REPORT TITLE

Source rock analyses of well 34/10-7

CLIENT

Statoil

CLIENT's REF.:	REPORT NO..
Bjørn Rasmussen	0-270/1/80

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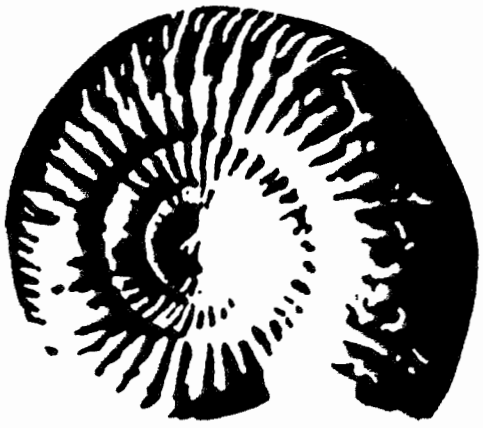

INSTITUTT FOR
KONTINENTALSOKKELUNDERSØKELSER

Continental Shelf Institute

Håkon Magnussons gt 1B
Postboks 1883
7001 Trondheim
Telefon (075) 15660
Telex 55548
Telegram 'NORSHELF"

IKU

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AUTHOR (S):

M. Bjorøy, T.M. Rønningsland,
J.O. Vigran, K. Lind

DATE.	PROJECT NO.
12.6.80	0-270
NO. OF PAGES	NO. OF ENCLOSURE

DEPARTMENT:	RESPONSIBLE SCIENTIST.
Org. Geochemistry	M. Bjorøy

SUMMARY.

The analysed sequence of the well is divided into five zones with the following rating:

A: 1690 - 1765: Limestone; good potential as a source roch for gas(and oil).
B: 1765 - 1930: Fair/good potential as a source rock for gas. Migrated HC in parts.
C: 1930 - 1990: Siltstone with migrated HC.
D: 1990 - 2050: Mud additive only.
E: 2050 - 2100: Sandstone zone. No indications of migrated HC. The whole sequence is immature.

KEY WORDS

Source rocks

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°C.

Total Organic Carbon (TOC).

Picked cuttings of the various lithologies in each sample were crushed in a centrifugal mill. Aliquotes of the samples were then weighted into Leco cruisibles and treated with hot 2N HCl to remove carbonate and washed twice with distilled water to remove traces of HCl. Thecrusibles were then placed in a vacuum oven at 50°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, 663-665)) for 10 min. using dichloromethane (DCM) as solvent. The DCM used as solvent was distilled 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 Rotavator and transferred to glas-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 where 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. 1.516 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 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, although in many cases this number could not be achieved.

The samples were also analysed in UV light, and the colour of the fluoressing material determined. Below, a scale comparing the vitrinite reflectance measurements and the fluorescence measurements are 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 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 to 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 consentrate 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).

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	1 Moderate mature	Mature (oil window)			Very mature	

Rock-Eval Pyrolyses.

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

RESULTS AND DISCUSSION

The sequence from 1690 - 2100 m was analysed. Some of the samples contained only cement and mud additives, particularly those from 1990 - 2050 m were found to contain no true material, and this interval is separated out as a separate zone.

Headspace Gas Analyses

Based on the headspace analysed together with the total analyses of true material in some samples, the analysed sequence is divided into five zones:

A: 1690 - 1765 m
B: 1765 - 1930 m
C: 1930 - 1990 m
D: 1990 - 2050 m
E: 2050 - 2100 m

Zone A: 1690 - 1765 m: The headspace analyses results are very irregular in this zone both concerning the abundance of the light hydrocarbons, and the composition.

Zone B: 1765 - 1930 m: This zone is separated from zone A mainly due to a steady increase of the wetness of the gas is registered while at the same time the abundance both of C_1 - C_4 and C_5+ hydrocarbons is more regular, both showing a good abundance. Two samples, at 1870 - 95 m and 1885 - 1900 m, show low abundances compared to the ones above and below. This is believed to be due to leaky cans, and they are not separated out as separate zones.

Zone C: 1930 - 1990 m: This zone consists mainly of clay/siltstone, and is separated from the zone above due to a sharp decrease in the abundance of light hydrocarbons with increasing depth. The wetness of the gas decreases also in this interval.

Zone D: 1990 - 2050 m: This zone is separated out from the others due to the samples containing mostly mud additives.

Zone E: 2050 - 2100 m: A zone consisting of sandstone only. The headspace analyses show relatively small abundances of light hydrocarbons, indicating that this zone does not contain migrated hydrocarbons.

Total Organic Carbon. TOC.

Total organic carbon was measured on all samples except sandstone samples and samples which contained only mud additives. 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: The upper part of this zone contained a significant amount of limestone which is found to vary a lot from sample to sample.

Zone B: Most of the analysed samples from this zone are claystone which show fair and good abundances of organis carbon. The lower part of the zone consists og siltstone with a good abundance of organic carbon.

Zone C: Again a zone with a significant amount of limestone with a high percent of organic carbon. The claystone in the zone shows a good abundance of organic carbon.

Zone D: Mud additives only.

Zone E: Mainly sandstone.

Extraction and Chromatographic Separation.

Zone A: One sample, 1690 - 1705 m, was extracted and found to have a rich abundance of extractable hydrocarbons. The gas chromatogram of the saturated hydrocarbon fraction is found to have a pronounced envelope indicating some weathering.

Zone B: Four samples: 1765 - 80 m, 1855 - 70 m, 1885 - 1900 m and 1900 - 15 m were extracted. The uppermost sample, 1765 - 80 m has a good abundance of extractable hydrocarbons while the three other samples have a rich abundance. The sample from 1855 - 70 m has a very high HC/TOC ratio indicating that the sample is contaminated by migrated hydrocarbons.

The gas chromatograms of the saturated hydrocarbon fractions of the three uppermost samples have a similar pattern with a smooth front based distribution, typical for well mature hydrocarbons. The lowermost sample, 1900 - 15 m has a slightly different distribution, especially in the high molecular weight end, with a significant higher CPI value than for the other samples. This might indicate that all three samples higher up in the zone are contaminated by migrated hydrocarbons.

Zone C: One sample, 1945 - 60 m from this zone was extracted and found to have a rich abundance of extractable hydrocarbons. The HC/TOC ratio is, however, that high, that it indicates migrated hydrocarbons in the sample.

The gas chromatogram of the saturated hydrocarbon fraction is found to have a bimodal distribution and high isoprenoid value. This together with an unresolved envelope indicate weathering of the sample.

Vitrinite Reflectance.

Seven samples were examined in reflected light, and vitrinite reflectance measured. Below, each sample is described and together with the reflectance values, other information from the analyses is given.

Sample K 2557, 1690 - 1705 m: Carbonate. No determination possible. No organic material was located.

Sample K 2563, 1780 - 95 m: Shale, Ro = 0,40 (20) and Ro = 0,72 (1).

The sample has a very low organic content with small particles of inertinite and reworked material dominant and clean vitrinite particles and wispy particles as subordinate. Only a trace of bitumen recorded. UV light shows a yellow/orange and mid. orange fluorescence from spores and a low exinite content.

Sample K 2586, 1866 - 70 m: Shale and silty shale, Ro = 0,31 (5) and Ro = 0,52 (3).

The sample has a low organic content with bitumen wisps and small particles of inertinite and reworked material. Only a trace of poor vitrinite particles are recorded.

