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REPORT TITLE

Source Rock Evaluation of Well 15/9 - 1.

N.15 PF

CONTRACTOR

Statoil

WELLFILE

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SUMMARY

The analysed sequence, 3200 - 3690 m can be divided into two zones by using the light hydrocarbon datas. A: 3200 - 3350 and B: 3350 - 3690. Zone A is poor as a source rock for the first 90 m, fair to good for the rest. Moderate to mature. Zone B is rich as a source rock for oil and gas, moderate mature. Oilwindow starts at approx. 3000 m. Significant oilshow at 3350 m.

KEY WORDS

Source Rock

INDEX

EXPERIMENTAL

The canned samples were washed with temperated water on a 0.125 mm sieve to remove drilling mud and thereafter dried at 35 °C. The core samples were washed in dichloromethane to remove surface contamination.

LIGHT HYDROCARBONS

Aliquote of the samples were dried at room temperature after washing, and sieved. The cuttings with grain size between 1 and 2 mm were used for light hydrocarbondetermination. .The cuttings were treated with 6N HCl in a closed evacuated system, thereafter flushed with water and the released gas analysed by gaschromatography.(Table I).

TOTAL ORGANIC CARBON

The lithology of the samples were studied, and those with variation in lithology were sorted, and aliquotes of the different lithologies were crushed to a grain size of 0,063 - 0,125 mm. The crushed samples were then treated with 6N HCl and analysed on a Leco WR 12 carbon analysator (Table II).

EXTRACTABLE ORGANIC MATTER (EOM)

From the light hydrocarbon and the TOC results, samples for extraction were chosen, and extracted with dichloromethane (DCM) on soxhlets for 48 h. (Table III).

CHROMATOGRAPHIC SEPARATION

The EOM were separated on columns packed with 2/3 silica and 1/3 alumina, by eluting with hexane, benzene and methanol (Table III). The saturated fractions were analysed gaschromatographic on a column, using a Carlo Erba FV 2150 gaschromatograph. The different measurements from the gaschromatograms are shown in Table VII.

VITRINITE REFLECTANCE

Side wall cores from 1664,2230, 2354, 2693.8, 2741.8 and 2801.5 m, coresamples from 3521, 3541,3, 3567, 3576.6, 3626,8 m and cuttings from 2000, 2420, 2932, 3028, 3103, 3226, 3343, 3436 and 3690 m were sent for vitrinite reflectance measurements at Geoconsultants, Newcastle upon Tyne.

Upon receipt, the cutting samples were soaked in warm water and sieved through 72 mesh to remove drilling mud. After oven drying at 40 °C, the cuttings were mounted in Bakelite resin blocks; care being taken during the setting in the plastic to avoid temperatures in excess of 100 °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 isopopyl 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. 1.515, 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 search for vitrinitic material was maintained for approximately 45 minutes on each sample before termination if the operator considered that no more vitrinitic particles were likely to be located.

SPORE COLORATION

Samples for spore coloration were chosen amongst those used for biostratigraphic determination at another department at IKU, plus some extra between 2800 and 3300 m. (Table VIII).

Maturity of the individual samples was determined by visual estimation of the colours of pollen, spores, cuticles, wood remains, and finely dispersed organic matter.

The colour tones are given according to Staplin's index (Staplin, F.L. 1969: Sedimentary organic matter, organic metamorphism, and oil and gas occurence. Bull. Canad. Petr. Geol. 17(1), 46-66).

The thermal alteration index indicates by 1 (fresh yellow) m alteration, 2 (brownish yellow) slight alteration, 3 (brown) moderate alteration, 4 and 5 (black) strong to severe alteration.

RESULTS AND DISCUSSION

LIGHT HYDROCARBONS

From the C_1-C_4 hydrocarbon abundance, the wetness of the gas and the isobutane/n-butane ratio, we can divide the analysed section, 3200-3690 m into two zones, A; 3200-3350 m and B; 3350-3690 m.

A: 3200-3350 m. This zone has a C_1-C_4 hydrocarbon abundance of approx. 1-2000 μl gas/kg rock, and it is a dry gas with a high iC_4/nC_4 ratio.

B: 3350-3690 m. The C_1-C_4 hydrocarbon abundance in this zone is generally higher than in zone A, and we have here a wet gas with a low iC_4/nC_4 ratio. The last sample analysed, 3690 m, has a sharp drop in C_1-C_4 hydrocarbon abundance and in wetness. This could indicate the start of a new zone.

SUMMARY FROM C_1-C_4 HYDROCARBON ANALYSIS

A: Fair potential, but dry gas. Limestone and shale at the top of the zone, but the limestone diminishes at the bottom of the zone.

B: Good potential for most of the zone and the gas is quite wet (approx. 50%). A short interval around 3600 m the C_1-C_4 hydrocarbon abundance decreases, but the gas stays quite wet. The sample cans came in two different boxes, with box II starting at 3450 m; this is only ten m. further down than a sample in box I. The samples both in box I and II were taken with thirty m. intervals, and the samples in box II continued to be ten m. lower than the samples in box I. We found that the samples in box II generally gave a far lower C_1-C_4 hydrocarbon abundance than the samples in box I. (Table I and Fig. I). It is impossible for us to explain this phenomena, especially since the samples from the two boxes were treated in the same way, and samples from box II were analysed in between samples from box I. However, there was not the same type of difference in the wetness of the gas, and the iC_4/nC_4 ratio.

The lithology of zone B vary a lot (Table II, Fig. 1), but it is mainly shale, silt- and sandstones. Two samples contained large amounts of coal, 3630 and 3660 m.

TOTAL ORGANIC CARBON

Total organic carbon (TOC) analysis were done on all the samples. Where there were significant amounts of different lithologies, TOC were measured on the different lithologies. With the canned cutting samples there were two canned core samples. These, together with four other core samples that had been done biostratographical analysis on, were analysed. (Table II, Fig. II.)

A: 3200-3350 m. The shales in this zone are poor at the top, but increases rapidly from 3300 m, and 3350 m is extremely rich. (12%).

B: 3350-3690 m. The TOC values in this zone varied a lot from approx. 3% to 10%. There was no special trend in the variations. Some of the samples contained a lot of coal particles. These were generally picked out before analysis was done, but the large variation might come because of this, i.e. some coal particles were left in the samples. All together, this zone must be classified as rich.

EXTRACTABLE ORGANIC MATTER AND CHROMATOGRAPHIC FRACTIONS

On special request from Statoil, three samples between 1700 and 2200 m were analysed. The sample from 1700 m is poor with only a small contribution of saturated hydrocarbons. The sample is non matured.
2000 m: Again the sample is poor, and the saturated hydrocarbon fraction is even less abundant than the sample from 1700 m. Moderate matured.
2180 m: Fair/good. This sample contains a far larger proportion of hydrocarbons than the samples above. The proportion of hydrocarbons is that high that it indicates the possibility of hydrocarbon contamination, possibly from oil

migrated into the shales. Moderate to mature.

A: Two samples from zone A were analysed, 3290 and 3320 m. 3290 m must be classified as poor and 3320 m as good. The sample from 3290 m contained extremely large proportion of saturated hydrocarbons compared to aromatic and non hydrocarbons. The samples are mature to moderate mature.

