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CLIENT/ OPPDRAGSGIVER

Saga Petroleum

RESPONSIBLE SCIENTIST/ PROSJEKTANSVARLIG

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SUMMARY/ SAMMENDRAG

See next page.

KEY WORDS/ STIKKORD

TROLL	31/5-1
Source rock	31/5-2

Summary

Zone A (966-660m)	-	Poor potential. Very immature.
Zone B (660-880m)	-	Good potential for gas but very immature.
Zone C (880-970m)	-	Variable potential. Poor to fair gas potential at the top of the zone. Good oil and gas potential at the base. Immature.
Zone D (970-1220m)	-	Poor to fair gas potential. Immature.
Zone E (1220-1320m)	-	Poor gas potential - immature.
Zone F (1320-1476m)	-	Very poor gas potential - immature. Some evidence of migrated light hydrocarbons.
Zone G (1476-1557m)	-	Good potential for oil and gas. Evidence of migrated hydrocarbon at the top of the zone. Immature.
Zone H (1557-1926m)	-	Fair to good hydrocarbon potential. Immature.
Zone I (1926-2061m)	-	Good potential (may represent caved material however) for oil and gas. Immature.
Zone J (2061-2124m)	-	Fair to good hydrocarbon potential. Immature.
Zone K (2124-2187m)	-	Variable hydrocarbon potential poor - good. Immature.
Zone L (2187-2394m)	-	Fair hydrocarbon potential. Immature.
Zone M (2394-2943m)	-	Very poor hydrocarbon potential. Immature.

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EXPERIMENTAL AND DESCRIPTION OF INTERPRETATION LEVELS

Rock-Eval Pyrolysis

Crushed sample (100mg) was weighed into a platinum crucible the base and cover of which are made of sintered steel, and analysed on a Rock-Eval pyrolyser.

Extractable Organic Matter

Powdered rock was extracted by a flowblending for 3 minutes using dichloromethane (DCM) as solvent. The DCM used was of organic geochemical grade and blank analyses showed the occurrence of negligible amounts of contaminating hydrocarbons.

Activated copper fillings were used to remove any free sulphur from the samples.

After extraction the solvent was removed on a Buchi Rotavapor and the amount of extractable organic matter (EOM) was determined.

Chromatographic Separation

The extractable organic matter (EOM) was separated into saturated fraction, aromatic fraction and non hydrocarbon fraction using a MPLC system with hexane as eluant (Radke et al., Anal. Chem., 1980). The various fractions were evaporated on a Buchi Rotavapor and transferred to glass vials and dried in stream of nitrogen.

Pyrolysis Gas Chromatography (Py-GC Programmed)

Thermoextraction.

20-30 mg of whole rock sample was placed in a boat shaped sample probe and thermoextracted in a stream of helium at 300°C for 5 minutes.

Py-GC

20-30 mg of solvent- and thermoextracted whole rock sample was programmed pyrolysed in helium (260°C to 520°C at 35°C/min.) in a furnace type pyrolyzer. The outlet of the pyrolyzer was directly connected to a splitter (30:1) and a fused silica capillary column. The pyrolysis product was trapped in a cooled (liq. Nitrogen) U-shaped section at the front of the column.

The outlet of the splitter was directly connected to a FID detector and the course of the pyrolysis could be followed by the detector response of the bulk pyrolysis product (30:1) which was recorded as a broad peak. At the end of the pyrolysis the pyrolysis product was injected on to the capillary column at ambient temperature (by removing the nitrogen bath) and analysed under the GC conditions given below.

GC-conditions

Column: 25m OV-1, I.D. 0.3 mm, fused silica capillary column.
Carrier gas: Helium with inlet pressure 10 psi. Flow; ca. 1.5. ml/min.
Oven programme: 40^{o} - 270^{o}C at 4^{o}C/min.

Vitrinite Reflectance

Vitrinite reflectance measurements of 4 of the samples, were done. The samples were mounted in Bakelite resin blocks; care being taken during the setting of the plastic to avoid temperatures in excess of 100^{o}C. The samples were then ground, initially on a diamond lap followed by two grades of corundum paper. All grinding and subsequent polishing stages in the preparation were carried out using isopropyl alcohol as lubricant, since water leads to the swelling and disintegration of the clay fraction of the samples.

Polishing of the samples was performed on Selvyt cloths using three grades of alumina, 5/20, 3/50 and Gamma, followed by careful cleaning of the surface.

Reflectance determinations were carried out on a Leitz M.P.V. microphotometer under oil immersion, R.I. 1.518 at a wavelength of 546 nm. The surface of the polished block was searched by the operator for suitable areas of vitrinitic material in the sediment. The reflectance of the organic particle was determined relative to optical glass standards of known reflectance. Where possible, a minimum of twenty individual particles of vitrinite was measured.

The samples were also analysed in UV light, and the colour of the fluorescing material determined. Below, a scale comparing the vitrinite reflectance measurements and the fluorescence measurements is given.

VITRINITE REFLECTANCE R.AVER. 546 NM 1516	0.20		0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00	1.10
% CARBON CONTENT DAF.	57		62	70	73	76	79	80.5	82.5	84	85.5
LIPTINITE FLUOR NM	725	750	790	820	840		860	890		940	
EXC. 400 nm BAR. 530 nm colour	G	G/Y	Y	Y/O	L.O	M.O.		D.O.		O/R	R
zone	1	2	3	4	5	6		7		8	9

NOTE: Liptinite NM = Numerical measurements of overall spore colour and not peak fluorescence wavelength.

Relationship between liptinite fluorescence colour, vitrinite reflectance and carbon content is variable with depositional environment and catagenic history. The above is only a guide. Liptinite will often appear to process to deep orange colour and then fade rather than develop or O/R red shade. Termination of fluorescence is also variable.

Processing of Samples and Evaluation of Visual Kerogen

Crushed rock samples were treated with hydrochloric and hydrofluoric acids to remove the minerals. A series of microscopic slides contain strew mounts of the residue:

T-slide represents the total acid insoluble residue.
N-slide represents a screened residue (15μ mesh).
O-slide contains palynodebris remaining after flotation ($ZnBr_2$) to remove heavy minerals.

X-slides contain oxidized residues, (oxidizing may be required to remove sapropel which embeds palynomorphs, or where high coalification prevents the identification of the various groups).

T and/or O slides are necessary to evaluate kerogen composition/-palynofacies which is closely related to sample lithology.

Screened or oxidized residues are normally required to concentrate the larger fragments, and to study palynomorphs (pollen, spores and dinoflagellates) and cuticles for paleodating and colour evaluation.

So far visual evaluation of kerogen has been undertaken from residues mounted in glycerine jelly, and studied by Leitz Dialux in normal light (halogene) using x10 and x63 objectives. By x63 magnification it is possible to distinguish single particles of diameters about 2 and, if required, to make a more refined classification of the screened residues (particles >15μ).

The colour evaluation is based on colour tones of spores and pollen (preferably) with supporting evidence from colour tones of other types of kerogen (woody material, cuticles and sapropel). These colours are dependant upon the maturity, but are also influenced by the paleo-environment (lithology of the rock, oxidation and decay processes). The colours and the estimated colour index of an individual sample may therefore differ from those of the neighbouring samples. The techniques in visual kerogen studies are adopted from Staplin (1969) and Burgess (1974).

In interpretation of the maturity from the estimated colour indices we follow a general scheme that is calibrated against vitrinite reflectance values (R_0).

Ro	0.45	0.6	0.9	1.0	1.3
colour index	2-	2	2+	3-	3
Maturity intervals	Moderate mature	Mature (oil window)			Condensate window

HPLC

The aromatic fractions were further separated by HPLC into subfractions according to ring size. The total aromatic fractions and the fractions containing aromatic hydrocarbons with 3 rings (AF2) were then analysed by gas chromatography.

RESULTS AND DISCUSSION

Samples were selected by the client for further analysis. The original zone system used in the screening analysis report has been retained with one modification - the top of zone G is now at 1476m (extra analyses in zone F and G have allowed a better definition of the zones). Quite a few new samples were required for Rock-Eval pyrolysis and new lithology and TOC that were not in the screening report. A new copy of the lithological description and TOC tables has been included in this report encorporating the new cuttings samples and the core samples provided.

For ease of reference the zones previously defined and the formation tops given by Saga are listed below.

Zone A -	466-660m	Hordaland Group	524m
Zone B -	660-880m	Rogaland Group	1210m
Zone C -	880-970m	Cretaceous	1432m
Zone D -	970-1220m	Kimmeridge Clay Fm.	1475m
Zone E -	1220-1320m	Sognefjord	1516m
Zone F -	1320-1476m	Brent Group	1957m
Zone G -	1476-1557m	Dunlin Group	2037m
Zone H -	1926-2061m	Statfjord Group	2336m
Zone I -	1926-2061m	Triassic	2393m
Zone J -	2061-2124m		
Zone K -	2124-2187m		
Zone L -	2187-2394m		
Zone M -	2394-2493m		

Well 31/5-2

Rock-Eval results

The samples analysed by Rock-Eval pyrolysis are those specified by Saga. No samples were analysed from zone A (466-660m) or from zone M (2394-2493m (Triassic)).

Zone B, 660-880m: The whole of this zone lies within the Tertiary section of this well. All the analyses except for the lowermost sample are from the light brown grey claystone. The results indicate a type III kerogen of variable richness (HI ranges from 109 - 184). The samples from 710 (B-148) and 730m (B-150) being richest in hydrogen. The low production indices and low T_{max} values indicate that the samples are very immature. This zone would, if mature, have good gas potential.

Zone C, 880-970m: This zone also lies entirely within the Tertiary. The Rock-Eval pyrolysis results show more variable kerogen types in this section. The upper three samples (down to 910m) show hydrogen poor type IV kerogen with fair gas potential. A similar kerogen type is found in the sample from 930m (B-170). Results from the samples from 920m, 940m and 950m indicate a type III kerogen. The lowest sample from this zone contains a more hydrogen rich type III/II kerogen. The oil and gas potential varies with kerogen type. The type IV and III samples show fair potential for gas. The type III/II sample shows good potential for oil and gas. The production indices are all low indicating that little generation has taken place. The Rock-Eval T_{max} results indicate that the zone is immature.