UV light shows a yellow and yellow/orange fluorescence from spores and hydrocarbon specks together with a low to moderate exinite content.

Sample 2569, 1885 - 1900 m: Silty shale, Ro = 0,32 (10) and Ro = 0,57 (2).

The sample has a very low organic content with small particles of reworked material and inertinite. A few scraps of poor, doubtful vitrinite wisps and some bitumen are recorded. The differentiation between vitrinite and bitumen is difficult. UV light shows a yellow/orange and light orange fluorescence from spores together with hydrocarbon specks and impregnation and a moderate exinite content.

Sample K 2573, 1945 - 60 m: Shale, Ro = 0,35 (21).

The sample has a low organic content, mostly vitrinite particles and wisps. Plentiful of bitumen wisps and locallised staining are recorded together with a trace of inertinite. UV light shows a light orange fluorescence from spores and hydrocarbon traces together with a moderate exinite content.

Sample K 2575, 1975 - 90 m: Calcareous shale and carbonate, Ro = 0,33 (20).

The sample has a low organic content with vitrinite particles and loose, vitrinic coal fragments, possibly additive. Some bitumen wisps and staining together with a trace of inertinite and reworked material are recorded. UV light shows a yellow/orange and light orange fluorescence from spores and hydrocarbon specks together with a low exinite content.

Sample K 2583, 2060 - 70 m: Shale and carbonate traces, Ro = 0,45 (22) and Ro = 0,78 (1).

Tre sample has only a trace of organic material with a few small vitrinite particles in the shale and as loose coal fragments, both of similar reflectance. Inertinite particles are subordinate. UV light shows a light to mid. orange fluorescence from spores and a low exinite content.

Visual Kerogen

Seven samples from the interval 1690 - 2070 m were processed for evaluation of visual kerogen.

The residues obtained from the rock samples were rather small. Due to the amount of acid resistant minerals contained in all residues, separation by $ZnBr_2$ was required.

The organic residues clearly include caved material and mud additives, therefore the results are rather unreliable.

Sample K 2557, 1690 - 1705 m: The sample is almost barren, mud additives dominate. No determination possible.

Sample K 2563 1780 - 95 m: Sapropel forming aggregates dominate. Cysts are present, well preserved or fairly well preserved. Colour index: 2-/ots

Sample 2586, 1855 - 1870 m: Sapropel dominates the residue and there is a minor element of herbaceous and woody material. Palynomorphs observed were fairly well preserved. Colour index: 2-/2.

Sample K 2569, 1885 - 1900 m: Amorphous material dominates. There are about 20% indeterminate, finely dispersed herbaceous material. Most palynomorphs are poorly preserved. Colour index: 2-/2.

Sample K 2573, 1945 - 60 m: Sapropel dominates and there is a minor element of herbaceous material. Palynomorphs, mostly of deltaic character are present and well preserved. Colour index: 2-/2.

Sample 2575, 1975 - 90 m: Sapropel dominates, but about one third of the residue is of suggested terrestrial derivation, 20% indeterminate herbaceous, 10% woody material. Colour index: 2-/2.

Sample K 2583, 2060 - 70 m: Sapropel forming aggregates dominate. There is a minor element of indeterminate finely dispersed herbaceous material. Mud additives are clearly observed. We suspect cavings in this sample. Colour index: 2-/2.

Rock-Eval Pyrolysis.

Six samples were analysed on a Rock - Eval instrument. The Tmax temperature indicate the samples to be immature with a slightly higher maturity for the samples below 1900 m.

The oxygen index is high for all the samples while the hydrogen index vary somewhat for the samples, but generally with a low value indicating kerogen type III. The highest hydrogen index is found for the limestone from 1690 - 1705 m. The type of kerogen found by the pyrolysis is not in agreement with the results from the visual kerogen examination. The samples were, however, poor and as a result the visual kerogen analyses were unreliable. Therefore we are inclined to put more weight on the Rock-Eval results which are from carefully picked cuttings.

CONCLUSION

Based on the headspace analyses, the analysed sequence of the well is divided into five zones:

A: 1690 - 1765 m
B: 1765 - 1930 m
C: 1930 - 1990 m
D: 1990 - 2050 m
E: 2050 - 2100 m

In our evaluations of the source rock potential of the well, the richness is estimated out from the headspace gas analyses, total organic carbon and extractable hydrocarbons while the type of kerogen is estimated from the Rock-Eval pyrolysis and visual kerogen examinations. For reasons described above, most emphasis is put on the Rock-Eval results. The maturation is decided with background in the vitrinite reflectance measurements, fluorescence in UV light, colour of kerogen and Tmax from the Rock-Eval results. The whole of the analysed sequence is found to be immature.

Zone A: 1690 - 1765 m. This zone consists mainly of claystone and limestone. The limestone in the upper part is found to have a good potential as a source for gas (and oil). Indication of some weathering.

Zone B: 1765 - 1930 m. A zone consisting mainly of claystone with some sandstone in parts. The claystone has a fair to good potential as a source rock for gas. Indication of migrated hydrocarbons in most samples from this zone.

Zone C: 1930 - 1990 m. This zone consists mainly of siltstone which has indications of migrated hydrocarbons.

Zone D: 1900 - 2050 m. Mud additives only.

Zone E: 2050 - 2100 m. This zone consists of sandstone. Only headspace analyses was undertaken. These do not suggest any migrated hydrocarbons.

TABLE 1

Concentration µ gas/pr. kg. rock (Headspace)

µl/kg.

Provenv.

Sample	Depth	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 2557	1690-1705	16482	5243	4301	1604	3299	4994	30930	14448	46.71	0.49
K 2558	1705-20	204	485	2988	2447	5930	20761	12054	11850	98.30	0.41
K 2559	1720-35	354	98	539	544	1193	6212	2728	2373	87.01	0.46
K 2560	1735-50	6605	1813	3425	1137	2703	3722	15683	9079	57.89	0.42
K 2561	1750-65	435	161	498	225	483	2346	1802	1368	75.87	0.47
K 2562	1765-80	40167	8549	15701	5158	12001	26153	81576	41409	50.76	0.43
K 2563	1780-95	35	14	24	10	22	44	107	71	66.71	0.46
K 2564	1795-1810	11942	8378	17119	4577	10464	15725	25480	40538	77.24	0.44
K 2565	1810-25	2735	2216	6397	2377	5690	19945	19415	16680	85,91	0.42
K 2566	1825-40	8734	5916	12882	3105	8564	14700	39201	30468	77.72	0.36
K 2567	1840-55	344	394	1615	796	1938	12795	5087	4743	93.23	0.41
K 2586	1855-70	8584	11069	29485	9106	21628	42267	79873	71290	89.25	0.42
K 2568	1870-75	16206	12635	25998	7529	16907	29107	79265	63059	79.55	0.45
K 2569	1885-1900	149	85	154	38	84	269	510	361	70.82	0.45
K 2570	1900-15	61237	25686	20366	6247	14557	34800	138094	76857	55.66	0.43
K 2571	1915-30	59341	14137	21536	2488	5368	8542	93871	34530	36.78	0.46
K 2572	1930-45	5430	2470	3757	929	2154	3030	14740	9309	63.16	0.43
K 2573	1945-60	8804	4737	5553	1055	1884	1571	22034	13230	60.04	0.56
K 2574	1960-75	1462	833	879	156	258	411	3590	2128	59.28	0.61
K 2575	1975-90	6143	2042	2122	432	919	1364	11658	5515	47.13	0.47
K 2576	1990-2000	673	439	1492	623	1526	4418	4753	4081	85.85	0.41