B: Ten samples from this zone were analysed, five cutting samples and five cores. The sample at 3350 m, which is the boundary between the two zones, is the richest sample extracted. The composition of hydrocarbons and non hydrocarbons give this to be an oilshow. The samples from the rest of the zone are all rich, and the saturated/aromatic ratio varied only slightly for most of the samples with exceptance of 3500 where the ratio was higher. All of the analysed samples in this zone had high pristane/nC_{17} and pristane/phytane ratios. Together with high CPI value this shows a moderate matured source. The saturated fractions were also rich in heavy end n-alcanes.

The different analyses indicate that we in zone B have a rich, moderate matured source rock, which will be the source for a heavy, waxy oil.

The lowermost sample, 3690 m is not as rich as the overlying, and it has a larger percentage of hydrocarbons. The latter indicates that here we might have migration of oil into the shales.

In the extraction, care was taken that coal was not included. The shale-cuttings were carefully handpicked for this.

The relatively high hydrocarbon/non hydrocarbon ratio, together with the low CPI value and low pristane/phytane ratio of sample 3590 indicate contamination of hydrocarbons, probably migrated oil.

VITRINITE REFLECTANCE

The vitrinite reflectance measurements on this well gave good readings from the top and the bottom of the succession, while the middle part is very poor. Together with the actual reflectance number, (Table VII), we also get other information, and in the following we will discuss each sample.

1664 m: Pyritic Shale. Ro = 0,31.
The sample has a low organic content, with a few small particles of vitrinite. Reworked particles are dominant. A few reworked particles of whole coal. UV light gives a good yellow fluorescence from spores, and shows a moderate exinite content.

2000 m: Shale + Siltstone. Ro ≙ 0,37 and Ro = 1,07.
The sample has a low organic content with a mixture of small particles and occasional wisps of corroded vitrinate and particles of reworked material. UV light shows a yellow fluorescence from spore specks, and a trace of exinite.

2230 m: Pyritic light Shale. Ro = 0,58 and 1,34.
The sample has a very low organic content. A single small rather unconvincing wispy particle of vitrinite. Three reworked particles, otherwise barren. UV light shows a yellow and orange fluorescence from a few spore specks with a trace of exinite. A rather poor sample.

2354 m: Pyritic light Shale. Ro = 0,37 and 0,66.
The sample has a low organic content with small rounded particles of reworked material. A little true vitrinite as wisps and particles. UV light shows a green/yellow fluorescence from spores and a low-moderate exinite content.

2420 m: Sand + Shale. Ro = 0,41.
The sample shows only a trace of organic material with a few wisps of vitrinite plus inertinite and reworked

particles in the shale. Most of the cuttings are barren. A few cuttings of coal which could be a lignite additive. UV light shows no organic fluorescence and no exinite.

2693 m: Shale. Ro = 0,40.
The sample has a moderate-rich organic content, with some, rather gnarled vitrinite particles. Inertinite particles are dominant. UV light shows yellow/orange fluorescence from spores, a hydrocarbon trace and a trace of exinite.

2741.8m: Calcareous shale. Ro = 0,48.
The sample has a low organic content, mostly with small gnarled particles of reworked material plus inertinite. Only one good vitrinite stringer. UV light shows orange fluorescence from a few spore specks and a trace of exinite.

2801.5m: Fine limestone, marl. Ro = 0,46 and Ro = 1,20.
The sample shows only a trace of organic material with two possible particles of true vitrinite. UV light shows yellow fluorescence from a few spores in a few cuttings with a trace of exinite.

2932 m: White marl. No determination possible.

3028 m: Shale. Ro = 1,14.
The sample is virtually barren with only a few particles of reworked material. No fluorescence in UV light.

3103 m: Chalk and light shale. Ro = 0,58 and Ro = 1,30.
The chalk is barren except for a single, good vitrinite particle. The shale has a few small scraps of reworked vitrinite. No organic fluorescence in UV light.

3226 m: Shale and chert. Ro = 1,46.
The sample is virtually barren with a few small particles of reworked material with high reflectance. No low Ro material. No organic fluorescence in UV light.

3343 m: Shale and chert. (Ro = 0,30, additive).
Only a trace of organic material with a few particles of inertinite and reworked material. Most cuttings are barren. There is a high content of coal particles which are assumed to be additive. UV light shows yellow fluorescence from spores and resins in coal, and a trace of exinite.

3436 m: Shale, siltstone and carbonate. Ro = 0,46.
The sample has a moderate organic content with a few particles of vitrinite in the shale and siltstone. The carbonate is barren. Some coal cuttings are present and these give a low Ro value. These could be additive. UV light shows a yellow/orange fluorescence from spores and a rich exinite content.

3521 m: Silty shale. Ro = 0,58.
The sample is moderate to rich in organic material with good particles and a few wisps of vitrinite. Reworked material is dominant. No inertinite recorded. UV light shows a deep orange fluorescence from spores and a rich exinite content.

3541 m: Shale. Ro = 0,55.
The sample is moderate to rich in organic material with plentiful good wisps and stringers of vitrinite plus a little reworked material. UV light shows a strong yellow to orange fluorescence from spores and a moderate exinite content.

3567 m: Siltstone. Ro = 0,57.
The sample is moderate to rich in organic material with good vitrinite stringers and wisps. A little reworking and a trace of inertinite. UV light shows a deep orange fluorescence from spores and a moderate to rich exinite content.

3576.6m: Siltstone. Ro = 0,64.
The sample has a moderate organic content with some good particles and a few wisps of vitrinite. Only a little reworking and a trace of inertinite. UV light

shows a good deep orange fluorescence from spores with a moderate exinite content.

3626.8m: Siltstone and coal partings. Ro = 0,65.
The sample has good vitrinite stringers with strong cell structure and resin infilling. UV light shows a strong orange fluorescence from resin and a rich exinite content.

3690 m: Variable lithologies, chalk, shale, coal and carbargilite. The sample has a variable organic content with lithology: Ro = 0,58.
Chalk: Barren
Coal: Wholly vitrinite with good cell structure.
Shale: Rich in inertinite, some reworking and some vitrinite particles.
UV light shows orange fluorescence from spores in shale cuttings, the rest barren, and a low exinite content.

SPORE COLORATION

The examined organic residues have an index of 2.1 - 2.3, indicating a slight to moderate maturation, and accordingly thermally unaltered wet or dry gas facies for most of this well.
Slightly higher indices, 2.3 - 2.4, were recorded for the following samples:

3052 m due to reworked material in an otherwise barren assemblage of Late Cretaceous age.
3530 m a restricted marine deltaic pollen and spore assemblage of Middle Jurassic age.
3591 m a deltaic assemblage of Middle Jurassic age.
3618 m a marine deltaic Middle Jurassic assemblage.

X

CONCLUSION

The interval 1700-2000 m has a poor potential as a source rock for oil and gas, and is non to moderate mature. 2180 m has a fair to good potential as a source rock and is moderate to mature.

The interval from 3200 m to the base of the well can be divided into two zones on the basis of the light hydrocarbon analysis.