Zone D, 970-1220m: This zone also lies entirely within the Tertiary section of the well. All the samples, apart from one from 1130m are found to contain a hydrogen poor type IV kerogen. The before mentioned sample contains a slightly richer type III kerogen. The samples from 1160 and 1180m (B-196 and B-194 respectively) show rather high oxygen indices. It is possible that some CO_2 from the siderite in these samples has influenced the oxygen indices (siderite has a rather low decomposition temperature) compared to other carbonates. The samples containing type IV kerogen show a poor potential for gas and the sample with type III kerogen shows a fair gas potential. The production indices are higher than in the proceeding zones but still indicate little generation of hydrocarbons. The T_{max} values are also low (409-420^oC) indicating low maturity. Some of the T_{max} values are very low (390's) and may have been affected by the presence of bitumens or asphaltenes. Overall, the zone contains poor source rocks that are immature.

Zone E, 1220-1320m: This zone is also in the Tertiary. The Rock-Eval pyrolyses were carried out on the dominant light brown grey claystone. The results indicate a uniformly hydrogen poor type IV kerogen with poor generating potential for gas. The production indices and T_{max} values show the samples to be immature.

Zone F, 1320-1476m: This zone contains the base of the Tertiary (1432m) and the entire Cretaceous section of the well. The Rock-Eval pyrolyses do not show any significant change throughout the zone however. The results indicate a hydrogen poor type IV kerogen throughout with very poor potential for gas. The production indices for this zone are fairly high which may indicate the presence of non-indigenous hydrocarbons. The T_{max} results seem to have been affected by the presence of bitumens or asphaltenes, especially the sample from 1467m (B-224). Those that are unaffected indicate that the samples are immature.

Zone G, 1476-1557m:This zone includes the whole of the Kimmeridge Clay Formation and the upper part of the Sognefjord formation. Samples from this zone also include the three core samples (B-2319, B-2320, B-2321) sent by Saga. The hydrogen indices indicate type II - II/III kerogens of variable richness. 2 samples, the core from 1506.4m and the cutting sample from 1539m show lower hydrogen indices than the rest of the samples. All samples show good oil and gas potential but the samples from 1485m and 1516.35m have richer potential than the rest. The production indices are all very low, indicating immature samples. The T_{max} values vary between 417 and 430^{o}C but the average value is around 427^{o}C, also indicating low maturity. This zone has good source rock potential but is still very immature.

Zone H, 1557-1926m:

This zone lies within the Sognefjord formation. The two cuttings samples analysed contain a type II/III kerogen, The lower sample is the richer in hydrogen. The upper sample shows a fair potential for oil and gas and the lower one a good oil and gas potential. The T_{max} values indicate that the samples are immature as do the low production indices.

Zone I, 1926-2061m: This zone encorporates the lower part of the Sognefjord formation and the entire Brent Group. The three samples pyrolysed are found to contain a type II/III kerogen. The lower Sognefjord samples are predominantly sandstone so the Rock-Eval results on the claystone from these samples may not be representative. The hydrogen indices are generally lower than in the overlying Kimmeridge Clay formation although the samples still show a good potential for oil and gas. The samples are still immature with low T_{max} values and low production indices.

Zone J, 2061-2124m: This zone lies within the upper part of the Dunlin Group. The Rock-Eval pyrolysis results indicate the presence of a type III kerogen in all of the samples except the one from 2097m which contains a richer type II/III kerogen. The samples containing type III kerogen show a fair potential for gas. The richer samples show a good potential for oil and gas. The production indices are all low although the lower 2 samples have higher values than the rest. T_{max} values indicate immature to early mature samples.

Zone K, 2124-2187m: This zone corresponds to the middle part of the Dunlin Group. There is a strong variation in kerogen type through the zone. The uppermost sample (2133m) shows a hydrogen poor type IV kerogen with fair gas potential. The next three samples from 2142m-2160m show hydrogen rich type II and type II/III kerogens showing good oil and gas potential. The hydrogen indices fall towards the base of zone. The sample from 2169m contains a type III humic kerogen with fair gas potential. The sample from the base of the zone contains a very poor type IV kerogen with almost no potential for oil or gas. This sample is a sandstone and would be expected to contain largely inertinitic organic matter. From T_{max} values the zone appears to be immature to early mature.

Zone L, 2187-2394m: This zone covers the lower part of the Dunlin Group, the whole of the Statfjord formation and part of the upper Triassic. 2 samples were analysed both from the lower Dunlin Group. The upper one contains a type II/III kerogen with fair potential for oil and gas, the lower one a more humic type III kerogen with fair gas potential. Both samples show low production indices indicating that little generation has taken place. The T_{max} values indicate immature to early mature samples.

Pyrolysis-gas chromatography (Py-GC, Programmed)

13 solvent and thermally extracted whole rock samples were analysed by Py-GC. The instrumental conditions are described in experimental section. The peaks are identified on the basis of retention and mass spectrometric data of other kerogens.

Peak identities in pyrolysis gas chromatograms.

1 = toluene
2 = (m+p)-xylenes
3 = C_3-alkylbenzenes + phenol
4 = C_4-alkylbenzenes + methylphenols
5 = C_4- and C_5-alkylbenzenes + naphthalene
6 = methylnaphthalenes
P = phenol
C_1P = methylphenols
Pr = pristenes
C_7, C_8 etc. are alkene/alkane doublets of that carbon number.

B-226 (1485m)
The pyrogram shows an n-alkene/n-alkane homology ranging from C_7 to ca. C_{27} and the abundance of aromatics is low relative to the aliphatics. Generally the pyrogram shows a type II kerogen fingerprint.

B-228 (1503m)
The pyrogram is overall similar to B-226, i.e. a type II kerogen fingerprint.

B-2319 (1506.40m); B-2320 (1509.40m) and B-2321 (1516.35m)
The pyrograms of these three samples are very similar showing n-alkene/n-alkane homologies ranging from C_7 to ca. C_{27}. The abundance of aromatics is higher than in B-226. The pyrograms show mixed type II/III kerogen fingerprints.

B-230 (1521m)
The pyrogram shows an n-alkene/n-alkane homology ranging from C_7 to ca. C_{27} and the abundance of phenols is higher than in B-2319 suggesting a higher input of terrestrial derived material. The pyrogram shows a mixed type III/II kerogen fingerprint.

B-580-81 (2052-2061m)

The pyrogram is overall very similar to B-230. i.e. a mixed type III/II kerogen fingerprint (Note difference in instrument sensitivity).

B-582 (2070m)

The pyrogram shows an n-alkene/n-alkane homology ranging from C_7 to ca. C_{27}. The abundance of phenols is very high which is characteristic for type III kerogens derived from higher plants. The pyrogram shows a typical type III kerogen fingerprint.

B-586-588 (2097-2124m) and B-591 (2151m)

The pyrograms of these two samples are very similar showing an n-alkene/n-alkane homology ranging from C_7 to ca. C_{20}. The abundance of aromatics is high suggesting a type III kerogen. The poor quality of the pyrograms is due to the very low TOC values of the samples.

B-598 (2214m)

The pyrogram is very similar to that of B-591, i.e. a mixed type II/III kerogen fingerprint. However the low TOC value makes interpretation somewhat more difficult.

Investigations in transmitted light

The organic material of well 31/5-2, interval 1485m to 2214m, was evaluated on the basis of 12 samples. Nine are picked lithologies from ditch cuttings and three core samples 1506.4m, 1509.4m, 1516.35m.

The material was derived dominantly from land plants with a considerable input, 25-50%, from leaf cuticles, pollen and spores. The maturation in this well was low, immature from colour index 1/1+. Higher readings were evaluated as controlled by a more oxidative environment.

Description of samples

B-226 (1485m), B-228 (1503m)
Fluffy pyritic aggregates of biodegraded material with remains of fungi/-bacterial activity. Embedded woody and reworked/oxidised woody material. Palynomorphs are fairly well preserved.
Colour index: 1, 1/1+.

B-2319 (1506.4m core)
Laminated grey amorphous aggregates. Well preserved dinoflagellate cysts and foraminifer linings. Some woody material.
Colour index: 1/1+.

B-2320 (1509.4m), B-2321 (1516.35m)
Well defined pyritic aggregates with a granulate matrix of degraded woody and cuticular material. Cysts and Tasmanites are well preserved. Remains of biodegradation (bacteria/fungi).
Colour index: 1/1+.

B-230 (1521m)
As samples above but also with subordinate grey amorphous material/acid resistant minerals (mixed lithologies).

B-580 (2052m), B-583 (2079m), B-587 (2115m)
Woody material partly coal and cuticles dominate. Some sapropelisation of woody material. Well preserved pollen and cysts, Botryococcus (in B-580). Variable colouring reflects some oxidative environment.
Colour index: 1/1+ 2-, 2-/2, 2+.

B-591 (2151m)
Resembles the above but rich in marine algal material (Tasmanites, Tyttodiscus and Nannoceratopsis graciles).

B-595 (2187)
Resembles the assemblage of B-591 above, but rich in coaly material. The presence of Callialasporites suggests contamination by a lithology from the Late Toarcian or younger levels.

B-598 (2214m)
Pyritic residue dominated by coaly material and large well preserved cuticles from leaves. Variable colouring suggest some oxidative environment. Colour index: 1+/2- 2-.

Samples were selected by Saga for further analysis. 6 samples from zone G, 3 cuttings and 3 core samples, were selected and 6 samples from zone I-L (all in the Dunlin Group). The 9 cuttings samples chosen were analysed for Rock-Eval, EOM, saturated and aromatic fraction, capillary gc, AF_2 fraction g.c., visual kerogen and pyrolysis gc. The core samples as requested were only analysed by py-gc, Rock-Eval pyrolysis and visual kerogen analysis.

Extraction and Chromatographic Results and Discussion

The results of extraction of the samples selected by the client can be found in tables 3-6. Data from the saturated fraction gas chromatograms can be found in table 7/8.

a) Upper Jurassic (Zone G samples)
3 samples were analysed, B-226 (1485m), B-228 (1503m) and B-230 (1521m). All 3 samples show rich extractability in relation to TOC content. Although only the upper sample (B-226) shows a rich abundance of EOM relative to rock volume (this sample show the highest hydrogen index in the Rock-Eval results). The upper and lower samples show extracts dominated by non-hydrocarbons, especially the lower sample where non-hydrocarbons comprise 70% of the total extract. A high proportion of non-hydrocarbon in an extract (especially as it is from a hydrogen rich kerogen) indicates that the sample is immature. There is evidence of this from the other analyses. The middle sample (1503m) is very different. 82% of the extract is hydrocarbons. Rock-Eval pyrolysis indicates the presence of a similar kerogen to the other 2 samples so this difference in extract composition may reflect the presence of non-indigenous hydrocarbons either contaminants or migrated hydrocarbons. It is interesting that the gas results also indicate possible migrated hydrocarbons at the top of zone G.

