REPORT TITLE

SOURCE ROCK, ANALYSES OF WELL ~~31/4-2~~ 34/4-2.

CLIENT

SAGA PETROLEUM

CLIENT's REF.:

Torbjørn Throndsen

REPORT NO.:

0-302/1/80

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CONTINENTAL SHELF INSTITUTE

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	NO. OF PAGES	NO. OF ENCLOSURE
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SUMMARY: The interval 2400-2800 m is divided into four zones:

A: 2400-2475 m and B 2475-2595m: Moderatemature, fair potential as a source rock for gas.

C: 2595-2700 m: Mainly sandstone. The claystone is moderate mature with a a poor potential as a source rock for gas.

D: 2700-2800 m: Mainly sandstone. The claystone is moderate mature with a poor potential as a source rock for gas. In parts, the claystone has a fair or good potential as source rocks for gas (and oil).

E: Some free hydrocarbons registered in the zone, especially in the samples 2820-35 m, 2925-40 m and 3375-90 m.

KEY WORDS

Source rock

Free hydrocarbons.

EXPERIMENTAL AND DESCRIPTION OF INTERPRETATION LEVELS

Headspace gas analyses.

One ml. of the headspace gas from each of the cans was analysed gas chromatographically for light hydrocarbons. The results are shown in Table Ia. The canned samples were washed with temperated water on 4, 2, 1 and 0.125 mm sieves to remove drilling mud and thereafter dried at 35^{o}C.

Occluded gas.

An aliquote of the 1-2 mm fraction of each sample before drying was crushed in water using an airtight ball mill, and one ml of the headspace analysed gas chromatographically. The results are shown in Table Ib.

Total Organic Carbon (TOC)

Picked cuttings of the various lithologies in each sample were crushed in a centrifugal mill. Aliquotes of the samples where then weighed into Leco cruisibles and treated with hot 2N HCl to remove carbonate and washed twice with destilled water to remove traces of HCl. The cruisibles were then placed in a vacuum oven at 50^{o}C and evacuated to 20 mm Hg for 12 hrs. The samples were then analysed on a Leco E C 12 carbon determinator, to determine the total organic carbon (TOC).

Extractable Organic Matter (EOM)

From the TOC results samples were selected for extraction. Of the selected samples, approximately 100 gm of each was extracted in a flow through system (Radke et al., 1978 (Anal. chem. 49, 663-655) for 10 min. using dichloromethane (DCM) as solvent. The DCM used as solvent was destilled in an all glass apparatus to remove contaminants.

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

After extraction, the solvent was removed on a Buchi Rotavapor and transferred to a 50 ml flask. The rest of the solvent was then removed and the amount of extractable organic matter (EOM) 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 evaluated on a Buchi Rotavapor and transferred to glass-vials and dried in a stream of nitrogen. The various results are given in Table III-VI.

Gas chromatographic analyses

The saturated fraction was diluted with n-hexane and analysed on a HP 5730 A gaschromatograph, fitted with a 25 m OV101 glasscapillary column and an automatic injection system. Hydrogen (0.7 ml/min.) was used as carrier gas and the injection was performed in the splitt mode (1:20).

Vitrinite Reflectance

Samples, taken at various intervals, were sent for vitrinite reflectance measurements at Geoconsultants, Newcastle-upon-Tyne. 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.

Reflection determinations were carried out on a Leitz M.P.V. microphotometer under oil immersion, R.I. 1.516 at a wavelength of 546 nm. The field measured was varied to suit the size of the organic particle, but was usually of the order of 2 micron diameter.

The surface of the polished block was searched by the operator for suitable areas of vitrinite 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, although in many cases this number could not be achieved.

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 is given.

VITRINITE REFLECTANCE R.AVER. 546nm 1·516		0·20	0·30	0·40	0·50	0·60	0·70	0·80	0·90	1·00	1·10
% CARBON CONTENT D.A.F.		57	62	70	73	76	79	80·5	82·5	84	85·5

LIPTINITE FLUOR. EXC. 400nm BAR. 530nm									
nm	725	750	790	820	840	860	890	940	
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 MEASUREMENT 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 PROGRESS TO DEEP ORANGE COLOUR AND THEN FADE RATHER THAN DEVELOP O/R AND 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 (15 m meshes).
O-slide contains palynodebris remaining after flotation (Zn Br_2) to remove disturbing heavy minerals.
X-slides contain oxidized residues, (oxidizing may be required due to sapropel which embeds palynomorphs, or too high coalification preventing 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 dino-flagellates) and cuticles for paleodating and colour evaluation.

So far visual evaluations of kerogen have 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 wanted, to make a more refined classification of the screened residues (particles >15 m).

The colour evaluation is based on colour tones of spores and pollen (preferably) with support from other types of kerogen (woody material, cuticles and sapropel). These colours are dependant upon the maturity, but also are under influence of the paleo-environment (lithology of the rock, oxidation and decay processes). The colours and the estimated colour index of an individual sample may therefore deviate 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_o).

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

Rock-Eval Pyrolyses

100 mg crushed sample was put into a platinum cruisible whose bottom and cover are made of sintered steel and analysed on a Rock-Eval pyrolyser.

RESULTS AND DISCUSSION

The interval 2400 - 3599 m was received for analyses where 2400 - 2800 m was to be analysed for source rock potential while 2800 - 3599 m was to be tested for possible free hydrocarbons.

Light Hydrocarbon analyses

All the samples were analysed gas chromatographically for C_1 - C_4 and C_5^+ hydrocarbons. The interval 2400 - 2800 m is divided into four zones, while the interval 2800 - 3599 m is kept as one zone. Some of the analysed samples in this zones show small kicks especially in the abundance of C_5^+ hydrocarbons. These samples were extracted to look at the heavier hydrocarbons and will be discussed separately.

Zone A, 2400 - 2475 m: The analysed samples in this zone have a fair abundance both of C_1 - C_4 and C_5^+ hydrocarbons. The wetness of the gas drops in the upper few meters of the zone, while the iso-butane/n-butane (iC_4/nC_4) ratio shows an increase with increasing depth.

Zone B, 2475 - 2595 m: This zone is separated out from Zone A due to a marked increase in the wetness of the gas together with a slight increase in the abundance of C_1 - C_4 and C_5^+ hydrocarbons. The iC_4/nC_4 ratio is constant throughout the zone.

Zone C, 2595 - 2700 m: The abundance of C_1 - C_4 hydrocarbons drops in this zone compared to zone B. A similar drop is observed for the wetness of the gas while the iC_4/nC_4 ratio is constant. The abundance of the C_5^+ hydrocarbons is rather erratic for this zone.

Zone D, 2700 - 2800 m: The abundance of C_1 - C_4 hydrocarbons vary from sample to sample in this zone and there is also similar variation for the wetness of the gas and the iC_4/nC_4 ratio. The C_5^+ hydrocarbon abundance does not, however, show this large variation and is found to have a poor abundance throughout the zone. The large variation in some of the parameters is probably due to the variation in lithology.

Zone D, 2800 - 3599 m: Some of the samples show markedly higher abundance of C_5^+ hydrocarbons than the others in this zone. These are; 2910 - 25 m, 2925 - 40 m, 3045 - 60 m, 3105 - 20 m, 3180 - 95 m and 3375 - 90 m. Most of these samples were extracted to look for possible higher hydrocarbons.

Total Organic Carbon

Total organic carbon measurements were undertaken on all samples in the interval 2400 - 2800 m except sandstones. Where more than one lithology was found in the samples, TOC was measured on each lithology which was found to be 10% or more of the whole sample.

Zone A: This zone consists mainly of claystone with small amounts of limestone. The claystone has a fair abundance of organic carbon, 0.8 - 0.9%. The analysed limestone samples have rather high TOC values for such a lithology, which could indicate the limestone as possible source rocks. This organic carbon could, however, also be of none interest, i.e. mainly reworked. With the small amounts of limestone available in these samples it is difficult to do any follow-up analyses on this, and it is not known at present if this limestone is cavings or not.

Zone B: Again a zone with mainly claystone. The TOC values of the samples from this zone have lower TOC values than Zone A, and are mainly found to have a poor/fair abundance of organic carbon. The only analysed limestone from this zone 2550 - 2565 m is found to have a far lower TOC value (0.2%) than those analysed in Zone A.

Zone C: This zone consists mainly of sandstone with small amounts of claystone. The claystone was analysed for organic carbon and this has far lower TOC values than the claystone in zones A and B, 0.1 - 0.3%.

Zone D: Again a zone with mainly sandstone and some claystone. The claystone in the sample from 2700 - 2715 m has a rich abundance of organic carbon while most of the other samples have TOC values similar to those in Zone C.

EXTRACTION AND CHROMATOGRAPHIC SEPARATION

Zone A: Two samples, 2400 - 2415 m and 2430 - 2445 m, from this zone were extracted and found to have a poor and fair abundance of extractable hydrocarbons respectively. The gas chromatograms of the saturated hydrocarbon fractions are similar to each other with a unimodel frontbiased distribution, indicating an input of mainly amorphous material. The carbon preferance index, CPI, is slightly above 1 indicating some immaturity.

Zone B: Four samples, 2475 - 90 m, 2490 - 2505 m, 2520 - 35 m and 2565 - 80 m, from this zone were extracted. Three of the samples have a poor abundance of extractable hydrocarbons while the sample from 2520 - 35 m has a fair abundance. The composition of the hydrocarbons vary a lot from sample to sample. Some of this might be due to errors in the weights of each fractions due to the very low amounts of each fraction. The gas chromatograms of the saturated hydrocarbon fractions of the samples vary. The samples from 2475 - 90 and 2490 - 2505 m show large abundances of heavy n-alkanes indicating an input from terrestrial material. The samples from 2520 - 35 m and 2565 - 80 m are similar to each others with a unimodel, frontbiased n-alkane distribution with maximum at nC_{18}. The pristane/phytane ratio is low. This could indicate that the samples have been deposited in a reducing environment. Apart from this low pristane/ phytane ratio, the distribution is typical for well mature hydrocarbons.

Zone C: No samples from this zone were extracted.