A: 3200-3350 m. The interval 3200-3290 m has a poor potential as a source rock, while 3290-3350 m has a good potential as a source rock. Both intervalls are moderate to mature. 3350 m has a significant oilshow.

B: 3350-3690 m. The whole zone has a rich potential as a source rock for oil and gas. The C_1-C_4 hydrocarbon abundance is high and contains mainly wet gas. The C_{15}+ fraction is rich in the heavy end n-alkanes.

High pristane/nC_{17} and pristane/phytane ratios together with high CPI value indicate a moderate mature source rock. A spore coloration index of approx. 2-2.4 in this zone,also indicates moderate maturity.

From 3567 m the spore coloration index increases and has a maximum of 2.4 at approx. 3600m, then to decrease again down to 2.1 at 3643 m. This minor variation fits in with a slight increase and decrease for vitrinite reflectance for the same levels. The maturity of this level would be slightly more mature than the rest of zone B.

At 3590 m we probably have contamination from migrated oil.

The vitrinite reflectance data show a good gradient for the well as a whole, even if the middle part was difficult to measure. The oilwindow (0.5-1.3) starts at approx. 3000m, and the reflectance reaches a maximum of 0.65 at 3626.8 m.

The sharp change in C_1-C_4 abundance, wetness of the gas and $C_{15}+$ abundance at 3690 m compared with the overlying samples, indicate the start of a new zone.

TABLE I

Concentration (μl gas/kg rock) of C_1 - C_4 hydrocarbon in cuttings.

Depth (m)	C_1	C_2	C_3	iC_4	nC_4	Tot C_1-C_4	Tot C_2-C_4	% Gas wetness	iC_4/nC_4
3200	1101	175	66	29	25	1396	295	21.1	1.16
3230	1579	145	43	17	15	1799	220	12.2	1.13
3260	1772	150	40	13	3	1978	206	10.4	4.33
3290	895	116	48	19	19	1097	202	18.4	1.00
3320	1478	102	34	6	15	1635	157	9.6	0.40
3350	1202	205	270	98	225	2000	798	39.9	0.44
3380	727	133	219	86	247	1412	685	48.5	0.35
3410	1252	248	338	147	305	2290	1038	45.3	0.48
3440	1091	245	394	142	595	2467	1376	55.8	0.24
3450	313	56	208	51	245	873	560	64.1	0.21
3470	1089	185	190	70	181	1615	526	32.6	0.39
3480	736	127	177	62	210	1312	576	43.9	0.30
3500	815	166	375	111	428	1895	1080	57.0	0.26
3510	351	53	46	19	39	508	157	30.9	0.49
3530	782	134	249	71	407	1643	861	52.4	0.17
3540	212	44	40	10	50	356	144	40.4	0.20
3560	540	96	217	90	405	1348	808	59.9	0.22

TABLE I - cont.

Depth (m)	C_1	C_2	C_3	iC_4	nC_4	Tot C_1-C_4	Tot C_2-C_4	% Gas wetness	iC_4/nC_4
3570	512	85	121	58	144	920	408	44.3	0.40
3590	919	145	150	51	173	1438	519	36.1	0.29
3600	762	123	176	76	191	1328	566	42.6	0.40
3620	584	570	436	44	130	1764	1180	66.9	0.34
3630	1744	288	219	72	100	2423	679	28.0	0.72
3660	701	661	990	211	432	2995	2294	76.6	0.49
3690	175	65	132	40	103	515	340	66.0	0.39

T A B L E II

Lithology and TOC measurements.

Sample depth (m)	TOC	Lithology
1700	2.22	App. 100% Shale, grey-green, partly silty shale and siltstone.
2000	0.55	App. 100% Shale, grey to light green. App. 1% Limestone and quartz.
2180	1.20	App. 100% Shale, grey-green, brownish. < 1% Limestone.
3200	0.23 0.30	App. 50-60% Limestone. App. 40-50% Shale, grey, some redbrown fragments. Max. 5% Quartz. Pyrite, observed.
3230	0.34 0.22	App. 60% Shale, grey, some redbrown fragments. App. 30-35% Limestone Max. 5% Siltstone. Glauconite, observed.
3260	0.20 0.18	80-85% Shale, grey. 15-20% Limestone.
3290	0.47	App. 95% Shale, grey. App. 5% Limestone.
3320	1.57	App. 95% Shale, grey, redbrown, some green fragments. < 5% Siltstone; Limestone.
3350	12.02	Min. 98% Shale, dark grey, some redbrown and green fragments. Max. 1-2% Limestone.

TABLE II - p.2

Sample depth (m)	TOC	Lithology
3380	5.61	App. 90-95% Shale, light to dark grey, some red-brown and green fragments. < 5% Limestone. Max. 3-4% Coal-like material (drilling mud). Pyrite, observed.
3410	4.03	App. 90% Shale, light to dark grey. Max. 5% Limestone. Max. 2-3% Quartz. App. 2-3% Coal-like material (drilling mud). Pyrite, observed.
3440	7.48	Min. 98% Shale, grey, some redbrown fragments. App. 2% Limestone and quartz. Pyrite, observed.
3450	5.58	Min. 90% Shale, grey, some redbrown fragments. Max. 5% Quartz. Max. 5% Limestone.
3470	0.85 5.74	Ca. 80% Siltstone, coarse, and Sandstone. App. 15-20% Shale, grey, some redbrown and greenish fragments. App. 2-3% Limestone. Coal-like material (drilling mud), sporadic. Pyrite, observed.
3480	4.66	App. 80% Shale, grey, some redbrown and light green fragments. Max. 10-15% Limestone. Max. 5% Sandstone and Siltstone. Pyrite, observed.
3500	4.72	App. 75% Shale, light to dark grey. App. 20% Quartz sand. Max. 5% Limestone.

TABLE II - p.3

Sample depth (m)	TOC	Lithology
3510	1.45 5.94	50-60% Sandstone and Siltstone. App. 40% Shale, grey, partly redbrown. App. 5-7% Limestone. Pyrite, observed.
*3522.4	7.00	Core: Shaly Siltstone, dark grey, with muscovite. Pyrite, observed.
*3530.3	5.74	Core: Siltstone, dark grey, with muscovite. Coal, very little, soft. Pyrite, observed.
3530	5.21	App. 95% Shale, dark grey, sporadic redbrown and light green fragments. 2-3% Quartz. 1-2% Limestone. Py, observed.
3540	5.35	Shale, dark grey, some redbrown fragments. Max. 3-4% Limestone. Py, observed.
* 3541.3	4.40	Core: Silty Shale, dark grey, with some muscovite. Coal, very little.
3560	5.95	App. 96% Shale, dark grey to brownish, sporadic redbrown and greenish. App. 3% Quartz. App. 1% Limestone. Glauconite and pyrite, observed.
* 3567	3.07	Core: Siltstone, dark grey, with muscovite. Coal, little.
3570	0.35 3.44	App. 90% Quartz sand, fine to medium. App. 8-10% Shale, grey, redbrown, green. Pyrite, glauconite, observed.

