
2660		60	Tr	40	a/a	a/a
2662		60	Tr	40	a/a	a/a
2665		50	10	40	a/a	a/a
2667		50	10	40	a/a	a/a.
CORE #5 2670.5			100		SILTSTONE	SLTST - m gy - mdk gy, h-v hd, blky, ang, sb fiss, non calc, arg, sl mic
2671			100		a/a	a/a
2672			100		a/a	a/a w carb specs.
2673			100		a/a	a/a
2674			100		a/a	a/a

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GEOCHEMICAL ANALYSIS SAMPLE LITHOLOGY DATA
NORSK HYDRO A/S WELL # 7321/8-1

DEPTH	PRE-PICKED LITH				ANALYSED LITH	ANALYSED LITHOLOGY DESCRIPTION
		CLYST	SLTST	SST		
2675			100		a/a	a/a
2676			100		a/a	a/a
2677			100		a/a	a/a.
26789			100		a/a	a/a.
2680		30	70		CLAYSTONE	CLAYSTONE - gy blk, hd-v.fd, blky, sb fiss, non calc, slty in prt.
2682	10	40	50		a/a w coal	coal - gy blk, blk, vhd, brit, v.f, sb conc.
2685	Tr.	30	60	10	a/a	a/a.
2687		20	70	10	SILTSTONE W/CLAYSTONE	SLTST - dk gy, gy blk, blky, crmb, v hd
2690		30	60	10	a/a	a/a
2692		50	50	Tr	a/a	a/a
2695		20	70	10	a/a	a/a
2697		10	80	10	a/a	a/a
2700		30	70		a/a	a/a
2702			100		SILTSTONE	a/a
2705		30	70		CLAYSTONE/SILTSTONE	a/a
2707	Tr.	40	60		a/a	a/a
2710		50	30	20	a/a	a/a
2712	Tr	50	20	30	a/a	a/a
2715		30	30	40	a/a	a/a
2717	Tr	40	20	40	a/a	a/a
2720	Tr	40	20	40	a/a	a/a
2722	Tr	50	20	30	a/a	a/a
2725	Tr.	50	20	30	a/a	a/a
2727		50	10	40	a/a	a/a
2730		50	10	40	a/a	a/a
2732		50	10	40	a/a	a/a
2735		60	10	30	CLAYSTONE	CLYST - dk brn gy, sft-mod hd, blky, rr amor, sl slty in prt, non calc.
2737		60	10	30	a/a	a/a
2740		70	10	20	a/a	a/a

EXLOG

GEOCHEMICAL ANALYSIS SAMPLE LITHOLOGY DATA
NORSK HYDRO A/S WELL # 7321/8-1

DEPTH	PRE-PICKED LITH				ANALYSED LITH	ANALYSED LITHOLOGY DESCRIPTION
		CLYST	SLTST	SST.		
2742		70	10	20	CLAYSTONE	CLAYSTONE - brn blk, olv blk, mod hd, blky, plty.
2745		80	10	10	a/a	a/a
2747		80	10	10	a/a	a/a
2750		40	20	40	a/a	a/a
2752		50	30	20	a/a	a/a
2755		20	10	70	CLAYSTONE/SILTSTONE	SILTSTONE - med-dk gy, occ gy blk,
2757		20	Tr	80	a/a	hd blky, sb Fiss
2760		30	10	60	a/a	a/a
2762		30	20	50	a/a	a/a
2765		30	10	60	a/a	a/a
2767		20	50	30	a/a	a/a
2770		20	40	40	a/a	a/a
2772		30	40	30	a/a	a/a
2775		20	60	20	a/a	a/a
2777		20	70	10	SILTSTONE	a/a
2780		Tr	40	60	a/a	a/a
2782		10	50	40	a/a	a/a
2785		10	40	50	a/a.	a/a
2787	LST 10	Tr	50	40	a/a	a/a.
2790		30	40	30	a/a	a/a
2792		10	40	50	a/a	a/a
2795		Tr	50	50	a/a	a/a
2797		Tr	40	60	a/a	a/a
2900		Tr	30	70	a/a	a/a
2802		10	30	60	a/a	a/a
2805		20	20	60	a/a	a/a
2807		20	20	60	a/a	a/a
2810		20	40	40	a/a	a/a
2812		20	40	40	a/a	a/a.