TABLE 1

Concentration μ gas/pr. kg. rock (Headspace)

Sample	Depth	C_1	C_2	C_3	iC_4	nC_4	C_{5+}	ΣC_1-C_4	ΣC_2-C_4	% wetness	$\frac{iC_4}{nC_4}$
K 2577	2000-10	Open	Lid								
K 2578	2010-20	1336	767	1878	536	1561	3097	6678	4743	78.03	0.34
K 2579	2020-30	73	43	139	35	118	578	408	335	82.01	0.30
K 2580	2030-40	14	5	9	2	5	42	35	21	60.18	0.43
K 2581	2040-50	8677	1784	3600	745	2189	3074	16996	8318	48.94	0.34
K 2582	2050-60	11654	2980	3340	794	2045	4127	20813	9159	44.01	0.39
K 2583	2060-70	1467	560	705	150	370	586	3253	1786	54.90	0.40
K 2584	2070-85	190	101	167	46	117	293	621	431	69.36	0.39
K 2585	2085-2100	292	73	96	35	85	244	582	290	49.83	0.41

TABLE II

IKU No.	Depth	TOC	Lithology
< 2557	1690 - 1705		83% Nutshells and some Mica and Cement (white)
		1,53	15% Limestone, white to light grey
			2% Claystone, grey, greenish
< 2558	1705 - 20		95% Cement
			5% Limestone, white (brownish), grey
			Sm.am. Claystone, grey, silty, calcareous
< 2559	1720 - 35		90% Cement
		0,5	10% Limestone, grey/light grey and white
			Sm.am. Claystone, as above
< 2560	1735 - 50	0,34	50% Silt/claystone, light grey to grey, slightly sandy, slightly calcareous
			45% Cement
			5% Siltstone/Marl, brownish white loose
			Sm.am. Sand, medium
< 2561	1750 - 65	0,88	72% Silty claystone grading clayey Siltstone, grey to light grey, calcareous
			25% Cement
			3% Limestone, as above
. 2562	1765 - 80	1,44	70% Clay/siltstone, as above, with very scattered coal-fragments
			30% Cement
. 2563	1780 - 95	0,42	50% Claystone, silty, grey, slightly calcareous
			50% Cement
			Limestone, grey; Siltstone/Marl. Limestone, white
2564	1795 - 1810	0,89	75% Claystone, silty, grey, slightly calcareous
			5% Limestone, grey, white (brownish) and clear/white to brown, Calcite (secondary crystallized in grey limestone, fissures)
			20% Cement
			Sm.am. Sand grains clear, angular, glassy; small coal-like particles (additive)

TABLE II

IKU No.	Depth	TOC	Lithology
K 2565	1810 - 25	2,0	88% Claystone, silty, grey, light green, slightly calcareous. 10% Sand, medium to coarse, clear, angular, and some medium sandstone 2% Calcite, brownish white/clear (secondary). Sm.am. Nut shells; Steel; Siltstone, light grey, micaceous.
K 2566	1825 - 40	0,86	70% Claystone, grey-greenish, slightly calcareous 15% Mud additives and cement 15% Sand, fine to coarse, subangular, clear, glauconitic Sm.am. Limestone, grey; Pyrite; Siltstone, grey, micaceous, sandy; Limestone, brownish white
K 2567	1840 - 55		50% Coal (? additive) 30% Mud/mud additives, cement 10% Sandstone, very fine to medium, light grey, micaceous, glauconitic 10% Claystone, as above
K 2586	1855 - 70	0,95	65% Claystone, silty, grey 15% Siltstone, sandy, (brownish) light grey grading to white very fine Sandstone 20% Cement, additives (Coal), steel Sm.am. Limestone, brownwhite, grey; obs. coarse rounded sand; Clauconite.
K 2568	1870 - 75	1,16	60% Claystone silty grading to clayey siltstone, grey 20% Coal (? additive) 20% Cement, mud additives (nut shells),steel . Sm.am. siltstone, light grey, sandy, micaceous, loose; Limestone, grey; Calcite, clear
K 2569	1885 - 1900	1,28	70% Sandy siltstone to silty claystone, grey to light grey (brownish), greenish, slightly calcareous 30% Mud additives (coal, nut shells) and steel Sm.am. sandstone, very fine; Pyrite

TABLE II

IKU No.	Depth	TOC	Lithology
K 2570	1900 - 15	1,77	60% Clay/siltstone, sandy, grey, micaceous 25% Mud additives (mainly coal) 15% Sand, medium to coarse, clear, subangular-sub rounded, some fine - very fine pyritic sandstone.
K 2571	1915 - 30	1,64	30% Silty claystone to siltstone, grey, some micaceous 70% Mud and mud additives (coal)
K 2572	1930 - 45	0,83	60% Clay/siltstone, as above 40% Mud and mud additives (Coal) Sm.am. Limestone, white (brownish)
K 2573	1945 - 60	1,68	60% Clay/siltstone, grey/light grey (brownish), green (sandy), slightly micaceous/coaly. 20% Mud additives (mostly coal) 20% Sand, fine to medium, clear, and sandstone, brownish, very fine - medium. Silty limestone, brownish; white ? Siderite, brown, hard
K 2574	1960 - 75	 1,68 2,08	50% Mud additives (mainly coal) 30% Limestone/Marl, light grey (brownish) to white partly sandy/silty and some ? Siderite (brown). 15% Clay/siltstone, as above 5% sand and sandstone (micaceous)
K 2575	1975 - 90	 1,08 0,94	40% Mud additives (mainly coal) 40% Limestone, brownish white - yellow brown 20% Clay/siltstone, as above Sm.am. sandstone, fine; pyrite
K 2576	1990 - 2000		95% Cement, light grey ; some mud additives (coal) 5% Clay/siltstone, as above
K 2577	2000 - 10		90% Cement, brownish white and mud additives (coal) 4% Clay/siltstone, as above 4% Limestone, sandy, yellowbrown 2% Sandstone, fine, light grey, Pyrite

TABLE II

IKU No.	Depth	TOC	Lithology
2578	2010 - 20		Cement and mud additives Sm.am. limestone; clay/siltstone; sandstone
2579	2020 - 30		95% Cement and mud additives (coal) 5% Clay/siltstone and limestone (yellowbrown), sandstone
2580	2030 - 40		100% Cement and mud additives white to brown, some coal Sm.am. Clay/siltstone; limestone; sandstone
2581	2040 - 50		97% Cement/additives (coal) 3% Clay/siltstone, grey
2582	2050 - 60		100% Sand, medium - very coarse, angular-subangular, white Sm.am. Claystone, grey (dark); limestone, light brownish grey
2583	2060 - 70	0,74	90% Sand, medium - very coarse, angular to sub-angular, white 10% Claystone, browngrey, with coal-fragments, slightly calcareous Sm.am. Coal (?additive)
2584	2070 - 85		93% Sand, as above 7% Claystone, browngrey to grey
2585	2085 - 2100		100% Sand, as above Sm.am. Mica/chlorite claystone, browngrey (waxy), grey sandstone/claystone, with chlorite

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 (%)
I.-2557	1690	16.4	27.3	10.1	5.2	15.3	12.0	1.5
I.-2562	1765	39.0	32.4	11.3	3.7	15.0	17.4	1.4
I.-2586	1855	24.5	127.9	55.8	20.4	76.2	51.7	1.0
I.-2569	1885	6.7	17.6	6.0	2.4	8.4	9.2	1.3
I.-2570	1900	16.0	25.6	8.2	5.0	13.2	12.4	1.8
I.-2573	1945	31.5	119.9	39.0	35.9	74.9	45.0	1.7

