THE ROBERTSON GROUP plc

REPORT NO. 6708/Ic

A PETROLEUM GEOCHEMICAL EVALUATION OF THE INTERVAL 13810' TO 16531' (TD) OF THE N 2/7-21s WELL, NORWEGIAN NORTH SEA

by

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PROJECT NO. RGPD/901/Ic/21883

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2 INTRODUCTION

This report presents the results of geochemical analysis of the Phillips Norway N2/7-21s well from the South Eldfisk area.

Ditch cuttings samples for the interval 13810' to 15080' arrived at The Robertson Group plc, North Wales laboratories on 31 October 1989. A second shipment of ditch cuttings samples to 16531' (TD) and thirteen sidewall core samples, covering the interval 14400' to 14865', followed on 31 November 1989. Selected core samples which were provided to our sedimentology group were obtained for the purpose of geochemical analysis, and a further suite of core samples from the interval 15250' to 16472' was provided by the client, arriving at the Robertson Group laboratories on 30 January 1990.

The analytical programme was carried out in accordance with the Robertson Group proposal number 89/Ic/029, which was accepted by Phillips Petroleum Company Norway on 2 August 1989. Subsequently, revisions to the programme were suggested by phone on 20 November 1989 and by fax on 11 January 1990. These proposals were approved by Phillips Norway by fax dated 24 November 1989, and by telephone on 16 January 1990, respectively.

Samples between 13810' and 15080' were exhaustively extracted prior to analysis using dichloromethane, in order to remove oil based drilling mud contaminants. This treatment removed indigenous free hydrocarbons as well as contamination, and thus precluded the fractionation, alkane chromatographic and gas chromatography-mass spectrometric analyses of the extractable hydrocarbons the samples contained. These analyses were, however, performed on selected core samples. No solvent extractions were performed below 15080', except in preparation for pyrolysis-gas chromatography. Oil based mud was still present throughout this section, however, and consequently, no advanced hydrocarbon analyses were performed on cuttings samples from 15080' to TD.

Analyses performed on cuttings included total organic carbon determination, Rock-Eval pyrolysis, spore colour index analysis, vitrinite reflectance analysis, and pyrolysis gas-chromatography. Additionally, selected core samples were analysed for bitumen reflectivity and extractable hydrocarbons.

The total numbers of analyses carried out were are follows:

Sample preparation and lithological description	131
Solvent extraction to remove oil based mud	66
Total organic carbon determination	134
Rock-Eval pyrolysis	101
Kerogen preparation	44
Spore colour index and visual kerogen description	44
Vitrinite reflectivity	33
Pyrolysis-gas chromatography	23
Quantitative solvent extraction of hydrocarbons	5
Hydrocarbon fractionation	5
Alkane gas chromatography	5
Gas chromatography - mass spectrometry	1

Preliminary results were transmitted to the client by fax (reference 450) on 11 January 1990, and by hand during a meeting with Ian Knight and Mark Scanlan of Phillips Petroleum Company Norway on 16 February 1990, at the Robertson Group laboratories.

Our client contact at Phillips Petroleum Company Norway has been Ian Knight.

Robertson Group personnel involved in the geochemical programme were:

R Harding	:	Interpretation, report preparation, microscopy
C Darlington/P C Barnard	:	Project Advice
N Owen	:	Supervision, chemical analysis
V D'Elia	:	Microscopy

COMPANY: PHILLIPS NORWAY WELL: N2/7-21S LOCATION: NORWEGIAN NORTH SEA

GENERAL DATA			MATURITY DATA		KEROGEN COMPOSITION DATA						
SAMPLE DEPTH (Feet)	SAMPLE TYPE	ANALYSED LITHOLOGY	SPORE COLOUR INDEX	VITR. REFL. R oil av %	% (Visual, from microscopy)			% (Calculated)			
					INERTINITE	VITRINITE	SAPROPEL	INERT	VIT	ALG SAP	WXY SAP
15820-840	Ctgs	SH, med-dk gy+ 30% IGN	9.5		Prt	75	25				
15920-940	Ctgs	SH, dk gy+ tr IGN+ tr MDST, wht	10. ?	1.58(3)B 2.35(1)B	*	95	5				
15970-990	Ctgs	SH, med-dk gy+ tr IGN	9.5		*	95	5				
16010-030	Ctgs	SH, dk gy+ mnr IGN	9.0		*	90	10				
16090-110	Ctgs	SH, dk gy+ 20% IGN	9.0		*	95	5				
16170-190	Ctgs	SH, gy-blk+ 40% IGN	9.5	1.40(55)B	*	95	5				
16215.70	Core	RHY+ 20% BIT									
	P	BIT		1.50(40)B							
16250-270	Ctgs	SH, dk gy+ 30% IGN	9.0		*	95	5				
16310-330	Ctgs	SH, dk gy+ 40% IGN+ mnr MDST, lt ol-gy	9.0		*	95	5				
16350-370	Ctgs	MDST, wht+ 10% SH, dk gy+ 10% MDST, lt ol-gy	8.5		*?	100?	Prt?				
16390-410	Ctgs	MDST, wht+ 20% MDST, dk gy+ mnr MDST, lt ol-gy+ tr SND	8.5	1.45(18)B 1.10(2)B	*	100	Prt				
16450-470	Ctgs	SH, dk gy+ 20% MDST, ol-gy, slty+ mnr SST + tr BIT	9.0	1.50(11)C .78(7)C 1.15(4)C 2.25(9)B	*	100	Prt				
16493.10	Core	IGN+ 10% BIT									
	P	BIT		1.38(50)B							
16521.60	Core	IGN+ 20% BIT									
	P	BIT		.47(1)B 1.29(29)B							

MATURITY AND KEROGEN COMPOSITION DATA

TABLE : 1C

COMPANY: PHILLIPS NORWAY WELL: N2/7-21S LOCATION: NORWEGIAN NORTH SEA

GENERAL DATA			CHEMICAL ANALYSIS DATA											
SAMPLE DEPTH (Feet)	SAMPLE TYPE	ANALYSED LITHOLOGY	TOC % OF ROCK	PYROLYSIS					SOLVENT EXTRACTION/FRACTIONATION					
				Tmax °C	HI	OI	PI	POT.YLD. (ppm)	EXTR. (ppm)	HC (ppm)	EXTR. % OC	HC %oOC	HC %EX	ALK. %HC
13810-820	Ctgs	LST, wht+ 40% MDST, ol-gy, calc+ tr pyr	-						*					
	Ctgs	After extraction	.67	430	57	230	.17	380						
13820-840	Ctgs	MDST, ol-gy, calc+ 10% MDST, lt ol-gy, calc	-						*					
	Ctgs	After extraction	.69	433	51	141	.17	350						
13840-860	Ctgs	MDST, ol-gy, calc+ 20% LST, v lt gy+ mnr MDST, dk gy, calc	-						*					
	Ctgs	After extraction	.64	434	55	130	.13	350						
13860-880	Ctgs	MDST, med gy, calc+ 20% LST, v lt gy+ mnr MDST, dk gy, calc	-						*					
	Ctgs	After extraction	.80	440	78	149	.07	620						
13880-900	Ctgs	MDST, lt brn-gy, calc+ 10% MDST, dk gy, calc+ 10% LST, v lt gy	-						*					
	Ctgs	After extraction	1.96	424	532	126	.04	10420						
13900-920	Ctgs	MDST, med gy, calc+ 20% LST, v lt gy	-						*					
	Ctgs	After extraction	1.66	452	614	104	.03	10190						
13920-940	Ctgs	MDST, med gy, calc+ 20% LST, v lt gy	-						*					
	Ctgs	After extraction	1.25	449	578	101	.03	7230						
13940-960	Ctgs	MDST, med gy, calc+ 10% LST, v lt gy	-						*					
	Ctgs	After extraction	1.11	445	482	112	.04	5350						
13960-980	Ctgs	MDST, med gy, calc+ 10% LST, v lt gy	-						*					
	Ctgs	After extraction	1.00	450	547	124	.03	5470						
13980-14000	Ctgs	MDST, med gy, calc+ mnr LST, v lt gy	-						*					
	Ctgs	After extraction	1.11	449	449	148	.04	4980						
14000-020	Ctgs	MDST, med gy, calc+ 20% LST, v lt gy	-						*					
	Ctgs	After extraction	1.13	441	529	116	.04	5980						
14020-040	Ctgs	MDST, med gy, calc+ 10% LST, v lt gy	-						*					
	Ctgs	After extraction	1.02	426	391	116	.06	3990						
14040-060	Ctgs	MDST, med gy, calc+ 10% LST, v lt gy	-						*					

SUMMARY OF CHEMICAL ANALYSIS DATA

TABLE : 2A

COMPANY: PHILLIPS NORWAY WELL: N2/7-21S LOCATION: NORWEGIAN NORTH SEA

GENERAL DATA			CHEMICAL ANALYSIS DATA											
SAMPLE DEPTH (Feet)	SAMPLE TYPE	ANALYSED LITHOLOGY	TOC % OF ROCK	PYROLYSIS					SOLVENT EXTRACTION/FRACTIONATION					
				Tmax °C	HI	OI	PI	POT.YLD. (ppm)	EXTR. (ppm)	HC (ppm)	EXTR. % OC	HC %oOC	HC %EX	ALK. %HC
14040-060	Ctgs	After extraction	.99	438	408	141	.08	4040						
14060-080	Ctgs	MDST, med gy, calc+ 20% LST, v lt gy	-						*					
	Ctgs	After extraction	1.11	432	370	156	.09	4110						
14080-100	Ctgs	MDST, med gy, calc+ 20% LST, v lt gy	-						*					
	Ctgs	After extraction	1.03	445	353	140	.08	3640						
14100-120	Ctgs	MDST, med gy, calc+ 10% LST, v lt gy	-						*					
	Ctgs	After extraction	1.06	445	325	123	.07	3440						
14120-140	Ctgs	MDST, med gy, calc+ 10% LST, v lt gy	-						*					
	Ctgs	After extraction	1.31	444	301	117	.06	3940						
14140-160	Ctgs	SST, pal yel-brn+ 20% SND+ 20% MDST, med gy, calc	-						*					
	Ctgs	After extraction	.75	442	231	124	.06	1730						
14170	Ctgs	SND+ 20% SST, pal yel-brn+ 20% MDST, dk gy+ mnr CALT	-						*					
	Ctgs	After extraction	.42											
14177.2	Core	SST, dk gy, OS	-						6425	5860			91	83
14267.2	Core	SST, med gy+ 10% MDST, mod red+ tr BIT	-						275	50			18	70
	P	BIT	-											
14280-300	Ctgs	MDST, med gy, calc+ 20% SST, pal yel-brn	-						*					
	Ctgs	After extraction	1.26	448	485	95	.03	6110						
14300-320	Ctgs	MDST, med gy, calc+ 20% SST, pal yel-brn+ 10% SST, mod red-brn+ 10% MDST, ol-gy	-						*					
	Ctgs	After extraction	1.14	435	374	104	.08	4260						
14320-340	Ctgs	MDST, med gy, calc+ 20% SST, pal yel-brn+ 20% MDST, ol-gy, calc+ 10% SST, mod red-brn	-						*					
	Ctgs	After extraction	1.14	451	396	94	.03	4510						
14340-360	Ctgs	MDST, ol-gy+ 10% SST, mod red-brn	-						*					
	Ctgs	After extraction	1.04	446	404	109	.04	4200						

SUMMARY OF CHEMICAL ANALYSIS DATA

TABLE : 2B

COMPANY: PHILLIPS NORWAY WELL: N2/7-21S LOCATION: NORWEGIAN NORTH SEA

GENERAL DATA			CHEMICAL ANALYSIS DATA											
SAMPLE DEPTH (Feet)	SAMPLE TYPE	ANALYSED LITHOLOGY	TOC % OF ROCK	PYROLYSIS					SOLVENT EXTRACTION/FRACTIONATION					
				Tmax °C	HI	OI	PI	POT.YLD. (ppm)	EXTR. (ppm)	HC (ppm)	EXTR. % OC	HC %oOC	HC %EX	ALK. %HC
14580-600	Ctgs	MDST, lt gy, calc+ 50% SST+ mnr MDST, mod red-brn	-						*					
	Ctgs	After extraction	.43											
14600-620	Ctgs	SND+ 20% MDST, lt gy, calc	-						*					
	Ctgs	After extraction	.38											
14633.0	Core	SST, dk gy, OS	-						1735	1555			90	84
14690-700	Ctgs	SND+ 20% MDST, lt gy, calc+ 20% MDST, med-dk gy	-						*					
	Ctgs	After extraction	.57	435	118	116	.09	670						
14700-720	Ctgs	SND+ 20% MDST, lt gy, calc	-						*					
	Ctgs	After extraction	.32											
14718.0	Swc	SST, dk yel-brn, arg	.53											
14720-740	Ctgs	SND+ 20% MDST, med-dk gy + 10% MDST, lt gy, calc	-						*					
	Ctgs	After extraction	.60	433	93	77	.07	560						
14740-760	Ctgs	SND+ 20% MDST, med-dk gy + 20% MDST, med gy, calc	-						*					
	Ctgs	After extraction	.52	433	94	100	.13	490						
	P	BIT	-											
14760-780	Ctgs	SND+ 20% MDST, med-dk gy + mnr MDST, v lt gy, calc	-						*					
	Ctgs	After extraction	.57	440	244	105	.06	1390						
14780-800	Ctgs	SND+ 20% MDST, v lt gy, calc+ 10% MDST, med-dk gy	-						*					
	Ctgs	After extraction	.44											
14786.0	Swc	MDST, gy-orng	.50											
14800-820	Ctgs	SND+ 20% MDST, v lt gy, calc+ 10% MDST, med-dk gy	-						*					
	Ctgs	After extraction	.41											
14820-840	Ctgs	SND+ 20% MDST, v lt gy, calc+ 10% MDST, med-dk gy	-						*					
	Ctgs	After extraction	.51	435	159	92	.10	810						