The compositions of the hydrocarbon fractions of the extracts vary down through the zone. The upper 2 samples are very rich in saturated hydrocarbons (the top sample having the highest sat/arom. ratio). The lowest sample shows a hydrocarbon fraction dominated by aromatic compounds. The hydrocarbon fraction compositions also indicate that there may be migrated or contaminant hydrocarbons present at the top of zone G.

The saturated fraction gas chromatogram for the upper sample shows a very different alkane distribution to those from the lower two samples. It has a relatively smooth alkane envelope dominated by lower molecular weight n-alkanes, with a maximum at nC_{19}. The pristane/nC_{17} ratio is low indicating a more mature source than other analyses would seem to indicate for this sample. The overall saturated hydrocarbon distribution indicates the presence of hydrocarbons from a more mature source. The low CPI (compared to the 2 samples immediately below) also reflects this. There is some difference in the kerogen richness between the three samples but not so great as to account for the differences seen in the saturated fraction gas chromatograms.

The chromatograms from B-228 and B-230 are more as would be expected from a type II/III immature kerogen extract. They show a strong bimodal distribution with maxima around nC_{27} and nC_{18} indicative of a mixed marine and higher plant organic matter input. The CPI is high as is the pristane/nC_{17} ratio both indicating low maturity.

A similar bimodal distribution would be expected for the top sample but this appear to have been masked by the presence of non-indigenous hydrocarbons. It is noticeable that all three chromatograms show similarly low pristane/phytane ratios which may indicate a similar source for the hydrocarbons but it seems unlikely that the Kimmeridge Clay Formation in the vicinity of the well is the source for these hydrocarbons as it is so immature (this does not preclude its being a source elsewhere).

Aromatic fraction gas chromatograms

The aromatic fraction chromatograms, by contrast to those from the saturated fractions are all very similar. There is a high proportion of unresolved material, bimodally distributed. The immaturity of the samples is reflected in the high proportion of aromatised steranes and triterpanes present and in the high proportion of unresolved material. The chromatograms from the upper 2 samples are dominated by the unresolved compounds however the di- and trimethyl naphthalenes and phenanthrene form major peaks at the low molecular weight end indicating a mixed input of organic matter. The chromatogram from the bottom sample is dominated by the mono, di and tri-methyl naphthalenes probably indicating a more marine organic matter input.

The appearance of the aromatic fraction chromatograms seems to confirm the presence of migrated hydrocarbons in the upper part of zone G. The variations in the compositions of the extracts and saturated fractions could be attributed to variation in kerogen type but then this should also be evident from the aromatic fraction chromatogram but it is not. They are all very similar in appearence.

b) Dunlin Group samples (IKU zones I-L)

3 of the 6 samples from the Dunlin Group are compound samples: B-580-581, B-582-583 and B-586-588 as too little material was available in the single samples from these depths.

The extractability of these samples varies with the kerogen type. The samples B-580-81 and B-591 contain type II/III kerogens and this is reflected in their rich extractability relative to rock volume and TOC. The sample B-596 shows a very high ratio of EOM to organic carbon which is interesting as rock eval results indicate a very poor type IV kerogen for this sample. This result indicates the presence of non-indigenous hydrocarbons either migrated or contaminant. The samples B-582-83 and B-586-88 contain type III kerogen. They show a good abundance EOM relative to rock weight (rich relative to TOC). The bottom sample B-598 shows a very high extractability. Py-GC and Rock-Eval results indicate a type III kerogen in this sample. The high proportion of EOM may be due to the presence of contaminants or to migrated hydrocarbons.

The extracts vary very much in hydrocarbon content. B-582-83 and B-596 show the highest proportion of hydrocarbons, over 90%. In the case of B-595 this again indicates some non-indigenous hydrocarbons. Such a high proportion of hydrocarbons would not be expected from a type IV kerogen. The samples containing type II/III kerogens have produced extracts with a slight predominance of hydrocarbons. The high proportion of non-hydrocarbons indicates fairly low maturity in the samples. The samples with a type III kerogen, influenced by migrated or contaminant hydrocarbons show lower proportions of hydrocarbons.

The hydrocarbon fractions contain approximately equal amounts of saturated and aromatic hydrocarbons except for the sample B-582-83 in which saturated hydrocarbons predominate.

Saturated fraction gas chromatography

The gas chromatograms of the saturated fractions indicate the cause of some of the anomalously high extract yields. The lower samples in the Dunlin Group appear to have been affected by contamination probably by pipe dope (seen as large hump of unresolved material). The upper sample also shows a large amount of unresolved high molecular weight material and may also be partially contaminated.

The upper 4 chromatograms show a bimodal distribution of alkanes (the alkane distribution in the lower samples is effectively marked by the hump of unresolved compounds). In the upper sample the maximum is at nC_{17} in the other three it is nC_{27}, indicating a greater marine algal input to the organic matter in the upper sample (this can be seen from the Rock-Eval pyrolysis and py-gc results as well).

The CPI values are high for the upper four samples indicating an immature zone. The strong odd dominance is clearly seen in the chromatograms in the range nC_{23}-C_{31}. The lower CPI values for the bottom two samples may be caused by the presence of a more mature contaminant or be caused by the difficulties in measuring the odd/even ratios in the presence of large amounts of unresolvable compounds (probably the latter). The pristane/nC_{17} ratios are uniformly low including those from the lower two samples. One exception is the sample from 2151m (B-591) where pristane is the dominant saturated hydrocarbon.

<u>Whole aromatic fraction gas chromatography Dunlin samples</u> (Zones I-L)
The aromatic fraction chromatograms reflect the type of organic matter input. The samples B-591 and B-580/81 are seen from Rock-Eval pyrolysis and pyrolysis-gc results to contain type II/III kerogens. The aromatic fraction chromatograms from B-580/81 shows fairly equal abundances of methyl naphthalenes, phenanthrene and methyl phenanthrenes, reflecting a mixed organic matter input. B-591 contains a more hydrogen rich type II/III kerogen and dominance of the methyl naphthalenes in the chromatogram.

Samples B-582-83, B-586-88, B-596 show chromatograms dominated by di- and tri-methyl naphthalenes and the phenanthrenes indicating a more terrestrial organic matter input. It is impossible to see much from the chromatogram from B-598 due to the presence of very large amounts of unresolved compounds (pipe dope contamination?).

All the chromatograms show an unresolved hump and a large number of peaks in region 12, aromatised steranes and triterpanes. This indicates that the samples are of low maturity.

AF2, aromatic fraction results and discussion

The AF2 fraction was obtained from the whole aromatic fraction as described on page.

The sample from B-226 contained too little material to be separated by HPLC. The sample B-228 showed only very small peaks on the FID trace and nothing on the FPD trace. It was not possible to identify any of the compounds. Methyl phenanthrene isomer ratios were used to calculate MPI values for all of the samples, however it has been onted (Radke et al., 1981) that this index is not a reliable maturity parameter below a reflectance of 0.6% Ro). As all of the samples involved are of lower reflectance than this the use of MPI on this set of samples is doubtful.

B-230

Methyl phenanthrene isomers and phenanthrene were identified from the FID trace. The methyl phenanthrene isomer ratios indicate that the sample is immature (the MPI was calculated, the value was 0.27, however it is not considered a reliable maturity parameter below a reflectance of 0.6% Ro. From the FPD trace dibenzothiophene, the 1, 2, 3 and 4 methyl dibenzothiophene isomers and dimethyldibenzothiophenes have been identified. The generally low proportions of sulphur compounds present indicates low maturity in the samples.

B-582-583

The FID trace is dominated by phenanthrene. The methyl phenanthrene isomer ratios indicate that the sample is immature.

B-580-81

This shows larger amount of high molecular weight unresolved material. The methyl phenanthrene isomer ratios indicate that the samples are immature. The peak marked x is probably a contaminant. Dibenzothiophene, methyldibenzothiophene isomers and dimethyldibenzothiophene have been identified from the FPD trace.

B-582-83

The FID trace is dominated by phenanthrene. The methylphenanthrene isomers indicate that the sample is immature. The FPD trace shows very low amounts of sulphur compounds to be present which is also indicative of immaturity.

B-591

The methyl phenanthrene isomer ratios indicate that the sample is of low maturity . This sample shows a significant amount of high molecular weight unresolved material. The FPD trace shows very small amounts of sulphur compounds. This is common in immature samples.

B-598

The FID trace is dominated by unresolved high molecular weight compounds the methyl phenanthrene isomer ratios indicate that the sample is immature. The FPD trace is also dominated by unresolved high molecular weight compounds. The high proportion of unresolved material in this sample probably comes from the pipe dope contaminating it.

Analyses in Reflected Light

Well 31/5-1

B-130, 520-530m: Sandstone, Ro = N.D.P., Sp.Fl. = N.D.P.
This sample consists largely of sandstone clasts and clasts containing a crystalline amphibole/quartz/biotite assemblage. Some reworked vitrinite is present in the sample. It was not possible to obtain any meaningful results from this sample.

B-147, 690-700m: Claystone, Ro = 0.43(1), Sp.Fl. = 4-5.
The main lithologies in this sample are light brown or light grey claystones, often containing calcareous fossils. Measureable vitrinite is generally absent. Most of the vitrinite present in the sample occurs in very small fragments which are often associated with liptinite. This material will not yield accurate reflectance values and is not measured.

B-164, 860-870m: Claystone, Ro = 0.43(4), Sp.Fl. = 3.
This sample consists largely of brown claystone which shows evidence of secondary mineralization. Most of the organic matter in the sample is degraded to some degree, probably as a result of this mineralization. Inertinite and liptinite are the two most common maceral types. Trace amounts of sporinite were observed to emit a yellow fluorescence in ultra-violet light.

Well 31/5-2

B-177, 990-1000m: Claystone, Ro = 0.39(2), Sp.Fl. = 3.
The sample is mostly light grey claystone which shows a moderate degree of pyritization. Organic matter in the sample is mostly inertinite or liptinite. Measureable vitrinite is largely absent. The moderate amount of sporinite which is present in the sample has a yellow fluorescence in ultra-violet light.

B-188, 1100-1110m: Claystone, Ro = 0.36(4), Sp.Fl. = 4.
The sample is largely light green or greenish-brown claystone which shows evidence of secondary mineralization. The organic matter present in the sample shows evidence of alteration and measureable vitrinite is rare. The low concentration of liptinite present in the sample has a yellow-orange fluorescence in ultra-violet light.