Zone D: One sample, 2575 - 90 m, from this zone were extracted and found to have a poor abundance of extractable hydrocarbons. The gas chromatogram of the saturated hydrocarbon fraction shows a bimodal distribution with maxima at nC_{20} and nC_{24} indicating an input from terrestral material. Two more samples, 2700 - 2715 m and 2745 - 2760 m from this zone have a good abundance of organic carbon. The amount of material was, however, too low to be extracted. These two samples are those with highest organic carbon values of all the analysed samples in the interval 2400 - 2800 m.

Zone E: Six samples, 2820 - 35 m, 2910 - 25 m, 2925 - 40 m, 3045 - 60 m, 3180 - 95 m and 3375 - 90 m, from this zone were extracted to test if there were any heavy hydrocarbons. The sample from 2820 - 35 m has a good abundance of extractable hydrocarbons while the samples from 2925 - 40 m and 3180 - 95 m have fair abundances and the rest poor abundances of extractable hydrocarbons when the weight relatived to rock is used as a parameter. If we compare the organic carbon normalized values, other results are found. The sample from 3180 - 3195 m has a fair extractability while the sample from 2910 - 35 and 3045 - 60 have good extractability. The rest have very high extractabilities. All the samples except 3180 - 95 m have very low organic carbon values. The reasons for the high organic carbon value for the samples from 2925 - 40 m is probably due to the coal cuttings registered in the sample. During picking of the cuttings, some minute coal particles might have been stuck to the claystone cuttings.

The gas chromatograms of the saturated hydrocarbon fractions vary only slightly from sample to sample. The four uppermost samples all have a unimodel front biased distribution typical for well mature hydrocarbons. Similar distribution is also found for the lowermost sample while the sample from 3180 - 95 m has a strange distribution with a large peak close to nC_{20}. This could be from a mudadditive or from the hydrocarbons in the sample. This peak is not identified. In the heavy molecular end a high CPI value is found indicating a low maturity. This gas chromatogram also indicates that some of the organic matter examined is coal. This coal, if it is not a mudadditive, would affect the light hydrocarbon results in the way which are observed for this sample.

Vitrinite reflectance

Ten samples from the 2400 - 2800 m interval were analysed in reflected light. Below, each sample is described and other information from the analyses are given together with the vitrinite reflectance results.

Sample 2400 - 25 m: Shale, R_0=0.50 (17) and R_0=0.72 (4).
The sample has a low organic content with mostly particles of high reflectance inertinite and reworked material. The measurements are partly on loose coal fragments and partly on vitrinite particals in the shale. UV light shows yellow/organe to mid-orange fluorecence from spores and a moderate exinite content.

Sample 2530 - 45 m: Shale, R_o=0.51 (19).
The sample has a moderate organic content with inertinite and reworked particles dominant. Occasional true vitrinite particles together with bitumen wisps and staining. UV light shows a yellow/orange and light orange fluorescence from spores and a moderate exinite content.

Sample 2460 - 75 m: Shale, R_o=0.57 (8).
The sample contained a large amount of drilling mud. Only a few shale cuttings containing inertinite and reworked particles. A handful of vitrinite particles and wispy particles together with bitumen wisps. UV light shows a light orange fluorescence from spores and a trace of exinite.

Sample 2475 - 90 m: Shale and carbonate traces, R_o=0.53 (16).

The sample has a moderate organic content with small inertinite and reworked particles are dominant. Only a trace of true vitrinite particles. UV light shows a light and mid-orange fluorescence from spores and hydrocarbon specks together with a low to moderate exinite content.

Sample 2505- 20 m: Shale, R_o=0.42 (4) and R_o=0.57 (16).
The sample has a low to moderate organic content with inertinite and reworked material being dominant. Most of the measurements are on the lowest reflectance particles located. Many are on minute coal specks within the sediment. Bitumen visps are recorded in the sample. UV light shows a yellow/orange and light orange fluorescence from spores and a moderate exinite content.

Sample 2520 - 35 m: Shale, R_o=0.21 (4) and R_o=0.47 (16).
The sample has a moderate organic content with inertinite and reworked particles being dominant. A few poor vitrinite particles are recorded together with bitument staining and wisps. UV light shows light orange fluorescence from spores and a low exinite content.

Sample 2565 - 80 m: Shale, R_o=0.54 (18).
The sample has a low to moderate organic content with particles of vitrinite and inertinite, mostly reworked. Only a handful of possibly true particles, very corroded and broken. Bitumen staining is recorded in the sample.

Sample 2700 - 15 m: Red and grey shale, R_0=0.59 (9).
The red shale is barren.
The grey shale has a moderate content of inertinite and reworked particles and bitument staining are recorded. UV light shows a mid.orange fluorescence from spores and a low to moderate exinite content.

Sample 2745 - 60 m: Red shale, R_0=0.90 (2).
The sample is barren apart for a few high reflectance vitrinite and inertinite particles, probably reworked and oxidised. The lowest particles were measured. UV light shows a very dull mid.orange fluorescence from spores and a trace of exinite.

Sample 2775 - 90 m: Red shale.

No determination possible.

No organic material was located in the sample.

Visual kerogen analysis

Ten samples had been chosen for the examination of the acid resistant organic material contained in the interval 2400 - 2790 m (390 m).

The results do not allow any subdivision of the interval which seems dominated by sapropel though with increased terrestrial influence at 2475 - 2490 m and 2565 - 2580 m.

The conditions at the site of deposition seem to have been more shallow at 2460 - 2475 m, 2745 - 2760 m and 2775 - 2790 m, if judged from the increased amounts of acid resistant minerals.

However, the entire interval contains cysts and partly pollen grains of Tertiary/Cretaceous age, and we suspect that also the main part of the sapropel was derived from deposits of this age.

If the interval is of a maximum Early Cretaceous age, the complete interval is immature.

Colour index: 1/1+ for 2400 m to 2470 m.
Colour index: 1+ for 2475 - 2580 m.

If the Cretaceous material is caved at 2700 - 2715 m and below we suggest a higher index for this interval. (Colour index: 2-/2). However, the darker colours observed may be due to lithologically controlled stronger oxidation of the organic material.

Rock-Eval pyrolyses

Fifteen samples from the 2400 - 2800 m interval were pyrolysed on a Rock-Eval instrument. All the analysed samples have high oxygen and low hydrogen indeces typical for kerogen type III. The samples from 2745 - 60 m and 2775 - 90 m have slightly higher hydrogen indeces than the others which may indicate a slight input of kerogen type II together with the kerogen type III which is the major part. The petroleum potential is poor for all the samples. The lowermost analysed sample has a high S_1 peak. The S_2 peak is too low to be registered for this sample so the production index can not be calculated. However, with the low organic carbon registered for this sample, the high S_1 peak indicates the sample to contain migrated hydrocarbons.

The results from the Rock-Eval pyrolyses are in places in strong contradiction to the visual kerogen examination, especially from 2500 - 2580 m and 2700 - 2790 m, while the visual kerogen examination shows to contain a large percentage of amorphous kerogen. Contradictions like this is found for various sections in wells in the Northern North Sea, and we believe this is caused partly by sapropelization of terrestrial material which looks amorphous but which will be recognized as kerogen type III on a Rock-Eval instrument. The lower section is also found to contain some amorphous material by Rock-Eval pyrolysis, but not to such a degree as the visual kerogen examination indicates.

The T_{max} of all the analysed samples are found to be 433 - 439^{o}C which indicates the samples to be moderate mature. This is in good agreement with the vitrinite reflectance data while the visual kerogen examination indicates a slightly lower maturity, especially for the upper samples.

CONCLUSION

In our source rock evaluation the maturity of the samples is determinaed on the basis of vitrinite reflectance, fluorescence of spores in UV light colour of kerogen in transmitted light and the T_{max} value from the Rock-Eval pyrolyses. The richness of the samples is determined from the light hydrocarbon, total organic carbon and extraction analyses, while the type of kerogen is decided on the background of the Rock-Eval pyrolyses and the visual kerogen examinations.

Based on the light hydrocarbon measurement, the interval 2400 - 2800 m is divided into four zones, which are given the following source rock rating:

A: 2400 - 2475 m: Mainly claystone with a fair abundance of organic carbon and a poor to fair abundance of extractable hydrocarbons. Based on the various analyses this zone is found to be moderate mature with a fair potential as a source rock for gas.

Zone B, 2475 - 2595 m: This zone has slightly lower organic carbon values than the zone above while the maturity is the same. The abundance of light hydrocarbons shows a slight increase. Based on the various analyses the zone is found to be moderate mature with a fair potential as a source rock for gas.

Zone C, 2595 - 2700 m: This zone consists mainly of sandstone and the analyses do not indicate this to contain migrated hydrocarbons. The claystone in the zone is found to be moderate mature with a poor potential as a source rock for gas.

Zone D: 2700 - 2800 m; This zone consists also mainly of sandstone. The claystone at 2700 - 2715 m has a rich abundance of organic carbons. The lithology and the amount of organic carbon vary throughout the zone and the source rock potential will therefore vary.

The whole zone is moderate mature and some small claystone lenses in the zone (2700 - 2715 m, 2745 - 60 m) have a good potential as source rock for gas (and oil). On the whole the claystone in the zone has a poor potential as a source rock for gas.

Zone E, 2800 - 3599 m: Some of the analysed samples from this interval do contain migrated hydrocarbons, especially those from 2820 - 35 m, 2925 - 40 m and 3375 - 90 m. The samples from 2910 - 25 m and 3045 - 60 m also probably contain free hydrocarbons but in lesser degree than the other samples. This conclusion is mainly based on the extractabilities of the samples and the large simularities between the gas chromatograms. The sample from 3180 - 95 m is affected from the coal cuttings in the sample.