SUMMARY OF CHEMICAL ANALYSIS DATA

TABLE : 2D

COMPANY: PHILLIPS NORWAY WELL: N2/7-21S LOCATION: NORWEGIAN NORTH SEA

GENERAL DATA			CHEMICAL ANALYSIS DATA											
SAMPLE DEPTH (Feet)	SAMPLE TYPE	ANALYSED LITHOLOGY	TOC % OF ROCK	PYROLYSIS					SOLVENT EXTRACTION/FRACTIONATION					
				Tmax °C	HI	OI	PI	POT.YLD. (ppm)	EXTR. (ppm)	HC (ppm)	EXTR. % OC	HC %oOC	HC %EX	ALK. %HC
14840-860	Ctgs	SND+ 10% MDST, v lt gy, calc+ 10% MDST, med-dk gy	-						*					
	Ctgs	After extraction	.33											
14860-880	Ctgs	SND+ 20% MDST, v lt gy, calc+ 10% MDST, med-dk gy	-						*					
	Ctgs	After extraction	.43											
14880-900	Ctgs	SND+ 20% MDST, v lt gy, calc+ 10% MDST, med-dk gy	-						*					
	Ctgs	After extraction	.45											
14900-920	Ctgs	SST+ 10% MDST, v lt gy, calc+ mnr MDST, med-dk gy	-						*					
	Ctgs	After extraction	.46											
14920-940	Ctgs	SND+ 10% MDST, v lt gy, calc+ mnr MDST, med-dk gy	-						*					
	Ctgs	After extraction	.41											
14940-950	Ctgs	MDST, v lt gy, calc+ 20% SND+ mnr MDST, med-dk gy	-						*					
	Ctgs	After extraction	.57	433	189	95	.06	1080						
14980-15000	Ctgs	MDST, med-dk gy+ 10% SND + 10% MDST, v lt gy, calc+ mnr MDST, mod red-brn	-						*					
	Ctgs	After extraction	1.20	407	415	126	.03	4980						
14980.0	Core	SST, gy-red	-						4575	3880			85	76
15000-020	Ctgs	SND+ 10% MDST, med-dk gy	-						*					
	Ctgs	After extraction	1.48	433	257	132	.04	3810						
15020-040	Ctgs	SND+ mnr MDST, med-dk gy + mnr mic+ mnr MDST, v lt gy, calc	-						*					
	Ctgs	After extraction	.95	432	214	194	.06	2030						
15040-060	Ctgs	SST+ 10% MDST, med-dk gy + mnr MDST, v lt gy, calc	-						*					
	Ctgs	After extraction	.38											
15060-080	Ctgs	SST+ 10% MDST, v lt gy, calc+ mnr MDST, med-dk gy	-						*					
	Ctgs	After extraction	.36											

SUMMARY OF CHEMICAL ANALYSIS DATA

TABLE : 2E

COMPANY: PHILLIPS NORWAY WELL: N2/7-21S LOCATION: NORWEGIAN NORTH SEA

GENERAL DATA			CHEMICAL ANALYSIS DATA											
SAMPLE DEPTH (Feet)	SAMPLE TYPE	ANALYSED LITHOLOGY	TOC % OF ROCK	PYROLYSIS					SOLVENT EXTRACTION/FRACTIONATION					
				Tmax °C	HI	OI	PI	POT.YLD. (ppm)	EXTR. (ppm)	HC (ppm)	EXTR. % OC	HC %OOC	HC %EX	ALK. %HC
15090-110	Ctgs	SST+ 10% MDST, lt ol-gy + mnr MDST, med gy	1.02	433	230	61	.62	2350	4400		43.1			
	Ctgs	After extraction	1.32											
15110-130	Ctgs	LST, med-dk gy+ 30% LST, lt ol-gy	.49											
15130-150	Ctgs	SST+ 10% MDST, lt ol-gy + mnr SH, dk gy	.86	425	330	64	.70	2840						
15150-170	Ctgs	SST+ 20% MDST, lt ol-gy, slty	.99	431	415	73	.72	4110						
15170-190	Ctgs	SST+ 30% MDST, lt ol-gy, slty+ mnr SH, dk gy	1.23	433	356	62	.74	4380	16920		138.			
	Ctgs	After extraction	.74											
15200-220	Ctgs	SH, dk gy+ mnr SST+ tr pyr	.69	434	365	72	.78	2520						
15220-240	Ctgs	SH, dk gy+ mnr MDST, wht + tr MDST, lt ol-gy, slty	.98	433	268	55	.75	2630						
	P	BIT	-											
15294.4	Core	SST, mod red-brn+ mnr BIT	-											
15320-340	Ctgs	SH, dk gy+ 10% SST+ mnr LCM	.71	426	208	85	.72	1480						
15350	Ctgs	SH, dk gy+ tr SST	.73	434	167	58	.56	1220						
15374.3	Core	SST, med gy	-						1270	1080			85	84
15392.0	Core	SST, lt gy	.35											
15400-420	Ctgs	SH, dk gy+ 20% SST	.84	431	244	82	.58	2050						
15420-440	Ctgs	SH, dk gy+ 20% SST	1.07	429	264	67	.78	2830	10985		103.			
	Ctgs	After extraction	.62											
15440-460	Ctgs	SST+ 30% SH, dk gy+ 30% LST, med gy	.76	430	259	97	.56	1970						
15460-480	Ctgs	SH, dk gy+ tr SST	.63	432	171	70	.66	1080						
15480-500	Ctgs	SH, dk gy+ 20% SST+ mnr MDST, lt ol-gy+ tr LST, med gy	.87	427	152	63	.83	1320						
15500-520	Ctgs	SH, dk gy+ 10% MDST, lt ol-gy, slty+ 10% SST	1.32	430	201	62	.79	2650						
15520-540	Ctgs	SH, dk gy+ tr SST	.75	429	257	83	.78	1930						
15540-560	Ctgs	SH, dk gy+ mnr LCM+ tr SST	1.16	427	249	63	.82	2890	18585		160.			
	Ctgs	After extraction	.79											

SUMMARY OF CHEMICAL ANALYSIS DATA

TABLE : 2F

COMPANY: PHILLIPS NORWAY WELL: N2/7-21S LOCATION: NORWEGIAN NORTH SEA

GENERAL DATA			CHEMICAL ANALYSIS DATA										
SAMPLE DEPTH (Feet)	SAMPLE TYPE	ANALYSED LITHOLOGY	TOC % OF ROCK	PYROLYSIS					SOLVENT EXTRACTION/FRACTIONATION				
				Tmax °C	HI	OI	PI	POT.YLD. (ppm)	EXTR. (ppm)	HC (ppm)	EXTR. % OC	HC %oOC	HC %EX	ALK. %HC
15560-580	Ctgs	SH, dk gy+ tr SST+ tr MDST, wht, calc	1.01	432	264	62	.77	2670						
15580-600	Ctgs	SH, dk gy+ mnr SST+ tr IGN	.85	433	191	81	.74	1620						
15600-620	Ctgs	SH, dk gy+ mnr SST+ tr MDST, wht	.77	430	168	69	.80	1290						
15620-640	Ctgs	SH, dk gy+ 10% SST+ tr MDST, wht	.84	429	127	60	.78	1070						
15640-660	Ctgs	SH, dk gy+ mnr SST	.99	430	149	46	.86	1480						
15660-680	Ctgs	SH, dk gy+ tr DOL, med-dk gy	.84	430	205	71	.86	1720						
15680-700	Ctgs	SH, dk gy	1.13	438	166	51	.86	1880						
15700-720	Ctgs	SH, dk gy	1.05	434	234	66	.82	2460						
15720-740	Ctgs	SH, med gy	1.08	430	183	71	.85	1980						
15740-760	Ctgs	SH, med-dk gy	1.11	428	241	58	.85	2680						
15760-780	Ctgs	SH, dk gy+ tr SST+ tr DOL, dk gn-gy	1.00	432	263	66	.79	2630	12005		120.			
	Ctgs	After extraction	.63											
15780-800	Ctgs	SH, dk gy, slty+ 10% IGN + tr MDST, pal red-brn	.75	430	296	69	.83	2220						
15800-820	Ctgs	SH, dk gy+ 30% IGN+ mnr MDST, pal yel-brn, slty	.79	402	203	76	.75	1600						
15820-840	Ctgs	SH, med-dk gy+ 30% IGN	1.34	428	222	96	.85	2970						
15840-860	Ctgs	SH, med-dk gy+ 30% IGN+ 30% MDST, pal red	1.24	429	306	86	.71	3800	10870		87.7			
	Ctgs	After extraction	.86											
15860-880	Ctgs	SH, dk gy+ 50% IGN	.93	428	195	54	.74	1810						
15880-900	Ctgs	SH, dk gy+ tr IGN+ tr MDST, wht	.85	432	158	59	.81	1340						
15900-920	Ctgs	SH, dk gy+ tr IGN+ tr MDST, wht	.93	432	156	58	.85	1450						
15920-940	Ctgs	SH, dk gy+ tr IGN+ tr MDST, wht	.76	435	155	70	.83	1180						
15940-950	Ctgs	SH, dk gy+ tr IGN+ tr MDST, wht	.96	431	113	65	.85	1080						
15950-970	Ctgs	SH, med-dk gy+ 40% IGN	1.24	423	189	62	.72	2340	8645		69.7			
	Ctgs	After extraction	.86											
15970-990	Ctgs	SH, med-dk gy+ tr IGN	.90	427	160	78	.63	1440						
15990-16010	Ctgs	SH, med-dk gy+ tr IGN	.87	435	132	70	.67	1150						
16010-030	Ctgs	SH, dk gy+ mnr IGN	.85	432	153	60	.73	1300						

SUMMARY OF CHEMICAL ANALYSIS DATA

TABLE : 2G

COMPANY: PHILLIPS NORWAY WELL: N2/7-21S LOCATION: NORWEGIAN NORTH SEA

GENERAL DATA			CHEMICAL ANALYSIS DATA											
SAMPLE DEPTH (Feet)	SAMPLE TYPE	ANALYSED LITHOLOGY	TOC % OF ROCK	PYROLYSIS					SOLVENT EXTRACTION/FRACTIONATION					
				Tmax °C	HI	OI	PI	POT.YLD. (ppm)	EXTR. (ppm)	HC (ppm)	EXTR. % OC	HC %oOC	HC %EX	ALK. %HC
16030-050	Ctgs	SH, dk gy+ 20% IGN	1.02	433	166	67	.82	1690						
16050-070	Ctgs	SH, med-dk gy+ 10% IGN	1.22	*	148	141	.79	1800						
16070-090	Ctgs	SH, ol-gy+ 30% IGN	1.61	427	122	64	.79	1970						
16090-110	Ctgs	SH, dk gy+ 20% IGN	.99	431	210	63	.73	2080						
16110-130	Ctgs	SH, dk gy, slty+ tr IGN	1.21	435	154	50	.79	1860						
16130-150	Ctgs	SH, dk gy, slty+ tr MDST wht	1.20	429	189	43	.77	2270	10455		87.1			
	Ctgs	After extraction	.82											
16150-170	Ctgs	SH, dk gy+ mnr IGN+ tr MDST, wht	1.10	429	115	51	.76	1260						
16170-190	Ctgs	SH, gy-blk+ 40% IGN	.99	433	174	59	.69	1720						
16190-210	Ctgs	IGN+ 30% SH, gy-blk	.80	432	273	81	.64	2180	5930		74.1			
	Ctgs	After extraction	.59											
16215.7	Core	RHY+ 20% BIT	-						275	180			65	72
16250-270	Ctgs	SH, dk gy+ 30% IGN	1.09	428	220	62	.75	2400						
16270-290	Ctgs	SH, dk gy+ 10% IGN+ mnr MDST, lt ol-gy	.93	430	189	81	.71	1760						
16290-310	Ctgs	IGN+ 30% SH, dk gy+ mnr MDST, lt ol-gy	1.08	433	284	70	.70	3070	9325		86.3			
	Ctgs	After extraction	.74											
16310-330	Ctgs	SH, dk gy+ 40% IGN+ mnr MDST, lt ol-gy	1.01	431	198	77	.78	2000						
16330-350	Ctgs	IGN+ 10% MDST, lt ol-gy, slty+ mnr MDST, dk gy	1.38	433	278	84	.62	3830						
16350-370	Ctgs	MDST, wht+ 10% SH, dk gy + 10% MDST, lt ol-gy	1.80	434	311	56	.71	5590	19015		106.			
	Ctgs	After extraction	1.05											
16370-390	Ctgs	MDST, wht+ 20% MDST, dk gy+ 10% MDST, lt ol-gy	1.63	433	322	52	.76	5250						
16390-410	Ctgs	MDST, wht+ 20% MDST, dk gy+ mnr MDST, lt ol-gy+ tr SND	1.59	428	272	60	.68	4330						
16410-430	Ctgs	MDST, wht+ mnr MDST, dk gy+ tr SST	1.59	434	367	60	.76	5840						
16430-450	Ctgs	MDST, wht+ 10% MDST, dk gy+ tr SST	2.06	429	376	65	.61	7740	17300		84.0			
	Ctgs	After extraction	1.25											
16450-470	Ctgs	SH, dk gy+ 20% MDST, ol-gy, slty+ mnr SST+ tr BIT	3.21	428	227	73	.68	7300						

