



RESEARCH CENTRE

SUNBURY - ON - THAMES

MIDDLESEX

EXPLORATION AND PRODUCTION DIVISION

TECHNICAL NOTE

AUGUST 1978

EPR/TN 7039

COMPARISON OF GEOCHEM LABORATORIES LIMITED AND BP SUNBURY GEOCHEMICAL DATA FOR NOCS WELL 7/12-3

by

J.A. Miles.

Summary

Geochemical data obtained from Geochem Laboratories Limited (GCL) and BP Sunbury for NOCS Well 7/12-3 were compared and contrasted.

Generally, analytical results were in agreement, but some discrepancies in the Total Organic Carbon (TOC) contents were noted. These could probably be explained by lithological variations between the two sets of samples examined by Sunbury and GCL.

Both sets of results highlighted the poor maturity indications within the well, but suggested that the oil generation threshold was in the range 3200 - 3555m and not 4500 + m as proposed by GCL.

A. INTRODUCTION

7 swc samples of ages ranging from Hauterivian to Portlandian from NOCS Well 7/12-3 were examined for source rock richness and maturity. The purpose of this examination was to provide a check on the geochemical results produced by Geochem Laboratories (GCL) on samples of related age, and to provide additional information on the geochemistry of this well. Unfortunately only two of these swc samples were identical to those used by GCL and this made it difficult to compare the results obtained.

B. ANALYSES UNDERTAKEN BY GEOCHEMISTRY BRANCH, SUNBURY

Total organic carbon contents (TOC), vitrinite reflectance measurements and kerogen stable carbon isotope ratios ($\delta^{13}\text{C}_{\text{PDB-1}}$) were obtained on all samples. As only small amounts of sample were available, Total Soluble Extracts (TSE) were obtained by sonic extraction, but the solubles parameters (SAC/TOC and SAC/TSE) were obtained for only two samples.

Visual kerogen descriptions were obtained from slides prepared and used by GCL.

C. RESULTS

1. Vitrinite Reflectance

Poor quality data was obtained on these swc samples. Large amounts of reworked material were noted, and bad distributions of autochthonous material resulted in difficulties with the interpretation of results. No trends with depth were noted, so no reliable estimates of generation threshold could be made. However, all the samples appeared to be marginally mature. This would suggest an oil generation threshold between 3300 - 3500m.

2. Basic Source Rock Parameters

Carbonate contents were low (6.6 - 17.1 per cent weight) confirming that the shales were only slightly calcareous (Table 1).

TOC contents were moderate to very good for the samples analysed, falling in the range 0.63 - 8.04 per cent weight.

No definite conclusions could be drawn from the solubles parameters, the low values (16 - 96 per mil) indicated either immaturity or gas-prone kerogens. Normal-alkane distributions obtained by gas chromatography of the TSE indicated that the samples were mature and probably contained some oil-prone kerogen. These distributions peaked at C_{17} and C_{19} , and no CPI was noted in the higher alkanes (i.e. up to C_{33}).

C_R/C_T measurements also indicated that the samples were marginally mature.

3. Visual Kerogen Descriptions

With the exception of swc 68 (3555m), all the slides prepared by GCL contained very low amounts of organic material and no reliable estimates of source potential or degree of organic diagenesis (DOD) could be made.

SWC 68 contained moderate amounts of mainly woody debris, but was not considered to have any good gas potential. DOD estimates from spore colour suggested that this sample was marginally mature.

4. Stable Carbon Isotope Measurements

Stable carbon isotope ratios of kerogens from the swc samples indicated that the samples were derived from a nearshore/marginal marine environment, in agreement with visual kerogen results.

D. COMPARISON OF GCL DATA WITH BP SUNBURY DATA

Most of the results obtained by GCL and Sunbury agreed quite well (Tables 1 - 4). Both sets of results indicated that the source rocks had poor hydrocarbon potential. Maturity indications for this well were generally of poor quality, and no trends with depth were observed over the very limited interval examined: hence, no accurate extrapolations of DOD could be made. Both sets of results indicated that the interval 3200 - 3555m was around the oil generation threshold.

In view of the paucity of organic material in the visual kerogen preparations, estimations of the derived hydrocarbon types were somewhat uncertain, but more gas prone than oil prone material appeared to be present.

The major disagreement between GCL and Sunbury data arose in TOC contents. The results obtained by Sunbury were considerably higher than GCL, however, on closer examination of the lithology, a possible reason for these discrepancies became apparent. Different samples were analysed by GCL and Sunbury, and those examined by the latter were from a thin band of shale which was described as being rich in carbonaceous debris. Samples analysed by GCL were from above this horizon, where no reference was made to carbonaceous remains.