TABLE : IV

CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

(Weight ppm of rock)

NIU-No	DEPTH (m)	EOM	Sat.	Aro.	HC	Non HC
H-2557	1690	1665	616	317	933	732
H-2562	1765	831	290	95	385	446
H-2586	1855	5220	2278	833	3110	2110
H-2569	1885	2627	896	358	1254	1373
H-2570	1900	1600	513	313	825	775
H-2573	1945	3806	1238	1140	2378	1429

TABLE : V

CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

(mg/g TOC)

IKU-No	DEPTH (m)	EOM	Sat.	Aro.	HC	Non HC
K-2557	1690	108.8	40.3	20.7	61.0	47.8
K-2562	1765	57.7	20.1	6.6	26.7	31.0
K-2586	1855	549.5	239.7	87.6	327.4	222.1
K-2569	1885	205.2	70.0	28.0	97.9	107.3
K-2570	1900	90.4	29.0	17.7	46.6	43.8
K-2573	1945	226.6	73.7	67.8	141.5	85.0

TABLE : 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-2557	1690	37.0	19.0	56.0	194.2	44.0	127.5
K-2562	1765	34.9	11.4	46.3	305.4	53.7	86.2
K-2586	1855	43.6	15.9	59.6	273.5	40.4	147.4
K-2569	1885	34.1	13.6	47.7	250.0	52.3	91.3
K-2570	1900	32.0	19.5	51.6	164.0	48.4	106.5
K-2573	1945	32.5	29.9	62.5	108.6	37.5	166.4

TABLE VII

TABULATION OF DATAS FROM THE GASCHROMATOGRAMS

IKU No.	Depth (m)	Pristane/nC_{17}	Pristane/Phytane	CPI
K - 2557	1690 - 1705 m	0,93	1,74	1,25
K - 2562	1765 - 80 m	0,59	2,0	1,05
K - 2586	1855 - 70 m	0,73	2,04	1,09
K - 2569	1885 - 1900 m	0,79	2,04	1,09
K - 2570	1900 - 15 m	0,83	1,85	1,36
K - 2573	1945 - 60 m	1,37	1,71	1,16

TABLE VIII.

VITRINITE REFLECTANCE MEASUREMENTS.

IKU No.	Depth (m)	Vitrinite reflectance	Fluorescence	Exinite content
K 2557	1690-1705	NDP		
K 2563	1780-95	0,40 (20), 0,72 (1)	Yellow/orange-mid.orange (4-6)	Low
K 2586	1855-70	0,31 (5), 0,52 (3)	Yellow + yellow/orange (3+4)	Low - moderate
K 2569	1885-1900	0,32 (10), 0,57 (2)	Yellow/orange - light orange (4-5)	Moderate
K 2573	1945-60	0,35 (21)	Light orange (5)	Moderate
K 2575	1975-90	0,33 (20)	Yellow/orange + light orange (4+5)	Low
K 2583	2060-70	0,45 (22), 0,78 (1)	Light - Mid.orange (5-6)	Low

TABLE IX

IKU	Well number 34/10-7	VISUAL KEROGEN ANALYSIS				
Code number	Sample depth	Composition of residue	Particle size	Presevation -palynomorphs	Thermal maturation index	Remarks (Trondheim 1980)
K 2557	1690-1705	(W, Am)	M	-	-	Almost barren, mud. add. present
K 2563	1780-95	Am, Cysts	F	F - G	2-/2	Aggregates
K 2586	1855-1970	Am/He	F	F	2-/2	Pollen- no spores, mud.add. present
K 2569	1885-1900	Am/He	F	P	(2-/2)	Considerable am. of caved or reworked material
K 2573	1945-60	Am/He	F	G	(2-/2)	Mud. add. present
K 2575	1975-90	Am/He	F	G	(2-/2)	
K 2583	2060-70	Am/He	F - M	F - G	2-/2	Aggregates
		Am amorphous	M medium	P poor	≦2- immature	Picked lithologies
		He herbaceous finely dispersed	F fine	G good	2- to 2 moderate mature	
		W woody material		F fair	>2 to 3 mature	
					> 3 very mature	
					( )based on sapropel	