SUMMARY OF CHEMICAL ANALYSIS DATA

TABLE : 2H

COMPANY: PHILLIPS NORWAY WELL: N2/7-21S LOCATION: NORWEGIAN NORTH SEA

GENERAL DATA			CHEMICAL ANALYSIS DATA											
SAMPLE DEPTH (Feet)	SAMPLE TYPE	ANALYSED LITHOLOGY	TOC % OF ROCK	PYROLYSIS					SOLVENT EXTRACTION/FRACTIONATION					
				Tmax °C	HI	OI	PI	POT.YLD. (ppm)	EXTR. (ppm)	HC (ppm)	EXTR. % OC	HC %oOC	HC %EX	ALK. %HC
16493.1	Core	IGN+ 10% BIT	-											
16521.6	Core	IGN+ 20% BIT	-						955	550			58	92
	P	BIT	-											

SUMMARY OF CHEMICAL ANALYSIS DATA

TABLE : 2I

COMPANY: PHILLIPS NORWAY WELL: N2/7-21S LOCATION: NORWEGIAN NORTH SEA

GENERAL DATA			CHEMICAL ANALYSIS DATA								
SAMPLE DEPTH (Feet)	SAMPLE TYPE	ANALYSED LITHOLOGY	TOC % OF ROCK	PYROLYSIS							
				S1 (ppm)	S2 (ppm)	S3 (ppm)	HI	OI	PI	Tmax °C	S2/S3
13810-820	Ctgs	LST, wht+ 40% MDST, ol-gy, calc+ tr pyr									
	Ctgs	After extraction	.67	80	380	1540	57	230	.17	430	.25
13820-840	Ctgs	MDST, ol-gy, calc+ 10% MDST, lt ol-gy, calc									
	Ctgs	After extraction	.69	70	350	970	51	141	.17	433	.36
13840-860	Ctgs	MDST, ol-gy, calc+ 20% LST, v lt gy+ mnr MDST, dk gy, calc									
	Ctgs	After extraction	.64	50	350	830	55	130	.13	434	.42
13860-880	Ctgs	MDST, med gy, calc+ 20% LST, v lt gy+ mnr MDST, dk gy, calc									
	Ctgs	After extraction	.80	50	620	1190	78	149	.07	440	.52
13880-900	Ctgs	MDST, lt brn-gy, calc+ 10% MDST, dk gy, calc+ 10% LST, v lt gy									
	Ctgs	After extraction	1.96	410	10420	2460	532	126	.04	424	4.24
13900-920	Ctgs	MDST, med gy, calc+ 20% LST, v lt gy									
	Ctgs	After extraction	1.66	290	10190	1730	614	104	.03	452	5.89
13920-940	Ctgs	MDST, med gy, calc+ 20% LST, v lt gy									
	Ctgs	After extraction	1.25	200	7230	1260	578	101	.03	449	5.74
13940-960	Ctgs	MDST, med gy, calc+ 10% LST, v lt gy									
	Ctgs	After extraction	1.11	200	5350	1240	482	112	.04	445	4.31
13960-980	Ctgs	MDST, med gy, calc+ 10% LST, v lt gy									
	Ctgs	After extraction	1.00	180	5470	1240	547	124	.03	450	4.41
13980-14000	Ctgs	MDST, med gy, calc+ mnr LST, v lt gy									
	Ctgs	After extraction	1.11	190	4980	1640	449	148	.04	449	3.04
14000-020	Ctgs	MDST, med gy, calc+ 20% LST, v lt gy									
	Ctgs	After extraction	1.13	230	5980	1310	529	116	.04	441	4.56
14020-040	Ctgs	MDST, med gy, calc+ 10% LST, v lt gy									
	Ctgs	After extraction	1.02	260	3990	1180	391	116	.06	426	3.38
14040-060	Ctgs	MDST, med gy, calc+ 10% LST, v lt gy									
	Ctgs	After extraction	.99	340	4040	1400	408	141	.08	438	2.89

ORGANIC CARBON AND ROCK-EVAL PYROLYSIS DATA

TABLE : 3A

COMPANY: PHILLIPS NORWAY WELL: N2/7-21S LOCATION: NORWEGIAN NORTH SEA

GENERAL DATA			CHEMICAL ANALYSIS DATA								
SAMPLE DEPTH (Feet)	SAMPLE TYPE	ANALYSED LITHOLOGY	TOC % OF ROCK	PYROLYSIS							
				S1 (ppm)	S2 (ppm)	S3 (ppm)	HI	OI	PI	Tmax °C	S2/S3
14060-080	Ctgs	MDST, med gy, calc+ 20% LST, v lt gy									
	Ctgs	After extraction	1.11	430	4110	1730	370	156	.09	432	2.38
14080-100	Ctgs	MDST, med gy, calc+ 20% LST, v lt gy									
	Ctgs	After extraction	1.03	300	3640	1440	353	140	.08	445	2.53
14100-120	Ctgs	MDST, med gy, calc+ 10% LST, v lt gy									
	Ctgs	After extraction	1.06	260	3440	1300	325	123	.07	445	2.65
14120-140	Ctgs	MDST, med gy, calc+ 10% LST, v lt gy									
	Ctgs	After extraction	1.31	250	3940	1530	301	117	.06	444	2.58
14140-160	Ctgs	SST, pal yel-brn+ 20% SND+ 20% MDST, med gy, calc									
	Ctgs	After extraction	.75	110	1730	930	231	124	.06	442	1.86
14170	Ctgs	SND+ 20% SST, pal yel-brn+ 20% MDST, dk gy+ mnr CALT									
	Ctgs	After extraction	.42								
14280-300	Ctgs	MDST, med gy, calc+ 20% SST, pal yel-brn									
	Ctgs	After extraction	1.26	190	6110	1200	485	95	.03	448	5.09
14300-320	Ctgs	MDST, med gy, calc+ 20% SST, pal yel-brn+ 10% SST, mod red-brn+ 10% MDST, ol-gy									
	Ctgs	After extraction	1.14	390	4260	1180	374	104	.08	435	3.61
14320-340	Ctgs	MDST, med gy, calc+ 20% SST, pal yel-brn+ 20% MDST, ol-gy, calc+ 10% SST, mod red-brn									
	Ctgs	After extraction	1.14	160	4510	1070	396	94	.03	451	4.21
14340-360	Ctgs	MDST, ol-gy+ 10% SST, mod red-brn									
	Ctgs	After extraction	1.04	170	4200	1130	404	109	.04	446	3.72
14360-380	Ctgs	MDST, ol-gy+ 10% SST, mod red-brn									
	Ctgs	After extraction	.80	120	2290	620	286	78	.05	445	3.69
14380-400	Ctgs	MDST, dsk yel-brn+ 40% SND									
	Ctgs	After extraction	1.01	80	2570	580	254	57	.03	452	4.43
14387.0	Swc	SST, yel-gy, arg	1.42								
14400-420	Ctgs	MDST, dsk yel-brn+ 40% SND									
	Ctgs	After extraction	.81	100	2400	680	296	84	.04	449	3.53

ORGANIC CARBON AND ROCK-EVAL PYROLYSIS DATA

TABLE : 3B

COMPANY: PHILLIPS NORWAY WELL: N2/7-21S LOCATION: NORWEGIAN NORTH SEA

GENERAL DATA			CHEMICAL ANALYSIS DATA								
SAMPLE DEPTH (Feet)	SAMPLE TYPE	ANALYSED LITHOLOGY	TOC % OF ROCK	PYROLYSIS							
				S1 (ppm)	S2 (ppm)	S3 (ppm)	HI	OI	PI	Tmax °C	S2/S3
14420-440	Ctgs	MDST, dsk yel-brn+ 40% SND									
	Ctgs	After extraction	1.02	140	4080	990	400	97	.03	445	4.12
14440-460	Ctgs	SND+ 20% MDST, dsk yel-brn									
	Ctgs	After extraction	1.51	130	4140	900	274	60	.03	448	4.60
14456.0	Swc	VOLC, ol-gy	2.95								
14460-480	Ctgs	SND+ 10% MDST, dsk yel-brn									
	Ctgs	After extraction	1.13	110	3610	930	319	82	.03	448	3.88
14480-500	Ctgs	MDST, dsk yel-brn+ 20% MDST, mod red-brn+ 20% SND									
	Ctgs	After extraction	1.12	130	3100	950	277	85	.04	446	3.26
14500-520	Ctgs	MDST, med gy, calc+ 20% MDST, mod red-brn+ 20% SND+ mnr MDST dsk yel-brn									
	Ctgs	After extraction	.77	210	3040	1200	395	156	.06	441	2.53
14520-540	Ctgs	SST+ 10% MDST, med gy, calc+ mnr MDST, dsk yel-brn+ mnr SND									
	Ctgs	After extraction	.68	150	1980	1140	291	168	.07	443	1.74
14520.0	Swc	IGN	.95								
14540-560	Ctgs	MDST, med gy, calc+ 40% SST									
	Ctgs	After extraction	.65	100	1690	950	260	146	.06	441	1.78
14560-580	Ctgs	MDST, lt gy, calc+ 20% SST+ 10% MDST, mod red-brn									
	Ctgs	After extraction	.49								
14580-600	Ctgs	MDST, lt gy, calc+ 50% SST+ mnr MDST, mod red-brn									
	Ctgs	After extraction	.43								
14600-620	Ctgs	SND+ 20% MDST, lt gy, calc									
	Ctgs	After extraction	.38								
14690-700	Ctgs	SND+ 20% MDST, lt gy, calc+ 20% MDST, med-dk gy									
	Ctgs	After extraction	.57	70	670	660	118	116	.09	435	1.02
14700-720	Ctgs	SND+ 20% MDST, lt gy, calc									
	Ctgs	After extraction	.32								
14718.0	Swc	SST, dk yel-brn, arg	.53								
14720-740	Ctgs	SND+ 20% MDST, med-dk gy+ 10% MDST, lt gy, calc									
	Ctgs	After extraction	.60	40	560	460	93	77	.07	433	1.22

ORGANIC CARBON AND ROCK-EVAL PYROLYSIS DATA

TABLE : 3C

COMPANY: PHILLIPS NORWAY WELL: N2/7-21S LOCATION: NORWEGIAN NORTH SEA

GENERAL DATA			CHEMICAL ANALYSIS DATA								
SAMPLE DEPTH (Feet)	SAMPLE TYPE	ANALYSED LITHOLOGY	TOC % OF ROCK	PYROLYSIS							
				S1 (ppm)	S2 (ppm)	S3 (ppm)	HI	OI	PI	Tmax °C	S2/S3
14740-760	Ctgs	SND+ 20% MDST, med-dk gy+ 20% MDST, med gy, calc									
	Ctgs	After extraction	.52	70	490	520	94	100	.13	433	.94
14760-780	Ctgs	SND+ 20% MDST, med-dk gy+ mnr MDST, v lt gy, calc									
	Ctgs	After extraction	.57	90	1390	600	244	105	.06	440	2.32
14780-800	Ctgs	SND+ 20% MDST, v lt gy, calc+ 10% MDST, med-dk gy									
	Ctgs	After extraction	.44								
14786.0	Swc	MDST, gy-orng	.50								
14800-820	Ctgs	SND+ 20% MDST, v lt gy, calc+ 10% MDST, med-dk gy									
	Ctgs	After extraction	.41								
14820-840	Ctgs	SND+ 20% MDST, v lt gy, calc+ 10% MDST, med-dk gy									
	Ctgs	After extraction	.51	90	810	470	159	92	.10	435	1.72
14840-860	Ctgs	SND+ 10% MDST, v lt gy, calc+ 10% MDST, med-dk gy									
	Ctgs	After extraction	.33								
14860-880	Ctgs	SND+ 20% MDST, v lt gy, calc+ 10% MDST, med-dk gy									
	Ctgs	After extraction	.43								
14880-900	Ctgs	SND+ 20% MDST, v lt gy, calc+ 10% MDST, med-dk gy									
	Ctgs	After extraction	.45								
14900-920	Ctgs	SST+ 10% MDST, v lt gy, calc+ mnr MDST, med-dk gy									
	Ctgs	After extraction	.46								
14920-940	Ctgs	SND+ 10% MDST, v lt gy, calc+ mnr MDST, med-dk gy									
	Ctgs	After extraction	.41								
14940-950	Ctgs	MDST, v lt gy, calc+ 20% SND+ mnr MDST, med-dk gy									
	Ctgs	After extraction	.57	70	1080	540	189	95	.06	433	2.00
14980-15000	Ctgs	MDST, med-dk gy+ 10% SND+ 10% MDST, v lt gy, calc+ mnr MDST, mod red-brn									
	Ctgs	After extraction	1.20	160	4980	1510	415	126	.03	407	3.30
15000-020	Ctgs	SND+ 10% MDST, med-dk gy									
	Ctgs	After extraction	1.48	140	3810	1960	257	132	.04	433	1.94