SWC's 68 and 69 (3555 and 3525m) were examined by both GCL and Sunbury. Good agreement was evident between GCL and Sunbury TOC results for swc 68, but not for swc 69 (GCL 0.64 per cent weight, Sunbury 2.08 per cent weight). It is possible that both of these results were correct, and that the discrepancy between them was related to lithology. However, variations of this order have been observed in TOC contents of standard samples (unknown to Geochem Labs) forwarded to GCL by Sunbury.

Very small amounts of sample were used for the TOC determinations and it was possible that a large sampling error could exist depending upon how much of the carbonaceous debris was incorporated into each sample. Hence, it was also conceivable that a large variation in TOC contents could be obtained if great care were not taken to ensure that samples were both uniform and representative of the particular interval being examined.

This concentration of carbonaceous debris appeared to be confined to a thin layer within the Portlandian succession, and lower TOC contents were probably more representative of the entire interval.

GCL suggested that samples below 3500m could contain migrated hydrocarbons, but no evidence could be found in Sunbury's results to confirm this. However, GCL results did appear to suggest that this was a possibility. It is of note that traces of residual hydrocarbons were recorded in the core sample from 3610m, and it is not impossible that trace quantities of hydrocarbons might have migrated through this succession.

E. CONCLUSIONS

1. Considering the results obtained by both BP and GCL it appears that the Valanginian, Berriasian and Portlandian have poor to moderate source rock richness, but some richer bands occur at the top of the Portlandian.
2. No definite indications were present as to kerogen type in the samples examined, but more gas-prone than oil-prone material appeared to be present.
3. DOD parameters suggested that the samples from 3200 - 3555m were close to the oil generation threshold. However, the maturity indications in this well were not very specific and no trends with depth were noted. Extrapolation of these data by GCL to indicate a generation threshold of 4500 + m was considered unrealistic and should be disregarded.

TABLE 1.

NOCS WELL 7/12-3

BASIC SOURCE ROCK DATA

SAMPLE	AGE	DEPTH m	SAMPLE TYPE/ LITHOLOGY	KEROGEN CARBONISATION CR/CT	CARBONATE % wt (HCl SOLUBLE)	TOTAL ORGANIC CARBON (TOC)% WT	VITRINITE REFLECTANCE (AUTOCHTHONOUS)
79	HAUT	3310	swc Shale	0.46	12.6	0.63	
75	VALA	3474.8	swc Silty Shale	0.35	17.1	0.69	0.53 (2)
73	BERRI	3495	swc Shale	0.51	11.2	0.82	
72	BERRI	3498	swc Shale	0.51	9.6	3.09	0.52 (6)
71	PORT	3500	swc Shale	0.47	6.6	8.04	0.58 (6)
69	PORT	3525	swc Shale	0.59	10.8	2.08	
68	PORT	3555	swc Shale	0.59	13.1	0.63	

TABLE 1 (CONTINUED).

NOCS WELL 7/12-3

BASIC SOURCE ROCK DATA

SAMPLE	TOTAL SOLUBLE EXTRACT (TSE)% wt	TSE TOC INDEX %	SAC TOC INDEX %	TSE		KEROGEN STABLE CARBON ISOTOPE VALUE $\delta^{13}\text{C}$	n-ALKANE CARBON PREFERENCE INDEX CPI
				SATURATE ALKANE CONTENT (SAC)% wt	PRISTANE/PHYTANE RATIO pr/ph		
79	0.0361	57			1.4	- 25.9	1.05
75	0.0669	96			1.7	N/D	1.05
73	0.0136	16			1.2	- 26.4	1.05
72	0.0631	20	6	30	1.6	- 27.3	1.05
71	0.3622	45	14	32	1.6	- 28.6	1.04
69	0.0780	37			1.5	- 28.1	1.05
68	0.0503	79			1.6	- 25.9	1.1

TABLE 2
VISUAL KEROGEN DATA

GEOCHEM SAMPLE NUMBER	DEPTH	ORGANIC MATTER DESCRIPTION				THERMAL MATURATION INDEX
		TYPES	REMARKS	PARTICLE SIZE	PRESERV- ATION	
161-001A	3200m	W;C;H	sparse organic matter. Contamination	F-M	P	2- (?)
161-004 swc	3268m	W-C;-;(H)	very sparse organic matter, unreliable.	M	P	
161-005C	3290m	C-W;H;S	very sparse organic matter. Some at 2 to 2+	F	P-F	2- (?)
161-006A	3320m	W-C;-;-	very sparse organic matter, unreliable.	F-M	P	
161-007A	3350m	C-W;-;-	very sparse organic matter, unreliable.	M	P	
161-008 swc	3357m	C-W;H;-	sparse organic matter.	F-M	F	1+ to 2-
161-010A	3410m	W-C;H;-	sparse organic matter. Reworked material (2 to 2+/2+).	F-M	F	2- (?)
161-013 swc	3490m	C-W;-;H	very sparse organic matter.	F	F	
161-015 swc	3525m	W;C-H;-	sparse organic matter	F-M	F	1+ to 2-
161-017 swc	3555m	W;C;H		M	F	1+ to 2-
161-019A	3590m	W;C;H	sparse organic matter.	M	F	1+ to 2-