B-202, 1240-1250m: Claystone, Ro = 0.49(4), Sp.Fl. = 3-4.
Most of the particles in the sample are grey or brown claystones which contain abundant pyrite. The vitrinite in the sample generally shows evidence of alteration and is often associated with liptinite, making measurement difficult. Liptinite ultra-violet fluorescence colours are yellow to yellow/orange.

B-214, 1360-1370m: Claystone, Ro = 0.61(1), Sp.Fl. = 3.
The sample is mostly light coloured claystone which shows evidence of secondary mineralization. The organic matter in the sample is mostly inertinite, although liptinite is common in darker clasts. The liptinite has a yellow fluorescence in ultra-violet light.

B-228, 1494-1503m: Claystone, Ro = 0.47(6), Sp.Fl. = 3-4.
Most of the sample has a grey or brown claystone lithology with well developed pyrite present. The organic matter present in the sample is mostly inertinite and liptinite. The liptinite is present in moderate amounts and shows a yellow or yellow/orange fluorescence in ultra-violet light).

B-238, 1584-1593m: Sandstone, Ro = 0.48(1), Sp.Fl. = 4.
The sample is mostly white sandstone with occasional clasts of light grey claystone. There is evidence of secondary mineralization in the claystone clasts. The vitrinite in the sample is often altered or associated with liptinite. Liptinite macerals have a moderate occurrence, and are mainly confined to the claystone clasts. The liptinites show a yellow/orange fluorescence in ultra-violet light.

B-250, 1692-1701m: Sandstone, Ro = 0.40(1), Sp.Fl. = 4-6.
This sample is mainly sandstone, although a few claystone clasts are present. Some particles of lignite are also present. Inertinite is the predominant maceral and traces of liptinite occur in the claystone clasts. The liptinite has a yellow/orange to mid-orange fluorescence in ultra-violet light. The former colour is predominant.

B-551, 1782-1791m: Sandstone, Ro = 0.46(6), Sp.Fl. = 3-4.
The sample consists mostly of white sandstone clasts with minor amounts of light grey claystone. Some lignite is also present. The organic matter is mostly inertinite, with vitrinite and liptinite largely restric-

ted to the claystone clasts. The liptinites have yellow to yellow/orange fluorescence in ultra-violet light.

B-559, 1854-1863m: Sandstone, Ro = 0.48(4), Sp.Fl. = 4.
The sample is mostly white sandstone with lesser amounts of brown or grey claystone. Vitrinite is relatively uncommon although liptinite appears to be quite common. In ultra-violet light, trace amounts of liptinite show fluorescence which is dominantly yellow/orange.

B-571, 1962-2025m: Claystone, Ro = 0.41(5), Sp.Fl. = 4.
This sample is mostly grey claystone. Organic matter is mostly represented by inertinite and reworked vitrinite. Indigenous vitrinite is often associated with liptinite. This can result in an artificially low reflectance value. The liptinites in the sample have a yellow/orange fluorescence in ultra-violet light.

B-586, 2097-2106m: Sandstone, Ro = 0.49(1), Sp.Fl. = 3-4.
The predominant lithology in this sample is sandstone with less common grey claystones. Pyrite is abundant in some claystone clasts. The vitrinite in the sample is largely reworked. Liptinites are present in moderate amounts and show yellow to yellow/orange fluorescence in ultra-violet light.

B-598, 2205-2214m: Sandstone, Ro = 0.44(5), Sp.Fl. = 3-4.
Sandstone is the predominant lithology in this sample. Some grey-brown claystone clasts are also present. Inertinite is the most common maceral in the sample. Liptinites are restricted to the claystone clasts. Only a small proportion of the liptinite shows a yellow to yellow/orange fluorescence in ultra-violet light.

B-607, 2286-2295m: Calcareous sandstone, Ro = 0.54(7), Sp.Fl. = 4.
The sample is mainly calcareous sandstone with occasional dark grey or brown claystone clasts. The organic matter in the sample is mostly inertinite. Vitrinite and liptinite are restricted to the claystone clasts. Liptinite macerals are abundant in the claystone clasts and have a yellow/orange fluorescence in ultra-violet light.

B-613, 2340-2349m: Sandstone, Ro = 0.53(3), Sp.Fl. = 3-4.
The sample is mostly white sandstone with some dark grey claystone clasts which may represent caved material. The organic matter is mainly inertinite and only traces of vitrinite and liptinite are present in the claystone clasts. The liptinite has a yellow to yellow/orange fluorescence in ultra-violet light.

B-623, 2430-2439m: Claystone, Ro = N.D.P., Sp.Fl. = 3.
This sample contains mostly red claystone clasts. The organic matter is generally altered and no indigenous vitrinite was seen. Some reworked vitrinite, liptinite and inertinite was found in a few grey claystone clasts. The trace amounts of liptinite have a yellow fluorescence in ultra-violet light.

B-629, 2484-2493m: Calcareous claystone, Ro = 0.44(1), Sp.Fl. = 3-4.
The sample is mostly red-brown, calcareous claystone. Very little organic matter is present in the sample and therefore little data can be obtained. Trace amounts of liptinite have been preserved which show a yellow to yellow/orange fluorescence in ultra-violet light.

CONCLUSIONS

Tertiary (466-1210m)

This comprises zones A, B, C, D, E and the upper part of zone F. The lithology and TOC have been discussed in the screening report. The whole Tertiary consists of various claystones with variable TOC values. Zone B (660-880m) shows good gas source potential. Zone C (880-970) shows very variable kerogen types ranging from a poor type IV to a type II/III kerogen. Hence this zone has a mixed oil and gas potential ranging from poor to good. Zone D (970-1220m) claystones contain type IV and type III kerogen with poor to fair gas potential. Zone E (1220-1320) shows a type IV kerogen with poor gas potential. The lowermost samples from the Tertiary (top zone F) show a very poor type IV kerogen with almost no potential for hydrocarbons. No further analyses were carried out on Tertiary samples. The whole of the Tertiary section in this well is immature as indicated by vitrinite reflectance, spore fluorescence and Rock-Eval T_{max}.

Cretaceous (1432-1475m)

The samples from the base of the zone F (1320-1476m) correspond to the Cretaceous in 31/5-2. The whole section appears to contain a very poor type IV kerogen with poor gas potential. In the screening report it was mentioned that the light hydrocarbon results are an indication of possible migrated hydrocarbons. The Rock-Eval results show high production indices for the samples and low T_{max} values. As none of the samples have been extracted it is not possible to say whether this is due to the presence of migrated hydrocarbons or contaminates but some non-indigenous hydrocarbons do appear to be present. It might be thought that these hydrocarbons are from the Kimmeridge Clay formation below but in this well the upper Jurassic is immature and the hydrocarbons if present must have been sourced outside the immediate area of the well (it is possible that the low TOC and nature of the kerogen has affected the production index values). Vitrinite reflectance, spore colouration and Rock-Eval T_{max} all indicate that the Cretaceous is immature.

Jurassic (1475-2336m)

Kimmeridge Clay Formation and Sognefjord formation (1475-1957m)

This corresponds zones G and H although all further analyses were on samples from zone G which includes only the upper part of the

Sognefjord Fm. Rock-Eval results indicate a type II/III kerogen for the whole of zone G decreasing in hydrogen richness slightly in the upper Sognefjord formation. The pyrolysis gc results from the upper Kimmeridge Clay formation indicate a type II kerogen for the upper Kimmeridge Clay fm. and II/III from the core samples from further down the Fm. Visual kerogen analysis indicates a large amount of terrestrial organic matter in all the samples, including those recorded as type II from pyrolysis gc results. Marine algal material is also evident, e.g. Tasmanites in the zone G samples.

The whole zone is immature as indicated by spore colouration index, vitrinite reflectance, spore fluorescence and Rock-Eval T_{max}. There is a good oil and gas potential in the Kimmeridge Clay Formation and upper Sognefjord Formation however the entire section is of very low maturity in this well. It has been mentioned that some of the vitrinite reflectance measurements may be too low as large amounts of liptinite associated with the vitrinite in some samples and this may have affected the reflectance. However, there is little doubt that the zone is immature from the evidence of other analyses.

There is some evidence of non-indigenous hydrocarbons in zone G. Especially towards the top of the Kimmeridge Clay formation where extraction data and capillary gc analyses indicate the presence of migrated hydrocarbons. It will be remembered that the light hydrocarbon analyses from min screening report indicated the presence of migrated light hydrocarbons in the upper Kimmeridge Clay Formation and lower Cretaceous.

There were no further analyses requested in the lower part of the Sognefjord formation (IKU zones H and upper part of zone I). Three samples, predominantly sandstone were subjected to Rock-Eval pyrolysis. The results probably reflect the kerogen content and source potential of caved upper Sognefjord or Kimmeridge Clay formation claystones. These form only a small part (ca. 5%) of the cuttings from the lower Sognefjord Fm. The results show a type II/III kerogen with good oil and gas potential but this is not a realistic prediction for the Sognefjord formation sandstone. This sand however appears to contain migrated light hydrocarbons (see C_1-C_7 hydrocarbon tables in screening reports). Samples B-561 - B-569 (1881-1953) show evidence of the presence of more mature light hydrocarbons.

Brent Group (1957-2037m)

No further analyses were requested apart from vitrinite reflectance and spore fluorescence on samples from the Brent. As stated in the screening report the coals and carbonaceous claystones may have good source potential. No Rock-Eval data is available for these samples. The entire Brent Group is assumed to be immature as the samples from above and below it and sample B-571 shows a reflectance of 0.41% (spore fluorescence 4).

Dunlin Group (2037-2336m)

This corresponds to IKU zones. I (lower part), J, K and L. Further analyses on 6 samples from the Dunlin Group were requested plus extra Rock-Eval and TOC analyses. Kerogen type and hydrocarbon potential are very variable in the Dunlin Group. From Rock-Eval results and py-gc the upper part of the Dunlin Group shows a type II/III kerogen with good oil and gas potential (corresponds with IKU zone I). Below this in zone J there is a predominantly type III kerogen with fair to good gas potential (the sample at 2097m, B-585, shows good potential for oil and gas and a more hydrogen rich type III/II kerogen). The lower 2 zones in the Dunlin Group show very variable kerogen types from very poor type IV to hydrogen rich type II/III kerogen, and hydrocarbon potential is accordingly mixed. These results are supported by the visual kerogen analyses, which indicate considerable marine algal input in samples with type II/III kerogens. The extraction data also indicate a mixed terrestrial and marine input to the organic matter in the Dunlin Group. However towards the base especially in the bottom two samples extracted (B-596 and B-598) there is a large amount of unresolvable material either a natural residue or contamination by pipe dope. In the lowest sample (B-598) the effects of these non-indigenous compounds on the gas chromatograms have exacerbated by the low content of indigenous bitumen. Rock-Eval T_{max}, spore colouration, spore fluorescence and vitrinite reflectance indicate low maturity.