T A B L E II - p.4

Sample depth (m)	TOC	Lithology
*3576.6	4.58	Core: Siltstone, dark grey, with muscovite.
		Plant fossils.
3590		App. 50% Quartz sand and Siltstone.
	6.07	App. 50% Shale, grey, sporadic redbrown fragments.
		App. 1% Coal-like material (drilling mud).
		App. 1% Limestone.
		Py, observed.
3600	3.64	50-55% Shale, grey, some reddish fragments.
		45-50% Sandstone and siltstone.
		Max. 1-2% Limestone.
3620		App. 70% Coal.
		App. 30% Quartz sand.
	3.64	App. 5% Shale, grey , partly redbrown.
*3626.8	5.08	Core: Siltstone, dark grey, with muscovite.
		Small parts of Coal.
3630	0.58	App. 92% Quartz sand and Siltstone.
	6.21	App. 3-4% Shale, grey to green.
		App. 3% Coal.
		Max. 1% Limestone.
3660	9.96	App. 75% Shale, grey.
		App. 10-20% Coal.
		App. 5% Quartz.
		App. 2-3% Limestone.
		Pyrite, observed.
3690	0.35	App. 85-90% Quartz sand.
	3.08	7-8% Shale.
		App. 5% Limestone.
		Pyrite, observed.

TABLE III

Weight (mg) of EOM and chromatographic fractions.

Depth(m)	Rock extracted	EOM	Sat	Aro	Hydrocarbons HC	Non Hydrocarbons
1700	92.0	18.6	1.5	3.2	4.7	12.7
2000	100.0	21.8	1.4	3.5	4.9	15.9
2180	42.0	26.0	6.1	12.7	18.8	5.0
3290	100.0	12.8	7.5	1.2	8.7	3.8
3320	100.0	34.3	2.7	5.9	8.6	20.3
3350	80.0	1.109.8	307.4	461.7	769.1	327.2
3410	84.4	275.8	16.7	58.6	75.3	188.2
3500	23.3	62.8	9.1	20.6	29.7	25.7
3522.4	100.0	261.4	28.0	84.4	112.4	127.6
3541.3	112.9	195.6	20.9	65.8	86.7	100.0
3567.0	100.0	214.4	11.1	40.7	51.8	153.4
3576.6	100.0	254.0	22.4	77.6	100.0	150.5
3590	40.0	148.3	21.7	65.9	87.1	55.3
3626.8	100.0	290.9	18.6	58.5	107.1	180.1
3660	100.0	399.6	45.3	138.7	184.0	210.1
3690	70.0	122.9	21.8	76.6	98.4	23.0

TABLE IV

Concentration of EOM and chromatographic fractions (Weight ppm of rock).

Depth(m)	EOM	Sat.	Aro	Total hydrocarb.	Non hydrocarb.
1700	200	16	35	51	138
2000	220	14	35	49	159
2180	620	145	302	447	119
3290	130	75	12	87	38
3320	340	27	59	86	203
3350	13870	3837	5771	9608	9614
3410	3270	198	693	891	2227
3500	2700	408	884	1292	1103
3522.4	2610	280	844	1124	1276
3541.3	1730	185	587	772	780
3567	2140	111	407	518	1534
3576.6	2540	224	776	1000	1505
3590	3710	543	1648	2191	1383
3626.8	2910	186	885	1071	1801
3660	4000	453	1387	1840	2101
3690	1760	311	1094	4405	329

TABLE V

Concentration of EOM and chromatographic fractions (mg/gTOC).

Depth (m)	EOM	Sat	Aro	Total hydrocarb.	Non hydrocarb.
1700	9.1	0.7	1.6	2.3	6.2
2000	39.6	2.5	6.4	8.9	28.9
2180	31.7	12.1	26.5	38.6	10.4
3290	27.2	15.9	2.6	18.5	8.1
3320	21.8	1.7	3.8	5.5	12.9
3350	115.4	31.9	48.0	79.9	34.0
3410	81.1	4.9	17.2	22.1	55.2
3500	57.1	8.2	18.7	26.9	23.4
3522.4	37.3	4.0	12.1	16.1	18.2
3541.3	39.3	4.2	13.2	17.4	20.1
3567	69.8	3.6	13.3	16.9	50.0
3576.6	55.5	4.9	16.9	21.8	32.8
3590	61.1	8.9	27.5	36.4	22.8
3626.8	57.2	3.7	17.5	21.2	35.5
3660	40.1	4.5	13.9	18.4	21.1
3690	57.2	10.1	35.5	45.6	10.7

T A B L E VI

Composition in % of the organic material extracted from the rock.

Depth(m)	Sat / EOM	Aro / EOM	HC / EOM	Sat / Aro	Non HC / EOM	HC / Non HC
1700	8.1	17.2	25.3	46.8	68.3	37.0
2000	6.4	16.1	22.5	40.0	72.9	30.8
2180	23.5	48.8	72.3	48.0	19.2	254.0
3290	61.1	9.4	70.5	625.0	29.7	43.7
3320	7.9	17.2	25.1	45.8	59.2	42.3
3350	27.7	41.6	69.3	66.6	29.5	42.5
3410	6.1	21.2	27.3	28.5	68.2	40.0
3500	14.5	32.8	47.3	44.1	40.9	115.5
3522.4	10.7	32.3	43.0	33.1	48.8	88.1
3541.3	10.6	31.1	41.7	31.8	51.1	86.7
3567	5.2	19.0	24.2	27.2	71.6	33.8
3576.6	8.8	30.5	39.3	28.9	59.3	66.4
3590	14.6	44.5	59.1	32.9	37.2	15.9
3626.8	6.4	30.5	36.9	21.0	62.1	57.0
3660	11.3	34.5	45.8	32.6	52.5	87.6
3690	17.7	62.2	79.9	28.5	18.6	429.7

TABLE VII

Tabulation of datas from thè gaschromatograms.

Depth (m)	Pristane/nC_{17}	Pristane/Phytane	CPI
1700	1.00	2.27	1.56
2000	0.55	1.84	1.02
2180	1.58	2.88	1.04
3290	0.97	1.54	0.98
3320	0.56	1.58	1.09
3350	0.67	0.78	0.99
3410	1.49	1.60	1.05
3500	1.27	1.70	0.97
*3522.4	2.76	6.18	1.13
*3541.3	2.00	6.00	1.29
*3567.0	1.74	5.46	1.25
*3576.6	1.88	5.59	1.15
3590	1.29	1.65	1.07
*3626.8	1.20	5.34	1.14
3660	1.31	4.37	1.11
3690	1.31	1.72	1.04

* Cores

T A B L E VIII

Vitrinite reflectance and spore coloration.
(number of particles measured for vitrinite reflectance in brackets.)