reworked organic matter present throughout

TABLE 3
VITRINITE REFLECTANCE DATA

GEOCHEM SAMPLE NUMBER	DEPTH	SAMPLE TYPE	AVERAGE REFLECTIVITY Ro (%)			NUMBER OF PARTICLES			REMARKS
			1	2	3	1	2	3	
161-001A	3200m	CUTTINGS	0.43	0.67		3	4		low organic content, only trace of true vitrinite
161-004	3268m	S.W.C.	0.44			3			low organic content
161-006A	3320m	CUTTINGS	0.43			19			
161-008	3357m	S.W.C.	0.45			18			
161-010A	3410m	CUTTINGS	0.51	0.80*		2	3		low organic content. *reworked
161-013	3490m	S.W.C.	0.36	1.49*		5	15		* reworked
161-015	3525m	S.W.C.	0.45			9			low-moderate organic content
161-017	3555m	S.W.C.	1.69*			13			* reworked, no true vitrinite
161-019A	3590m	CUTTINGS	0.39	0.65		18	2		

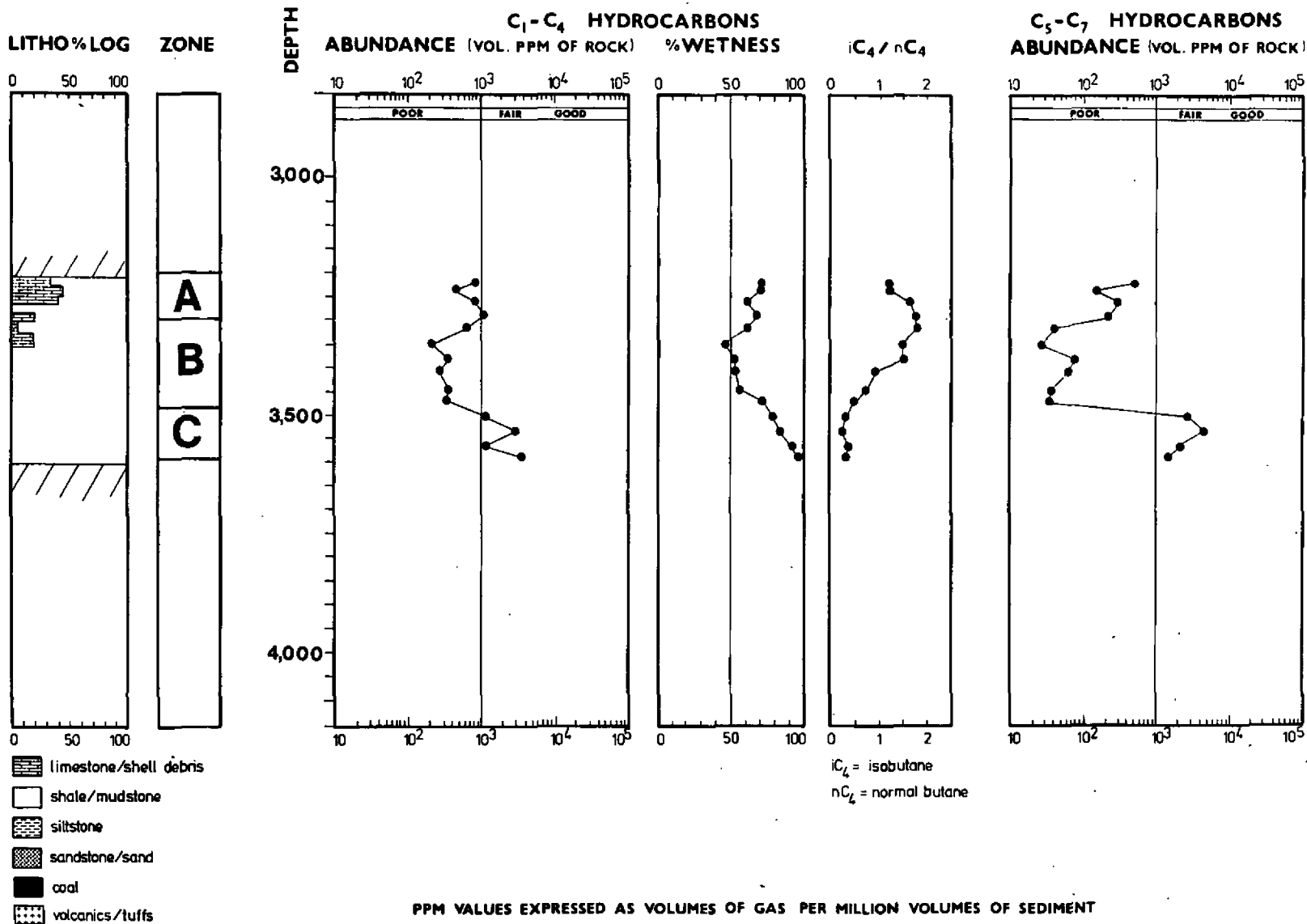
TABLE 4
SIGNIFICANT RATIOS (%) OF C₁₅₊ FRACTIONS AND ORGANIC CARBON

GEOCHEM SAMPLE NUMBER	DEPTH	ORGANIC CARBON	<u>HYDROCARBONS</u> TOTAL EXTRACT	<u>HYDROCARBONS</u> ORGANIC CARBON	<u>TOTAL EXTRACT</u> ORGANIC CARBON
161-001	3200m	0.47	20.61	2.45	11.87
161-002	3230m	0.44	23.63	3.23	13.66
161-003	3260m	0.54	28.68	3.57	12.46
161-004 swc	3268m	0.26, 0.26	15.44	15.23	98.65
161-005B	3290m	0.53	23.66	15.11	63.89
161-006D	3320m	0.37	18.60	42.16	226.68
161-007	3350m	0.41	16.52	2.37	14.32
161-008 swc	3357m	1.02	23.81	44.70	187.73
161-011	3450m	0.33	27.26	4.67	17.12
161-012	3470m	0.32, 0.32	24.27	3.88	15.97
161-013 swc	3490m	0.57	25.36	100.44	395.98
161-014	3500m	0.32	32.34	4.06	12.56
161-015 swc	3525m	0.66	27.28	20.47	75.03
161-016	3530m	0.40	40.75	7.33	17.98
161-017 swc	3555m	0.70, 0.70	33.86	20.51	60.59
161-018	3570m	0.38	37.28	3.82	10.24
161-019	3590m	0.40	45.28	7.68	16.95