There is little evidence of the presence of migrated hydrocarbons. The light hydrocarbon analyses in the screening report indicate the presence of more mature light hydrocarbons in sample B-582-583 but not in any samples above or below this.

Statfjord Formation (2336-2393m)

This corresponds to the lower part of zone L. No further analyses were carried out. Vitrinite reflectance and spore fluorescence indicate that the formation is immature (0.5% Ro, spore fluorescence 3-4). The zone consists mainly of sandstone. The claystone present may represent caved material. The source potential based on the TOC of the claystones is fair.

Triassic (2393-2493m)

No further analyses were carried out. Vitrinite reflectance and spore fluorescence indicate that the sediments are immature. Source potential (based on TOC only) is very poor.

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 31/5-1

Sample	Depth (m)	TOC	Lithology
B-124	466-470		90% Cement 10 Metamorphic and plutonic rock fragments
B-126	480-490		70% Metamorphic and plutonic rock fragments 30% Cement Sm.am. Shell fragments
B-128	500-510		50% Sand 50% Metamorphic and plutonic rock fragments Sm.am. Shell fragments
B-130	520-530		70% Metamorphic and plutonic rock fragments 30% Sand Sm.am. Shell fragments; Pyrite
B-134	560-570		90% Metamorphic and plutonic rock fragments 10% Sand Sm.am. Sideritic limestone; Tuff; Shell fragments
B-136	570-580		60% Metamorphic and plutonic rock fragments 40% Sand Sm.am. Shell fragments; Tuff; Limestone (occasionally sideritic)
B-138	600-610		50% Sand 50% Metamorphic and plutonic rock fragments Sm.am. Limestone; Shell fragments; Tuff
B-140	620-630		60% Sand 40% Metamorphic and plutonic rock fragments Sm.am. Glauconite (abundant); Shell fragments; Claystone; Limestone; Tuff

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 31/5-1

Sample	Depth (m)	TOC	Lithology
B-142	640-660		70% Sand 30% Metamorphic and plutonic rock fragments Sm.am. Glauconite; Shell fragments
B-144	660-670	1.38	60% Claystone, light brownish grey, silty, micaceous, calcareous 20% Sand 20% Metamorphic and plutonic rock fragments Sm.am. Glauconite; Shell fragments
B-147	690-700	1.72	70% Claystone, as above 10% Sand 20% Metamorphic and plutonic rock fragments Sm.am. Glauconite; Shell fragments
B-148	700-710	1.94	60% Claystone, as above 20% Sand 20% Metamorphic and plutonic rock fragments Sm.am. Glauconite; Shell fragments; Limestone, brownish grey
B-150	720-730	1.91	100% Claystone, as above Sm.am. Sand; Rock fragments; Glauconite
B-152	740-750	1.77	95% Claystone, as above 5% Limestone, as above Sm.am. Sand; Metamorphic and plutonic rock fragments; Glauconite
B-154	760-770	1.80	100% Claystone, as above Sm.am. Limestone, as above; Plutonic and metamorphic rock fragments; Pyrite

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 31/5-1

Sample	Depth (m)	TOC	Lithology
B-156	780-790	1.86	100% Claystone, as above Sm.am. Limestone, as above; Pyrite; Metamorphic and plutonic rock fragments (trace)
B-158	800-810	1.63	100% Claystone, as above Sm.am. Metamorphic and plutonic rock fragments
B-161	830-840	1.71	100% Claystone, as above, locally silty, micaceous, glauconitic Sm.am. Rock fragments; Glauconite
B-162	840-850	1.48	100% Claystone, as above, with some glauconite Sm.am. Metamorphic and plutonic rock fragments; Glauconite, metamorphic and plutonic rock fragments
B-164	860-870	0.61	80% Claystone, brownish white, white, occasionally very glauconitic 15% Claystone, silty, brownish grey 5% Glauconite, green
B-166	880-890	2.04	95% Claystone, brownish grey to brown, occasionally dark, micaceous 5% Claystone, brownish white, glauconitic Sm.am. Glauconite; Sideritic limestone
B-167	890-900	1.93 0.47	60% Claystone, brownish grey, slity, partly micaceous 30% Siderite/Sideritic Limestone, yellowish brown, dark yellowish brown 5% Claystone, brownish white Sm.am. Glauconite

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 31/5-1

Sample	Depth (m)	TOC	Lithology
B-168	900-910	2.26	90% Claystone, brownish grey to brown, occasionally dark 5% Claystone, brownish white 5% Limestone, brownish grey, sideritic Sm.am. Glauconite; Pyrite; Siderite

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 31/5-2

Sample	Depth (m)	TOC	Lithology
B-169	910-920	2.53	80% Claystone, brownish grey - dark brown, silty, slightly micromicaceous 20% Sideritic Limestone/Siderite, yellowish brown, olive black Sm.am. Pyrite (abundant); Glauconite; Claystone (brownish white); Sand
B-170	920-930	2.60	90% Claystone, dark brownish grey to dark brown, micaceous 10% Sideritic limestone, blocky Sm.am. Siderite; Glauconite; Pyrite
B-171	930-940	3.17	95% Claystone, dark brownish grey - dark brownish 5% Sideritic Limestone/Siderite, brownish white - dark brown Sm.am. Sand; Glauconite; Pyrite
B-172	940-950	3.69	90% Claystone, dark brown to dark brownish grey, micaceous 10% Sideritic limestone, brownish white to dark brown Sm.am. Siderite; Pyrite; Glauconite (rare)
B-173	950-960	3.04	90% Claystone, dark brownish grey, dark brown 10% Sideritic Limestone/Siderite, as above Sm.am. Glauconite; Pyrite
B-175	970-980	0.61	90% Claystone, light greenish grey, occasionally green 10% Claystone, dark brown to dark brownish grey, micaceous Sm.am. Siderite; Pyrite; Glauconite

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 31/5-2

Sample	Depth (m)	TOC	Lithology
B-177	990-1000	0.51	100% Claystone, light greenish grey Sm.am. Claystone, dark brownish grey
B-178	1000-1010	0.42	100% Claystone, light greenish grey Sm.am. Claystone, dark brown, dark brownish grey; Pyrite
B-180	1020-1030	0.43	100% Claystone, light greenish grey Sm.am. Claystone, dark brown, dark brownish grey
B-182	1040-1050	0.64	100% Claystone, light greenish grey Sm.am. Claystone, dark brownish grey, dark brown; Limestone and sideritic limestone
B-184	1060-1070	0.71	100% Claystone, light greenish grey Sm.am. Claystone, dark brownish grey
B-186	1080-1090	0.91	100% Claystone, light greenish grey, occasionally light brownish grey Sm.am. Claystone, dark brownish grey, dark brown
B-188	1100-1110	1.26	100% Claystone, light greenish grey to light brownish grey Sm.am. Claystone, dark brownish grey
B-190	1120-1130	1.60	95% Claystone, light greenish grey to light brownish grey 5% Claystone, dark brown to dark brownish grey Sm.am. Siderite
B-192	1140-1150	1.16	95% Claystone, light greenish grey to light brownish grey 5% Claystone, brownish grey to dark brownish grey

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 31/5-2

Sample	Depth (m)	TOC		Lithology
B-196	1150-1160	0.76	95%	Claystone, light greenish grey to light brownish grey
			5%	Claystone, brownish grey to dark brownish grey
			Sm.am.	Casing cement; Glauconite
B-194	1170-1180	0.62	95%	Claystone, light greenish grey to light brownish grey
			5%	Claystone, brownish grey to dark brownish grey
			Sm.am.	Pyrite; Glauconite
B-198	1200-1210	0.43	75%	Claystone, light greenish grey to light brownish grey
		0.00	10%	Claystone, reddish brown
		0.00	10%	Claystone, pink to purple
			5%	Claystone, grey
B-200	1220-1230	1.48	100%	Claystone, grey, micaceous, occasionally silty
			Sm.am.	Claystone, light greenish grey, light brownish grey; Limestone, sideritic; Glauconite
B-202	1240-1250	1.38	95%	Claystone, light brownish grey to brownish grey, occasionally grey to light grey
			5%	Claystone, dark brownish grey
			Sm.am.	Tuff; Pyrite; Siderite
B-204	1260-1270	1.16	90%	Claystone, light brownish grey to brownish grey, occasionally light grey to grey
		0.55	10%	Claystone, dark grey to dark brownish grey
			Sm.am.	Tuff

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 31/5-2

Sample	Depth (m)	TOC		Lithology
B-206	1280-1290	1.04	95%	Claystone, light grey to grey, light brownish grey to brownish grey to brownish grey
			5%	Claystone, dark grey, dark brownish grey
			Sm.am.	Claystone, light greenish grey, off-white; Tuff; Limestone
B-206	1280-1290		85%	Claystone, light grey to grey, light brownish grey to grey
			15%	Claystone, dark grey, dark brownish grey
			Sm.am.	Claystone, light greenish grey; Tuff; Siderite
B-208	1300-1310	1.18	100%	Claystone, light grey to grey, light brownish grey to brownish grey
			Sm.am.	Claystone, dark grey; Tuff; Pyrite
B-210	1320-1330	0.39	100%	Claystone, light grey, non-micaceous
			Sm.am.	Pyrite; Tuff; Claystone, dark grey
B-212	1340-1350	0.30	100%	Claystone, light grey
			Sm.am.	Various other claystones; Pyrite; Tuff
B-214	1360-1370	0.27	60%	Claystone, light greenish grey
		0.23	40%	Claystone, light brownish grey
			Sm.am.	Various other claystones; Sideritic limestone; Limestone
B-216	1380-1390	0.27	50%	Claystone, greenish grey to light greenish grey, grey to light grey
		0.31	50%	Claystone, brownish grey to light brownish grey
			Sm.am.	Limestone; Chalk, white; ?Tuff

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 31/5-2

Sample	Depth (m)	TOC	Lithology
B-218	1400-1410	0.37 0.53	50% Claystone, grey to greenish grey 50% Claystone, brownish grey Sm.am. Chalk; Limestone, Siderite
B-220	1420-1430	0.51 0.63	50% Claystone, grey to greenish grey 50% Claystone, brownish grey Sm.am. Claystone, off-white; Limestone, sideritic; Tuff
B-221	1431-1440	0.49	50% Claystone, grey - greenish grey 50% Casing Cement Sm.am. Claystone, brownish grey
B-222	1440-1449	0.53	75% Claystone, grey to greenish grey 20% Sandstone, white, glauconitic 5% Claystone, brownish grey Sm.am. Limestone, sideritic
B-223	1449-1458	 0.50	50% Marl, white, light grey 50% Claystone, grey (greenish grey)
B-224	1458-1467	0.26	90% Marl, white to light grey, occasionally light greenish grey 10% Claystone, grey, brownish grey, occasionally glauconitic Sm.am. Pyrite
B-225	1467-1476	0.27 0.56	80% Marl, white - light grey 20% Claystone, grey, greenish grey, light brownish grey