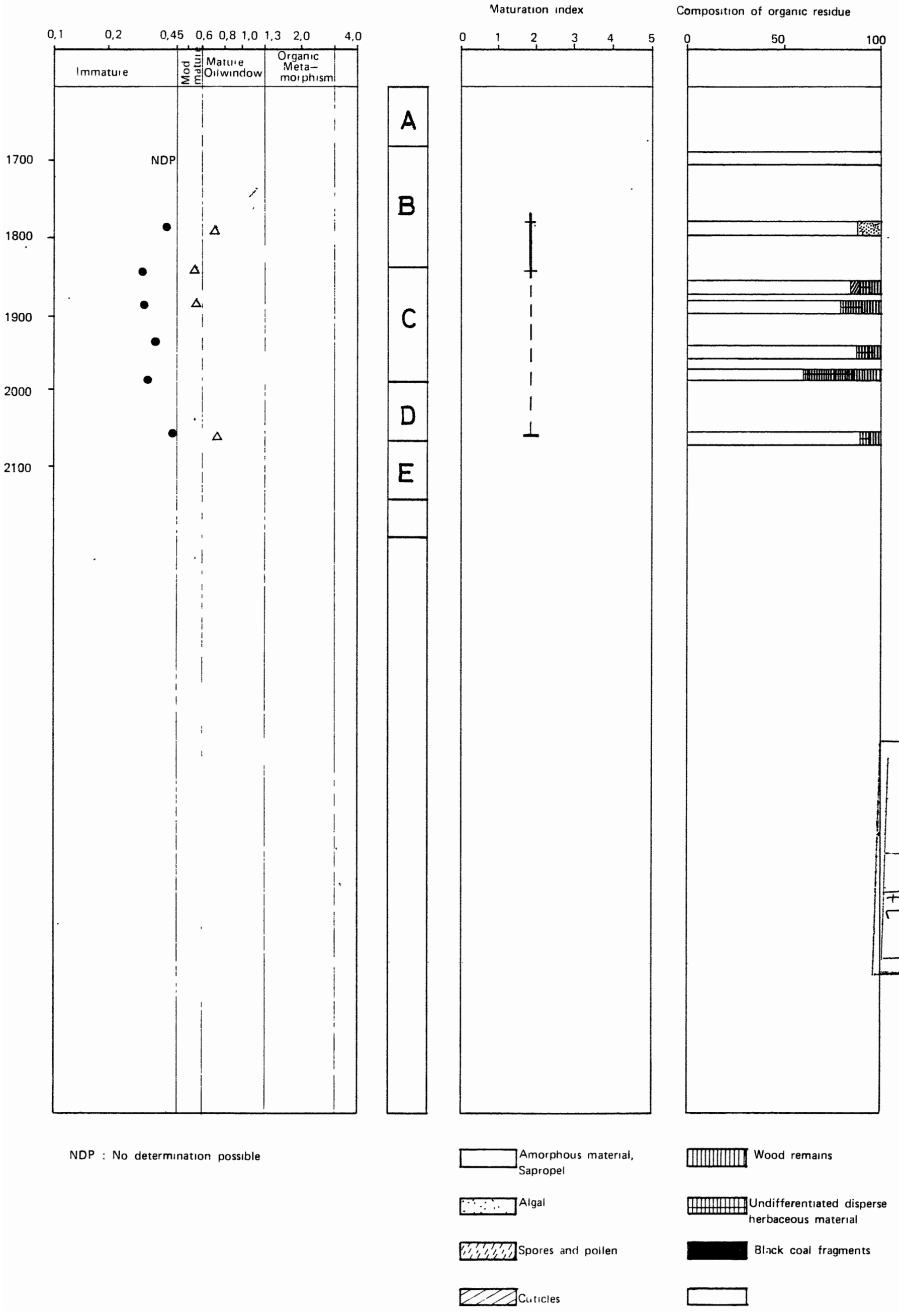
TABLE X

Rock-Eval Pyrolyses

Sample	Depth	S_1	S_2	S_3	C_{org}	Hydrogen Index	Oxygen Index	Oil of gas content ($S_1 + S_2$)	Production Index $\frac{S_1}{S_1 + S_2}$	T_{max} °C
K-2557 Limest.	1690-1705	3,27	2,34	3,13	1,53	148,37	149,02	5,23	0,57	413°
K-2566 Clayst.	1825-40	0,08	0,34	2,37	0,86	39,53	275,58	0,42	0,19	423°
K-2586 Clayst.	1855-70	0,20	0,39	2,60	0,95	41,05	273,68	0,59	0,34	424°
K-2569 Silt/Clayst.	1885-1900	0,93	0,80	2,56	1,28	62,50	200,00	1,73	0,55	432°
K-2574 Silt/Clayst.	1945-60	0,33	1,93	2,75	1,68	114,88	163,69	2,26	0,15	431°
K-2575 Limest.	1960-75	0,35	0,40	3,98	1,08	37,04	368,52	0,75	0,47	432°