ORGANIC CARBON AND ROCK-EVAL PYROLYSIS DATA

TABLE : 3D

COMPANY: PHILLIPS NORWAY WELL: N2/7-21S LOCATION: NORWEGIAN NORTH SEA

GENERAL DATA			CHEMICAL ANALYSIS DATA								
SAMPLE DEPTH (Feet)	SAMPLE TYPE	ANALYSED LITHOLOGY	TOC % OF ROCK	PYROLYSIS							
				S1 (ppm)	S2 (ppm)	S3 (ppm)	HI	OI	PI	Tmax °C	S2/S3
15020-040	Ctgs	SND+ mnr MDST, med-dk gy+ mnr mic+ mnr MDST, v lt gy, calc									
	Ctgs	After extraction	.95	140	2030	1840	214	194	.06	432	1.10
15040-060	Ctgs	SST+ 10% MDST, med-dk gy+ mnr MDST, v lt gy, calc									
	Ctgs	After extraction	.38								
15060-080	Ctgs	SST+ 10% MDST, v lt gy, calc+ mnr MDST, med-dk gy									
	Ctgs	After extraction	.36								
15090-110	Ctgs	SST+ 10% MDST, lt ol-gy+ mnr MDST, med gy	1.02	3800	2350	620	230	61	.62	433	3.79
	Ctgs	After extraction	1.32								
15110-130	Ctgs	LST, med-dk gy+ 30% LST, lt ol-gy	.49								
15130-150	Ctgs	SST+ 10% MDST, lt ol-gy+ mnr SH, dk gy	.86	6660	2840	550	330	64	.70	425	5.16
15150-170	Ctgs	SST+ 20% MDST, lt ol-gy, slty	.99	10380	4110	720	415	73	.72	431	5.71
15170-190	Ctgs	SST+ 30% MDST, lt ol-gy, slty + mnr SH, dk gy	1.23	12230	4380	760	356	62	.74	433	5.76
	Ctgs	After extraction	.74								
15200-220	Ctgs	SH, dk gy+ mnr SST+ tr pyr	.69	8890	2520	500	365	72	.78	434	5.04
15220-240	Ctgs	SH, dk gy+ mnr MDST, wht+ tr MDST, lt ol-gy, slty	.98	7990	2630	540	268	55	.75	433	4.87
15320-340	Ctgs	SH, dk gy+ 10% SST+ mnr LCM	.71	3860	1480	600	208	85	.72	426	2.47
15350	Ctgs	SH, dk gy+ tr SST	.73	1530	1220	420	167	58	.56	434	2.90
15392.0	Core	SST, lt gy	.35								
15400-420	Ctgs	SH, dk gy+ 20% SST	.84	2880	2050	690	244	82	.58	431	2.97
15420-440	Ctgs	SH, dk gy+ 20% SST	1.07	9920	2830	720	264	67	.78	429	3.93
	Ctgs	After extraction	.62								
15440-460	Ctgs	SST+ 30% SH, dk gy+ 30% LST, med gy	.76	2470	1970	740	259	97	.56	430	2.66
15460-480	Ctgs	SH, dk gy+ tr SST	.63	2140	1080	440	171	70	.66	432	2.45
15480-500	Ctgs	SH, dk gy+ 20% SST+ mnr MDST, lt ol-gy+ tr LST, med gy	.87	6660	1320	550	152	63	.83	427	2.40
15500-520	Ctgs	SH, dk gy+ 10% MDST, lt ol-gy, slty+ 10% SST	1.32	9940	2650	820	201	62	.79	430	3.23
15520-540	Ctgs	SH, dk gy+ tr SST	.75	6900	1930	620	257	83	.78	429	3.11
15540-560	Ctgs	SH, dk gy+ mnr LCM+ tr SST	1.16	13060	2890	730	249	63	.82	427	3.96
	Ctgs	After extraction	.79								

ORGANIC CARBON AND ROCK-EVAL PYROLYSIS DATA

TABLE : 3E

COMPANY: PHILLIPS NORWAY WELL: N2/7-21S LOCATION: NORWEGIAN NORTH SEA

GENERAL DATA			CHEMICAL ANALYSIS DATA								
SAMPLE DEPTH (Feet)	SAMPLE TYPE	ANALYSED LITHOLOGY	TOC % OF ROCK	PYROLYSIS							
				S1 (ppm)	S2 (ppm)	S3 (ppm)	HI	OI	PI	Tmax °C	S2/S3
15560-580	Ctgs	SH, dk gy+ tr SST+ tr MDST, wht, calc	1.01	8930	2670	630	264	62	.77	432	4.24
15580-600	Ctgs	SH, dk gy+ mnr SST+ tr IGN	.85	4600	1620	690	191	81	.74	433	2.35
15600-620	Ctgs	SH, dk gy+ mnr SST+ tr MDST, wht	.77	5160	1290	530	168	69	.80	430	2.43
15620-640	Ctgs	SH, dk gy+ 10% SST+ tr MDST, wht	.84	3840	1070	500	127	60	.78	429	2.14
15640-660	Ctgs	SH, dk gy+ mnr SST	.99	8870	1480	460	149	46	.86	430	3.22
15660-680	Ctgs	SH, dk gy+ tr DOL, med-dk gy	.84	10190	1720	600	205	71	.86	430	2.87
15680-700	Ctgs	SH, dk gy	1.13	11200	1880	580	166	51	.86	438	3.24
15700-720	Ctgs	SH, dk gy	1.05	11390	2460	690	234	66	.82	434	3.57
15720-740	Ctgs	SH, med gy	1.08	11580	1980	770	183	71	.85	430	2.57
15740-760	Ctgs	SH, med-dk gy	1.11	14700	2680	640	241	58	.85	428	4.19
15760-780	Ctgs	SH, dk gy+ tr SST+ tr DOL, dk gn-gy	1.00	9630	2630	660	263	66	.79	432	3.98
	Ctgs	After extraction	.63								
15780-800	Ctgs	SH, dk gy, slty+ 10% IGN+ tr MDST, pal red-brn	.75	11170	2220	520	296	69	.83	430	4.27
15800-820	Ctgs	SH, dk gy+ 30% IGN+ mnr MDST, pal yel-brn, slty	.79	4860	1600	600	203	76	.75	402	2.67
15820-840	Ctgs	SH, med-dk gy+ 30% IGN	1.34	16200	2970	1290	222	96	.85	428	2.30
15840-860	Ctgs	SH, med-dk gy+ 30% IGN+ 30% MDST, pal red	1.24	9440	3800	1070	306	86	.71	429	3.55
	Ctgs	After extraction	.86								
15860-880	Ctgs	SH, dk gy+ 50% IGN	.93	5180	1810	500	195	54	.74	428	3.62
15880-900	Ctgs	SH, dk gy+ tr IGN+ tr MDST, wht	.85	5800	1340	500	158	59	.81	432	2.68
15900-920	Ctgs	SH, dk gy+ tr IGN+ tr MDST, wht	.93	8090	1450	540	156	58	.85	432	2.69
15920-940	Ctgs	SH, dk gy+ tr IGN+ tr MDST, wht	.76	5650	1180	530	155	70	.83	435	2.23
15940-950	Ctgs	SH, dk gy+ tr IGN+ tr MDST, wht	.96	6150	1080	620	113	65	.85	431	1.74
15950-970	Ctgs	SH, med-dk gy+ 40% IGN	1.24	6140	2340	770	189	62	.72	423	3.04
	Ctgs	After extraction	.86								
15970-990	Ctgs	SH, med-dk gy+ tr IGN	.90	2440	1440	700	160	78	.63	427	2.06
15990-16010	Ctgs	SH, med-dk gy+ tr IGN	.87	2310	1150	610	132	70	.67	435	1.89
16010-030	Ctgs	SH, dk gy+ mnr IGN	.85	3520	1300	510	153	60	.73	432	2.55
16030-050	Ctgs	SH, dk gy+ 20% IGN	1.02	7740	1690	680	166	67	.82	433	2.49

ORGANIC CARBON AND ROCK-EVAL PYROLYSIS DATA

TABLE : 3F

COMPANY: PHILLIPS NORWAY WELL: N2/7-21S LOCATION: NORWEGIAN NORTH SEA

GENERAL DATA			CHEMICAL ANALYSIS DATA								
SAMPLE DEPTH (Feet)	SAMPLE TYPE	ANALYSED LITHOLOGY	TOC % OF ROCK	PYROLYSIS							
				S1 (ppm)	S2 (ppm)	S3 (ppm)	HI	OI	PI	Tmax °C	S2/S3
16050-070	Ctgs	SH, med-dk gy+ 10% IGN	1.22	6760	1800	1720	148	141	.79	*	1.05
16070-090	Ctgs	SH, ol-gy+ 30% IGN	1.61	7470	1970	1030	122	64	.79	427	1.91
16090-110	Ctgs	SH, dk gy+ 20% IGN	.99	5500	2080	620	210	63	.73	431	3.35
16110-130	Ctgs	SH, dk gy, slty+ tr IGN	1.21	7210	1860	600	154	50	.79	435	3.10
16130-150	Ctgs	SH, dk gy, slty+ tr MDST, wht	1.20	7660	2270	520	189	43	.77	429	4.37
	Ctgs	After extraction	.82								
16150-170	Ctgs	SH, dk gy+ mnr IGN+ tr MDST, wht	1.10	3990	1260	560	115	51	.76	429	2.25
16170-190	Ctgs	SH, gy-blk+ 40% IGN	.99	3750	1720	580	174	59	.69	433	2.97
16190-210	Ctgs	IGN+ 30% SH, gy-blk	.80	3830	2180	650	273	81	.64	432	3.35
	Ctgs	After extraction	.59								
16250-270	Ctgs	SH, dk gy+ 30% IGN	1.09	7290	2400	680	220	62	.75	428	3.53
16270-290	Ctgs	SH, dk gy+ 10% IGN+ mnr MDST, lt ol-gy	.93	4410	1760	750	189	81	.71	430	2.35
16290-310	Ctgs	IGN+ 30% SH, dk gy+ mnr MDST, lt ol-gy	1.08	7020	3070	760	284	70	.70	433	4.04
	Ctgs	After extraction	.74								
16310-330	Ctgs	SH, dk gy+ 40% IGN+ mnr MDST, lt ol-gy	1.01	7140	2000	780	198	77	.78	431	2.56
16330-350	Ctgs	IGN+ 10% MDST, lt ol-gy, slty + mnr MDST, dk gy	1.38	6220	3830	1160	278	84	.62	433	3.30
16350-370	Ctgs	MDST, wht+ 10% SH, dk gy+ 10% MDST, lt ol-gy	1.80	13880	5590	1000	311	56	.71	434	5.59
	Ctgs	After extraction	1.05								
16370-390	Ctgs	MDST, wht+ 20% MDST, dk gy+ 10% MDST, lt ol-gy	1.63	16330	5250	840	322	52	.76	433	6.25
16390-410	Ctgs	MDST, wht+ 20% MDST, dk gy+ mnr MDST, lt ol-gy+ tr SND	1.59	9360	4330	950	272	60	.68	428	4.56
16410-430	Ctgs	MDST, wht+ mnr MDST, dk gy+ tr SST	1.59	18320	5840	950	367	60	.76	434	6.15
16430-450	Ctgs	MDST, wht+ 10% MDST, dk gy+ tr SST	2.06	12320	7740	1330	376	65	.61	429	5.82
	Ctgs	After extraction	1.25								
16450-470	Ctgs	SH, dk gy+ 20% MDST, ol-gy, slty+ mnr SST+ tr BIT	3.21	15600	7300	2350	227	73	.68	428	3.11

ORGANIC CARBON AND ROCK-EVAL PYROLYSIS DATA

TABLE : 3G

COMPANY: PHILLIPS NORWAY WELL: N2/7-21S LOCATION: NORWEGIAN NORTH SEA

SAMPLE DATA						
SAMPLE DEPTH (Feet)	14177.2	14633.0	14980.0	15374.3	16215.7	
SAMPLE TYPE	Core	Core	Core	Core	Core	

COMPONENTS	QUANTIFIED NORMAL AND ISOPRENOID ALKANE ABUNDANCES (%)					
n-C10						
n-C11						
n-C12						
n-C13						
n-C14	9.17	1.75	.73	.32	.15	
n-C15	16.88	7.56	2.52	1.27	.77	
n-C16	18.33	15.09	5.62	3.09	3.52	
n-C17	15.87	17.10	9.15	4.94	7.28	
n-C18	8.46	11.03	10.56	6.26	8.28	
n-C19	4.44	6.95	11.18	7.40	10.16	
n-C20	2.71	4.45	10.48	8.60	9.40	
n-C21	2.27	3.77	7.57	8.15	8.37	
n-C22	1.70	2.97	6.04	7.67	7.42	
n-C23	1.67	2.78	4.52	7.36	6.87	
n-C24	1.26	2.16	3.59	5.69	5.20	
n-C25	1.28	1.92	3.46	5.26	4.88	
n-C26	.94	1.77	3.26	4.54	3.97	
n-C27	.76	1.22	2.69	3.85	3.04	
n-C28	.67	1.14	2.15	4.22	2.37	
n-C29	.56	1.04	1.50	2.90	2.04	
n-C30	.46	.85	1.01	2.55	1.57	
n-C31	.37	.82	.69	2.18	1.74	
n-C32	.35	.63	.49	1.49	.99	
n-C33	.20		.44	1.66	1.34	
n-C34	.27	.55	.35	1.83	.66	
n-C35	.12	.32		.37	.61	
n-C36						
i-C15 (Farnesane)						
i-C16						
i-C18 (Norpristane)						
i-C19 (Pristane)	7.48	9.21	6.11	3.89	4.79	
i-C20 (Phytane)	3.77	4.91	5.92	4.53	4.58	