EXLOG

GEOCHEMICAL ANALYSIS SAMPLE LITHOLOGY DATA
NORSK HYDRO A/S WELL # 7321/8-1

DEPTH	PRE-PICKED LITH				ANALYSED LITH	ANALYSED LITHOLOGY DESCRIPTION
		CLYST	SLTST	SST		
2815		30	40	30	CLAYSTONE/SILTSTONE	CLAYSTONE - dk brn gy, brn blk, frm - med hd, blky, v ft amor
2817		20	50	30	a/a	SILTSTONE - dk brn, brn blk, gen frm - mod hd, occ fri.
2820		30	40	30	a/a	a/a
2822		40	30	30	a/a	a/a
2825		60	20	20	a/a	a/a
2827		70	20	10	a/a	a/a
2830		70	20	10	a/a	a/a
2832		70	10	20	a/a	a/a
2835		40	10	50	a/a	a/a
2837	SHALE	40	TR	60	CLAYSTONE	a/a
CORE #6 2840				100	SANDSTONE	SST - lt gy, hd v hd, ang, v f-f, well srt, loc micaceous, dol cmt.
2841				100	a/a	a/a
2842.5				100	a/a	a/a
2843.43	100				SHALE	Sh - brn blk, hd, blky - subfis, non calc, slty, v. carb, micas
2844				100	SANDSTONE	a/a (2842.5)
2845.5	100				SHALE	a/a (2843.43
2846.23				100	SANDSTONE	a/a (2842.5)
2847		70		30	CLAYSTONE	CLYST - md dk gy, sft - frm, amor - sb blky, slty non calc
2850		70		30	a/a	a/a
2852		20	20	60	CLAYSTONE W/SILTSTONE	SLTSTONE - brn blk, med hd - hd, fri, blky,
2855		10	30	60	a/a	plty, arg occ w/blk carb specs.
2857			20	80	SILTSTONE	a/a
2860			10	90	a/a	a/a
2862			10	90	a/a	a/a
2865		10	20	70	CLAYSTONE W/SILTSTONE	a/a
2867		20	10	70	a/a	a/a
2870		10	10	80	a/a	a/a
2872		10	10	80	a/a	a/a
2875			10	90	SILTSTONE	a/a.

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GEOCHEMICAL ANALYSIS SAMPLE LITHOLOGY DATA
NORSK HYDRO A/S WELL # 7321/8-1

DEPTH	PRE-PICKED LITH				ANALYSED LITH	ANALYSED LITHOLOGY DESCRIPTION
		CLYST	SLTST	SST		
2877			10	90	SILTSTONE	SLTSTONE - dk gy blk, mod hd - v hd, blky, sub fiss, loc carb mat.
2880			10	90	a/a	a/a
2882		10	10	80	a/a w CLAYSTONE	CLAYSTONE md dk gy, SFt-frm, amor-sub blky, slty, non calc.
2885			10	90	SILTSTONE	
2887				100	SILTSTONE W/CLAYSTONE	a/a
2890		10	40	50	SILTSTONE	a/a
2892		20	50	30	a/a	a/a
2895		20	60	20	a/a	a/a
2897		10	60	30	a/a	a/a
2900		50	30	20	CLAYSTONE	a/a
2902		60	30	10	a/a	a/a
2905		70	20	10	a/a	a/a
2907		70	20	10	a/a	a/a
2910		80	10	10	a/a	a/a
2912		50	40	10	a/a	a/a
2915		20	60	20	SILTSTONE	a/a
2917		20	60	20	a/a	a/a
2920		20	60	20	a/a	a/a
2922		30	50	20	a/a	a/a
2925		40	40	20	a/a	a/a
2927		40	50	10	a/a	a/a
2930		30	60	10	a/a	a/a
2932		60	30	10	CLAYSTONE	a/a
2935		50	40	10	a/a	a/a
2937		60	40	Tr	a/a	a/a
2940		50	40	10	a/a	a/a
2942		60	40		a/a	a/a
2945		40	30		a/a	a/a
2947		70	30		a/a	a/a