34/10–7

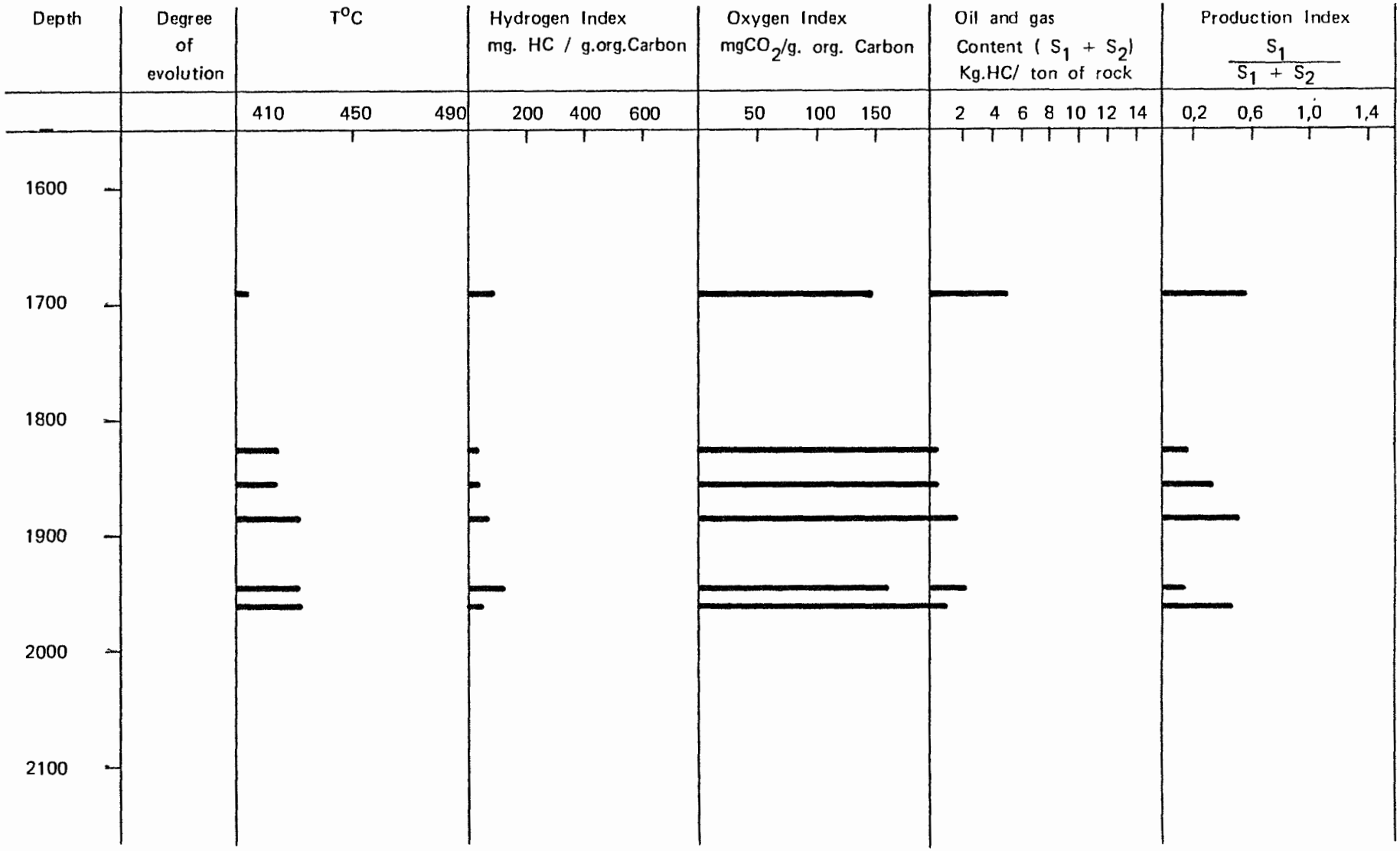
MATURATION



NDP : No determination possible

34/10–7

Rock – Eval Pyrolysis



34/10–7

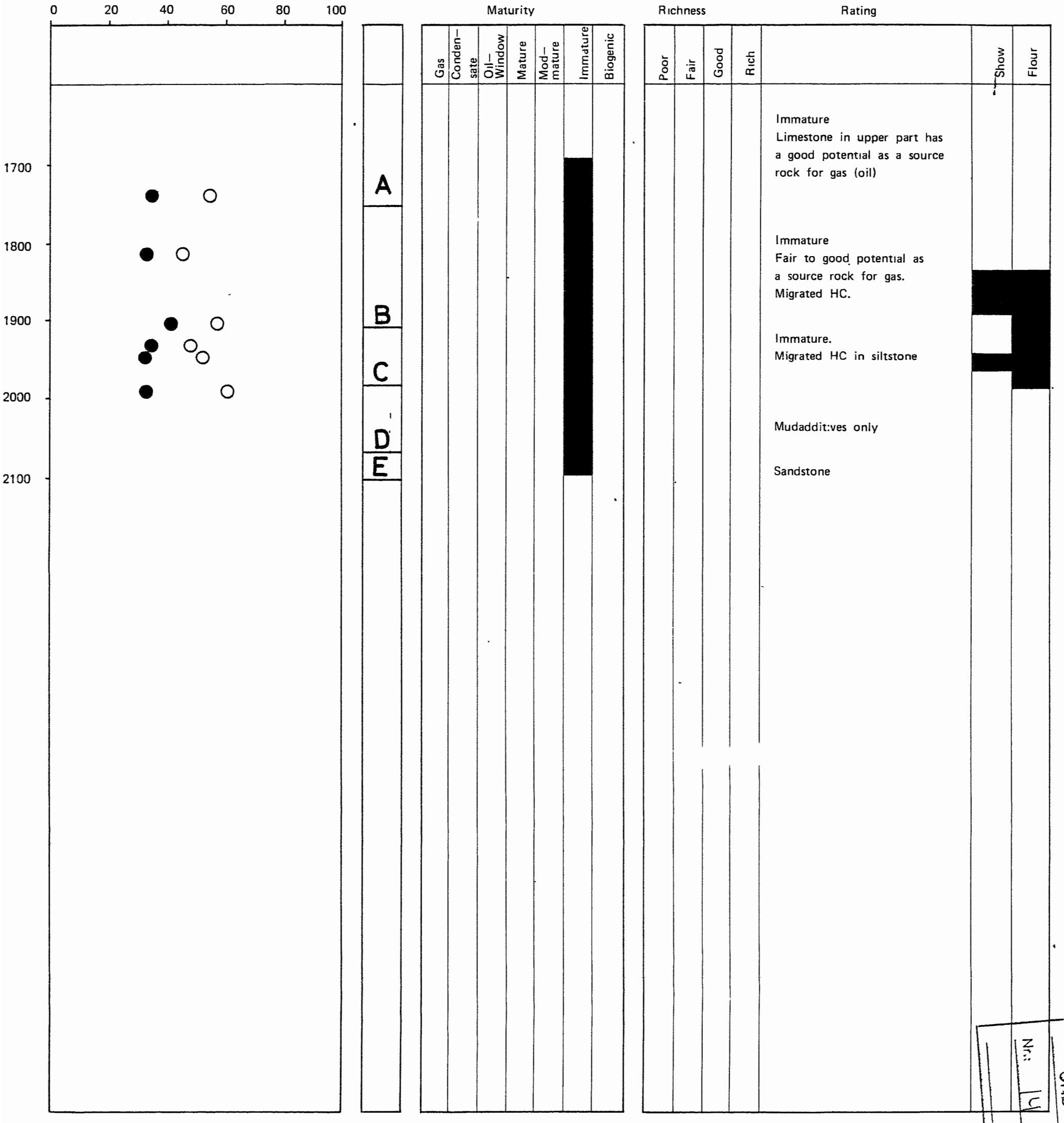
INTERPRETATION DIAGRAM

DEPTH

MATURATION
C_{15}^{+} FRACTION

ZONE

RATING
SUMMARY OF SOURCE POTENTIAL



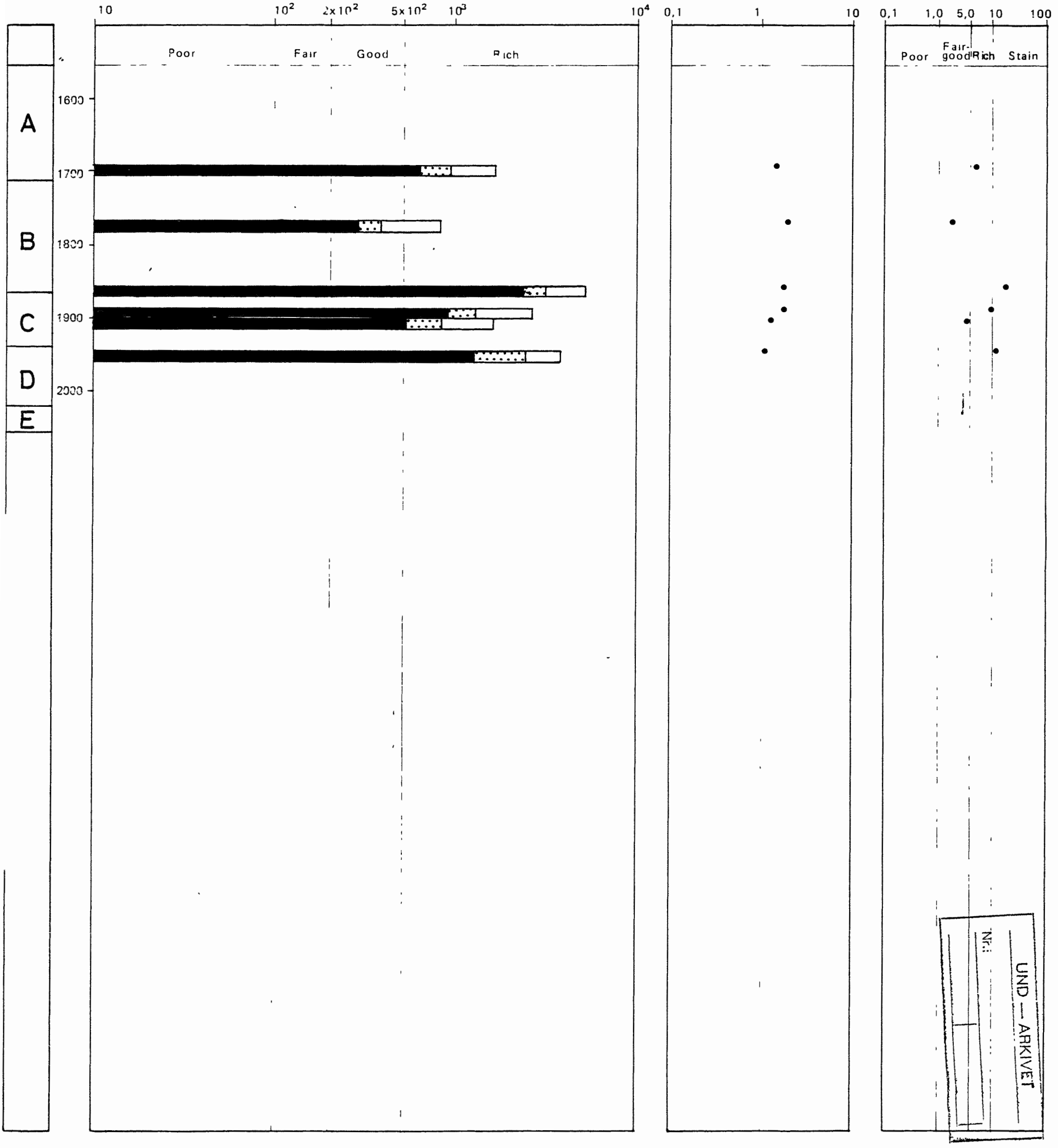
● % $\frac{\text{Sat}}{\text{EOM}}$ ○ % $\frac{\text{HC}}{\text{EOM}}$