Table Ia

Saga 34/4 Headspace Concentration µl gas/pr. kg rock of hydrocarbons in cuttings

Sample	Depth (m)	C_1	C_2	C_3	iC_4	nC_4	C_5+	ΣC_1-C_4	ΣC_2-C_4	% wetness	iC_4/nC_4
K4347	2400 - 15	425	99	590	306	728	147	2149	1725	80.25	0.42
K4348	2415 . 30	202	56	256	96	206	372	816	614	75.24	0.47
K4349	2430 - 45	2327	311	718	155	270	459	3781	1454	38.46	0.57
K4350	2445 - 60	8696	990	1900	336	473	555	12396	3699	29.84	0.71
K4351	2460 - 75	4595	589	971	171	220	427	6546	1951	29.81	0.78
K4352	2475 - 90	265	64	115	29	39	80	512	248	48.35	0.75
K4353	2490-2505	990	230	608	132	169	301	2130	1140	53.52	0.78
K4354	2505 - 20	2398	472	933	231	271	524	4306	1908	44.31	0.85
K4355	2520 - 35	2140	507	1348	436	536	1037	4968	2828	56.92	0.81
K4356	2535 - 50	10315	2389	3685	934	952	686	18275	7960	43.56	0.98
K4357	2550 - 65	9878	2444	3744	932	992	785	17991	8112	45.09	0.94
K4358	2565 - 80	Open lid									
K4359	2580 - 95	4132	713	965	312	380	665	6503	2371	36.46	0.82
K4360	2595-2610	1170	148	226	72	94	185	1710	540	31.59	0.77
K4361	2610 - 25	135	6	29	5	8	21	184	48	26.26	0.67
K4362	2625 - 40	280	12	24	6	10	100	334	54	16.31	0.62
K4363	2640 - 55	open lid									
K4364	2655 - 70	380	20	38	20	41	144	499	119	23.90	0.49
K4365	2670 - 85	269	18	26	6	11	63	311	62	18.77	0.54
K4366	2685-2700	476	16	37	6	12	38	548	72	13.15	0.52
K4367	2700 - 15	1315	48	178	86	221	602	1848	533	28.84 5	0.39
K4368	2715 - 30	330	16	7	24	26	193	401	73	18.18	0.93
K4369	2730 - 45	1106	90	50	4	7	11	1258	151	12.05	0.62

Table Ia cont.

Sample	Depth (m)	C_1	C_2	C_3	iC_4	nC_4	C_5+	ΣC_1-C_4	ΣC_2-C_4	% wetness	iC_4/nC_4
K4370	2745 - 60	118	19	9	26	14	20	257	69	26.93	1.00
K4371	2760 - 75	700	35	73	10	32	66	851	151	17.71	0.33
K4372	2775 - 90	568	23	35	8	26	96	660	92	13.97	0.30
K4373	2790-2805	Open lid									
K4374	2805 - 20	281	8	46	5	18	66	358	77	21.63	0.31
K4375	2820 - 35	83	13	6	9	7	229	119	36	30.26	1.00
K4376	2835 - 50	185	14	8	1	6	9	214	29	13.50	0.13
K4377	2850 - 65	9	21	9	7	7	76	53	44	83.28	1.00
K4378	2865 - 80	59	8	-	-	-	3	69	9	13.58	1.00
K4379	2880 - 95	59	2	1	4	2	48	69	10	14.83	1.00
K4380	2895-2910	50	9	6	5	5	3	75	25	33.02	1.00
K4381	2910 - 25	82	Below the detection limit				24	82			
K4382	2925 - 40	161		- " -			97	161			
K4383	2940 - 55	229		- " -			39	229			
K4384	2955 - 70	27		- " -			12	27			
K4385	2970 - 85	99		- " -			3	99			
K4386	2985-3000	97		- " -			25	97			
K4387	3000 - 15	176		- " -			44	176			
K4388	3015 - 30	113		- " -			74	113			
K4389	3030 - 45	143		- " -			35	143			
K4390	3045 - 60	78		- " -			124	78			
K4391	3060 - 75	189		- " -			13	189			
K4392	3075 - 90	97		- " -			6	97			
K4393	3090-3105	189		- " -			74	189			

Sample	Depth (m)	C_1	C_2	C_3	iC_4	nC_4	C_5+	ΣC_1-C_4	ΣC_2-C_4	% wetness	iC_4/nC_4
K4394	3105 - 20	166	Below the detection limit				130	166			
K4395	3120 - 35	100		-"-			16	100			
K4396	3135 - 50	46		-"-			5	46			
K4397	3150 - 65	72		-"-			17	72			
K4398	3165 - 80	226		-"-			36	226			
K4399	3180 - 95	95		-"-			403	95			
K4400	3195-3210	44		-"-			28	44			
K4401	3210 - 25	96		-"-			13	96			
K4402	3225 - 40	80		-"-			3	80			
K4403	3240 - 55	72		-"-			11	72			
K4404	3255 - 70	34		-"-			6	34			
K4405	3270 - 85	19		-"-			5	19			
K4406	3285-3300	3		-"-			2	3			
K4407	3300 - 15			-"-			-	-			
K4408	3315 - 30	38	1	1	-	-	14	38			
K4409	3330 - 45	-	Below the detection limit				-	-			
K4410	3345 - 60	-		-"-			-	-			
K4411	3360 - 75	-		-"-			-	-			
K4412	3375 - 90	53		-"-			24	53			
K4413	3390-3405	60		-"-			10	60			
K4414	3405 - 20	96		-"-				96			
K4415	3420 - 35	87		-"-			10	87			
K4416	3435 - 50	73	40	3	4	2	40	124	51	41.26	
K4417	3450 - 65	55	Below the detection limit				3	55			

Table Ia cont

Sample	Depth (m)	C_1	C_2	C_3	iC_4	nC_4	C_5+	ΣC_1-C_4	ΣC_2-C_4	% wetness	iC_4/nC_4
K4418	3465 - 80	144	Below the detection limit				3	144			
K4419	3480 - 95	198		-"-			-	198			
K4420	3495-3510	62		-"-			1	62			
K4421	3510 - 25	122		-"-			2	122			
K4422	3525 - 40	-"-		-"-			-	-			
K4423	3540 - 55	46		-"-			-	46			
K4424	3555 - 70	30		-"-			17	30			
K4425	3570 - 85	59		-"-			5	59			
K4426	3585-3600	72		-"-			3	72			

Table Ib

Saga 34/4-2 Okkulert gass Concentration µl gas/pr. kg. rock of hydrocarbons in cuttings

Sample	Depth (m)	C_1	C_2	C_3	iC_4	nC_4	C_5+	ΣC_1-C_4	ΣC_2-C_4	% wetness	iC_4/nC_4
K4347	2400 - 15	144	20	88	86	347	33446	686	541	78.95	0.25
K4348	2415 - 30	137	28	103	75	300	3016	644	507	78.68	0.25
K4349	2430 - 45	109	15	98	62	199	818	483	374	77.48	0.31
K4350	2445 - 60	162	26	68	29	91	570	377	214	56.88	0.32
K4351	2460 - 75	53	5	26	13	38	2736	136	82	60.65	0.35
K4352	2475 - 90	95	5	67	37	101	2439	304	209	68.80	0.36
K4353	2490-2505	68	7	41	29	72	239	217	149	68.76	0.40
K4354	2505 - 20	61	10	25	8	23	94	126	65	51.79	0.35
K4355	2520 - 35	269	31	40	29	68	2322	438	168	38.39	0.42
K4356	2535 - 50	121	15	53	39	80	975	307	189	60.68	0.49
K4357	2550 - 65	126	20	77	63	118	664	405	279	68.91	0.53
K4358	2565 - 80	108	22	118	122	261	1660	631	523	82.94	0.47
K4359	2580 - 95	138	53	589	420	783	1018	1982	1844	93.04	0.54
K4360	2595-2610	87	68	43	39	98	222	336	249	74.14	0.40
K4361	2610 - 25	216	6	40	14	30	220	307	90	29.51	0.47
K4362	2625 - 40	115	79	13	9	9	233	226	110	48.83	1.00
K4363	2640 - 55	162	1	1	4	9	1884	177	15	8.68	0.38
K4364	2655 - 70	64	89	7	11	20	21	191	127	66.43	0.58
K4365	2670 - 85	128	9	5	3	10	50	155	27	17.52	0.31
K4366	2685-2700	16	121	4	8	8	384	156	140	89.46	1.00
K4367	2700 - 15	38	1	-	6	21	253	66	28	42.74	0.30
K4368	2715 - 30	74	249	5	4	4	18	336	262	78.04	1.00
K4369	2730 - 45	79	32	116	18	38	56	283	205	72.23	0.47
K4370	2745 - 60	67	15	22	5	12	128	122	55	44.87	0.40

Table Ib cont.

Sample	Depth (m)	C_1	C_2	C_3	iC_4	nC_4	C_5+	ΣC_1-C_4	ΣC_2-C_4	% wetness	iC_4/nC_4
K4371	2760 - 75	179	67	61	31	10	42	348	170	48.71	3.00
K4372	2775 - 90	100	12	7	4	11	86	155	34	25.53	0.39
K4373	2790-2805	75	109	27	-	5	17	216	141	65.28	0.10
K4374	2805 - 20	986	9	6	5	5	4	1010	24	2.41	1.00
K4375	2820 - 35	55	1	-	-	-	3	58	3	4.74	1.00
K4376	2835 - 50	90	3	5	75	24	28	197	107	54.42	3.00
K4377	2850 - 65	18	40	-	-	-	36	59	41	70.08	1.00
K4378	2865 - 80	97	2	1	1	1	9	103	6	5.78	1.00
K4379	2880 - 95	148	210	1	1	1	88	362	214	59.18	1.00
K4380	2895 - 2910	422	2	1	1	1	9	428	6	1.39	1.00
K4381	2910 - 25	-	Below the detection limit				-				
K4382	2925 - 40	45	27	24	13	9	1111	119	73	62.03	1.44
K4383	2940 - 55		Below the detection limit								
K4384	2955 - 70			-"-							
K4385	2970 - 85	7	11	13	10	-	-	41	34	83.54	
K4386	2985-300	15	Below the detection limit					15			
K4387	3000 - 15	22	67	Below the detection limit				22			
K4388	3015 - 30	78	Below the detection limit				37	78			
K4389	3030 - 45	5		-"-				5			
K4390	3045 - 60	16	33	Below the detection limit				16			
K4391	3060 - 75	18	16	16	14	2	30	67	48	72.52	5.34
K4392	3075 - 90	139	Below the detection limit				5	139			

Table 1b cont.