FIGURE 1

C₁-C₇ HYDROCARBONS

PRESENTATION OF ANALYTICAL DATA



GEOLOGICAL LIBRARY
 7/12-3 W 25 COPY 2

FIGURE 2
C₄-C₇ HYDROCARBONS

PRESENTATION OF ANALYTICAL DATA

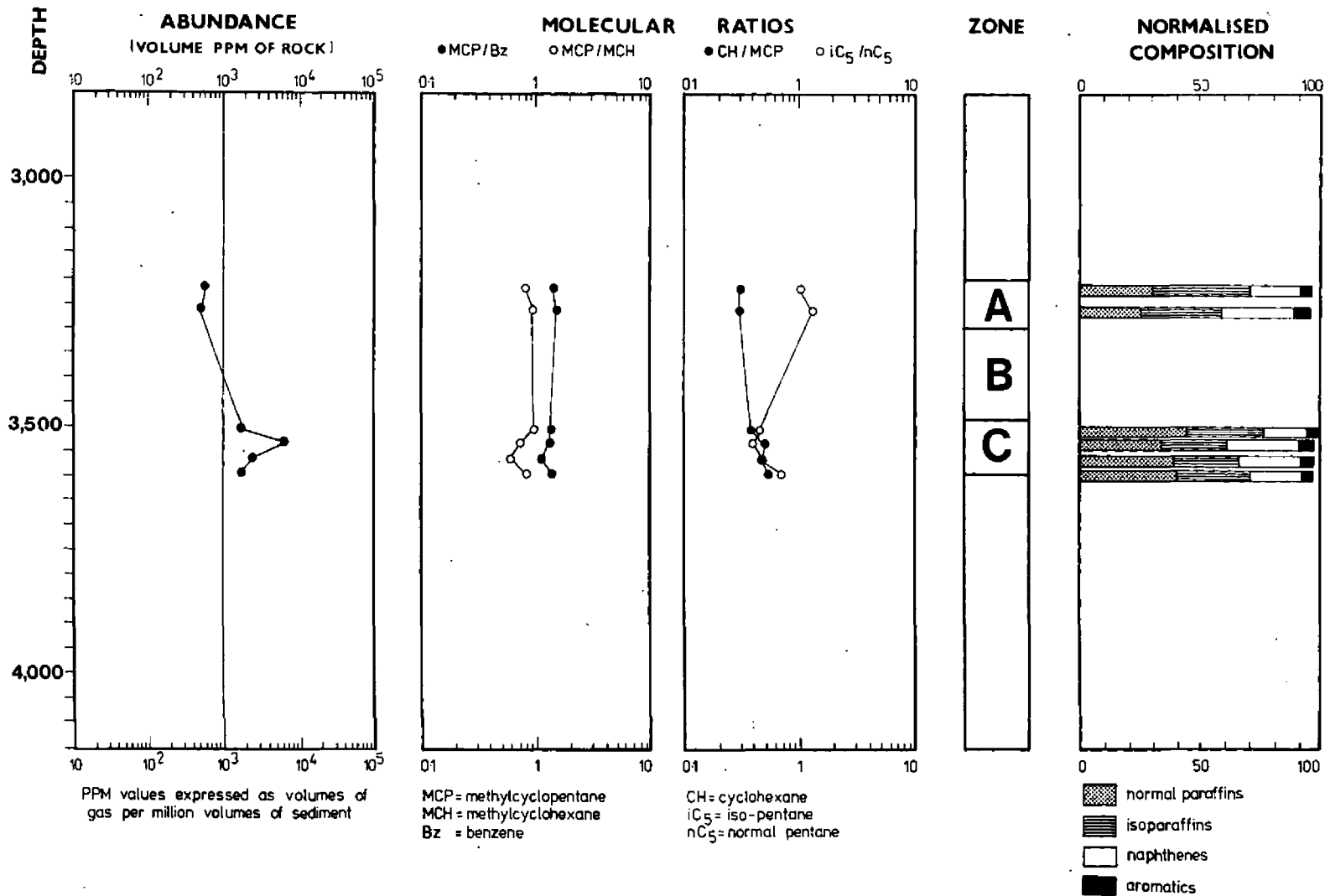


FIGURE 3

C₁₅₊ HYDROCARBONS — RICHNESS

PRESENTATION OF ANALYTICAL DATA

C₁₅₊ EXTRACTION DATA

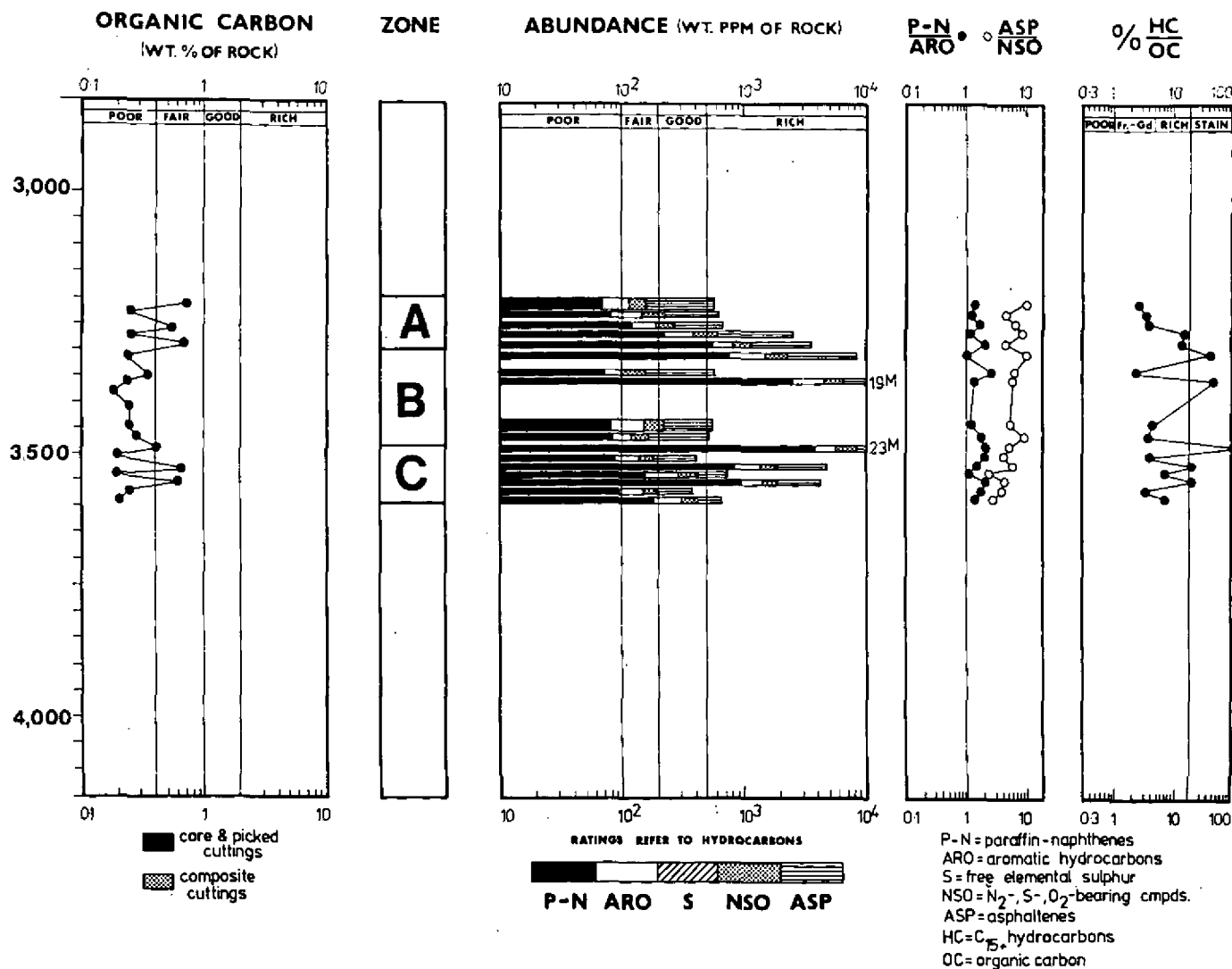


FIGURE 4a