EXLOG

GEOCHEMICAL ANALYSIS SAMPLE LITHOLOGY DATA
NORSK HYDRO A/S WELL # 7321/8-1

DEPTH	PRE-PICKED LITH				ANALYSED LITH	ANALYSED LITHOLOGY DESCRIPTION
		CLYST.	SLTST	SST		
2950		60	40	Tr	CLAYSTONE	CLYST - dk gy, dk gy brn, occ dk olv gy, frm mod hd, occ slty - frm, blky, occ tr subfiss, pred grading sltst, occ tr mmic.
2952		60	40	Tr	a/a	
2955		70	30	Tr	a/a	a/a
2957		70	20	10	a/a	a/a
2960		70	30	Tr	a/a	a/a
2962		80	20	Tr	a/a	a/a
2965		80	20	Tr	a/a	a/a
2967		80	20	Tr	a/a	a/a
2970		90	10	Tr	a/a	CLYST - v dk gy, v. occ blk, frm - mod hd, blky, plty, occ subfiss, non calc.
2972		90	10	Tr	a/a	a/a
2975		80	20		a/a	a/a
2977		90	10	Tr	a/a	a/a
2980		100	Tr	Tr	a/a	CLYST - brn blk - dk blk, gen mod hd, occ mod frm, blky - plty, occ subfiss carb specs in spl, SLST - slty, rr mod slty, non calc.
2982		100	Tr	Tr	a/a	
2985		100	Tr	Tr	a/a	a/a
2987		100	Tr		a/a	a/a
2990		100	Tr	Tr	a/a	a/a
2992		100	Tr		a/a	a/a
2995		100	Tr		a/a	a/a
2997		90	10		a/a	a/a
3000		100	Tr		a/a	a/a
3002		100	Tr		a/a	a/a
3005		100	Tr	Tr	a/a	a/a
3007		100	Tr	Tr	a/a	a/a
3010		100	Tr	Tr	a/a	a/a
3012		100	Tr		a/a	a/a
3015		100	Tr	Tr	a/a	a/a
3017		90	10	Tr	a/a	a/a
3020		100	Tr	Tr	a/a	a/a

EXLOG®

GEOCHEMICAL ANALYSIS SAMPLE LITHOLOGY DATA
NORSK HYDRO A/S WELL # 7321/8-1

DEPTH	PRE-PICKED LITH				ANALYSED LITH	ANALYSED LITHOLOGY DESCRIPTION
		CLYST	SLTST	SST		
3022		100	Tr	Tr	CLAYSTONE	CLYST - dk gy - gy blk, occ blk, v. frm - hd, blky, plty occ subfiss, com grdg sltst () non calc.
3025		100	Tr	Tr	a/a	
3027		100	Tr	Tr	a/a	a/a
3030		80	10	10	a/a	a/a
3032		70	20	10	a/a	a/a
3035		60	20	20	a/a	a/a
3037		50	20	30	a/a	a/a
3040		50	20	30	a/a	a/a
3042		60	30	10	a/a	CLYST, dk gy, occ m gy, v. frm - v. hd, blky occ v. dol.
3045		70	30	Tr	a/a	
3047		80	20	Tr	a/a	a/a
3050		90	10	Tr	a/a	a/a
3052		90	10	Tr	a/a	a/a
3055		70	10	20	a/a	a/a
3057		80	10	10	a/a	a/a
3060		70	10	20	a/a	a/a
3062		70	10	20	a/a	CLYST - dk gy, gy blk, brn blk, v. frm - mod hd occ v. hd, blky, plty, sl - occ v. slty non calc.
3065	10	70	Tr	20	a/a	a/a
3067	Tr	80	Tr	20	a/a	a/a
3070		80	Tr	20	a/a	a/a
3072		70	10	20	a/a	a/a
3075		70	10	20	a/a	a/a
3077		80	Tr	20	a/a	a/a
3080		70	Tr	30	a/a	a/a
3082		80	Tr	20	a/a	a/a
3085		80	10	10	a/a	a/a
3087		80	10	10	a/a	a/a
3090		80	10	10	a/a	a/a
3095		90	Tr	10	a/a	a/a