Depth (m)	Spore col.	Vitrinite refl.
1664		0.31(20)
2000		0.37(16) 1.07(4)
2226	2.2	
2230		0.55(1) 1.38(4)
2294.5	2.0-2.2	
2354		0.37(18) 0.66(2)
2420		0.41(14)
2693.8	2.2	0.40(20)
2741.8		0.48(4)
2801.5		0.46(3) 1.20(5)
2802.8	2.2	
2932		No determination possible
3028		1.14(3)
3052	2.3-2.4	
3103		0.58(4) 1.30(6)
3226		1.46(4)
3301	2.2-2.3	
3343		0.30 (Additive)
3370	2.1	
3388	2.2	
3409	2.2-2.3	
3430	2.2-2.3	
3436		0.46(13)
3451	2.2-2.3	
3472	2.0-2.3	
3490	2.1-2.3	
3514	2.3	
3521	2.2-2.3	0.58(22)
3523	2.0-2.1	
3530	2.5	
3541		0.55(20)
3543	2.1-2.2	
3566	2.1-2.2	
3567		0.57(21)

TABLE VIII - p.2

Depth (m)	Spore col.	Vitrinite refl.
3576.6	2.2-2.3	0.64(21)
3591	2.3-2.4	
3618	2.3-2.4	
3626	2.2-2.3	
3626.8	2.2-2.3	0.65(21)
3643	2.1-2.2	
3690		0.58(26)
3693	2.1-2.2	
3708	2.1-2.2	
3732	2.1-2.3	

PRESENTATION OF ANALYTICAL DATA

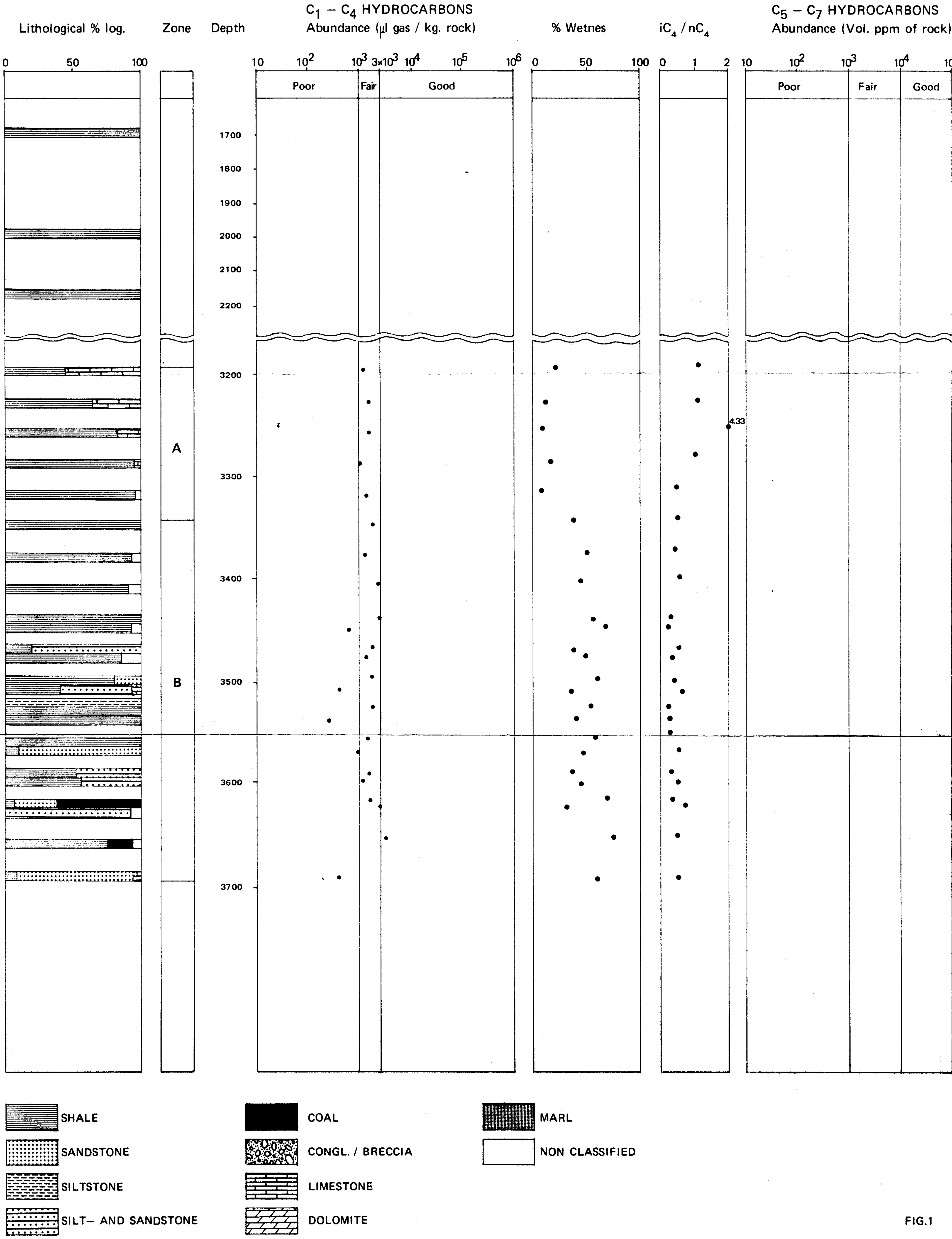
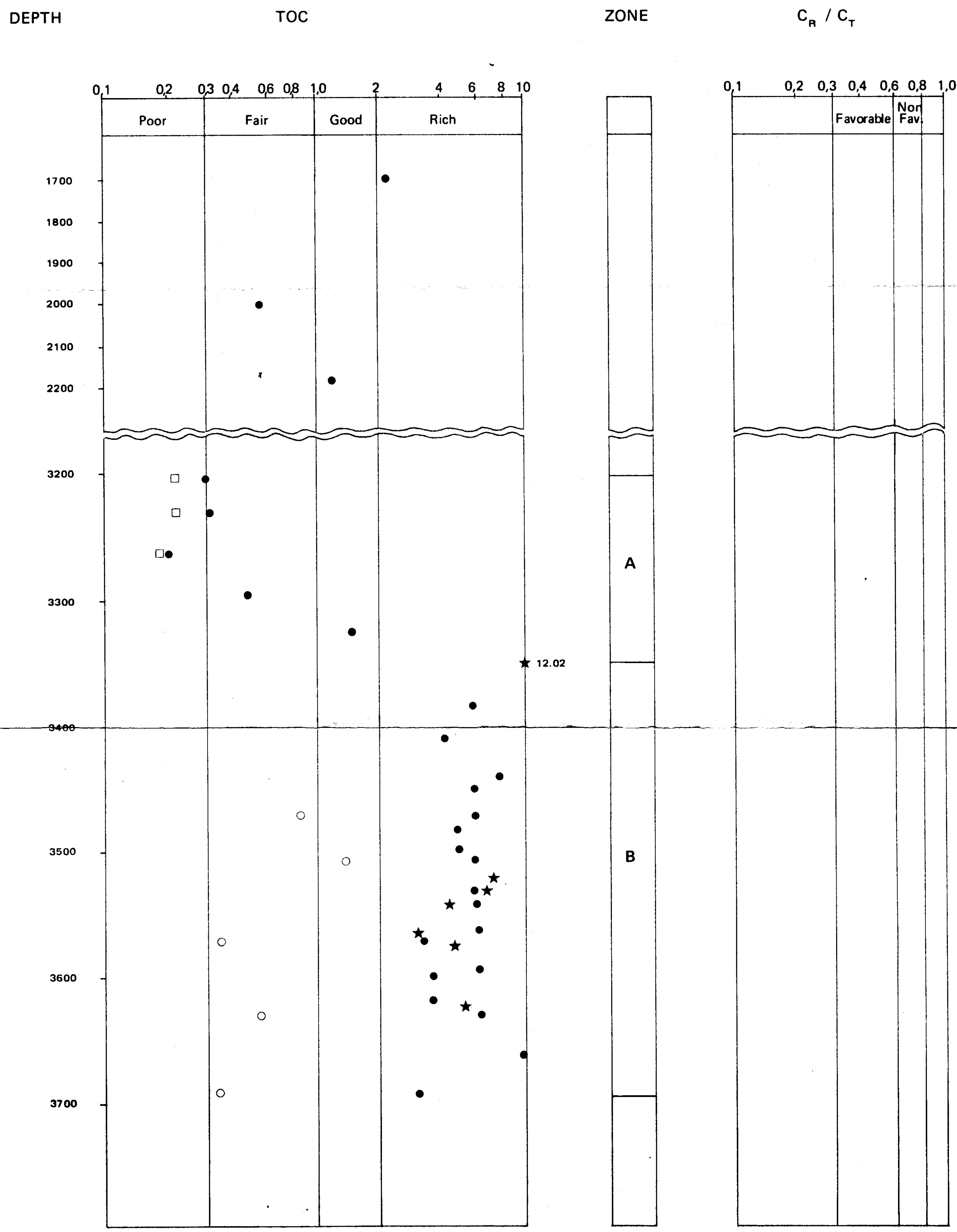