GENERAL DATA						
Total Abundance(%)	100	100	100	100	100	
TOC (% of Rock)						
Extract (ppm)	6425	1735	4575	1270	275	
Hydrocarbons (ppm)	5860	1555	3880	1080	180	
Hydrocarbon(mg/gTOC)						
Alks(% Hydrocarbons)	83	84	76	84	72	
Rock-Eval HI						
Rock-Eval PI						

RATIOS						
CPI-1	1.02	.89	1.02	.97	1.14	
CPI-2	1.05	.99	1.02	.97	1.10	
CPI-3	.94	.84	.99	.88	.96	
Bias	6.31	4.28	2.55	1.11	1.60	
i-C19 / n-C17	.47	.54	.67	.79	.66	
i-C20 / n-C18	.45	.45	.56	.72	.55	
i-C19 / i-C20	1.98	1.87	1.03	.86	1.05	

LEGEND
i - isoprenoid n - normal

ALKANE GAS CHROMATOGRAPHY DATA

TABLE : 4

Figure : 3.1
Depth : 13880'-13900'
TOC : 1.96
HI : 532

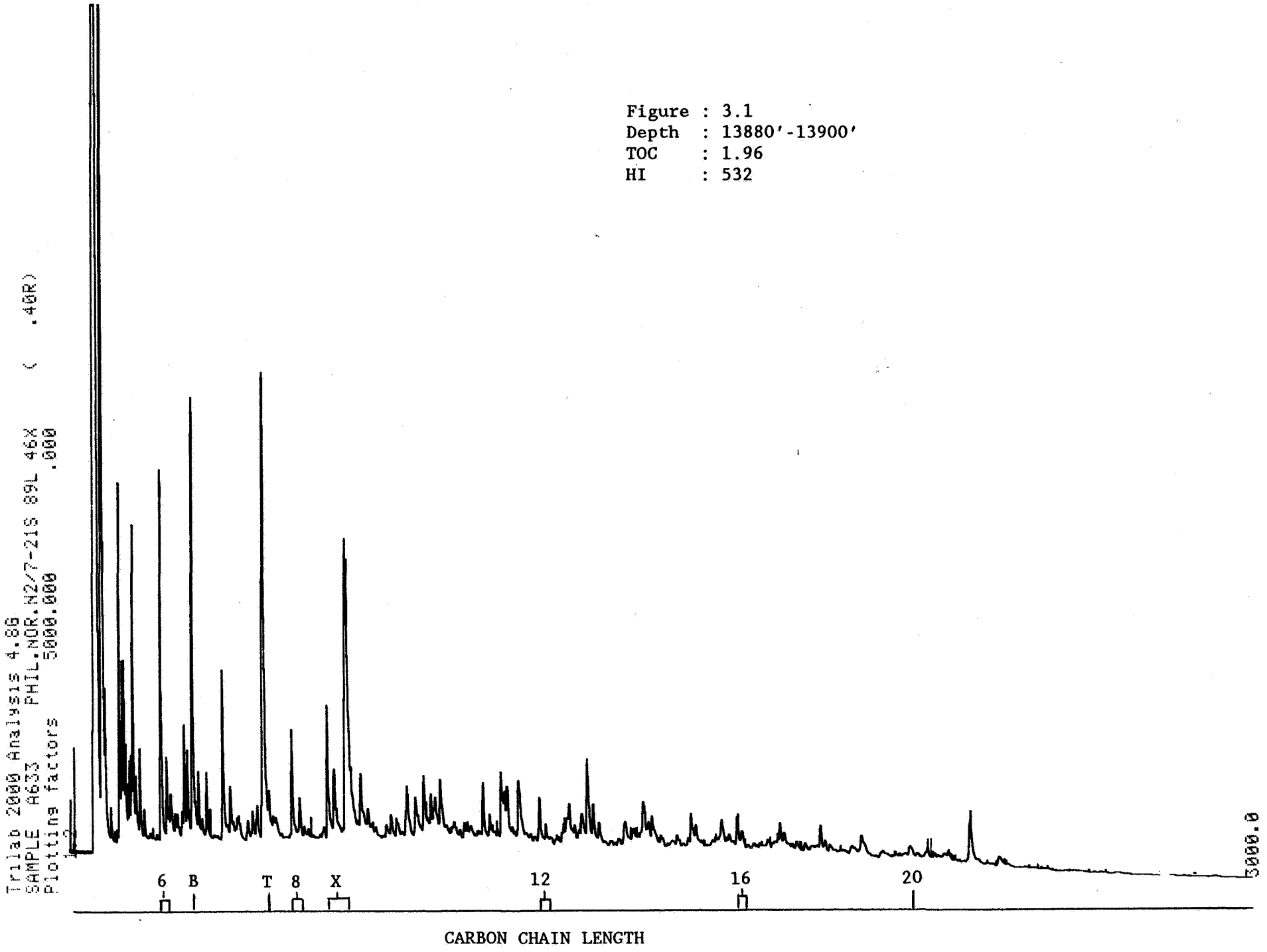
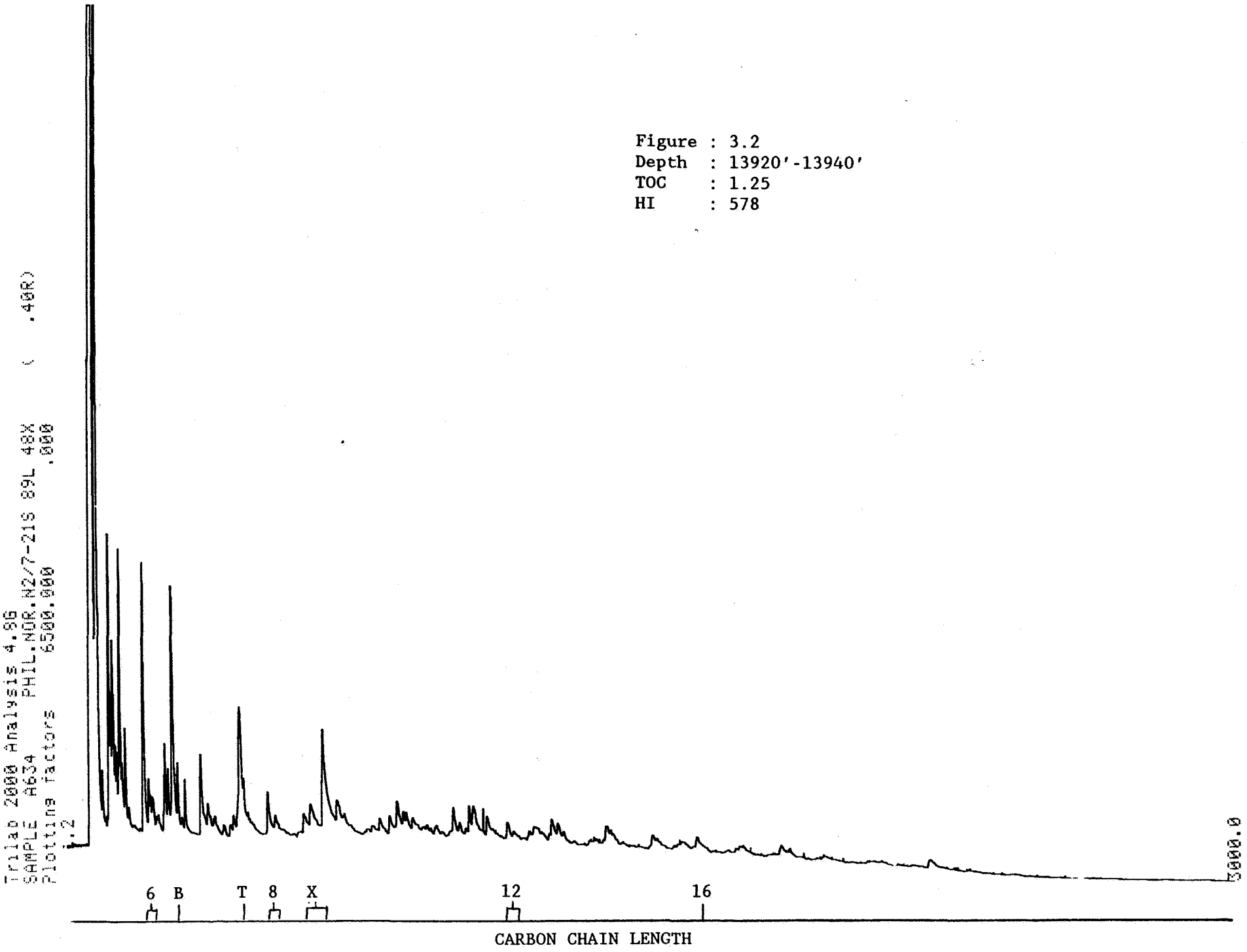


Figure : 3.2
Depth : 13920'-13940'
TOC : 1.25
HI : 578



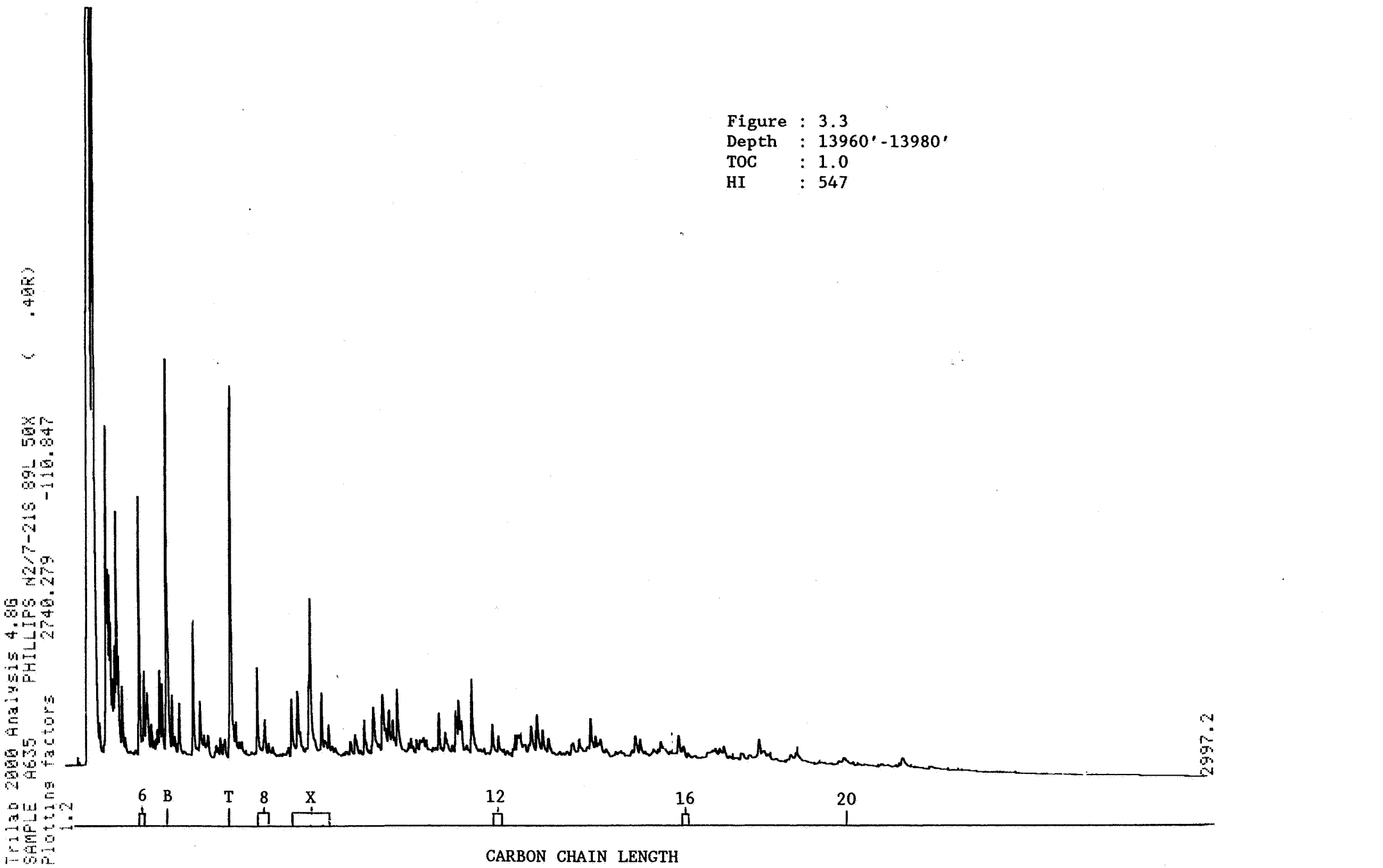


Figure : 3.3
Depth : 13960'-13980'
TOC : 1.0
HI : 547
Trilab 2000 Analysis 4.8G
SAMPLE A635 PHILLIPS N2/7-21S 89L 50X (.40R)
Plotting factors 2740.279 -110.847
2997.2
1.2
6 B T 8 X 12 16 20
CARBON CHAIN LENGTH