Sample	Depth (m)	C_1	C_2	C_3	iC_4	nC_4	C_5+	ΣC_1-C_4	ΣC_2-C_4	% wetness	iC_4/nC_4
K4393	3090-3105		Below the detection limit								
K4394	3105 - 20		-"-								
K4395	3120 - 35		-"-								
K4396	3135 - 50	68	139	5	4	4	17	221	152	68.99	1.00
K4397	3150 - 65		Below the detection limit								
K4398	3165 - 80		-"-								
K4399	3180 - 95	195	40	5	5	4	361	250	54	21.74	1.17
K4400	3195-3210	73	Below the detection limit				4	73			
K4401	3210 - 25		-"-								
K4402	3225 - 40		-"-								
K4403	3240 - 55		-"-								
K4404	3255 - 70	38	-"-				21	38			
K4405	3270 - 85		-"-								
K4406	3285-3300		-"-								
K4407	3300 - 15		-"-								
K4408	3315 - 30	68	-"-				4	68			
K4409	3330 - 45		-"-								
K4410	3345 - 60		-"-								
K4411	3360 - 75		-"-								
K4412	3375 - 90	88	-"-				289	88			
K4413	3390-3405		-"-								
K4414	3405 - 20		-"-								
K4415	3420 - 35		-"-				36				

Table Ib cont

Sample	Depth (m)	C_1	C_2	C_3	iC_4	nC_4	C_5+	ΣC_1-C_4	ΣC_2-C_4	% wetness	iC_4/nC_4
K4416	3435 - 50	44	Below the detection limit				3	44			
K4417	3450 - 65			-"-			9				
K4418	3465 - 80			-"-							
K4419	3480 - 95			-"-							
K4420	3495-3510	39		-"-			52	39			
K4421	3510 - 25			-"-							
K4422	3525 - 40			-"-							
K4423	3540 - 55			-"-							
K4424	3555 - 70	60		-"-			3	60			
K4425	3570 - 85			-"-							
K4426	3585-3600	56		-"-			11	56			

Table Ic

Saga 34/4-2 Concentration µl gas/pr. kg. rock of C_1 - C_7 hydrocarbons (Ia + Ib)

Sample	Depth (m)	C_1	C_2	C_3	iC_4	nC_4	C_5+	ΣC_1-C_4	ΣC_2-C_4	% wetness	iC_4/nC_4
K 4347	2400-15	569	119	678	392	1075	33593	2835	2266	79.93	0.36
K 4348	2415-30	339	84	359	171	506	3388	1460	1121	76.78	0.34
K 4349	2430-45	2436	326	7816	217	469	1277	4264	1828	42.87	0.46
K 4350	2445-60	8858	1016	1968	365	564	1125	12773	3913	30.63	0.65
K 4351	2460-75	4648	594	997	184	258	3136	6682	2033	30.42	0.71
K 4352	2475-90	360	69	182	66	140	2519	816	457	56.00	0.47
K 4353	2490-2505	1058	237	649	161	241	540	2437	1289	54.92	0.67
K 4354	2505-20	2459	482	958	239	294	618	4432	1973	44.52	0.81
K 4355	2520-35	2409	538	1388	465	604	3359	5406	2996	55.42	0.77
K 4356	2535-50	10436	2404	3738	973	1032	1661	18582	8147	43.24	0.94
K 4357	2550-65	1004	2464	3821	995	1110	1449	18396	8391	45.61	0.90
K 4358	2565-80	108	22	118	122	261	1660	831	523	82.88	0.47
K 4359	2580-95	4270	766	1554	732	1163	1683	8485	4215	49.67	0.63
K 4360	2595-2610	1257	216	269	111	192	407	2046	789	38.56	0.58
K 4361	2610-25	351	12	69	19	38	241	491	138	28.10	0.50
K 4362	2625-40	395	91	37	15	19	333	560	164	29.28	0.79
K 4363	2640-55	162	1	1	4	9	1884	177	15	8.47	0.44
K 4364	2655-70	444	109	45	31	61	165	690	246	35.65	0.51
K 4365	2670-85	397	27	31	9	21	88	466	89	19.10	0.43
K 4366	2685-2700	492	137	41	14	20	422	704	212	30.11	0.70
K 4367	2700-15	1353	49	178	92	242	855	1914	561	29.31	0.38
K 4368	2715-30	404	265	12	28	30	111	737	335	45.45	0.93
K 4369	2730-45	1185	122	166	22	45	67	1541	356	23.10	0.49
K 4370	2745-60	255	34	31	31	26	138	379	124	32.71	1.19
K 4371	2760-75	879	102	134	41	42	108	1199	321	26.77	0.98

Table Ic cont.

Sample	Depth (m)	C_1	C_2	C_3	iC_4	nC_4	C_5+	ΣC_1-C_4	ΣC_2-C_4	% wetness	iC_4/nC_4
K4372	2775 - 90	668	35	42	12	37	182	795	126	15.85	0.32
K4373	2790-2805	75	109	27	-	5	17	216	141	65.27	0.50
K4374	2805 - 20	1267	17	52	10	23	70	1368	101	7.38	0.43
K4375	2820 - 35	138	14	6	9	7	232	177	39	22.03	1.29
K4376	2835 - 50	275	17	13	76	30	37	411	136	33.09	0.81
K4377	2850 - 65	27	61	9	7	7	112	112	85	75.89	1.00
K4378	2865 - 80	138	10	1	1	1	12	172	15	8.72	1.00
K4379	2880 - 95	207	212	2	5	3	136	431	224	51.97	1.67
K4380	2895-2910	472	11	7	6	6	12	503	31	6.16	1.00
K4381	2910 - 25	82	Below the detection limit				240	82			
K4382	2925 - 40	206		-"-			1208	206			
K4383	2940 - 55	229		-"-			39	229			
K4384	2955 - 70	27		-"-			12	27			
K4385	2970 - 85	106	11	13	10	-	3	106			
K4386	2985-3000	112	Below the detection limit				25	112			
K4387	3000 - 15	199		-"-			44	199			
K4388	3015 - 30	191		-"-			111	191			
K4389	3030 - 45	148		-"-			35	148			
K4390	3045 - 60	94		-"-			124	94			
K4391	3060 - 75	207	16	16	14	2	43	67	48	72.52	
K4392	3075 - 90	236	Below the detection limit				11	236			
K4393	3090-3105	189		-"-			74	189			
K4394	3105 - 20	166		-"-			130	166			
K4395	3120 - 35	100		-"-			16	100			

Table Ic cont.

Sample	Depth (m)	C_1	C_2	C_3	iC_4	nC_4	C_5+	ΣC_1-C_4	ΣC_2-C_4	% wetness	iC_4/nC_4
K4396	3135 - 50	114	139	5	4	4	22	221	152	68.99	
K4397	3150 - 65	72	Below the detection limit				17	72			
K4398	3165 - 80	220		-"-			36	220			
K4399	3180 - 95	290	40	5	5	4	764	250	54	21.74	
K4400	3195-3210	117	Below the detection limit				32	117			
K4401	3210 - 25	96		-"-			13	96			
K4402	3225 - 40	80		-"-			3	80			
K4403	3240 - 55	72		-"-			11	72			
K4404	3255 - 70	72		-"-			27	72			
K4405	3270 - 85	19		-"-			5	19			
K4406	3285-3300	3		-"-			2	3			
K4407	3300 - 15	-		-"-			-	-			
K4408	3315 - 30	106		-"-			18	106			
K4409	3330 - 45	-		-"-			-	-			
K4410	3345 - 60	-		-"-			-	-			
K4411	3360 - 75	-		-"-			-	-			
K4412	3375 - 90	141		-"-			313	141			
K4413	3390-3405	60		-"-			10	60			
K4414	3405 - 20	96		-"-			-	96			
K4415	3420 - 35	87		-"-			10	87			
K4416	3435 - 50	117		-"-			43	117			
K4417	3450 - 65	55		-"-			12	55			
K4418	3465 - 80	144		-"-			3	144			

Table Ic cont.

Sample	Depth (m)	C_1	C_2	C_3	iC_4	nC_4	C_5+	ΣC_1-C_4	ΣC_2-C_4	% wetness	iC_4/nC_4
K4419	3480 - 95	198	Below the detection limit				-	198			
K4420	3495-3510	101		-"-			53	101			
K4421	3510 - 25	122		-"-				122			
K4422	3525 - 40	-		-"-				-			
K4423	3540 - 55	46		-"-				46			
K4424	3555 - 70	90		-"-			409	90			
K4425	3570 - 85	59		-"-				59			
K4426	3585-3600	128		-"-			247	128			

Table II

LITHOLOGY AND TOTAL ORGANIC CARBON

IKU No.	Depth	TOC	Lithology	
K4347	2400-2415 m	0.80	85%	Claystone, grey - greenish grey, calcareous - very calcareous, the the rock may be classified as a marl. Some grains; pink, also very calcareous disintegrates easily in HCl-Lamination is evident in some grains.
		0.67	15%	Limestone/siltstone; as laminar bands in claystone, and as single grains, white crystalline, often containing grains of pyrite and glauconite. Some grains are of another type, these are tight, light brownish yellow and probably represents dolomite or siderite.
			Minor:	Pyrite and glauconite.
K4348	2415-240 m	0.86	85%	Claystone, light grey with white limestone laminae.
		0.88	15%	Limestone/siltstone, as single fragments, and as thin bands in claystone, white, sucrosic, and often associated with glauconite and pyrite Some limestone fragments are yellowish-brown and probably represents dolomite or siderite.
			Minor:	Pyrite & glauconite.
K4349	2430-2445 m	0.93	80%	Claystone, grey, often silty, calcareous, micaceous, with limestone laminae.
		0.60	20%	Limestone/siltstone, white, crystalline, sucrosic, often containing small grains of glauconite -also light brownish white carbonate minerals (siderite or dolomite) very fine to medium grained.
			Minor:	Pyrite.
			Added;	material, steel, fibres, asphalt?, coal (lignite).
K4350	2445-2460 m	0.68	90%	Claystone, grey, micaceous; silty calcareous with limestone laminae, also green due to high glauconite content.