FIG.1

TOTAL ORGANIC CARBON (TOC) AND C_R / C_T

Presentation of Analytical Data



● Shale

○ Sand – and siltstone

□ Limestone

★ Cores

TOC : Total Organic Carbon

C_R / C_T : Organic Carbon Residue / Total Organic Carbon

FIG. 2

C_{15}^{+} HYDROCARBONS

Presentation of Analytical Data

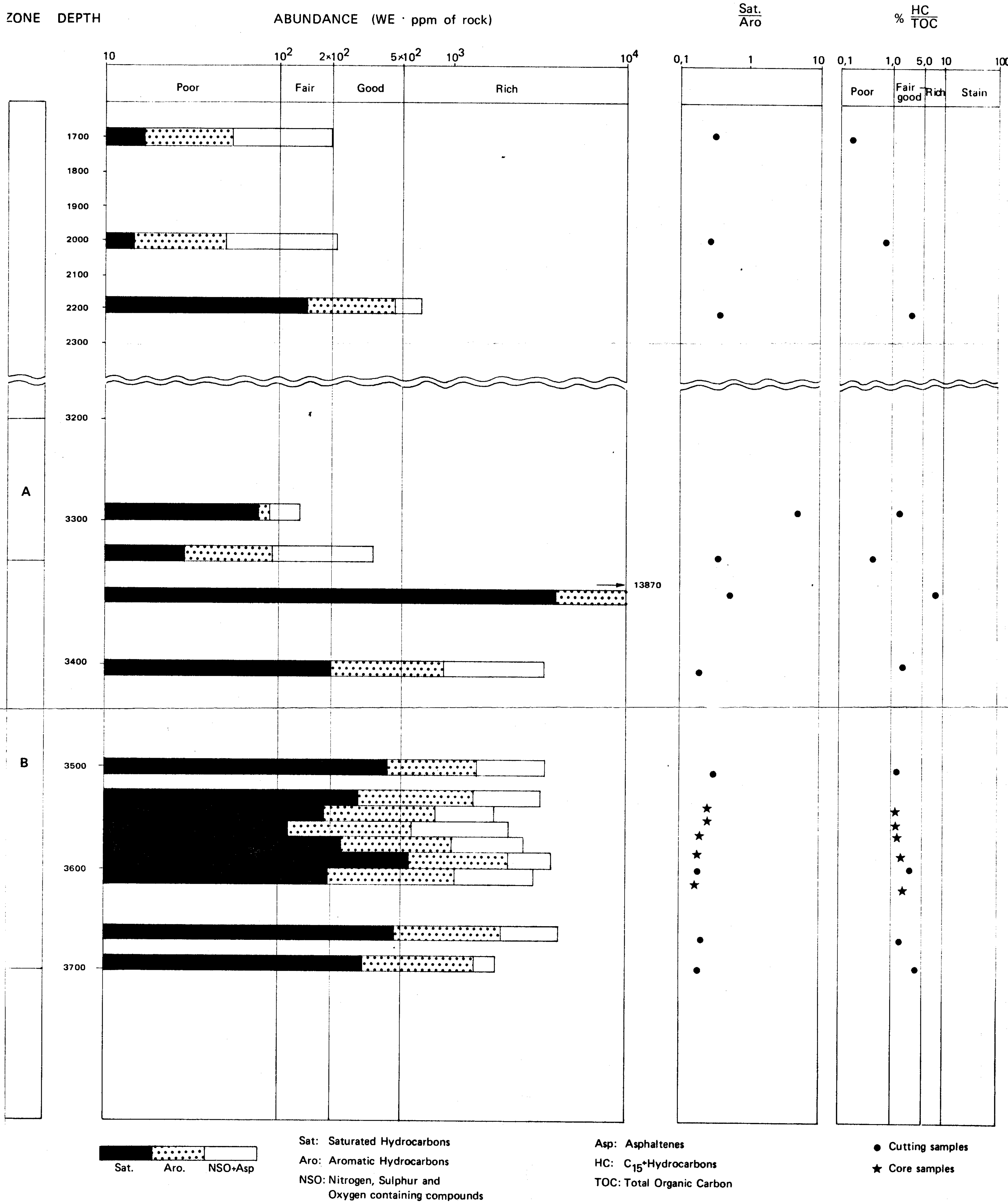
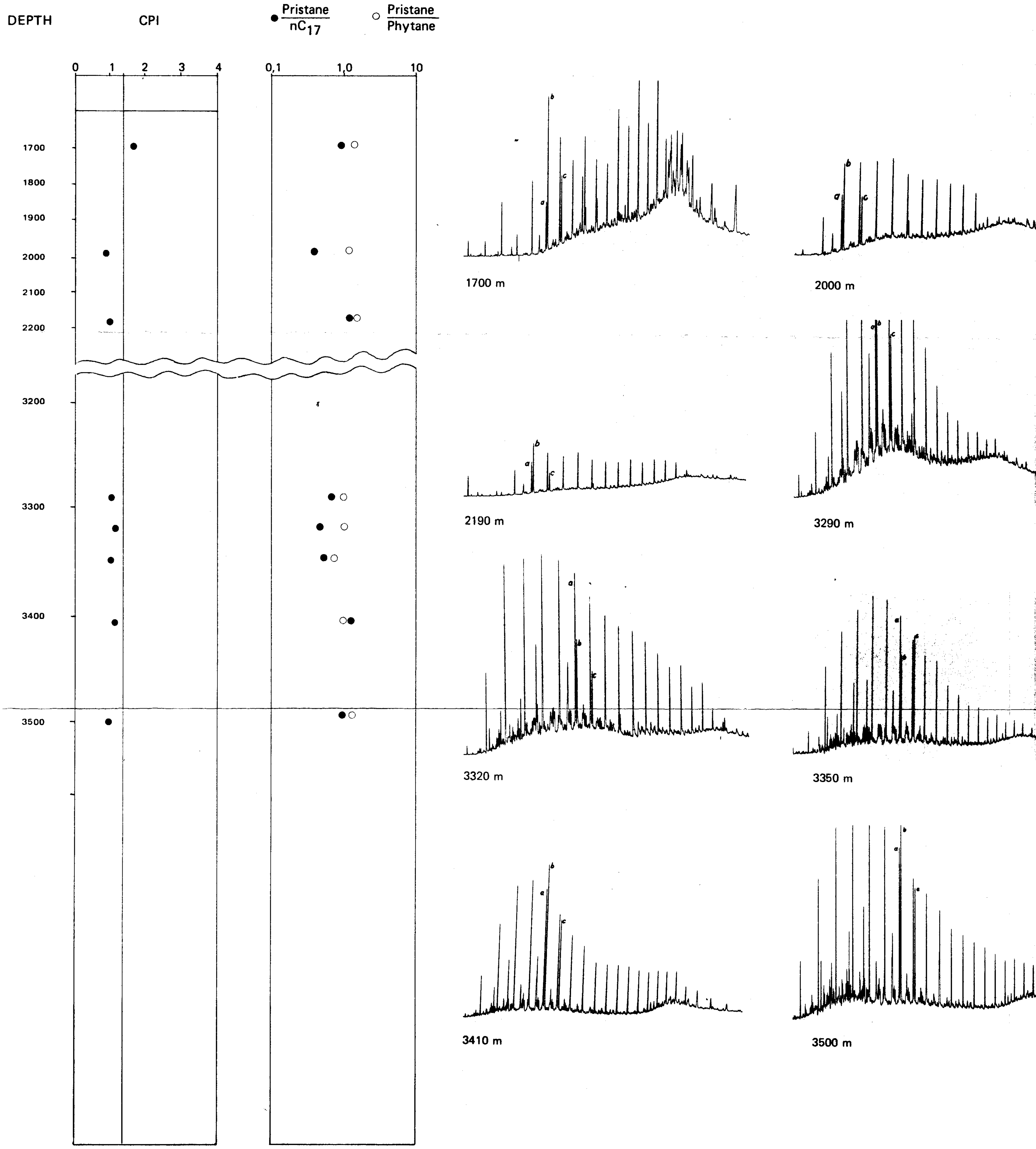