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

34/10–7

C_{15}^{+} HYDROCARBONS

Presentation of Analytical Data

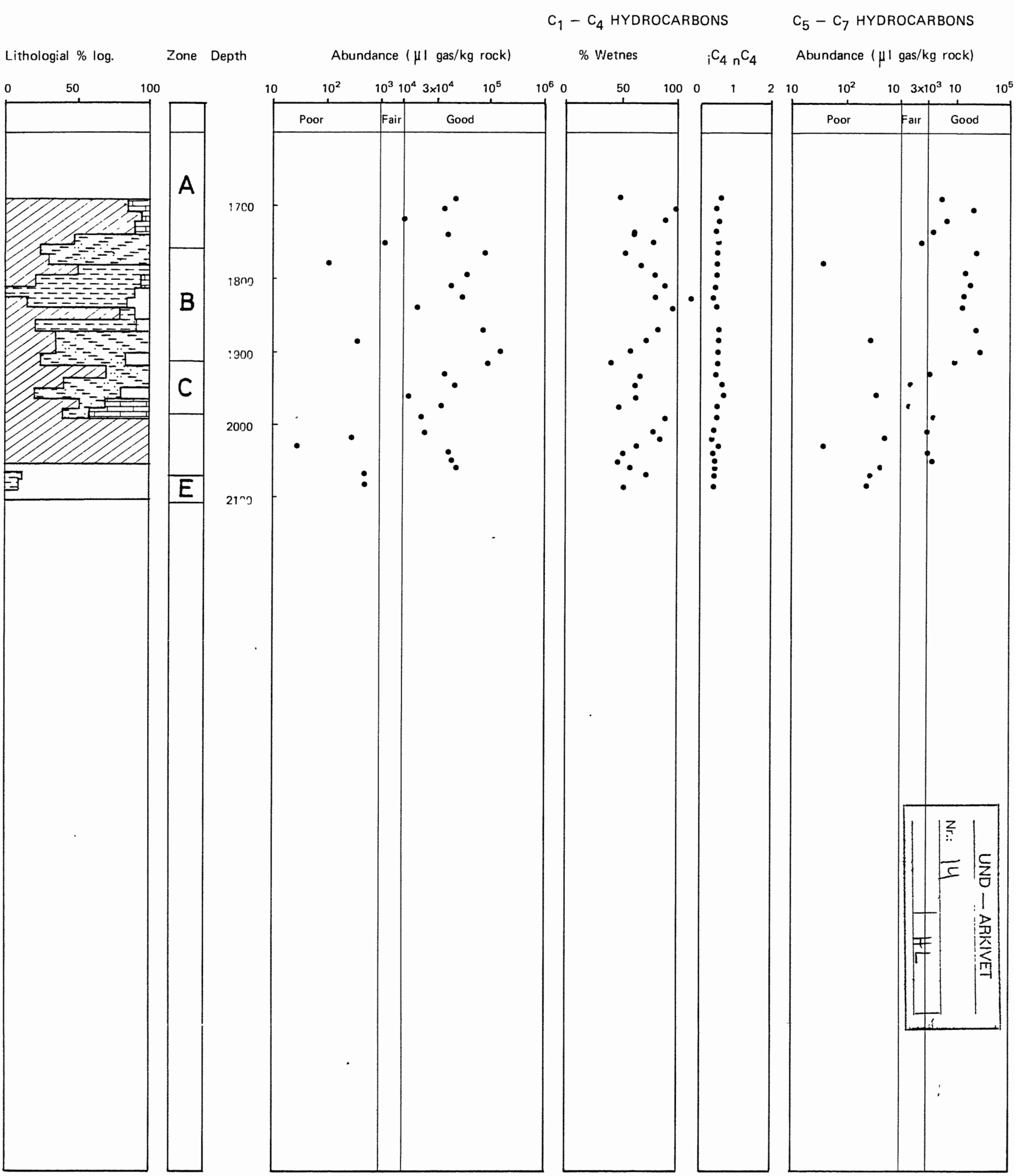


Sat Saturated Hydrocarbons
Aro Aromatic Hydrocarbons
NSO Nitrogen, Sulphur and Oxygen containing compounds

Asp: Asphaltenes
HC. C_{15} Hydrocarbons
TOC. Total Organic Carbon

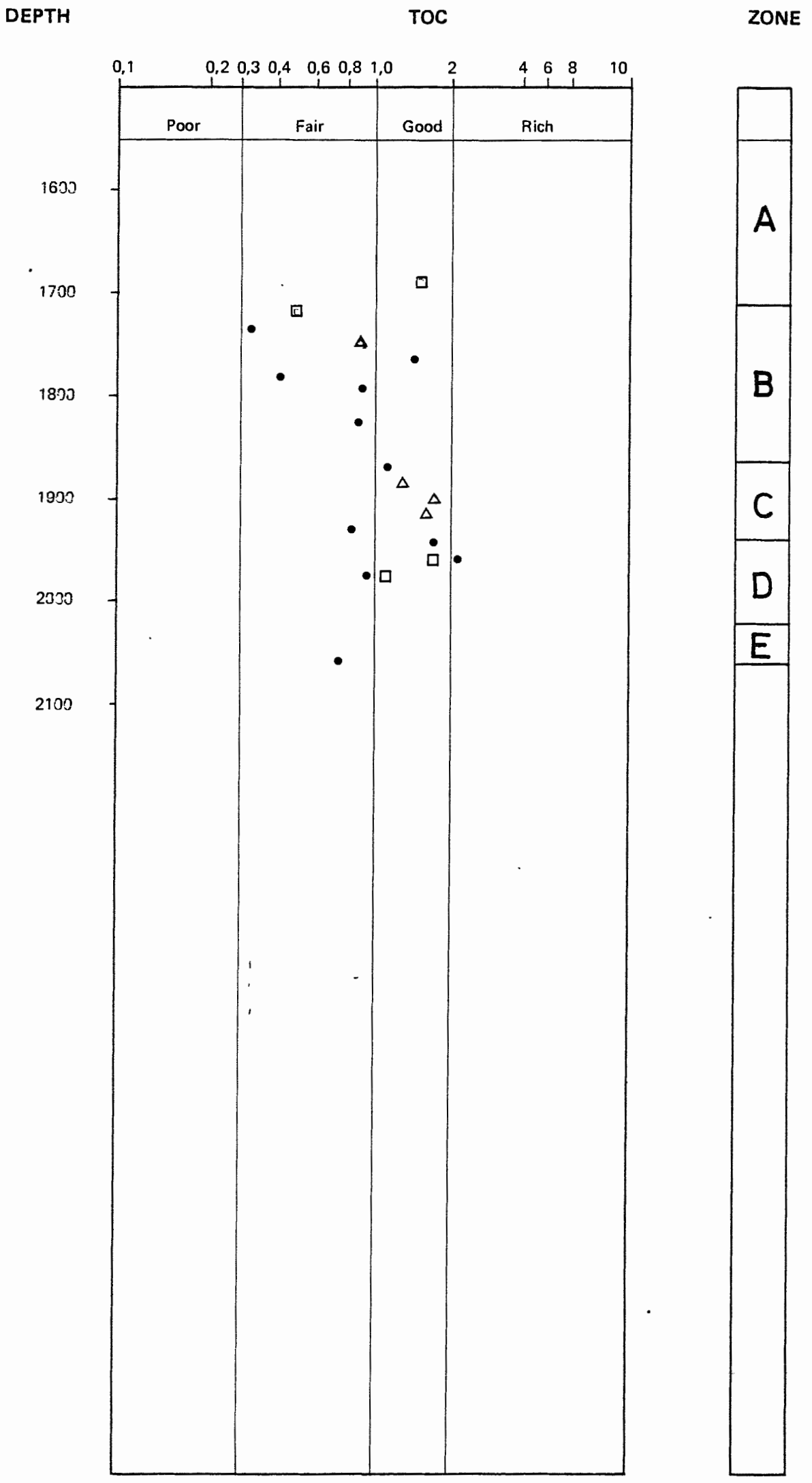
34 ·· 7

$C_1 - C_7$ HYDROCARBONS
Presentation of Analytical Data



TOTAL ORGANIC CARBON (TOC)