Table II

Lithology and Total Organic Carbon (s.2)

IKU No.	Depth	TOC	Lithology
K4350 (cont.)	2445-2460 m	0.68	10% Limestone/siltstone, as aggregates within claystone, white and occuring in a mass consisting of calsite, glauconite, mica. Possibly also some organic content 1% Pyrite. Added: Steel.
K4351	2460-2475 m	0.90	60% Claystone, grey, micaceous, silty, calcareous; also brownish red. 5% Limestone, brown-brownish yellow or brownish grey, crystalline. Minor: 1% Pyrite. Added: Steel. Cement 30%.
K4352	2475-2490 m	0.74	90% Claystone; grey-greenish grey laminated with alternating thin limestone bands, but not as abundant as above. Green colour due to glauconite, silty, grains of glauconite and mica. 5% Limestone, white. Minor: Pyrite, glauconite, organic matter? Added: 5% Rice grains. 2% Cement, brownish white, grey.
K4353	2490-2505 m	0.58	85% Claystone; grey-greenish grey, sometimes silty, micaceous, calcareous, laminated, brownish red, occationally silty. 5% Limestone, white-brownish white, as laminae in claystone, medium coarse, crystalline often associated with glauconite. 2% Calsite (sid), brown-white as columns perpendicular to walls of formation chamber. (Shell fragments). Minor: Pyrite, glauconite, quartz. Added: Steel, mica. 1% Cement.

Table II

Lithology and Total Organic Carbon (s.3)

IKU No.	Depth	TOC	Lithology
K4354	2505-2520 m	0.59	90% Claystone; grey, as above, brownish red. 10% Limestone; white-brownish white, crystalline as above. Minor: Pyrite, glauconite, organic matter (coal). Added: Steel and fibres.
K4355	2520-2535 m	0.88	90% Claystone; grey-greenish grey, sometimes silty; micaceous, calcareous, with laminae of limestone (calsite). 5% Limestone; As laminar bands in claystone, white, crystalline, medium to coarse often with grains of glauconite. 1% Limestone, brownish, white, grey, as tight masses, but also in masses of long crystals. (Shell fragments). 5% Sand/Sandstone with quartz grains. Minor: Glauconite, pyrite. Added: Steel, cement, mica (muscovite), fibres, red and green foreign matter.
K4356	2535-2550 m	0.66	80% Claystone, grey-greenish grey, occationally silty, with laminae of limestone, calcareous, micaceous. - A little (1%) brownish red, sometimes silty. 10% Limestone (3%) white crystalline (3%) white crystalline with glauconite. (7%) brownish white, brownish grey, from fine to coarse grained. 5% Sand/Sandstone; mainly quartz; angular to subangular, also calsite, grey-brownish grey. Minor: Coal?, quartz, calsite, glauconite, pyrite. Added: Steel, coal, fibres, green plastic flakes, mica.

Table II

Lithology and Total Organic Carbon (s.4)

IKU No.	Depth	TOC	Lithology
K4357	2550-2565 m	0.57	70% Claystone, grey, partly silty, with limestone laminae, micaceous, carbonaceous and reddish brown (minor).
		0.24	20% Limestone 1. white, coarse as laminae in claystone 2. light brownish white to medium brownish white, fine to coarse crystals.
			10% Sand; medium grained angular to subangular, grains of quarts, calsite and pyrite, glauconite and coal.
			Added: as above, most important: Cement.
K4358	2565-2580 m	0.72	80% Claystone, as above.
			5% Claystone, black, probably with a high coal (organic) content.
			5% Limestone, as above.
			5% Sand, as above (2% of this is quartz).
			Minor: Claystone, purple.
			Added: as above.
K4359	2580-2595 m	0.63	80% Claystone A. Brownish red - purple (30%) occationally silty, but mostly fine. B. Dark grey - black (25%) probably high in coal (organic) content. C. Light grey (25%) as above.
			10% Limestone; white, tight, fine grained.
			10% Sand; grains of quartz (clear, angular to subangular), rounded grains of limestone (calsite), coal, pyrite. Cementing material not seen.
			Minor: Glauconite and pyrite.
			Added: Fibres, wood, steel.

Table II

Lithology and Total Organic Carbon (s.5)

IKU No.	Depth	TOC	Lithology
K4360	2595-2610 m		85% Sand; grains of quartz (80%), clear, subangular, medium coarse grained.
			10% Claystone, as above, but as small grains, red, black and grey.
			Minor: Limestone, as small grains, white.
			Added: Mica, steel.
K4361	2610-2625 m		90% Sand; grains of quartz (90%).
			5% Claystone, grey, pink, reddish brown, black.
			Added: Mica.
K4362	2625-2640 m		85% Sand; clear to white, angular to subangular, mainly quartz.
		0.15	15% Claystone; reddish brown, greenish yellow, purple and black; silty.
K4363	2640-2655 m		85% Sand, clear to white, angular to subangular, mainly quartz.
		0.33	15% Claystone.
			5% Limestone, white, greyish white.
			1% Pyrite.
			Added: Mica, steel.
K4364			85% Sand; clear and white, angular to subangular, medium to coarse grained, mainly quartz.
		0.28	15% Claystone; partly silty or sandy, brownish red, purple, green, grey, yellowish grey, black.
			1% Limestone; white, greyish white to brownish white.
			Added: Mica.

Table II

Lithology and Total Organic Carbon (s.6)

IKU No.	Depth	TOC	Lithology
K4365	2670-2685 m		90% Sand; white to clear, also some grains stained yellow or pink, medium to coarse grained, mainly quartz.
		0.21	10% Claystone; reddish brown, purple, green and light grey, silty, micaceous.
			2% Limestone, white and greyish white, tight.
			Added: Mica.
K4366	2685-2700 m		85% Sand, white/clear, some grains stained light yellow or pink.
		0.29	10% Claystone, silty or sandy; grey, reddish grey, reddish brown, green.
			2% Limestone, white and greyish white, tight.
			Added: Mica.
K4367	2700-2715 m		50% Sand, medium to coarse, clear or white angular to subangular.
		2.17	40% Claystone; silty and sandy, reddish brown, grey, greenish grey, purple, mainly quartz.
			5% Limestone, white, greyish white, greenish white, red white.
			Added: Nut shells (30%), fragments of wood 20%, mica.
K4368	2715-2730 m		60% Sand, clear, white, angular to sub-angular, medium to coarse grained, mainly quartz.
		0.28	35% Claystone, partly silty, olive green to purple (red), seems to be oxidized along cracks, with the purple colour there, calcareous, reddish brown, probably a part of the above.
			1% Limestone; white, greyish white.
			< 1% Pyrite.
			Added: Wood, nut shells, mica.

Table II

Lithology and Total Organic Carbon (s.7)

IKU No.	Depth	TOC	Lithology
K4369	2730-2745 m		60% Sand; clear and white, angular to subangular, medium to coarse, mainly quartz.
		0.22	40% Claystone; olive green, green, purple, reddish brown. The claystone seems to have been broken up after deposition. There is no normal lamination in the rock.
			1% Limestone, mostly white but other colours occationally seen.
			Added: Wood, nut shells and mica.
			Some coal fragments are probably added.
K4370	2745-2760 m		60% Sand; medium to coarse, white to clear, angular to subangular, mainly quartz.
		1.58	40% Claystone, colours and types as above.
			1% Limestone, white or pink, occationally green, some brownish white (siderite, dolomite?).
			Added: Mica, wood (sparse), coal (which can be derived from the rock, but is probably added), nut shells (very little).
K4371	2760-2775 m	0.35	60% Claystone, very silty or sandy, with coal? and quartz grains, various colours seen, grey, olive green, green, yellowish green, purple, reddish grey and reddish brown.
			40% Sand/Sandstone medium to coarse, white to clear, some fragments of the original sandstone (still preserved) can be seen. The grains are mainly quartz, but two types of mica are also observed, one of these similar to the above mentioned mica, which might lead to the conclusion that the previously mentioned mica is a part of the sandstone, cementing material is observed to be calsite.
			1% Limestone as white tight masses.

Table II

Lithology and Total Organic Carbon (s.8)

IKU No.	Depth	TOC	Lithology
K4369 (cont.)			Added: Mica, wood, nut shells. (The mica content in the sandstone might have been misleading because mica is seen enclosed in post drilling cemented "rock" together with pieces of added wood fibres).
K4372	2775-2790 m	0.91	60% Claystone, silt and sand, the above mentioned colours seen, the claystone contains coal.
			35% Sand/Sandstone, white to grey, sand grains, angular to subangular, medium to coarse.
			1% Limestone, white pinkish white, often containing grains of quartz.
			1% Pyrite; often in masses of grains cemented by calsite, together with quartz.
			Added: Mica, nut shells.
K4373	2790-2805 m		80% Sand; white to clear, sometimes stained pink, poor cementing, medium to coarse, mainly quartz.
		0.10	15% Claystone, reddish brown dominant, silty, calcareous, micaceous. Also; grey, greenish grey, silty often grading to reddish brown (perhaps due to difference in oxidation, also; purple and olive green.
			1% Limestone, white.
			<1% Pyrite, as grains, together with quartz.
			Minor: Coal; as wee fragments, probably derived from the claystone.
			Added; mica, nut shells.
K4374	2805-2820 m		80% Sand, as above, mainly quartz.
		0.25	15% Claystone, mainly reddish brown, silty micaceous, also grey and greenish grey, purple and olive green.
			1% Limestone, white-pinkish white, tight.
			Minor: coal, pyrite.
			Added: mica.

Table II

Lithology and Total Organic Carbon (s.10)

IKU No.	Depth	TOC	Lithology
K4399	3180-3195	2.10	60% Claystone/sandy siltstone, brownish red micaceous, calcareous, sometimes silty and sandy. 30% Sand/Sandstone, white to clear often stained yellowish brown, calsite cement. 2% Claystone, black, dark grey, very fissile. 5% Coal; black, strings. Minor: mica (added?), salt?.
K4412	3375-3390	0.08	90% Sand/Sandstone, grains clear to white, often stained yellowish brown. Cementing material: calsite. 10% Claystone, reddish brown, silty and sandy. 1% Limestone, white. Added: mica.

Added: means material supposed not to have have been present in the original rock.