FIG. 3

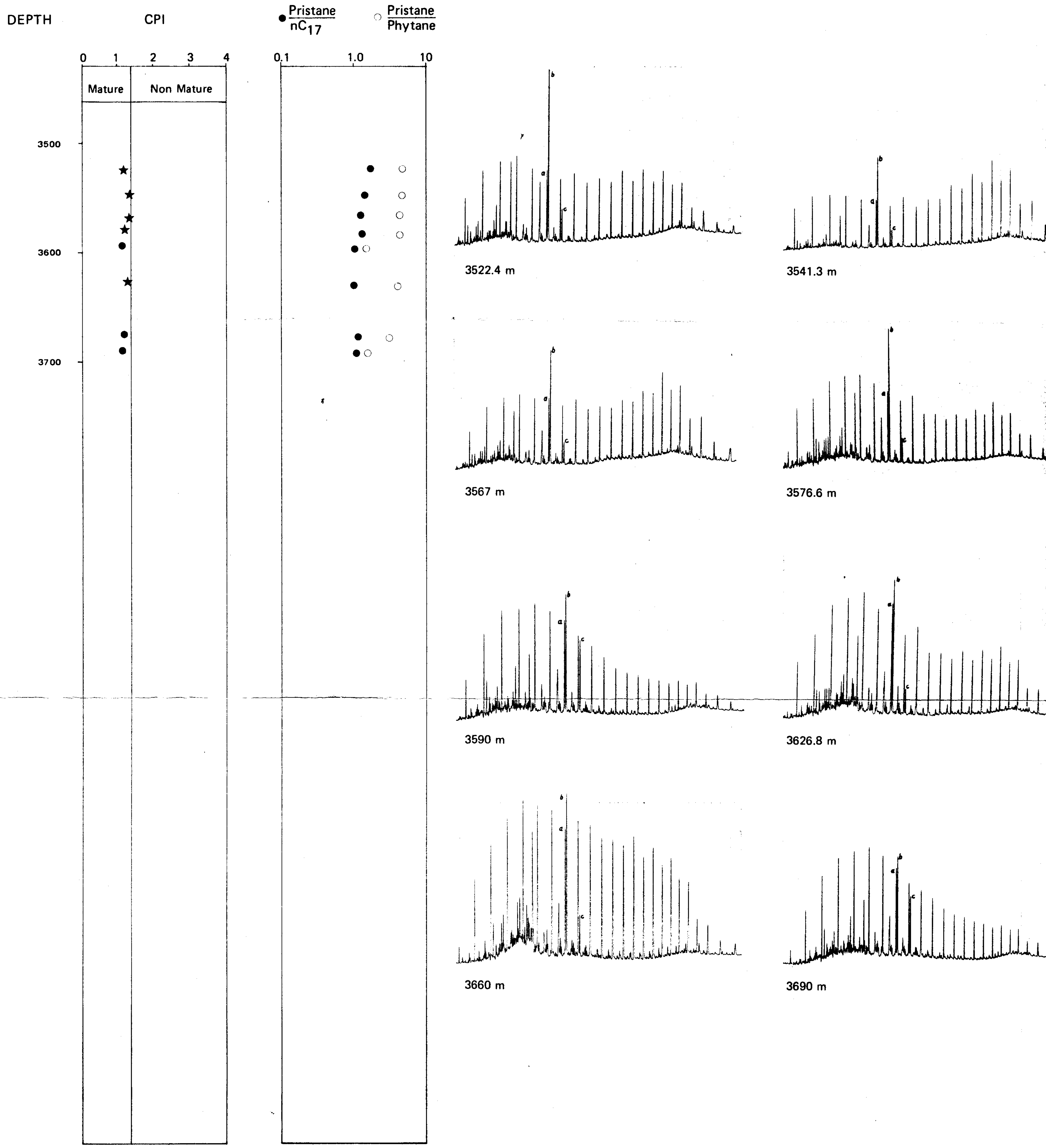
C_{15}^{+} SATURATED HYDROCARBONS



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

FIG. 4A

C_{15}^{+} SATURATED HYDROCARBONS



★ Core samples

● Cutting samples

a : nC_{17}

b : Pristane