Figure : 3.4
Depth : 14000'-14020'
TOC : 1.13
HI : 529

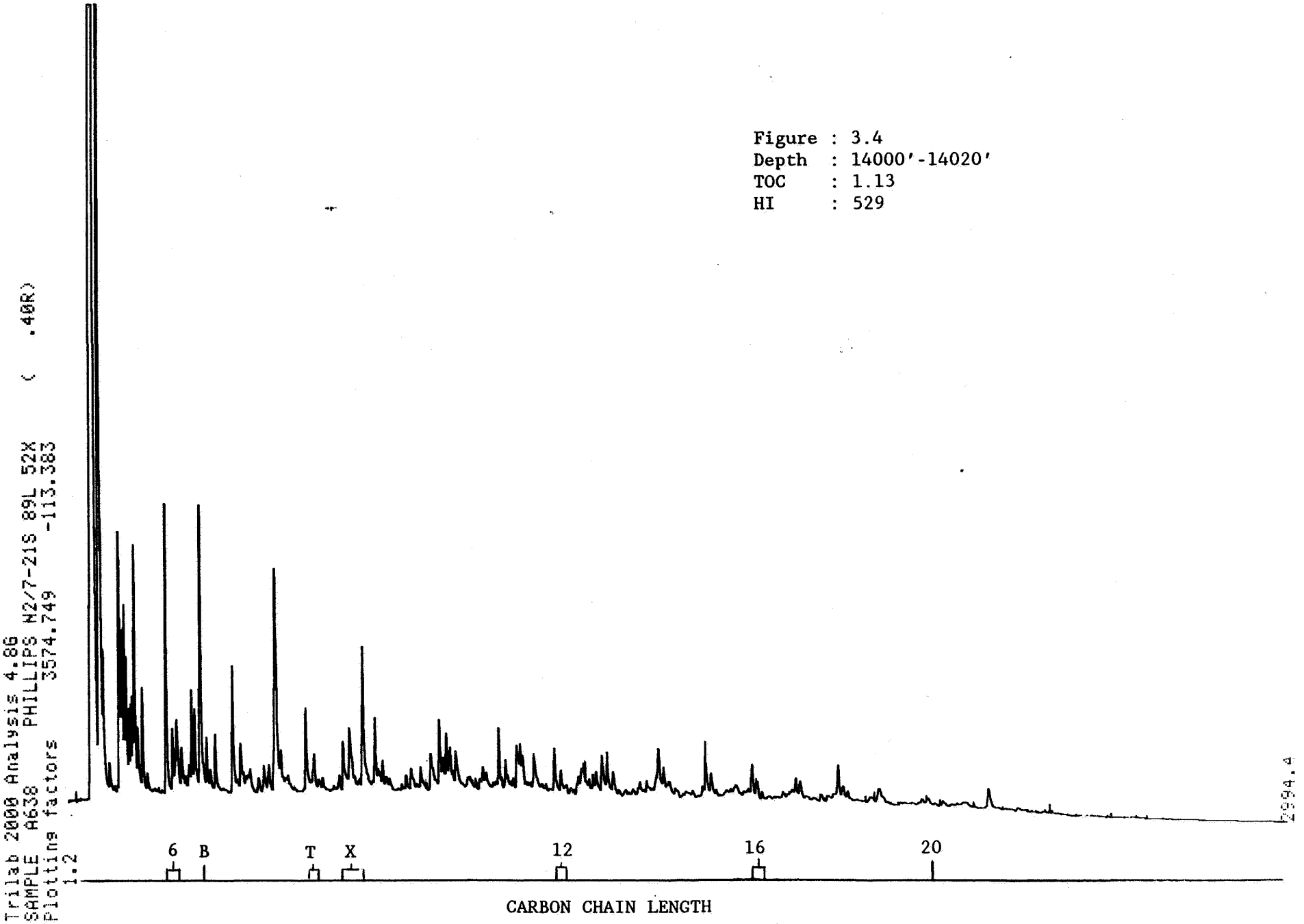


Figure : 3.5
Depth : 14120'-14140'
TOC : 1.31
HI : 301

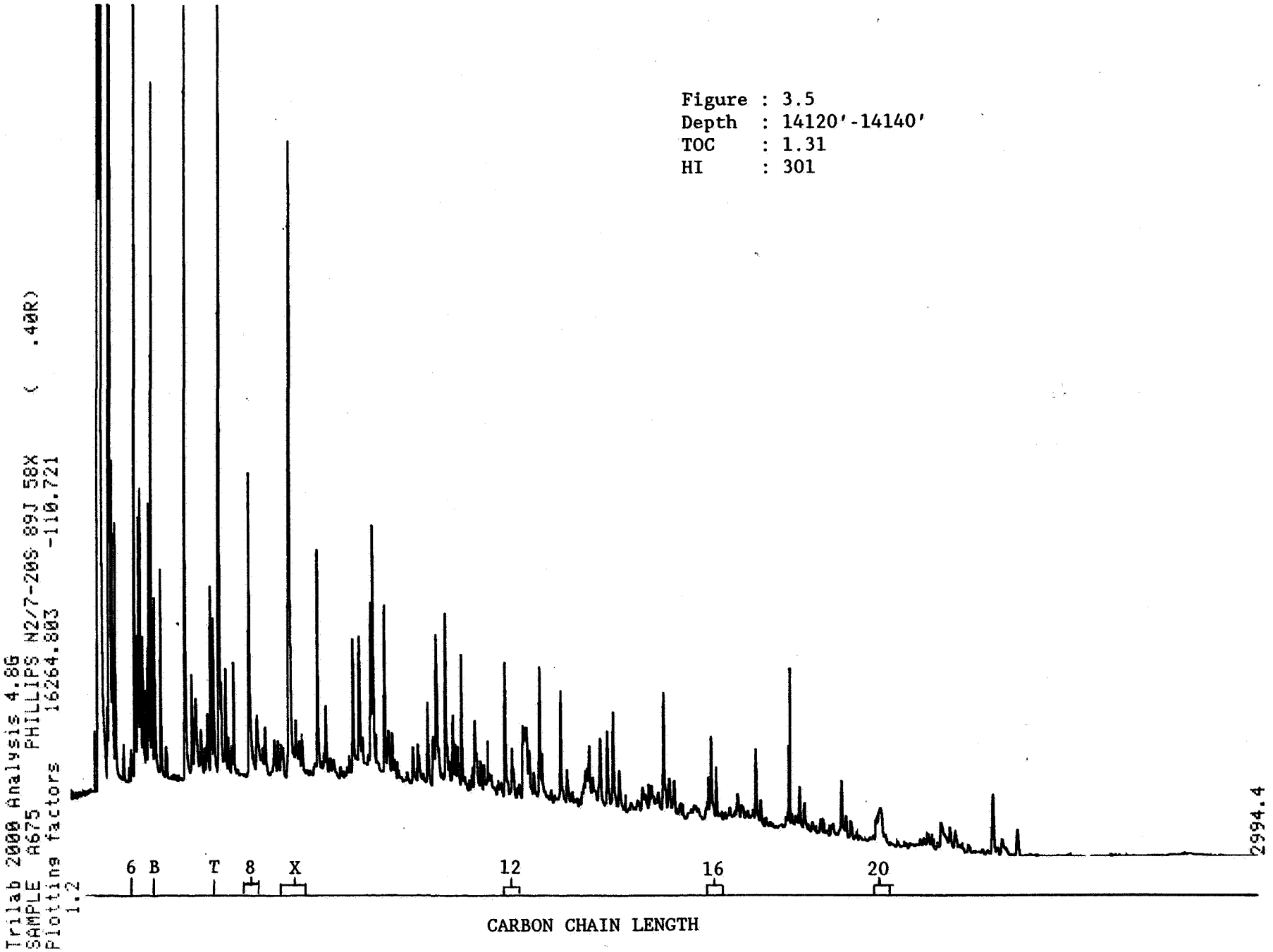


Figure : 3.6
Depth : 14280'-14300'
TOC : 1.26
HI : 485

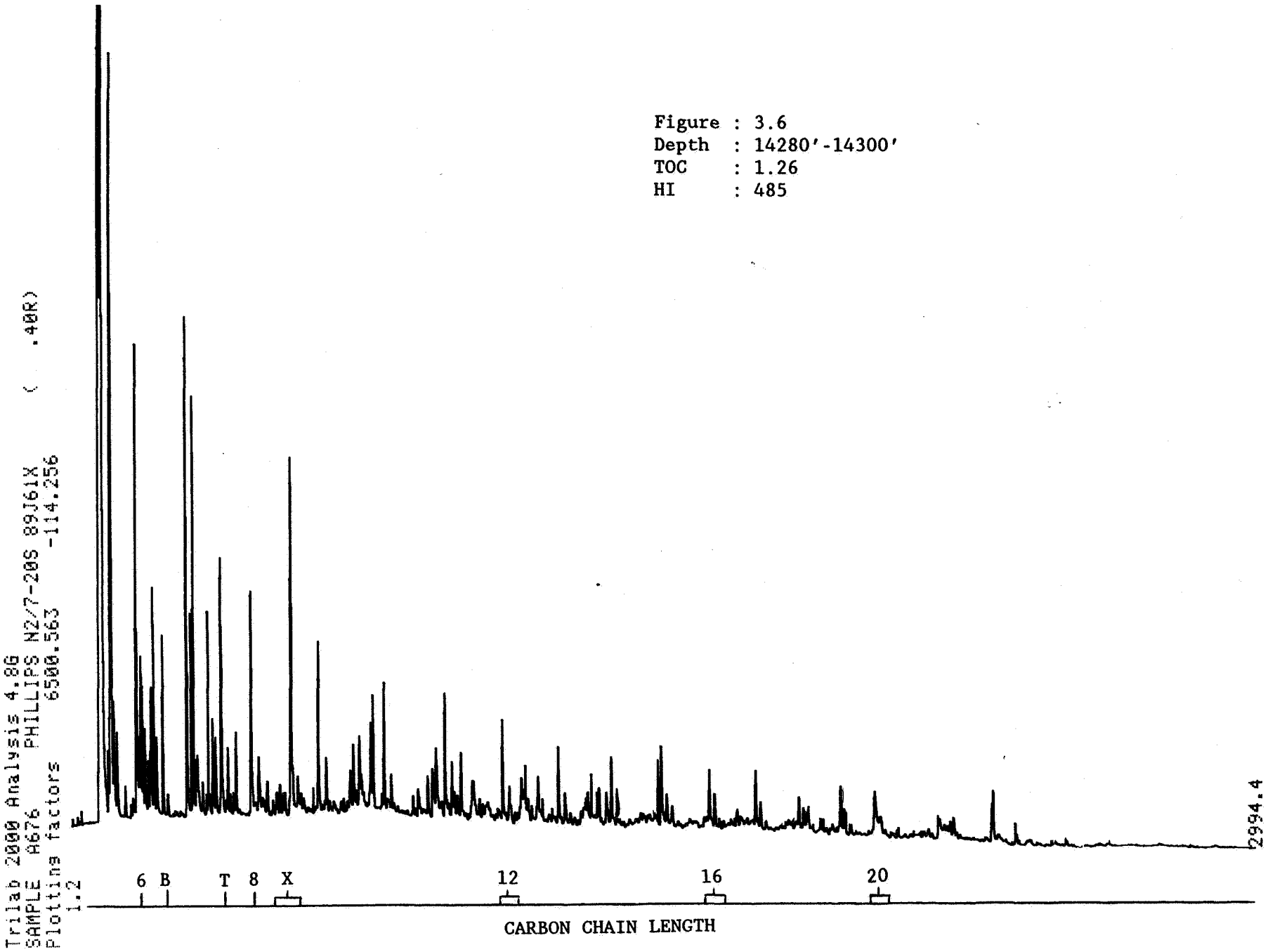
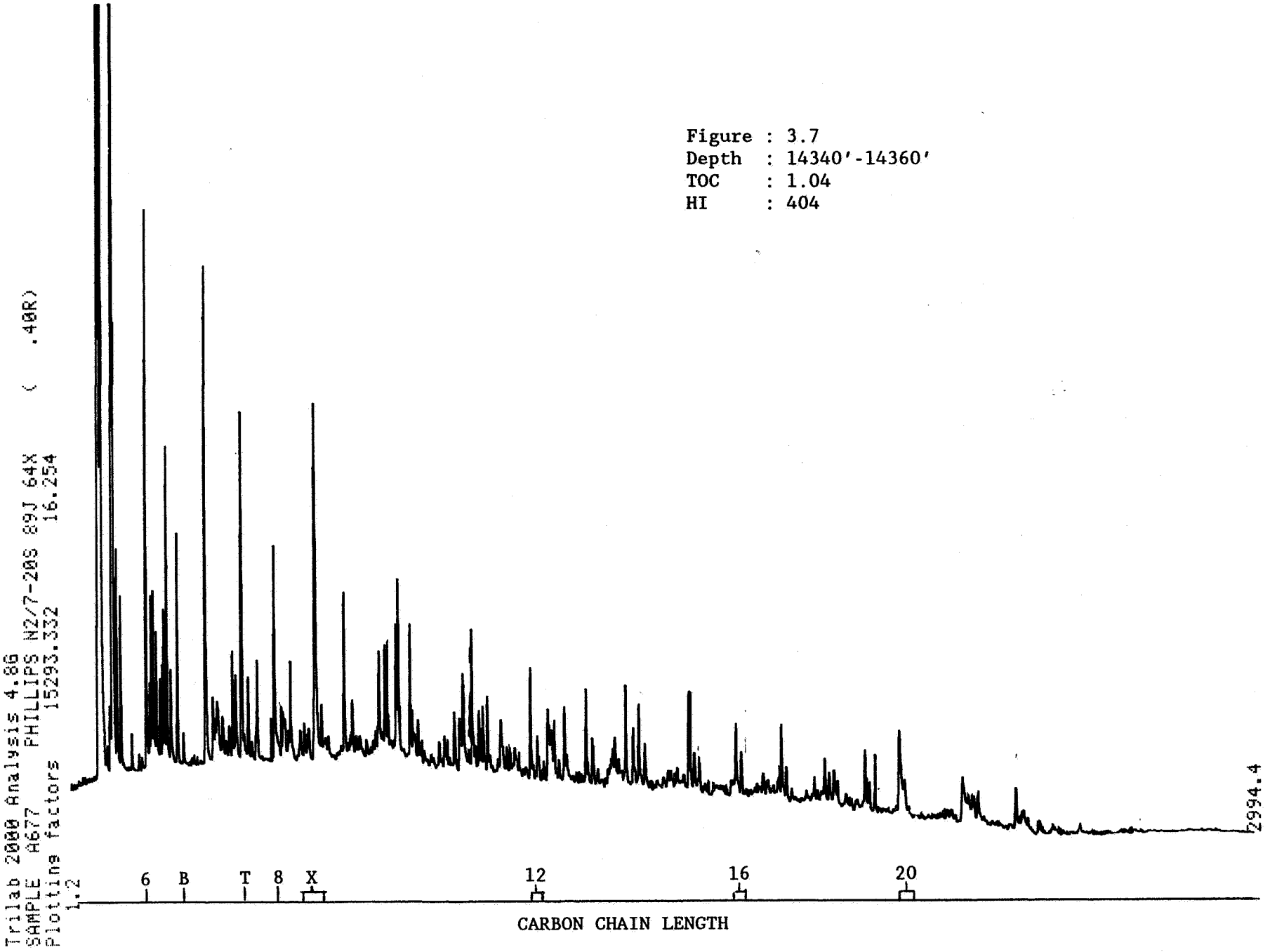