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 31/5-2

Sample	Depth (m)	TOC	Lithology
B-226	1476-1485	3.83	70% Claystone, grey to dark grey 20% Claystone, light green 10% Marl, as above Sm.am. Pyrite
B-227	1485-1494	2.53	80% Claystone, grey - dark grey 15% Marl, as above 5% Claystone, light green Sm.am. Limestone
B-228	1494-1503	2.84	90% Claystone, grey to dark grey 5% Claystone, light green Sm.am. Marl, as above; Pyrite
B-229	1503-1512	2.66	90% Claystone, grey - dark grey 5% Claystone, light green 5% Marl, as above
			CORES
B-2319	1506.40	1.89	Claystone, medium grey - medium dark grey, silty, slightly micromicaceous, non-calcareous
B-2320	1509.40	2.94	Claystone, medium dark grey, silty, slightly micromicaceous, non-calcareous, fissile
B-2321	1516.35	4.61	Claystone, medium dark grey, silty, slightly micromicaceous, partly micropyritic, non-calcareous, fissile
B-230	1512-1521	2.94	90% Claystone, grey to dark grey 5% Claystone, light green, light brownish grey 5% Marl, white

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 31/5-2

Sample	Depth (m)	TOC	Lithology
B-231	1521-1530	2.51	90% Claystone, grey - dark grey 5% Marl 5% Sand, fine - coarse
B-232	1530-1539	2.78	90% Claystone, grey to dark grey 10% Marl, white to greenish and brownish white
B-234	1548-1557	2.79	40% Claystone, grey to dark grey 60% Sandstone
B-236	1566-1575	2.81	60% Sandstone 40% Claystone, grey to dark grey
B-238	1584-1593	2.68	70% Sandstone 30% Claystone, as above
B-240	1602-1611	3.03	80% Claystone, grey to dark grey 20% Sandstone Sm.am. Claystone, light grey; Marl
B-242	1620-1629	2.18	60% Sandstone, occasionally well cemented, occasionally gravelly 40% Claystone, grey to dark grey Sm.am. Pyrite
B-244	1638-1647	3.17	80% Sandstone, well cemented 20% Claystone, grey to dark grey Sm.am. Marl
B-246	1656-1665	2.74 0.20	80% Sandstone 10% Claystone, grey to dark grey 10% Claystone, greenish white

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 31/5-2

Sample	Depth (m)	TOC	Lithology
B-248	1674-1683		90% Sandstone 5% Claystone, grey to dark grey 5% Claystone, light grey
B-250	1692-1701		90% Sandstone 5% Claystone, grey to dark grey 5% Claystone, light green, light grey Sm.am. Coal
B-252	1710-1719		100% Sandstone, loose Sm.am. Claystone, light green, light grey, white; Claystone, dark grey to grey
B-254	1728-1737	2.83	90% Sandstone 10% Claystone, grey to dark grey Sm.am. Claystone, light grey
B-256	1746-1755		90% Sandstone 5% Claystone, light grey, light green 5% Claystone, grey to dark grey Sm.am. Pyrite
B-258	1764-1773		95% Sandstone 5% Claystone, grey to dark grey Sm.am. Claystone, light green, light grey
B-551	1782-1791		95% Sandstone 5% Claystone, grey to dark grey Sm.am. Coal; Pyrite
B-553	1800-1809		95% Sandstone 5% Claystone, grey to dark grey Sm.am. Coal

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 31/5-2

Sample	Depth (m)	TOC	Lithology
B-555	1818-1827		90% Sandstone 5% Claystone, grey to dark grey 5% Claystone, light grey
B-557	1836-1845		95% Sandstone 5% Claystone, light grey Sm.am. Claystone, grey to dark grey
B-557	1836-1845		90% Sandstone 5% Claystone, light grey to white 5% Claystone, grey to dark grey
B-559	1854-1863		100% Sandstone Sm.am. Claystone, grey to dark grey; Pyrite
B-561	1872-1881		100% Sandstone Sm.am. Claystone, grey to dark grey
B-563	1890-1899		100% Sandstone, ver coarse to gravelly Sm.am. Claystone, dark grey
B-565	1908-1917		100% Sandstone, very coarse Sm.am. Claystone, dark grey
B-566	1917-1926		100% Sand, fine - very coarse Sm.am. Claystone, dark grey
B-567	1926-1935	2.64	60% Claystone, grey to brownish grey 40% Sandstone Sm.am. Claystone, light grey, light green

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 31/5-2

Sample	Depth (m)	TOC	Lithology
B-569	1944-1953	1.29	55% Claystone, grey to brownish grey
			40% Sandstone
			5% Claystone, dark grey
			Sm.am. Coal
B-571	1962-1971		60% Casing cement
			20% Coal, mainly black
			15% Sandstone
			5% Claystone, light grey to white
			Sm.am. Claystone, dark grey
B-573	1980-1989		30% Sandstone
		1.72	20% Claystone, brownish grey to grey
			20% Coal
			20% Casing cement
			Sm.am. Steel shavings
B-575	1998-2007	1.16	80% Claystone, brownish grey, waxy
			5% Claystone, light green to white
			5% Claystone, grey to dark grey
			10% Coal, black shiny
			Sm.am. Sandstone
B-577	2016-2025		60% Sandstone
		1.88	15% Claystone, brownish grey
			5% Claystone, grey to dark
			5% Coal
			5% Casing cement
B-579	2034-2043		60% Sandstone
			20% Casing cement
		2.44	10% Claystone, grey to dark grey
		2.71	10% Claystone, brownish grey
			Sm.am. Coal; Pyrite

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 31/5-2

Sample	Depth (m)	TOC	Lithology
B-580	2043-2052	2.38	50% Claystone, brownish grey - dark grey
			45% Sand/Sandstone
			5% Claystone, grey
B-581	2052-2061	2.03	60% Claystone, brownish grey
			20% Casing cement
			10% Sandstone
			5% Claystone, grey
			5% Claystone, dark grey
			Sm.am. Pyrite; Coal
B-582	2061-2070		50% Sandstone, white, calcite cemented
		2.24	20% Claystone, dark grey, dark brownish grey
		0.56	25% Claystone, light grey - light brownish grey
			5% Casing Cement
			Sm.am. Coal
B-583	2070-2079		70% Sandstone, well cemented
		0.96	20% Claystone, light grey, light brownish grey
		2.16	10% Claystone, dark grey, dark brownish grey
			Sm.am. Coal; Pyrite
B-584	2079-2088		85% Sandstone, white, very calcareous
			10% Claystone, light grey - light brownish grey
			5% Claystone, dark grey, dark brownish grey
			Sm.am. Coal
B-585	2088-2097		80% Sandstone, as above
			15% Claystone, light grey, light brownish grey
		3.04	5% Claystone, dark grey, dark brownish grey
B-586	2097-2106		95% Sandstone, very calcareous
			5% Claystone, light brownish grey
			Sm.am. Coal

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 31/5-2

Sample	Depth (m)	TOC	Lithology
B-587	2106-2115	0.84	90% Sandstone, well cemented 10% Claystone, light grey, light brownish grey Sm.am. Claystone, dark brown, dark brownish grey; Coal
B-588	2115-2124	1.45	50% Claystone - Mudstone, grey, micaceous 50% Sandstone Sm.am. Casing cement; Claystone (dark grey)
B-589	2124-2133	1.48	60% Claystone, grey, occasionally silty 35% Sandstone, well cemented 5% Claystone, dark grey Sm.am. Limestone
B-590	2133-2142	1.82	90% Claystone, grey - brownish grey, silty, partly very silty 10% Sandstone Sm.am. Casing cement, coal
B-591	2142-2151	2.16	90% Claystone, dark grey, micaceous 10% Sandstone, as above Sm.am. Claystone, dark grey; Claystone, light grey
B-592	2151-2160	1.45	80% Claystone, dark grey, dark brownish grey 10% Claystone, Mudstone, grey 10% Sandstone Sm.am. Casing cement
B-593	2160-2169	1.56	90% Claystone, dark grey 10% Claystone, light grey, light brown Sm.am. Chalk; Coal
B-594	2169-2178		95% Sandstone, calcite cemented 5% Claystone, dark grey - dark brownish grey

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 31/5-2

Sample	Depth (m)	TOC	Lithology
B-595	2178-2187	0.24	95% Sandstone, well cemented 5% Claystone, dark grey, dark brownish grey Sm.am. Claystone, grey; Coal
B-596	2187-2196	0.00	95% Sandstone, as above 5% Claystone, as above Sm.am. Coal
B-597	2196-2205	1.73	90% Sandstone, as above 5% Claystone, grey, silty 5% Claystone, dark grey, dark brownish grey, silty Sm.am. Coal
B-598	2205-2214	0.64	90% Sandstone, as above 5% Siltstone, Mudstone, grey 5% Claystone, as above Sm.am. Coal
B-599	2214-2223	0.74	85% Sandstone, as above, occasionally grading to Siltstone 10% Claystone, grey, silty 5% Claystone, dark grey Sm.am. Coal
B-601	2232-2241	0.68	85% Sandstone, brownish grey 15% Claystone, brownish grey, waxy Sm.am. Coal
B-603	2250-2259	0.80	90% Sandstone 10% Claystone, brownish grey to grey, waxy

IKU

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 31/5-2

Sample	Depth (m)	TOC	Lithology
B-605	2268-2277	0.82	55% Claystone, grey to brownish grey
			40% Sandstone, coarse, loose
			5% Claystone, dark grey, dark brownish grey
			Sm.am. Coal
B-607	2286-2295		95% Sandstone, as above
		2.24	5% Claystone, brownish grey
			Sm.am. Coal
B-609	2304-2313		95% Sandstone
		0.91	5% Claystone, grey, brownish grey
			Sm.am. Claystone, light grey, light brownish grey; Coal
B-611	2322-2331		90% Sandstone, occasionally well cemented
			5% Claystone, grey to brownish grey
			5% Claystone, dark grey, dark brownish grey
B-613	2340-2349		85% Sandstone, coarse
		37.12	10% Claystone, dark grey, dark brownish grey
			5% Coal
B-615	2358-2367		40% Coal, black, shiny
			30% Sandstone, as above
		17.03	20% Claystone, dark grey, dark brownish grey, carbonaceous
		1.01	10% Claystone, grey, brownish grey
B-617	2376-2385		60% Sandstone, as above
		1.63	30% Claystone, brownish grey, occasionally grey
			5% Claystone, dark grey, dark brownish grey
			5% Coal