Table II

Lithology and Total Organic Carbon (s.9)

IKU No.	Depth	TOC	Lithology
K4375	2820-2835	0.44	40% Claystone, brownish-red, often silty. Sometimes showing greenish spots.
			20% Sandstone, angular most often represented as sand grains (because of loose cementing of the grains). Where sandstone preserved, calsite seems to be cementing material.
			5% Claystone, black to greyish black, fissile.
			5% Limestone, grey sucrosic.
			25% Cement (added).
K4381	2910-2925		70% Sandstone; consolidation poor, quartz fragments as single grains, clear to white, subangular. Brownish stained cementing material, mainly calsite (siderite?).
		0.26	20% Claystone, reddish-brown, micaceous, and sometimes silty.
			Added: 10% Cement, nut shells and other.
K4382	2925-2940	0.21	60% Sandstone, quarts fragments, angular to subangular, clear to white, but often stained yellowish brown.
			35% Claystone of which (33%) is reddish brown, partly micaceous and often silty (2%) black and fissile.
			Minor: Limestone, white and tight.
			Added: Steel (minor) Muscovite flakes (minor).
K4389	3045-3060	0.19	90% Sandstone, with grains of quartz, angular to subangular, white to clear, stained brown. Cementing material calsite (siderite, dolomite?).
			5% Claystone, brownish red, silty, micaceous, carbonaceous.
			1% Limestone, white to greenish white.
			1% Claystone, black, fissile.
			Added: (5%) mica, steel, nut shells etc.

IKU

T A B L E : III

WEIGHT OF EOM AND CHROMATOGRAPHIC FRACTIONS

IKU-No	DEPTH (m)	Rock Extr. (g)	EOM (mg)	Sat. (mg)	Aro. (mg)	HC (mg)	Non HC (mg)	TOC (%)
K-4347	2400	50.0	18.7	3.2	1.0	4.2	14.5	.8
K-4349	2430	44.0	12.0	4.8	1.8	6.6	5.4	.9
K-4352	2475	27.0	4.3	1.7	.2	1.9	2.4	.7
K-4353	2490	35.0	10.9	3.2	.6	3.8	7.1	.6
K-4355	2520	37.0	13.1	5.0	1.6	6.6	6.5	.9
K-4358	2565	17.5	7.7	1.3	.1	1.4	6.3	.7
K-4372	2775	25.8	5.9	.1	.4	.5	5.4	.9
K-4375	2820	50.0	46.7	16.4	7.9	24.3	22.4	.4
K-4381	2910	43.2	7.0	1.8	.7	2.5	4.5	.3
K-4382	2925	23.7	6.6	1.8	2.0	3.8	2.8	.2
K-4390	3045	50.0	5.4	1.3	1.4	2.7	2.7	.2
K-4399	3160	50.0	27.9	5.5	3.6	9.1	18.8	2.1
K-4412	3375	50.0	4.5	.8	1.9	2.7	1.8	.1

IKU

T A B L E : IV

CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

(Weight ppm of rock)

IKU-No	DEPTH (m)	EOM	Sat.	Aro.	HC	Non HC
K-4347	2400	374	64	20	84	290
K-4349	2430	273	109	41	150	123
K-4352	2475	159	63	7	70	89
K-4353	2490	311	91	17	109	203
K-4355	2520	354	135	43	178	176
K-4358	2565	440	74	6	80	360
K-4372	2775	229	4	16	19	209
K-4375	2820	934	328	158	486	448
K-4381	2910	162	42	16	58	104
K-4382	2925	278	76	84	160	118
K-4390	3045	108	26	28	54	54
K-4399	3180	558	110	72	182	376
K-4412	3375	90	16	38	54	36

IKU

TABLE: V

CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

(mg/g TOC)

IKU-No	DEPTH (m)	EOM	Sat.	Aro.	HC	Non HC
K-4347	2400	46.8	8.0	2.5	10.5	36.3
K-4349	2430	30.3	12.1	4.5	16.7	13.6
K-4352	2475	22.8	9.0	1.1	10.1	12.7
K-4353	2490	51.9	15.2	2.9	18.1	33.8
K-4355	2520	39.3	15.0	4.8	19.8	19.5
K-4358	2565	62.9	10.6	.8	11.4	51.4
K-4372	2775	25.4	.4	1.7	2.2	23.3
K-4375	2820	233.5	82.0	39.5	121.5	112.0
K-4381	2910	54.0	13.9	5.4	19.3	34.7
K-4382	2925	139.2	38.0	42.2	80.2	59.1
K-4390	3045	54.0	13.0	14.0	27.0	27.0
K-4399	3160	26.6	5.2	3.4	8.7	17.9
K-4412	3375	90.0	16.0	38.0	54.0	36.0

T A B L E : VI

COMPOSITION IN % OF THE MATERIAL EXTRACTED FROM THE ROCK

IKU-No	DEPTH (m)	Sat / EOM	Aro / EOM	HC / EOM	Sat / Aro	Non HC / EOM	HC / Non HC
K-4347	2400	17.1	5.3	22.5	320.0	77.5	29.0
K-4349	2430	40.0	15.0	55.0	266.7	45.0	122.2
K-4352	2475	39.5	4.7	44.2	850.0	55.8	79.2
K-4353	2490	29.4	5.5	34.9	533.3	65.1	53.5
K-4355	2520	38.2	12.2	50.4	312.5	49.6	101.5
K-4358	2565	16.9	1.3	18.2	1300.0	81.8	22.2
K-4372	2775	1.7	6.8	8.5	25.0	91.5	9.3
K-4375	2820	35.1	16.9	52.0	207.6	48.0	108.5
K-4381	2910	25.7	10.0	35.7	257.1	64.3	55.6
K-4382	2925	27.3	30.3	57.6	90.0	42.4	135.7
K-4390	3045	24.1	25.9	50.0	92.9	50.0	100.0
K-4399	3160	19.7	12.9	32.6	152.8	67.4	48.4
K-4412	3375	17.8	42.2	60.0	42.1	40.0	150.0

TABLE VII

TABULATION OF DATAS FROM THE GASCHROMATOGRAMS

IKU No.	Depth (m)	Pristane/nC_{17}	Pristane/Phytane	CPI
K 4347	2400-~~20~~ 15	0,5	1,5	1,2
K 4349	2430-45	0,6	1,6	1,1
K 4352	2475-90	0,5	0,9	1,0
K 4353	2490-2505	0,4	0,9	1,0
K 4355	2520-35	0,4	1,1	1,0
K 4358	2565-80	0,5	1,2	1,0
K 4372	2775-90	0,5	0,8	0,9
K 4375	2820-35	0,4	0,9	0,8
K 4381	2910-25	0,3	0,7	0,6
K 4382	2925-40	0,4	0,9	0,9
K 4390	3045-60	0,3	0,8	0,9
K 4399	3180-95	0,3	0,8	1,7
K 4412	~~3395-90~~ 3375-90	0,4	0,62	0,9

IKU

NB! forsteduppe logges inn: dyp + 15 m

TABLE NO.: VIII

SECTION .:

VITRINITE REFLECTANCE MEASUREMENTS

Sample	Height	Vitrinite reflectance	Fluorescence in UV light	Exinite content
K4347	2400	0.50(17),0.72(4)	Yellow/Orange - Mid Orange	Moderate
K4349	2430	0.51(19)	Yellow/Orange - light orange	Moderate
K4351	2460	0.57(8)	Light orange	Trace
K4352	2475	0.53(16)	Light - Mid-orange	Low-Moderate
K4354	2505	0.42(4).0.57(16)	Yellow(orange - light orange	Moderate
K4355	2520	0.21(4),0.47(16)	Light orange	Low
K4358	2565	0.54(8)	Light - Mid.orange	Low-Moderate
K4367	2700	0.59(9)	Light - Mid.orange	Low-Moderate
K4370	2745	0.90(2)	Very Dull. Mid. orange	Trace
K4372	2775	NDP	-	-

IKU

TABLE NO.: IX

SECTION .:

VISUAL KEROGEN ANALYSIS 34/4-2

(Trondheim 1980)

Sample	Depth	Composition of residue	Particle size	Preservation - palynomorphs	Thermal maturation index	Remarks
K 4347	2400-2415	Am/He,WR!	F-M	good	1/1+	Caved Tertiary or Cretaceous material is suspected in most of this interval particularly from 2700 m to 2790 m.
K 4349	2430-2445	Am/He,WR!	F-M-L	good	1/1+	
K 4351	2460-2475	*(Am) Cysts/Cut,WR!,W,He	F-M	good	1/1+	
K 4352	2475-2490	He,W,WR!Poll-spor/Am,Cysts	F	good and poor	1+	
K 4354	2505-2520	Am,Cysts/W,WR!,Poll	F-M-L	good,fair to poor	1+	
K 4355	2520-2535	Am,Cysts/He,W,WR!,Poll	F-M	good	1+	
K 4358	2565-2580	Am,Cysts/W,WR!,He,Poll	F-M-L	good	1+	
K 4367	2700-2715	Am,Cysts/He,W,WR!,Poll	F-M	good to fair	1/1+ or 2-/2	
K 4370	2745-2760	*(Am)/WR!,W	F-M	fair	1/1+ or 2-/2	
K 4372	2775-2790	*(Am)/WR!,W	F-M	fair	1/1+ or 2-/2	

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
( )	estimated amount	*	screened residue				

IKU

TABLE NO.: X

ROCK – EVAL PYROLYSES

SECTION .:

Sample	Depth	S_1	S_2	S_3	C_{org}	Hydrogen Index	Oxygen Index	Petroleum potential (S_1+S_2)	Production Index S_1/S_1-S_2	T_{max} °C
K 4347	2400-15	0.07	0.22	1.43	0.80	27.50	178.75	0.29	0.24	435°
K 4348	2415-30	0,09	0.36	1.33	0.86	41.86	154.65	0.45	0.20	437°
K 4349	2430-45	0.09	0.42	1.34	0.93	45.16	144.09	0.51	0.18	434°
K 4351	2460-75	0.08	0.28	1.39	0.90	31.11	154.44	0.36	0.22	435°
K 4352	2475-90	0.18	0.14	1.41	0.74	18.92	190.54	0.32	0.56	436°
K 4354	2505-20	0.12	0.22	1.32	0.59	37.39	223.73	0.34	0.35	439°
K 4355	2520-35	0.08	0.29	1.07	0.88	32.95	121.59	0.37	0.22	435°
K 4356	2535-50	0.06	0.08	1.44	0.66	12.12	218.18	0.14	0.43	436°
K 4358	2565-80	0.07	0.19	1.50	0.72	26.39	208.33	0.26	0.27	433°
K 4363	2640-55	0.05	-	1.86	0.33	-	563.64	-	-	-
K 4365	2670-85	0.18	-	1.73	0.21	-	823.21	-	-	-
K 4367	2700-15	0.09	0.92	2.83	2.17	42.40	130.41	1.01	0,09	336°
K 4370	2745-60	0.07	1.76	4.83	1.58	111.39	305.70	1.83	0.04	335°
K 4372	2775-90	0.09	1.46	4.15	0.91	160.44	456.04	1.55	0.06	338°
K 4374	2805-20	0.10	-	1.67	0,25	-	668.0	-	-	-