Figure : 3.7
Depth : 14340'-14360'
TOC : 1.04
HI : 404



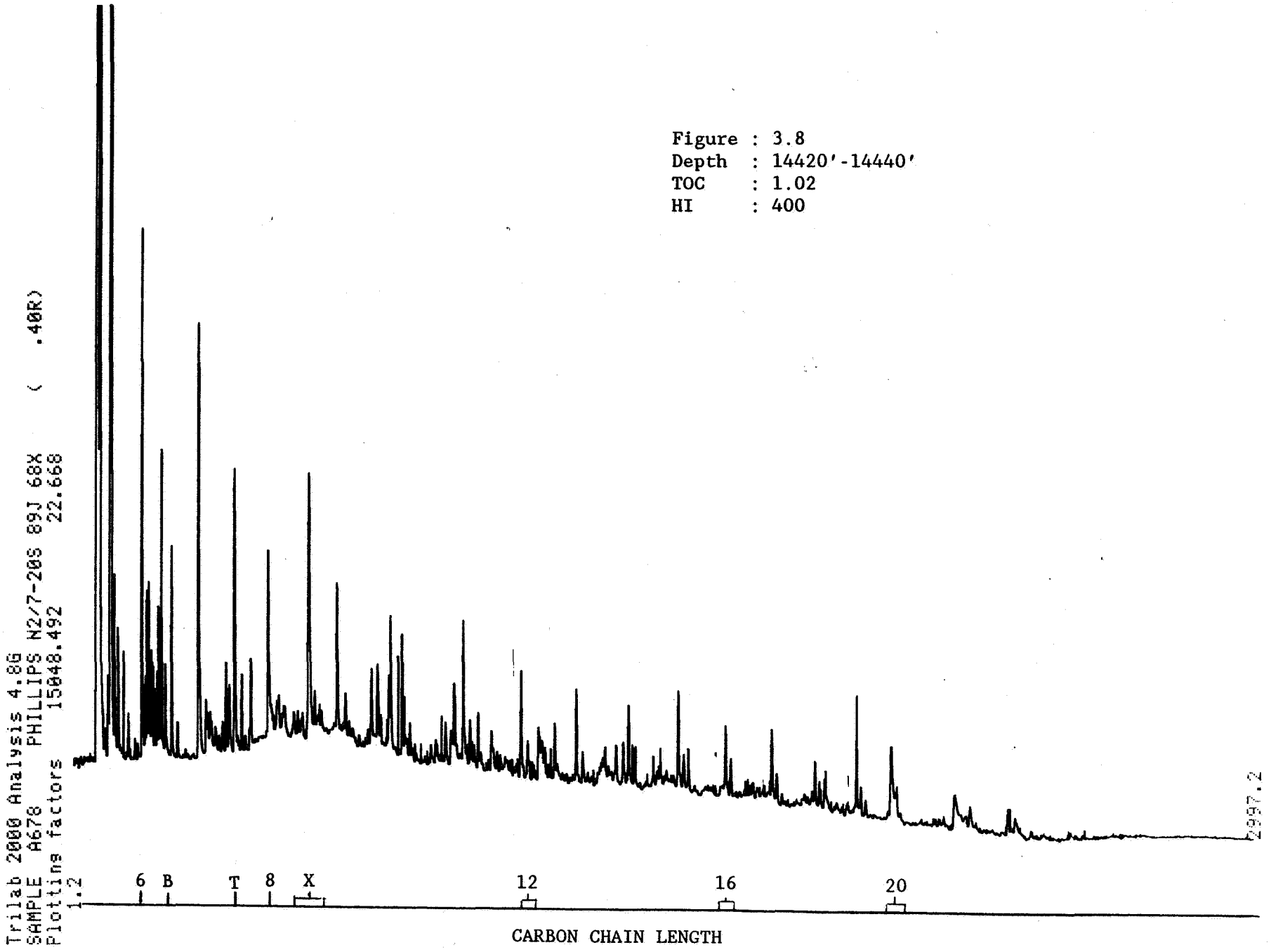


Figure : 3.8
Depth : 14420'-14440'
TOC : 1.02
HI : 400
Trilab 2000 Analysis 4.86
SAMPLE A678 PHILLIPS N2/7-20S 89J 68X
Plotting factors 15048.492 22.668 (.40R)
1.2
6
B
T
8
X
12
16
20
CARBON CHAIN LENGTH
2997.2