Lithology and Total Organic Carbon measurements

TABLE NO.: 1.
WELL NO.: 31/5-2

Sample	Depth (m)	TOC	Lithology
B-619	2394-2403	0.72	80% Claystone, brownish grey, occasionally grey 20% Sandstone, as above Sm.am. Chalk; Coal; Claystone, reddish brown
B-621	2412-2421	0.33 0.54	80% Claystone, brownish grey, occasionally grey 20% Claystone, multicoloured, including reddish brown, reddish grey, yellow, olive green Sm.am. Coal; Claystone, dark brownish grey
B-623	2430-2439	0.45	100% Claystone, multicoloured, including reddish brown, grey, brownish grey, yellow, purple, olive green Sm.am. Chalk; Claystone, dark brownish grey
B-625	2448-2457	0.49 0.76	70% Claystone, reddish brown, grey, olive green, yellow 20% Claystone, grey, brownish grey 10% Sandstone
B-627	2466-2475	0.17 0.38	80% Claystone, reddish brown, yellow, olive green, occasionally silty 20% Claystone, grey, brownish grey Sm.am. Coal; Chalk; Claystone, dark brownish grey
B-629	2484-2493	0.00 0.65	90% Claystone, reddish brown, reddish grey 10% Claystone, light grey, grey, light brownish grey Sm.am. Chalk

TABLE : 2.

CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

IKU-No	DEPTH (m)	Rock Extr. (g)	EOM (mg)	Sat. (mg)	Aro. (mg)	HC (mg)	Non HC (mg)	TOC (%)
B 226	1485	9.7	12.2	4.8	0.5	5.3	6.9	3.16
B 228	1503	22.5	12.0	8.6	1.2	9.8	2.2	2.53
B 230	1521	24.1	13.7	1.6	2.5	4.1	9.6	2.50
B 580 -81	2043 -2061	5.8	11.7	4.1	3.6	7.7	4.0	2.65
B 582 -83	2061 -2079	11.0	6.6	5.2	1.2	6.4	0.2	2.80
B 586 -88	2097 -2124	6.9	3.0	0.2	0.2	0.5	2.5	1.15
B 591	2151	12.5	13.2	3.5	3.2	6.7	6.5	2.08
B 596	2196	18.3	1.2	0.5	0.6	1.1	0.1	0.00
B 598	2214	10.0	14.5	5.0	3.1	8.2	6.3	0.64

DATE : 8 - 3 - 84.

TABLE : 3.

WEIGHT OF EOM AND CHROMATOGRAPHIC FRACTIONS

(Weight ppm OF rock)

IKU-No	DEPTH (m)	EOM	Sat.	Aro.	HC	Non HC
B 226	1485	1258	495	49	544	713
B 228	1503	535	385	53	438	96
B 230	1521	568	65	104	169	399
B 580 -81	2043 -2061	2031	708	625	1333	698
B 582 -83	2061 -2079	601	470	113	583	18
B 586 -88	2097 -2124	432	35	35	69	363
B 591	2151	1053	278	259	536	517
B 596	2196	66	27	33	60	5
B 598	2214	1450	504	312	816	634

DATE : 8 - 3 - 84.

TABLE : 4.

CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

(mg/g TOC)

IKU-No	DEPTH (m)	EOM	Sat.	Aro.	HC	Non HC
B 226	1485	39.8	15.7	1.6	17.2	22.6
B 228	1503	21.1	15.2	2.1	17.3	3.8
B 230	1521	22.7	2.6	4.2	6.8	16.0
B 580 -81	2043 -2061	76.7	26.7	23.6	50.3	26.3
B 582 -83	2061 -2079	21.5	16.8	4.0	20.8	0.7
B 586 -88	2097 -2124	37.6	3.0	3.0	6.0	31.6
B 591	2151	50.6	13.4	12.4	25.8	24.9
B 596	2196	6557.4	2732.2	3278.7	6010.9	546.4
B 598	2214	226.6	78.8	48.8	127.5	99.1

DATE : 8 - 3 - 84.

T A B L E : 5.

COMPOSITION IN % OF MATERIAL EXTRACTED FROM THE ROCK

IKU-No	DEPTH (m)	Sat / EOM	Aro / EOM	HC / EOM	SAT / Aro	Non HC / EOM	HC / Non HC
B 226	1485	39.3	3.9	43.3	1000.0	56.7	76.3
B 228	1503	72.0	10.0	82.0	720.0	18.0	455.6
B 230	1521	11.4	18.4	29.8	61.9	70.2	42.4
B 580 -81	2043 -2061	34.9	30.8	65.6	113.3	34.4	191.0
B 582 -83	2061 -2079	78.2	18.8	97.0	416.1	3.0	3200.0
B 586 -88	2097 -2124	8.0	8.0	16.0	100.0	84.0	19.0
B 591	2151	26.4	24.5	50.9	107.4	49.1	103.7
B 596	2196	41.7	50.0	91.7	83.3	8.3	1100.0
B 598	2214	34.8	21.5	56.3	161.5	43.7	128.7

DATE : 8 - 3 - 84.

T A B L E 6.

TABULATION OF DATA FROM THE GASCHROMATOGRAMS

IKU No.	DEPTH (m)	PRISTANE / n-C17	PRISTANE / PHYTANE	CPI
B 226	1485	0.6	0.8	1.1
B 228	1503	1.8	0.6	1.7
B 230	1521	1.4	0.7	1.3
B 580 +81	2043 -2061	0.6	2.0	2.4
B 582 +83	2061 -2079	0.7	3.4	3.1
B 586 +88	2097 -2124	0.8	2.1	2.2
B 591	2151	1.5	1.7	2.0
B 596	2196	0.5	1.4	1.4
B 598	2214	0.6	1.6	0.8

DATE : 13 - 3 - 84.

TABLE 7.

DATA FROM ROCK EVAL PYROLYSIS

IKU No.	DEPTH m/ft	S1	S2	S3	TOC (%)	HYDR. INDEX	OXYGEN INDEX	PETROLEUM POTENTIAL S1+S2	PROD. INDEX S1/S1+S2	TEMP. MAX (C)
B 144	670	0.39	1.51	1.48	1.38	109	107	1.90	0.21	415
		Clst	lt -brn - gy							
B 147	700	0.51	2.20	1.51	1.72	128	88	2.71	0.19	415
		Clst	lt -brn - gy							
B 148	710	0.61	3.64	1.86	1.94	188	96	4.25	0.14	404
		Clst	lt -brn - gy							
B 150	730	0.54	3.51	2.01	1.91	184	105	4.05	0.13	413
		Clst	lt -brn - gy							
B 152	750	0.47	1.98	1.83	1.77	112	103	2.45	0.19	415
		Clst	lt -brn - gy							
B 154	770	0.43	2.94	1.66	1.80	163	92	3.37	0.13	413
		Clst	lt -brn - gy							
B 156	790	0.50	2.43	2.12	1.86	131	114	2.93	0.17	424
		Clst	lt -brn - gy							
B 158	810	0.36	2.00	1.76	1.63	123	108	2.36	0.15	422
		Clst	lt -brn - gy							
B 161	840	0.33	1.94	2.27	1.71	113	133	2.27	0.15	421
		Clst	lt -brn - gy							
B 162	850	0.44	1.70	1.52	1.48	115	103	2.14	0.21	423
		Clst	lt -brn - gy							
B 164	870	0.37	0.37	9.17	0.61	61	1503	0.74	0.50	419
		Clst	brn - wh							
B 166	890	0.36	1.31	1.71	2.04	64	84	1.67	0.22	427
		Clst	brn - gy							
B 167	900	0.16	1.64	3.05	1.93	85	158	1.80	0.09	432
		Clst	brn - gy							
B 168	910	0.47	1.74	2.32	2.26	77	103	2.21	0.21	421
		Clst	brn - gy							
B 169	920	0.23	3.61	2.44	2.53	143	96	3.84	0.06	428
		Clst	dk -brn - gy							
B 170	930	0.45	2.10	2.64	2.60	81	102	2.55	0.18	425
		Clst	dk -brn - gy							
B 171	940	0.27	4.78	3.87	3.17	151	122	5.05	0.05	428
		Clst	dk -brn - gy							
B 172	950	0.46	4.42	2.46	3.69	120	67	4.88	0.09	428
		Clst	dk -brn - gy							
B 173	960	0.25	6.23	3.22	3.04	205	106	6.48	0.04	428
		Clst	dk -brn - gy							
B 175	980	0.36	0.25	1.44	0.61	41	236	0.61	0.59	413
		Clst	lt - gn - gy							
B 177	1000	0.16	0.16	0.86	0.51	31	169	0.32	0.50	417
		Clst	lt - gn - gy							
B 178	1010	0.35	0.19	1.22	0.42	45	290	0.54	0.65	414
		Clst	lt - gn - gy							
B 180	1030	0.30	0.31	1.13	0.43	72	263	0.61	0.49	383
		Clst	lt - gn - gy							

DATE : 7 - 3 - 84.

TABLE 7.