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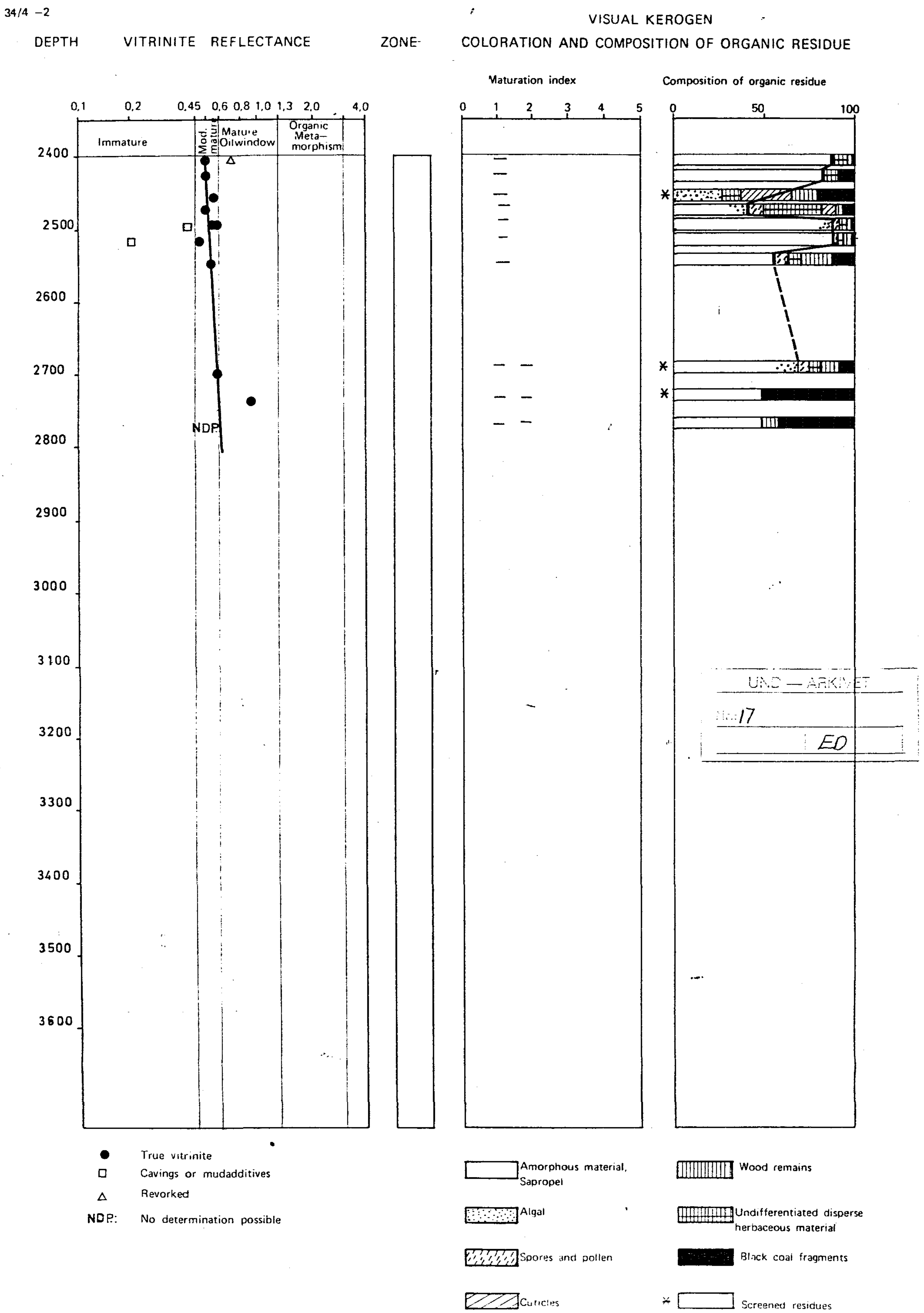
MATURATION



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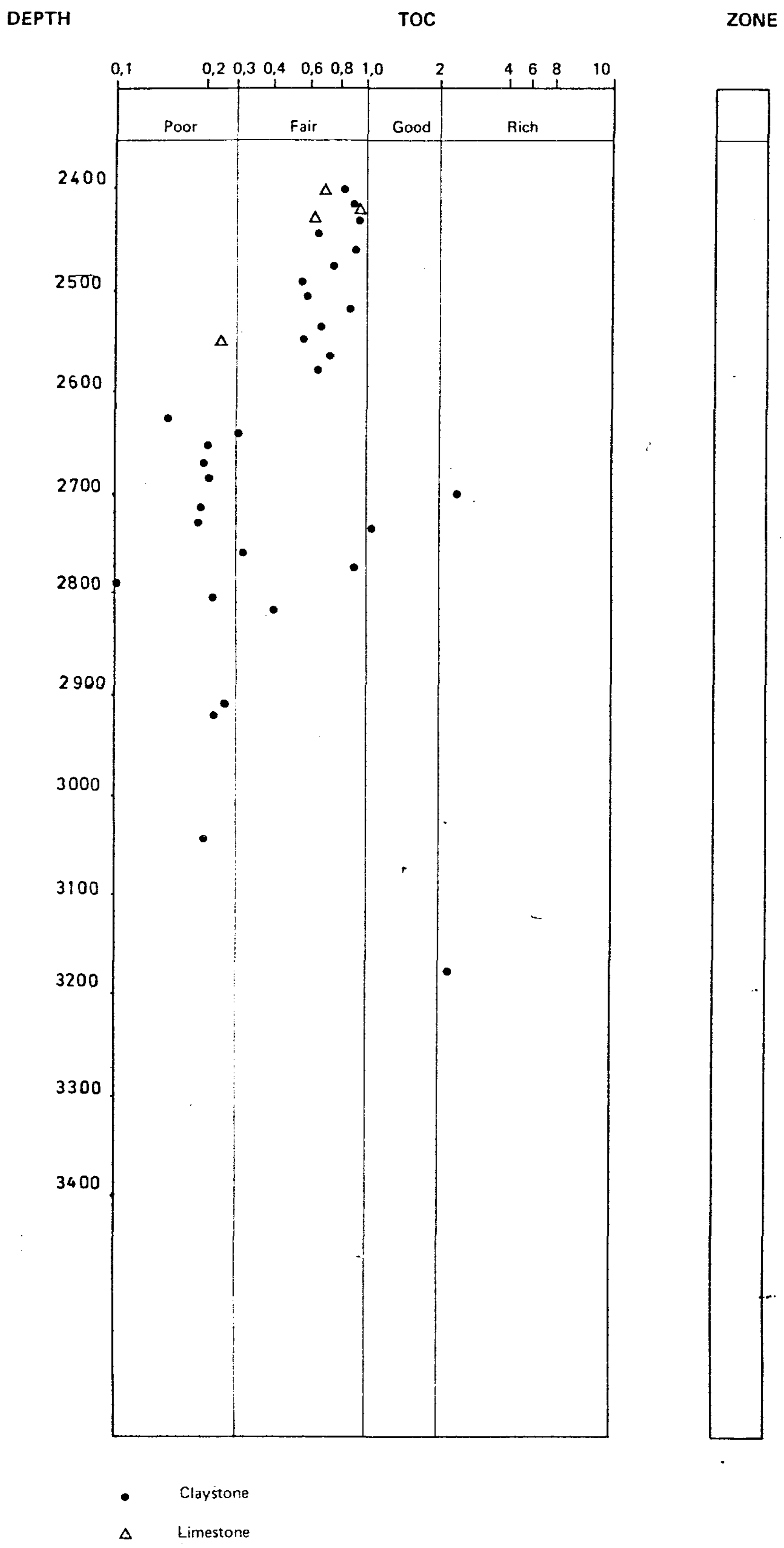
TOTAL ORGANIC CARBON (TOC)