C₁₅₊ PARAFFIN - NAPHTHENE HYDROCARBONS

PRESENTATION OF ANALYTICAL DATA

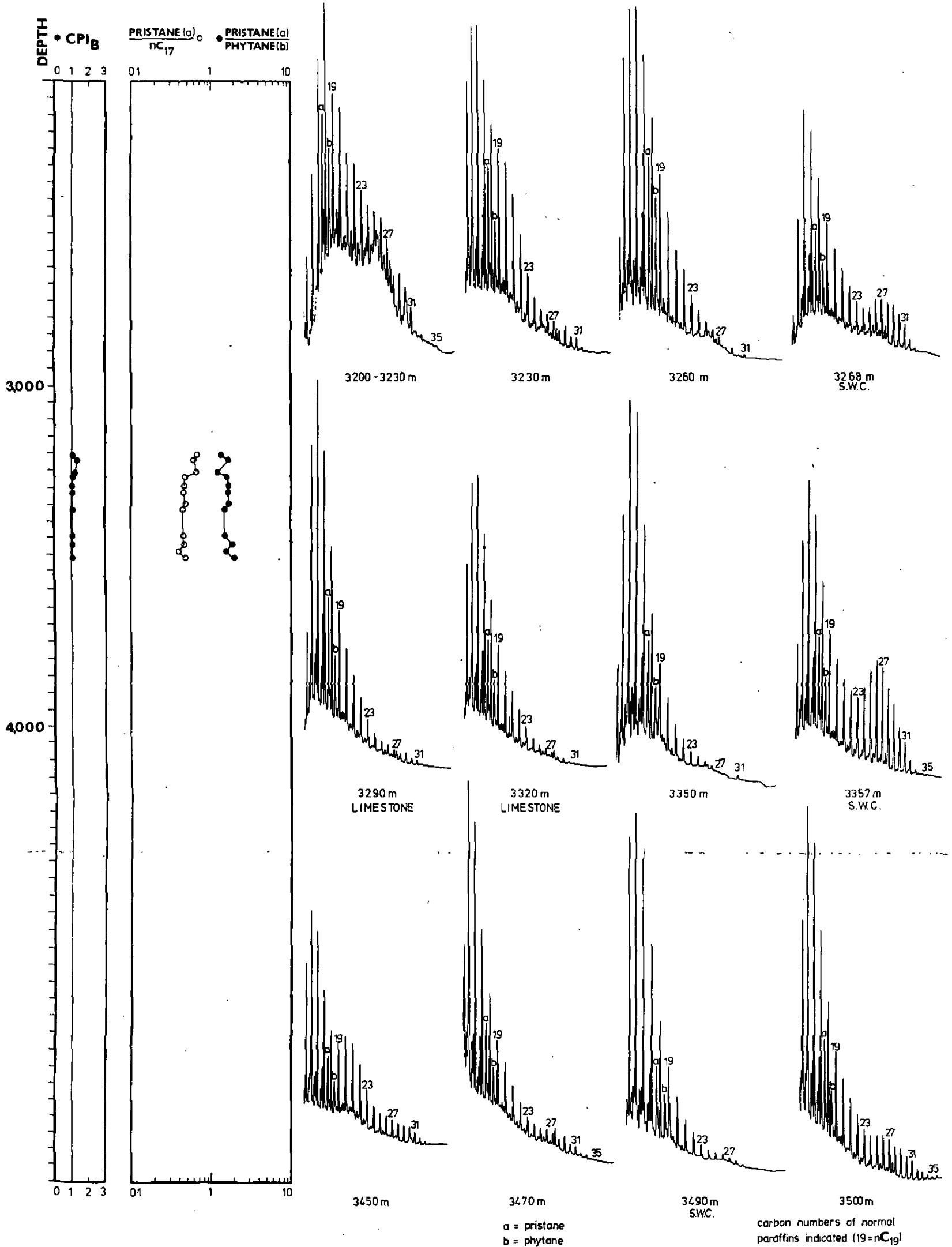


FIGURE 46

C₁₅ + PARAFFIN - NAPHTHENE HYDROCARBONS

PRESENTATION OF ANALYTICAL DATA