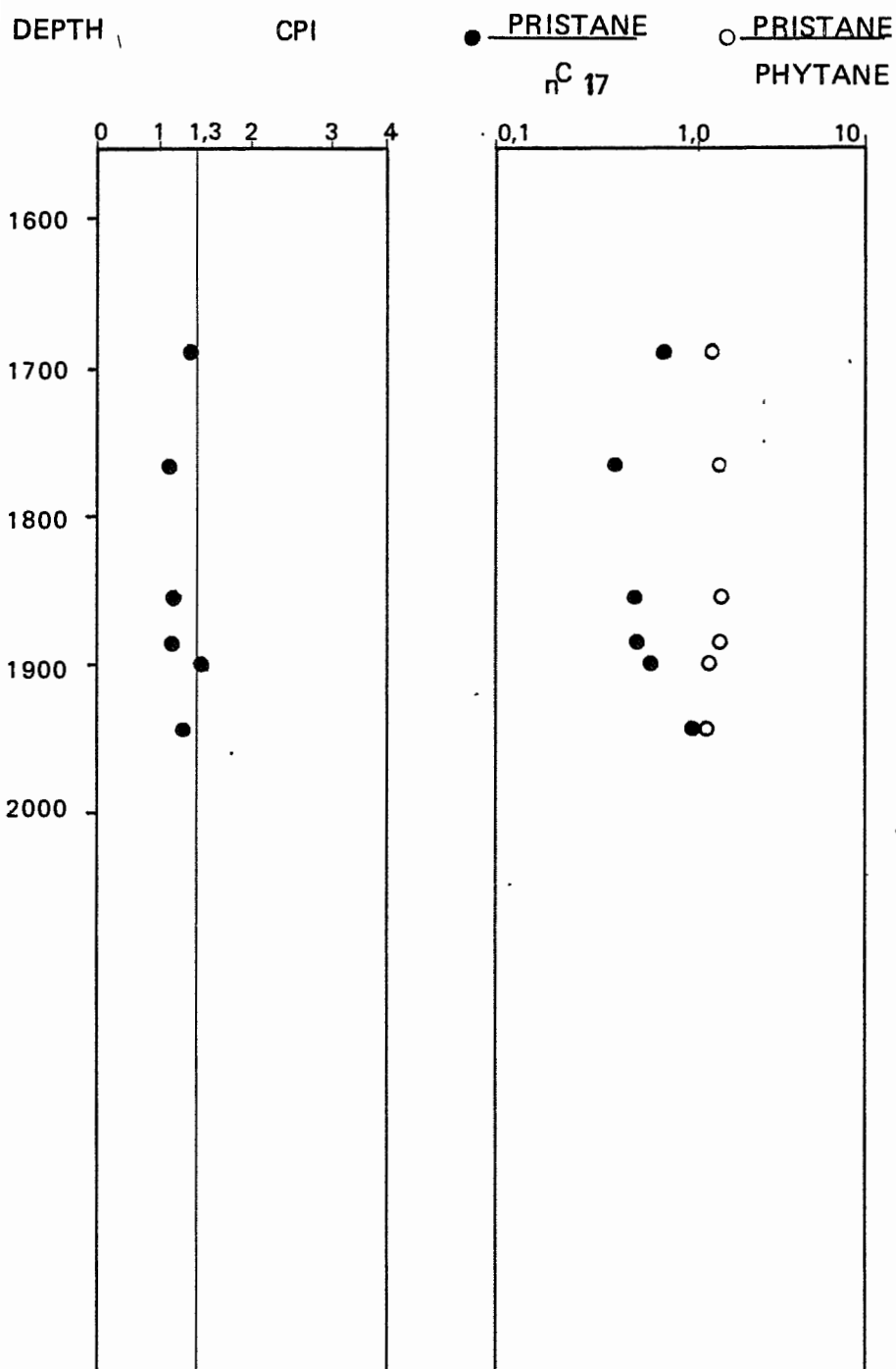
Presentation of Analytical Data

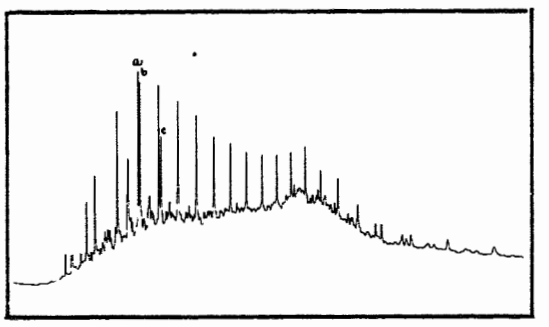


Claystone
Limestone
Siltstone

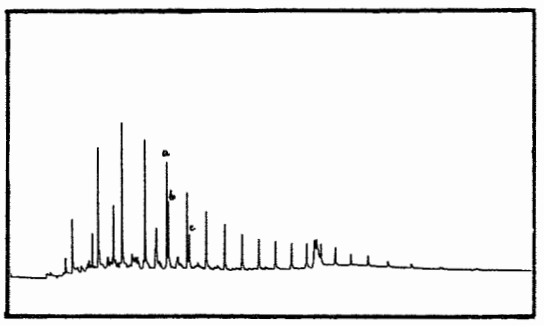
34/10–7

C_{15}^{+} SATURATED HYDROCARBONS

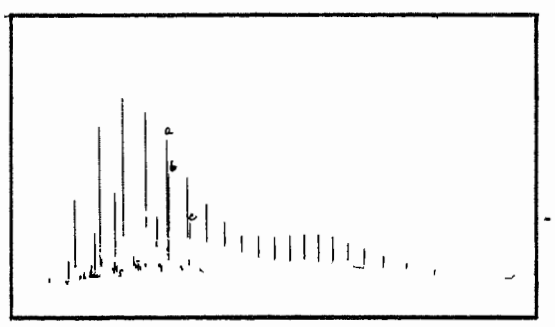




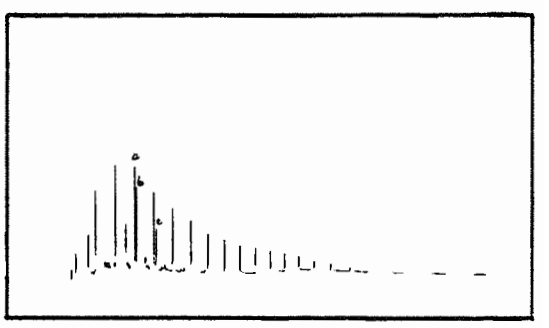
1690



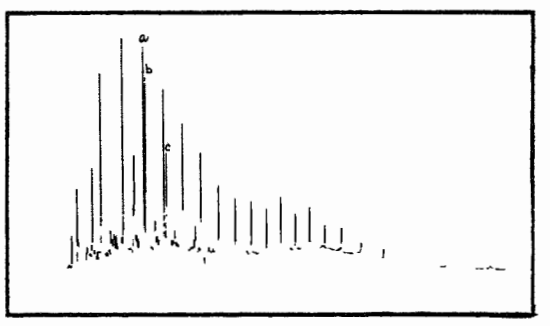
1765 – 1780



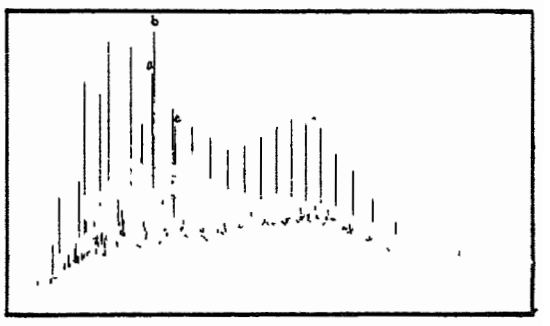
1855 – 1870



1885 – 1900



1900 – 1915



1945 – 1960

a : nC_{17}
b : Pristane
c : Phytane