Presentation of Analytical Data



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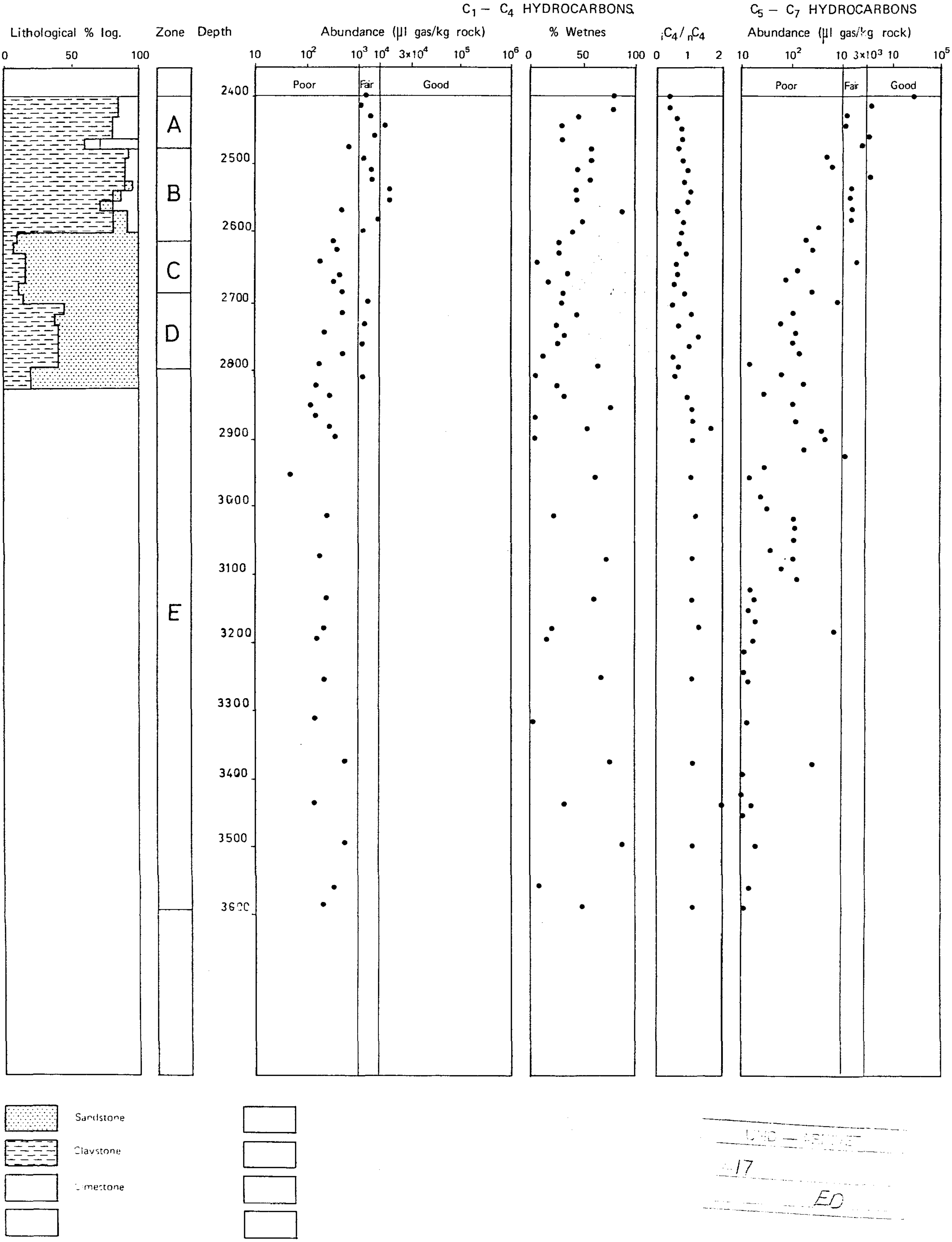
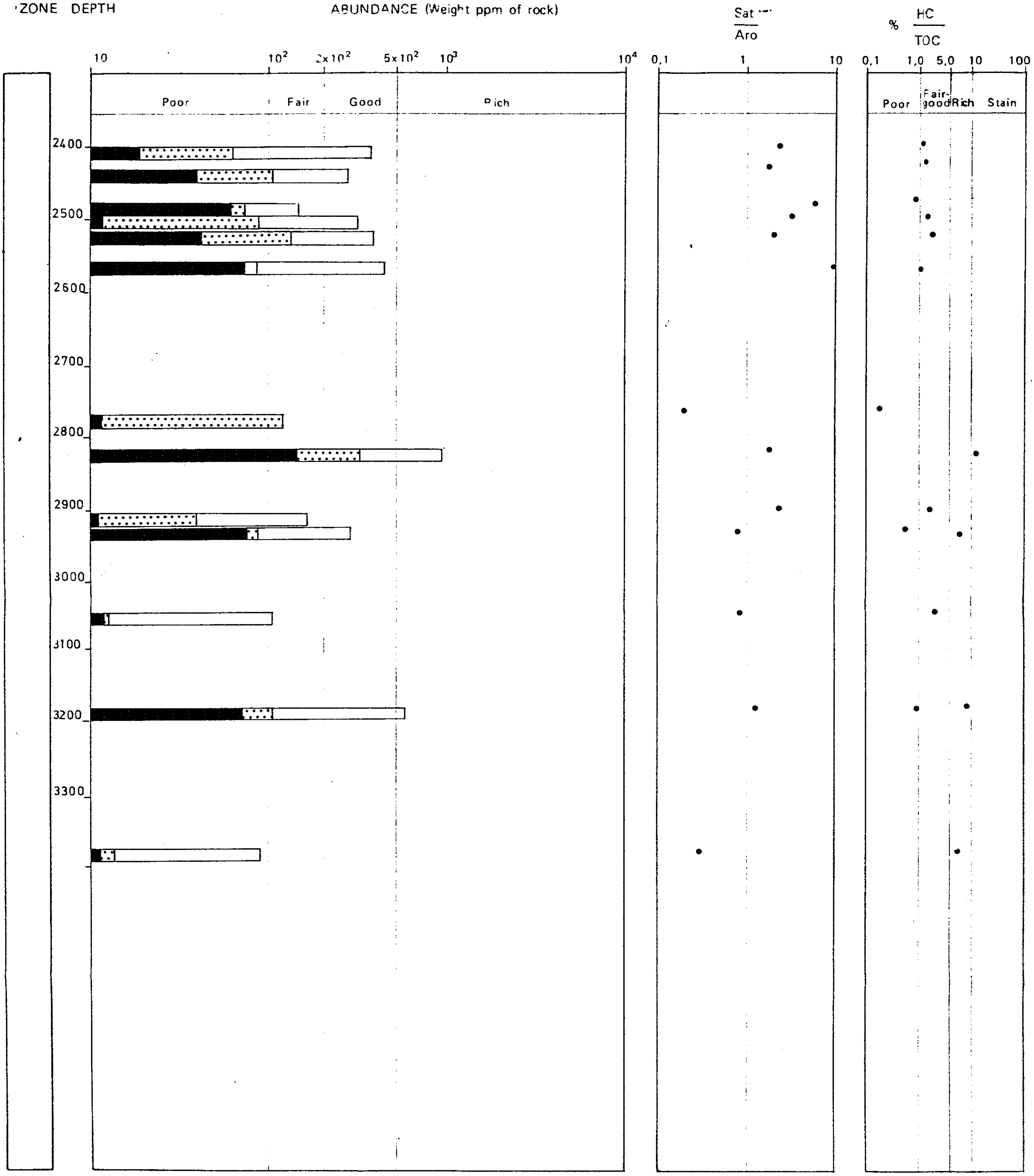
$C_1 - C_7$ HYDROCARBONS
Presentation of Analytical Data



C_{15}^{+} HYDROCARBONS

Presentation of Analytical Data



Sat: Saturated Hydrocarbons
Aro: Aromatic Hydrocarbons
NSO: Nitrogen, Sulphur and Oxygen containing compounds
Asp: Asphaltenes
HC: C_{15} Hydrocarbons
TOC: Total Organic Carbon

INTERPRETATION DIAGRAM

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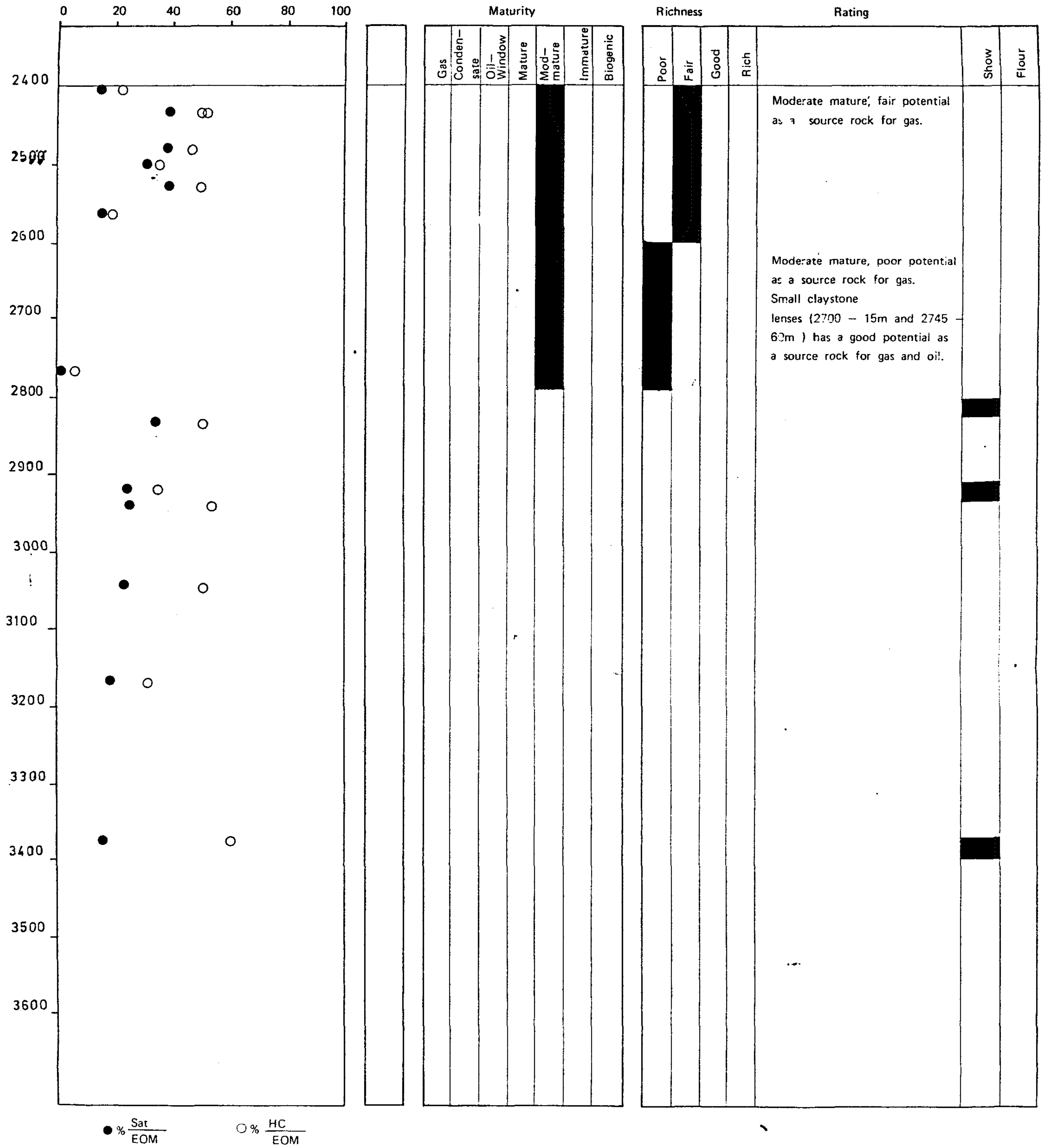
C_{15}^{+} SATURATED HYDROCARBONS

DEPTH	MATURATION C_{15}^{+} FRACTION	ZONE	RATING SUMMARY OF SOURCE POTENTIAL



● % Sat/EOM ○ % HC/EOM

Sat: Saturated Hydrocarbons
HC. Hydrocarbons
EOM: Extractable Organic Matter

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C_{15}^{+} SATURATED HYDROCARBONS