D A T A   F R O M   R O C K   E V A L   P Y R O L Y S I S

IKU No.	DEPTH m/ft	S1	S2	S3	TOC (%)	HYDR. INDEX	OXYGEN INDEX	PETROLEUM POTENTIAL S1+S2	PROD. INDEX S1 / S1+S2	TEMP. MAX (C)
B 182	1050	0.13	0.30	0.97	0.64	47	152	0.43	0.30	409
		Clst	lt - gn - gy							
B 184	1070	0.18	0.38	1.14	0.71	54	161	0.56	0.32	396
		Clst	lt - gn - gy							
B 186	1090	0.10	0.49	1.08	0.91	54	119	0.59	0.17	396
		Clst	lt - gn - gy							
B 188	1110	0.32	1.01	1.10	1.26	80	87	1.33	0.24	420
		Clst	lt - gn - gy							
B 190	1130	0.27	2.00	1.02	1.60	125	64	2.27	0.12	425
		Clst	lt - gn - gy							
B 192	1150	0.17	0.92	1.18	1.16	79	102	1.09	0.16	406
		Clst	lt - gn - gy							
B 196	1160	0.20	0.32	2.53	0.76	42	333	0.52	0.38	399
		Clst	lt - gn - gy							
B 194	1180	0.14	0.29	1.40	0.62	47	226	0.43	0.33	392
		Clst	lt - gn - gy							
B 198	1210	0.05	0.14	0.68	0.43	33	158	0.19	0.26	419
		Clst	lt - gn - gy							
B 200	1230	0.10	1.04	0.72	1.48	70	49	1.14	0.09	424
		Clst	gy							
B 202	1250	0.12	0.68	0.99	1.38	49	72	0.80	0.15	408
		Clst	lt -brn - gy							
B 204	1270	0.14	0.61	1.03	1.16	53	89	0.75	0.19	417
		Clst	lt -brn - gy							
B 206	1290	0.16	0.40	0.99	1.04	38	95	0.56	0.29	409
		Clst	lt -brn - gy							
B 208	1310	0.19	0.92	1.03	1.18	78	87	1.11	0.17	404
		Clst	lt -brn - gy							
B 210	1330	0.00	0.00	0.85	0.39	0	218	0.00	******	428
		Clst	lt - gy							
B 212	1350	0.13	0.07	0.68	0.30	23	227	0.20	0.65	350
		Clst	lt - gy							
B 214	1370	0.15	0.02	0.94	0.27	7	348	0.17	0.88	382
		Clst	lt - gn - gy							
B 216	1390	0.13	0.06	0.64	0.31	19	206	0.19	0.68	339
		Clst	lt -brn - gy							
B 218	1410	0.22	0.07	0.78	0.53	13	147	0.29	0.76	383
		Clst	brn - gy							
B 220	1430	0.09	0.11	0.65	0.63	17	103	0.20	0.45	418
		Clst	brn - gy							
B 221	1440	0.18	0.14	2.24	0.49	29	457	0.32	0.56	425
		Clst	gy - gn - gy							
B 222	1449	0.13	0.07	0.73	0.53	13	138	0.20	0.65	419
		Clst	gy - gn - gy							
B 223	1458	0.13	0.09	0.57	0.50	18	114	0.22	0.59	423
		Clst	gy							

DATE : 7 - 3 - 84.

TABLE 7.

D A T A   F R O M   R O C K   E V A L   P Y R O L Y S I S

IKU No.	DEPTH m/ft	S1	S2	S3	TOC (%)	HYDR. INDEX	OXYGEN INDEX	PETROLEUM POTENTIAL S1+S2	PROD. INDEX S1/S1+S2	TEMP. MAX (C)
B 224	1467	0.13	0.03	0.46	0.26	12	177	0.16	0.81	268
B 225	1476	0.19	0.09	0.83	0.56	16	148	0.28	0.68	391
		Clst gy - gn - gy								
B 226	1485	0.42	15.38	0.95	3.83	402	25	15.80	0.03	423
		Clst gy - dk - gy								
B 227	1494	0.24	9.32	0.72	2.53	368	28	9.56	0.03	428
		Clst gy - dk - gy								
B 228	1503	0.23	9.18	0.68	2.84	323	24	9.41	0.02	429
		Clst gy - dk - gy								
B 2319	1506.40	0.28	5.08	0.24	1.89	269	13	5.36	0.05	433
		CORE								
B 2320	1509.40	0.46	10.93	0.62	2.94	372	21	11.39	0.04	426
		CORE								
B 229	1512	0.32	9.97	0.78	2.66	375	29	10.29	0.03	430
		Clst gy - dk - gy								
B 2321	1516.35	1.44	18.39	0.61	4.61	399	13	19.83	0.07	417
		CORE								
B 230	1521	0.28	9.20	0.69	2.94	313	23	9.48	0.03	427
		Clst gy - dk - gy								
B 231	1530	0.38	9.18	0.96	2.51	366	38	9.56	0.04	429
		Clst gy - dk - gy								
B 232	1539	0.35	8.27	0.68	2.78	297	24	8.62	0.04	424
		Clst gy - dk - gy								
B 565	1917	0.39	4.12	1.29	1.51	273	85	4.51	0.09	430
		Clst								
B 566	1926	0.33	7.41	1.17	2.43	305	48	7.74	0.04	431
		Clst								
B 567	1935	0.37	7.04	0.67	2.64	267	25	7.41	0.05	424
		Clst gy -brn - gy								
B 580	2052	0.46	5.40	2.89	2.38	227	121	5.86	0.08	434
		Clst dk -brn - gy								
B 581	2061	2.02	6.32	4.92	2.03	311	242	8.34	0.24	422
		Clst brn - gy								
B 582	2070	0.16	2.80	0.88	2.24	125	39	2.96	0.05	440
		Clst dk -brn - gy								
B 583	2079	0.37	3.64	1.17	2.16	169	54	4.01	0.09	435
		Clst dk -brn - gy								
B 585	2097	0.57	8.70	1.25	3.04	286	41	9.27	0.06	428
		Clst dk -brn - gy								
B 587	2115	0.34	1.41	1.49	0.84	168	177	1.75	0.19	429
		Clst lt -brn - gy								
B 588	2124	0.46	2.10	1.87	1.45	145	129	2.56	0.18	431
		Clst gy								
B 589	2133	0.29	1.44	0.96	1.48	97	65	1.73	0.17	434
		Clst gy								

DATE : 7 - 3 - 84.

TABLE 7.

D A T A   F R O M   R O C K   E V A L   P Y R O L Y S I S

IKU No.	DEPTH m/ft	S1	S2	S3	TOC (%)	HYDR. INDEX	OXYGEN INDEX	PETROLEUM POTENTIAL S1+S2	PROD. INDEX S1 / S1+S2	TEMP. MAX (C)
B 590	2142	0.41	8.17	0.88	1.82	449	48	8.58	0.05	426
		Clst	gy -brn - gy							
B 591	2151	0.41	7.58	0.84	2.16	351	39	7.99	0.05	426
		Clst	dk - gy							
B 592	2160	0.33	5.37	0.82	1.45	370	57	5.70	0.06	433
		Clst	dk -brn - gy							
B 593	2169	0.27	2.03	1.31	1.56	130	84	2.30	0.12	435
		Clst	dk - gy							
B 595	2187	0.10	0.08	0.75	0.24	33	313	0.18	0.56	424
		Sst								
B 597	2205	0.41	3.74	0.97	1.73	216	56	4.15	0.10	434
		Clst	dk -brn - gy							
B 598	2214	0.42	0.95	0.63	0.64	148	98	1.37	0.31	431
		Sst								

DATE : 7 - 3 - 84.

T A B L E 8.

TABULATION OF MATURITY DATA

IKU No.	DEPTH (m/ft)	VITRINITE REFLECTANCE Ro(%) and Counts	MATURATION INDEX (TAI)	FLUOR-ESCENCE
B 130	530	N.D.P. —	N.A.	
B 147	700	0.43(1) CLST —	N.A.	4/5
B 164	870	0.43(4) CLST —	N.A.	3
B 177	1000	0.39(2) CLST —	N.A.	3
B 188	1110	0.36(4) CLST —	N.A.	4
B 202	1250	0.49(4) CLST —	N.A.	3/4
B 214	1370	0.61(1) CLST —	N.A.	3
B 226	1485	N.A. —	1 1/1+	
B 228	1503	0.47(6) CLST —	1 1/1+	3/4
B 2319	1506.40	N.A. CORE —	1/1+	
B 2320	1509.40	N.A. CORE —	1/1+	
B 2321	1516.35	N.A. CORE —	1/1+	
B 230	1521	N.A. —	1/1+	
B 238	1593	0.48(1) SST —	N.A.	4
B 250	1701	0.40(1) SST —	N.A.	4/6
B 551	1791	0.46(6) SST —	N.A.	3/4
B 559	1863	0.48(4) SST —	N.A.	4
B 571	2025	0.41(5) CLST —	N.A.	4
B 580	2052	N.A. —	1/1+2 2-/2 2+	
B 583	2079	N.A. —	1/1+2 2-/2 2+	
B 586	2106	0.49(1) SST —	N.A.	3/4
B 587	2115	N.A. —	1/1+2 2-/2 2+	
B 591	2151	N.A. —	N.D.P.	

DATE : 8 - 3 - 84.

TABLE 8.

TABULATION OF MATURITY DATA

IKU No.	DEPTH (m/ft)	VITRINITE REFLECTANCE Ro(%) and Counts		MATURATION INDEX (TAI)	FLUOR-ESCENCE
B 595	2187	N.A.	–	N.D.P.	
B 598	2214	0.44(5) SST	–	1+/2- 2-	3/4
B 607	2295	0.54(7) SST	–	N.A.	4

DATE : 8 - 3 - 84.

IKU

Visual Kerogen Analysis

TABLE NO.: 9.
WELL NO.: 31/5-2

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
B-226	1485	W,Cut,P,S/Am	F-M-L	fair-good	1, 1/1+	Biodegraded material as fluffy aggregates, Pyritic. Remains of fungi, and bacterial activities.
B-228	1503	W,Cut,WR!,P,S/Am,Cy	F-M-L	fair-good	1/1+	As above but more of well defined woody material and reworked woody material. Foram linings.
B-2319	1506.4	Am,Cy/W,P	F-M	good	1, 1/1+	Laminated grey amorphous aggregates with some pyrite, and remains of biodegradation. Some acid resistant minerals. Well preserved cysts and foram linings.

ABBREVATIONS

Am	Amorphous	Cy	Cysts, algae	W	Woody material	F	Fine
He	Herbaceous	P	Pollen grains	C	Coal	M	Medium
Cut	Cuticles	S	Spores	R!	Reworked	L	Large

IKU

Visual Kerogen Analysis

TABLE NO.: 9. 2
WELL NO.: 31/5-2

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
B-2320	1509.4	W,P/Am,Cy	F-M	good	1/1+	Fairly well defined aggregates with a granulate matrix and signs of biodegradation (Bacteria and fungi).
B-2321	1515.35	W,Cut,P,S/Am	F-M-L	fair-good	1/1+	Pyritic large aggregates of biodegraded material. Tasmanitis.
B-230	1521	W,WR!,Cut,P,S/Am,Cy	F-M-L	fair-good	1, 1/1+	Denser pyritic aggregates with abundant traces of biodegradation. Some grey amorphous with acid resistant minerals embedded. Mixed lithologies.

ABBREVATIONS

Am	Amorphous	Cy	Cysts, algae	W	Woody material	F	Fine
He	Herbaceous	P	Pollen grains	C	Coal	M	Medium
Cut	Cuticles	S	Spores	R!	Reworked	L	Large

114/D/jbl/4