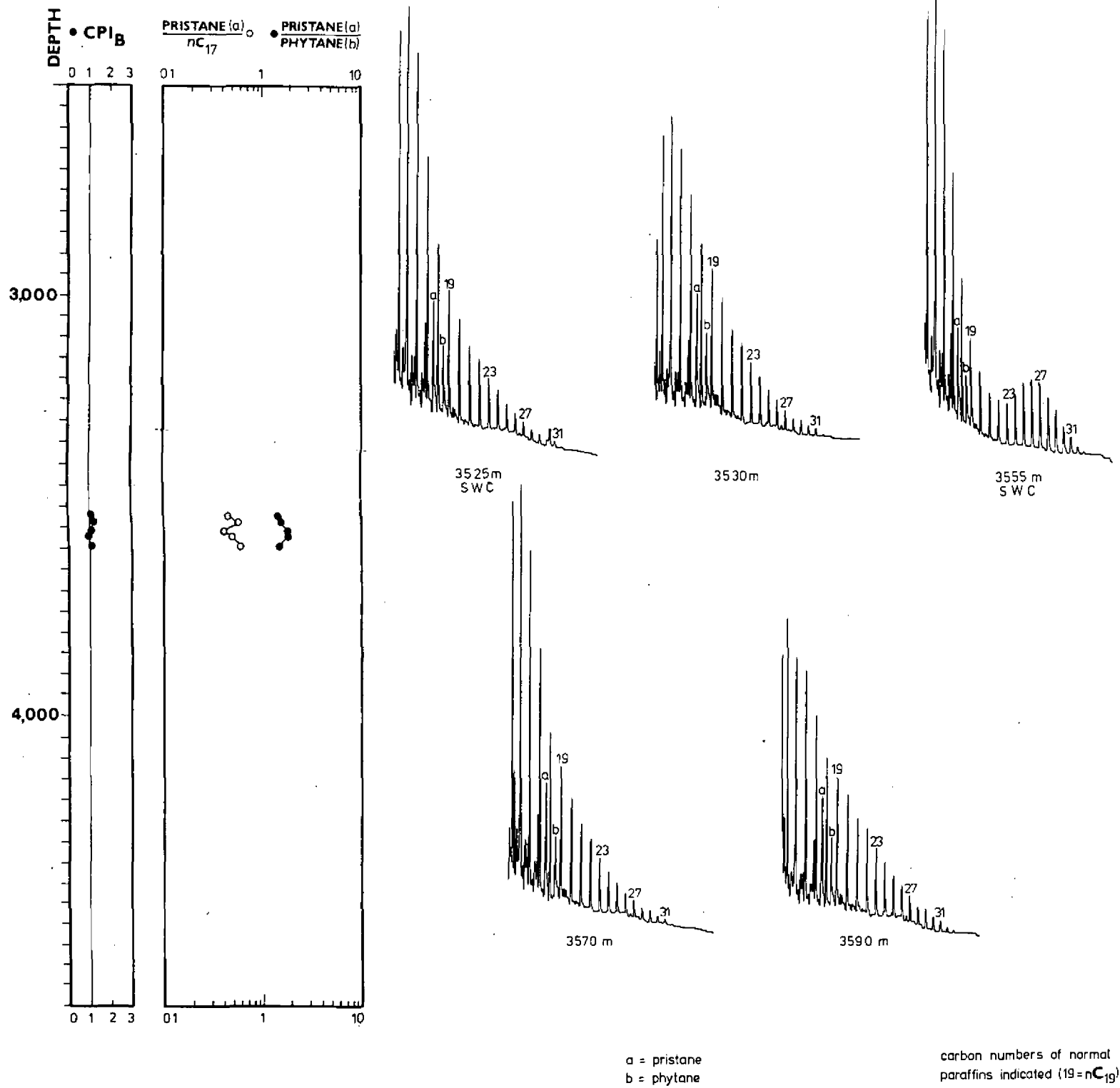
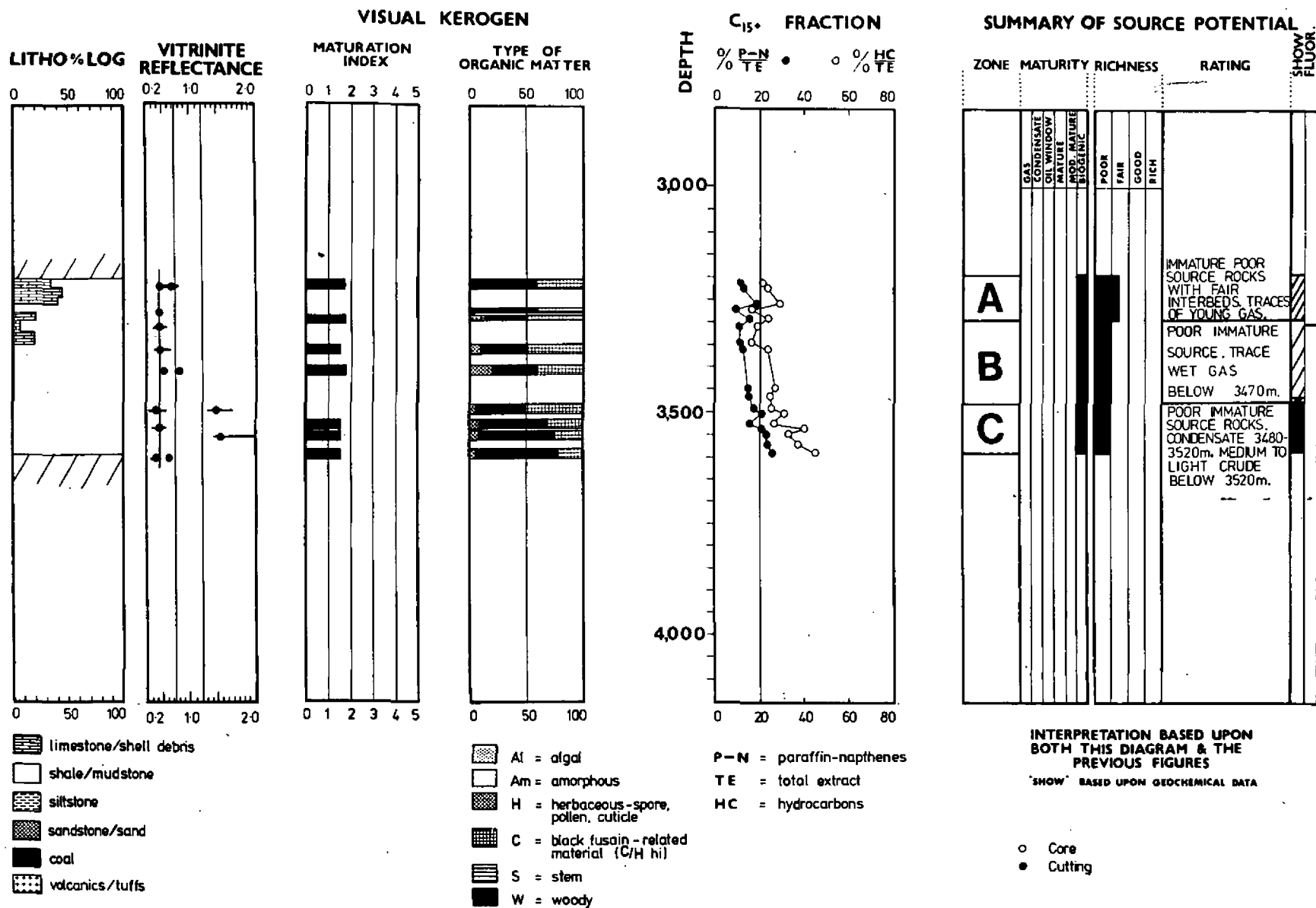


FIGURE 5

INTERPRETATION DIAGRAM

SOURCE TYPE MATURATION RATING



IMMATURE POOR SOURCE ROCKS WITH FAIR INTERBEDS. TRACES OF YOUNG GAS.

POOR IMMATURE SOURCE. TRACE WET GAS BELOW 3470m.

POOR IMMATURE SOURCE ROCKS. CONDENSATE 3480-3520m. MEDIUM TO LIGHT CRUDE BELOW 3520m.