c : Phytane

FIG. 4B

MATURATION

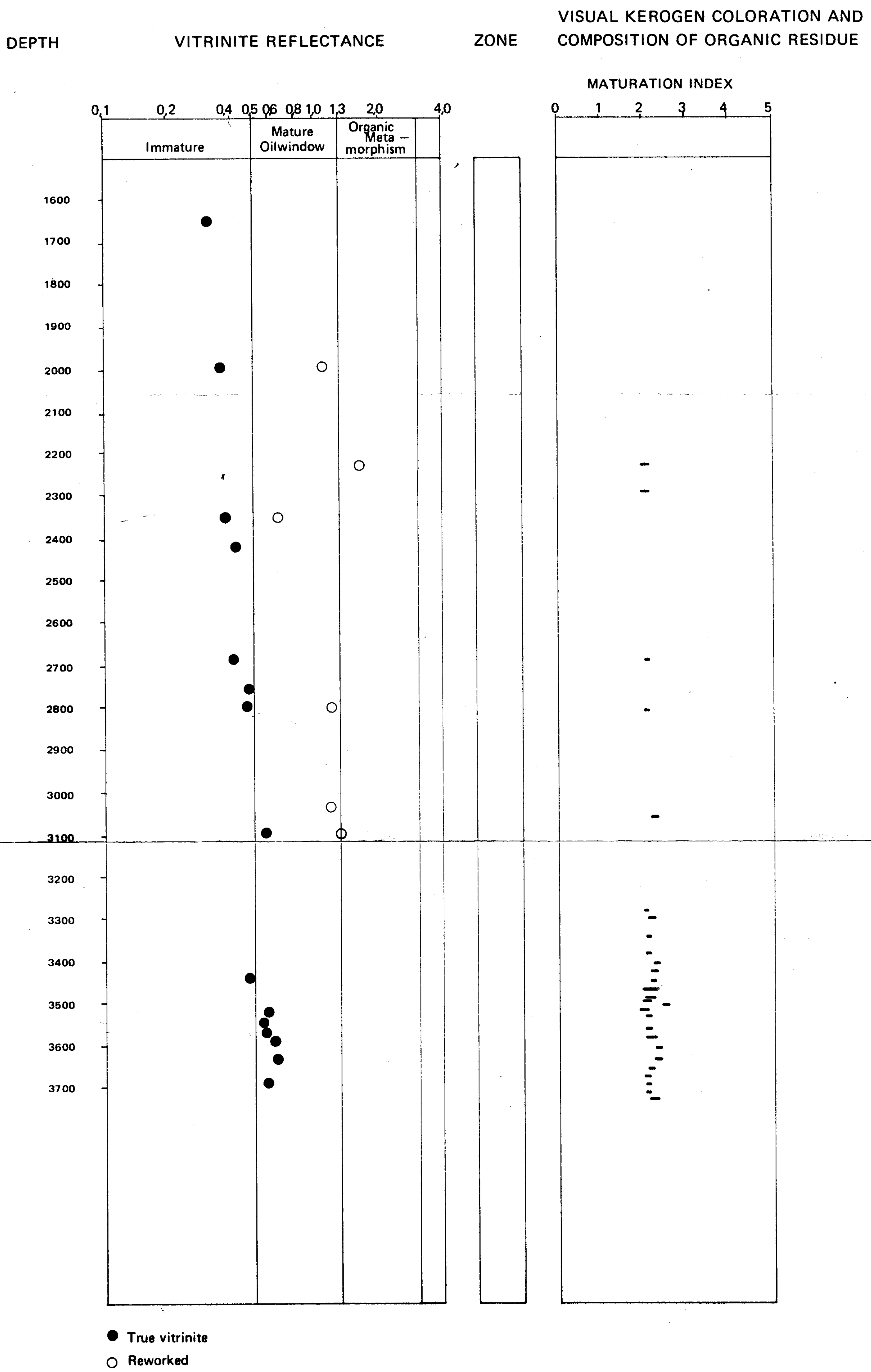
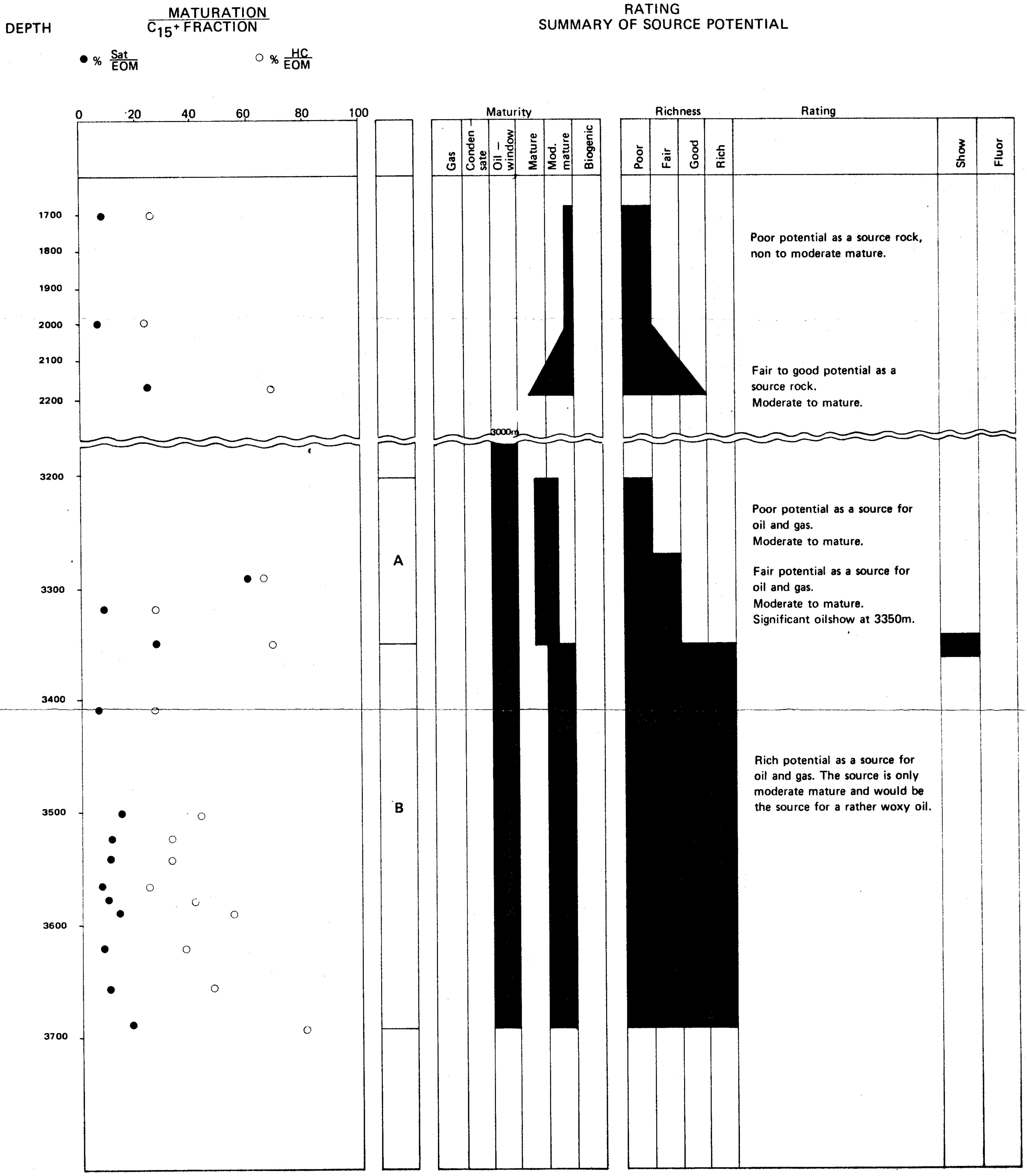


FIG. 5

INTERPRETATION DIAGRAM



Sat: Saturated Hydrocarbons

HC: Hydrocarbons

EOM: Extractable Organic Matter

FIG. 6