EXLOG

GEOCHEMICAL ANALYSIS SAMPLE LITHOLOGY DATA
NORSK HYDRO A/S WELL # 7321/8-1

DEPTH	PRE-PICKED LITH				ANALYSED LITH	ANALYSED LITHOLOGY DESCRIPTION
		CLYST	SLTST	SST		
3100		80	10	10	CLAYSTONE	CLYST- brn blk - gy blk, frm - mod hd, loc sl frm, sl - mod slty in prts, non calc.
3105		90	10		a/a	a/a
3110		80	10	10	a/a	a/a
3115		90	10	10	a/a	a/a
3120		40	Tr	60	a/a	a/a
3125		60	Tr	40	a/a	a/a
3130		50	Tr	50	a/a	a/a
3135		40	10	50	a/a	a/a
3140		30	10	60	a/a	a/a
3145		30	Tr	70	a/a	a/a - grdy to arg sltst.
3150		80		Tr	a/a	a/a
3155		60		40	a/a	a/a
3160		70		30	a/a	CLYST - dk gy/brn, gy blk, mod sft - mod hd, pred slty, grdy to sltst,
3165		70	Tr	30	a/a	a/a
3170		90	Tr	10	a/a	a/a
3175		90	Tr	10	a/a	a/a
3180		90	Tr	10	a/a	become more slty, sub fiss
3185		90	Tr	10	a/a	a/a
3190		80	Tr	20	a/a	a/a
3195		90		10	a/a	a/a
3200		90	Tr	10	a/a	a/a
3205		90	Tr	10	a/a	a/a
3210		100	Tr	Tr	a/a	a/a
3215		100	Tr	Tr	a/a	a/a
3220		100	Tr	Tr	a/a	CLYST - brn blk - ol blk loc blk blky, oft slty, occ sub fiss, non - mod slty, non calc.
3225		100		Tr	a/a	a/a
3230		100	Tr	Tr	a/a	a/a
3235		100			a/a	a/a
3240		100	Tr	Tr	a/a	a/a

EXLOG

GEOCHEMICAL ANALYSIS SAMPLE LITHOLOGY DATA
NORSK HYDRO A/S WELL # 7321/8-1

DEPTH	PRE-PICKED LITH				ANALYSED LITH	ANALYSED LITHOLOGY DESCRIPTION
	CHERT	CLYST	SLTST	SST		
3245		100			CLAYSTONE	CLYST - BRN BLK - OT BLK, GEN MOD FRM, occ MOD HD, RR SFT, BLKY, PLTY, OCC SUBFISS,
3255		100			a/a	NON-MOD SLTY IN PTS, SL CARB, NON CALC.
3265		100			a/a	a/a
3275		100			a/a	a/a
3285		100			a/a	a/a bec sl calc
3295		100			a/a	a/a
3305		100			a/a	a/a
3315		100			a/a	a/a
3325		100			a/a	a/a
3335		100			a/a	a/a
3345		100			a/a	a/a bec mod calc, slty in prt.
3355		100			a/a	a/a
3365		100			a/a	a/a
3375		100			a/a	a/a
3385		100			a/a	a/a
3395		100			a/a	a/a
3405		100			a/a	a/a
3415		100			a/a	a/a
3425	10	80	10		a/a	a/a
3430		100			a/a	a/a
CORE #7 3430.17		100			CLAYSTONE	CLYST, V DK GY, V HD, OCC BRIT, RYLO, SILIC, W/ PYR, CALCITE XLS. QTZ VNG.
3430.7		100			a/a	a/a
3431.1		100			a/a	a/a
3431.4		100			a/a	a/a
3435		100			a/a	a/a
3445		100			a/a	a/a
3455		100			a/a	a/a
3465	10	90			a/a	a/a
3475		100			a/a	a/a

EXLOG

GEOCHEMICAL ANALYSIS SAMPLE LITHOLOGY DATA
NORSK HYDRO A/S WELL # 7321/8-1

DEPTH	PRE-PICKED LITH CHERT	CLYST	SLTST	SST	ANALYSED LITH	ANALYSED LITHOLOGY DESCRIPTION
3482'	10	90			a/a	a/a

APPENDIX F

PYROLYSIS INSTRUMENTATION TEMPERATURE/TIME GRAPHS

ROCK EVAL II CONTROLLED PYROLYSIS METHOD

CYCLE 1

1. 300 deg.C initial temp
2. 450 deg.C purge and cooling to 300 deg.C 3.5 mins
3. 300 deg.C level 3 mins
4. 25 deg.C/min temp gradient
5. CO2 trap shut_off temp 350 deg.C
6. 550 deg.C final oven temp
7. 550 deg.C level 1 min