Figure : 3.9
Depth : 14500'-14520'
TOC : 0.77
HI : 395

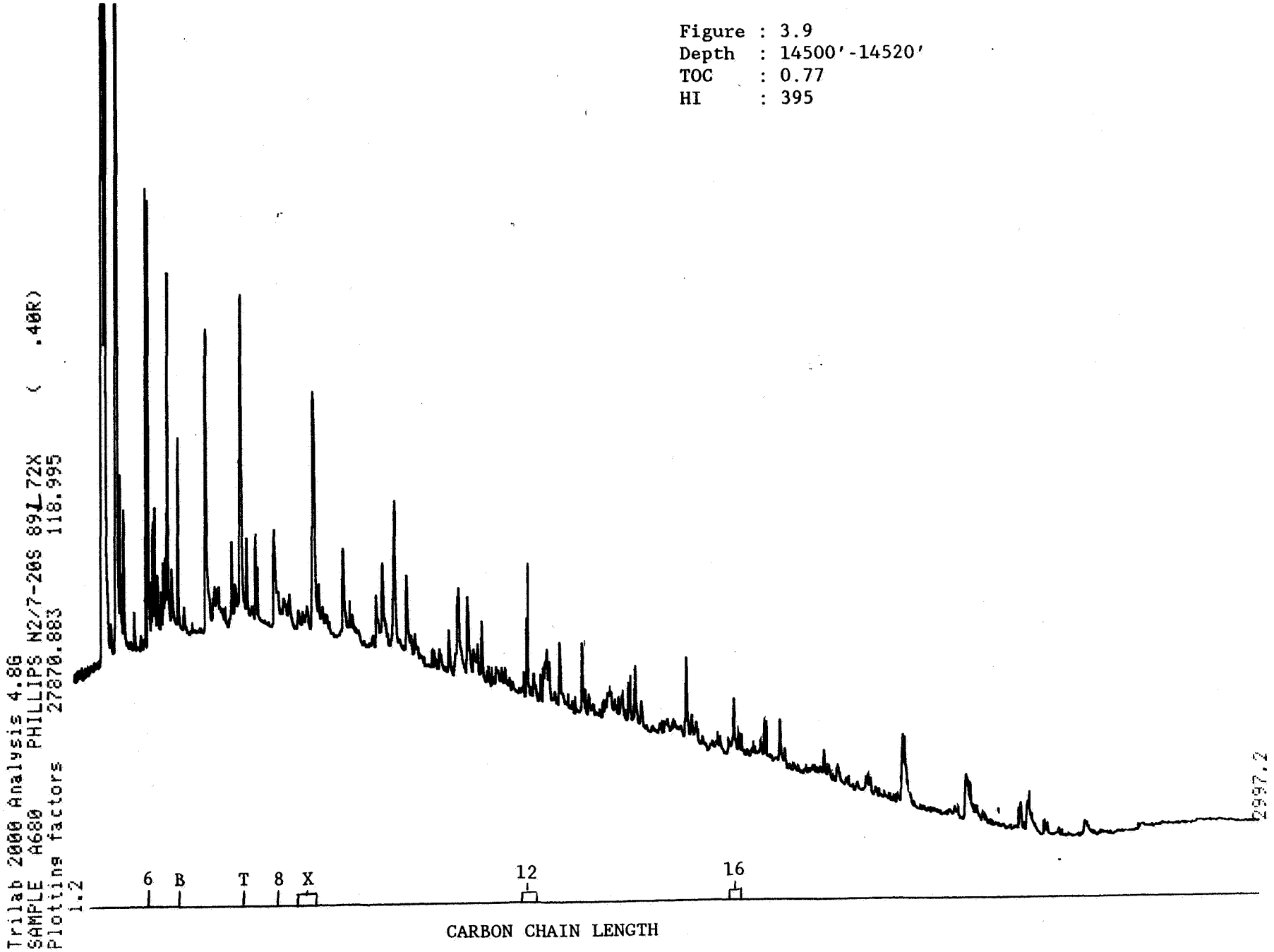


Figure : 3.10
Depth : 14980'-15000'
TOC : 1.20
HI : 415

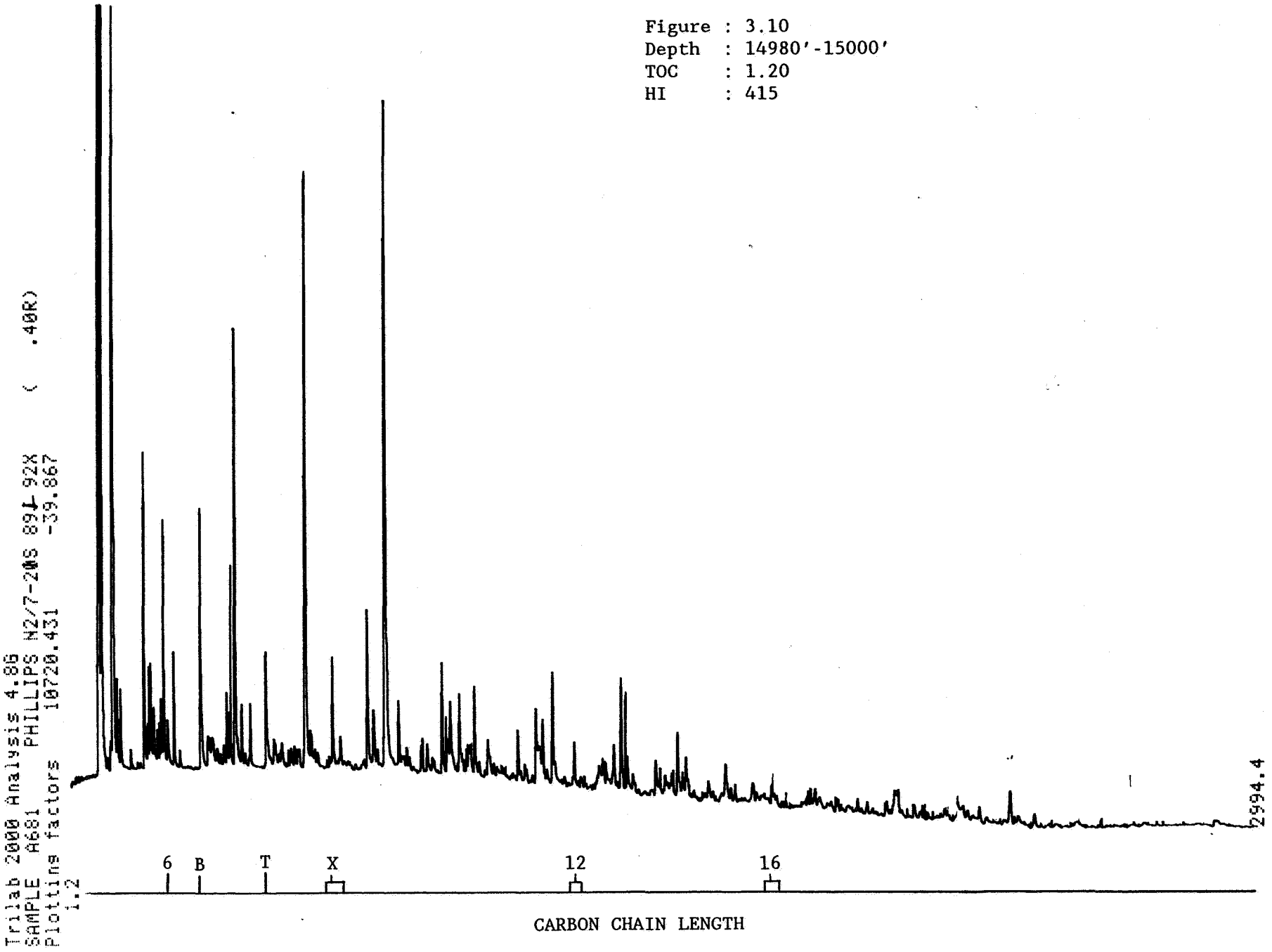
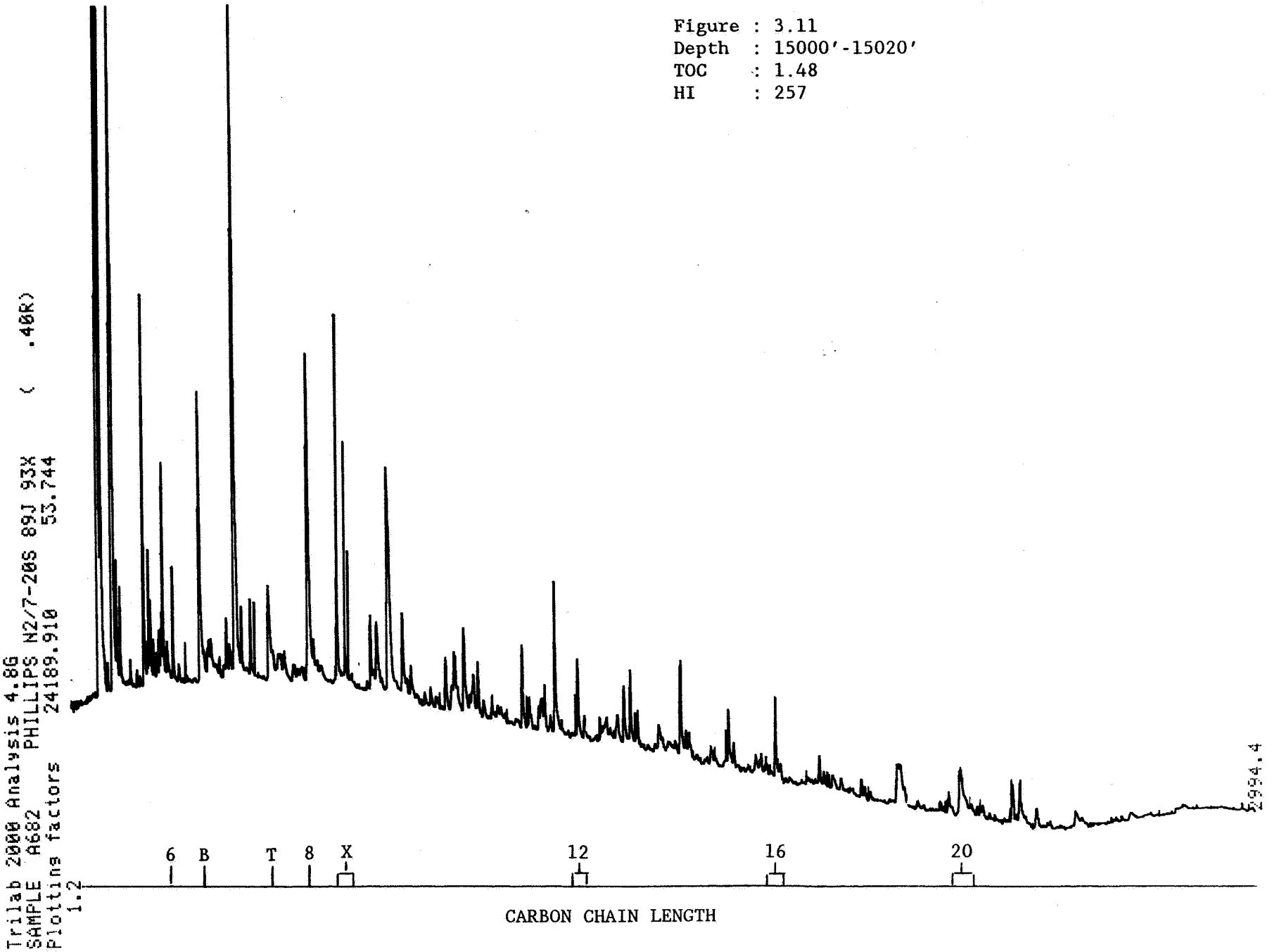


Figure : 3.11
Depth : 15000'-15020'
TOC : 1.48
HI : 257



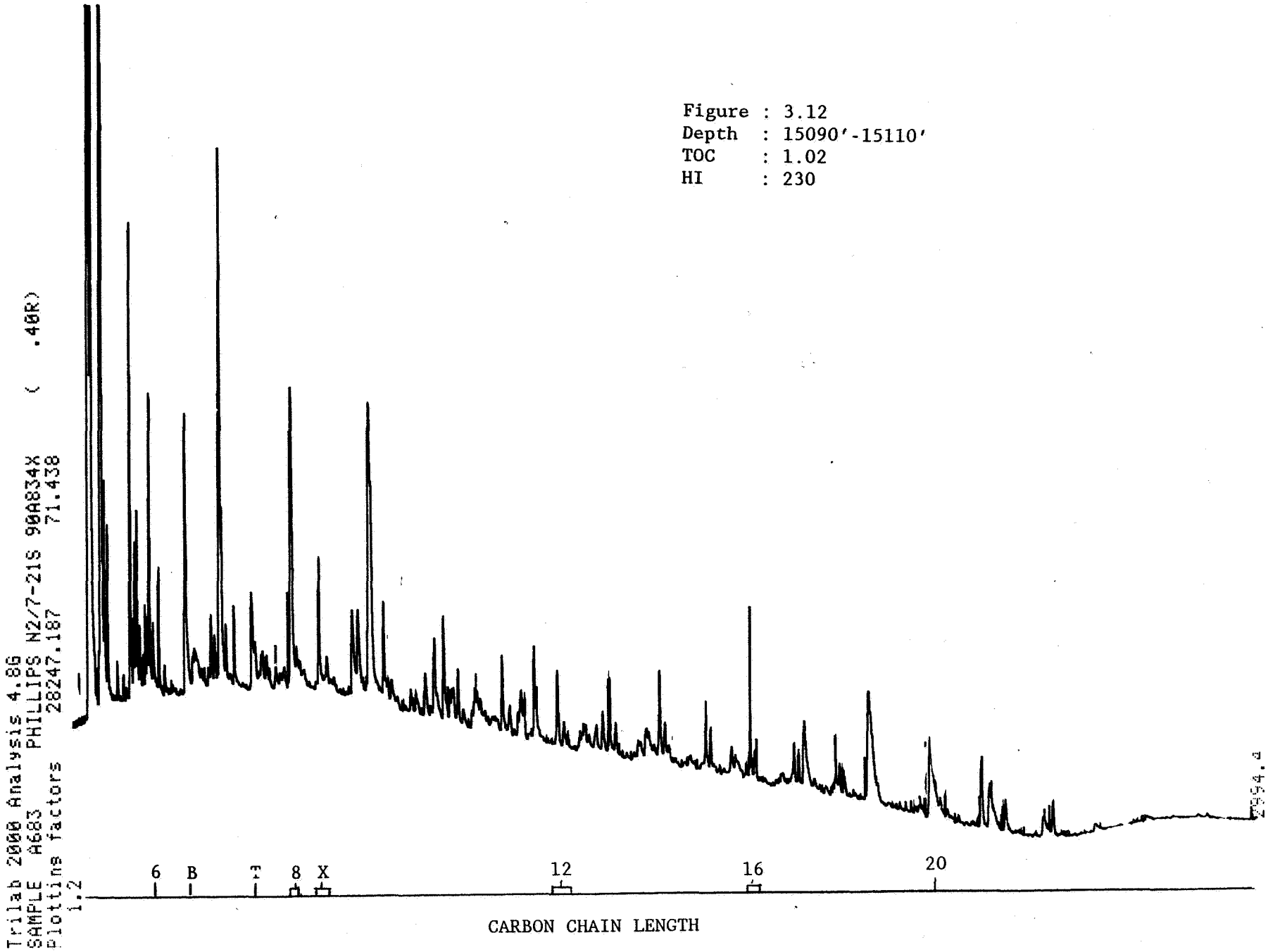
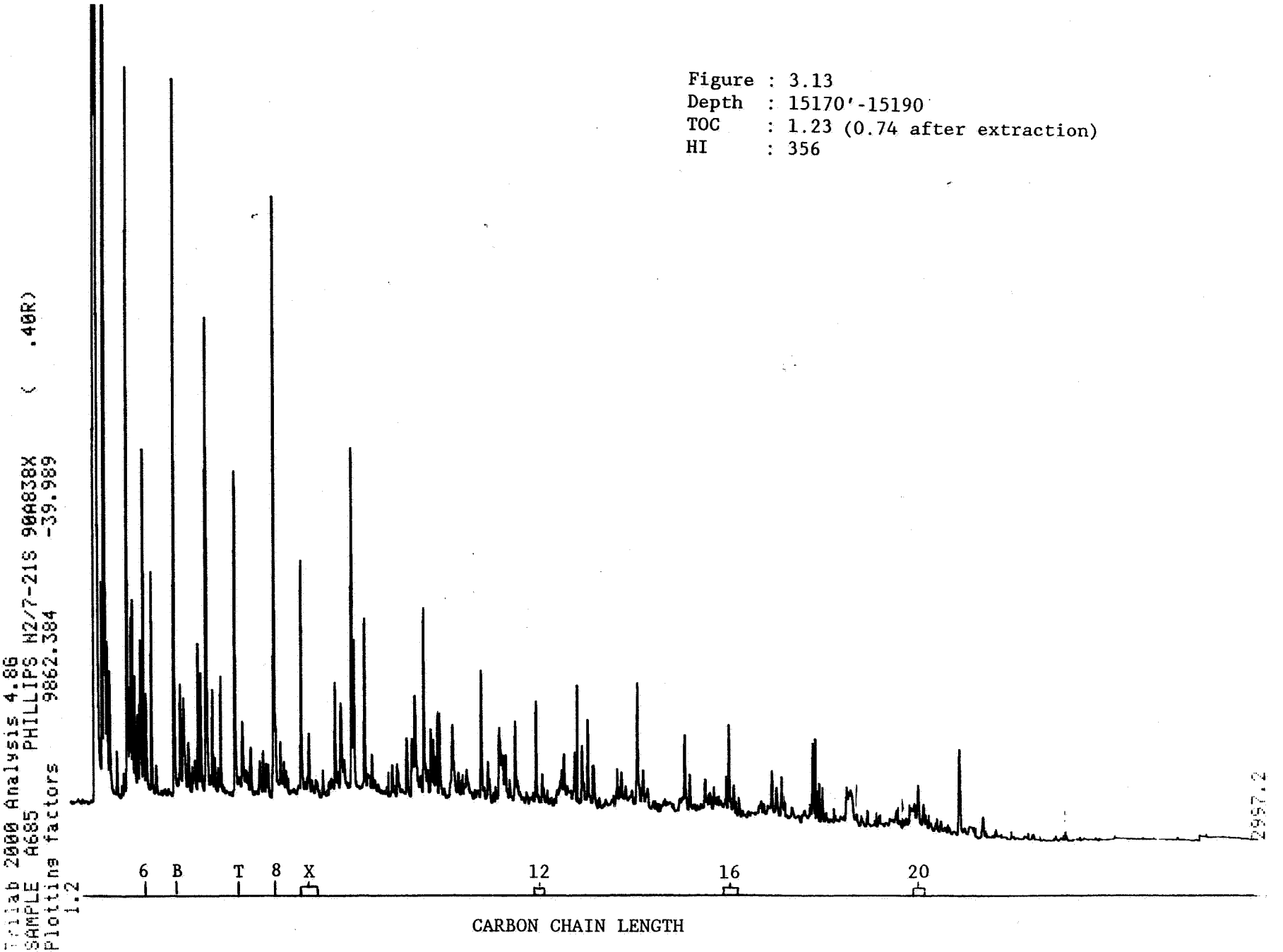


Figure : 3.12
Depth : 15090'-15110'
TOC : 1.02
HI : 230
Trilab 2000 Analysis 4.8G
SAMPLE A683 PHILLIPS N2/7-21S 90A834X (.40R)
Plotting factors 28247.187 71.438
1.2
6
B
8
X
12
16
20
CARBON CHAIN LENGTH

Figure : 3.13
Depth : 15170'-15190
TOC : 1.23 (0.74 after extraction)
HI : 356



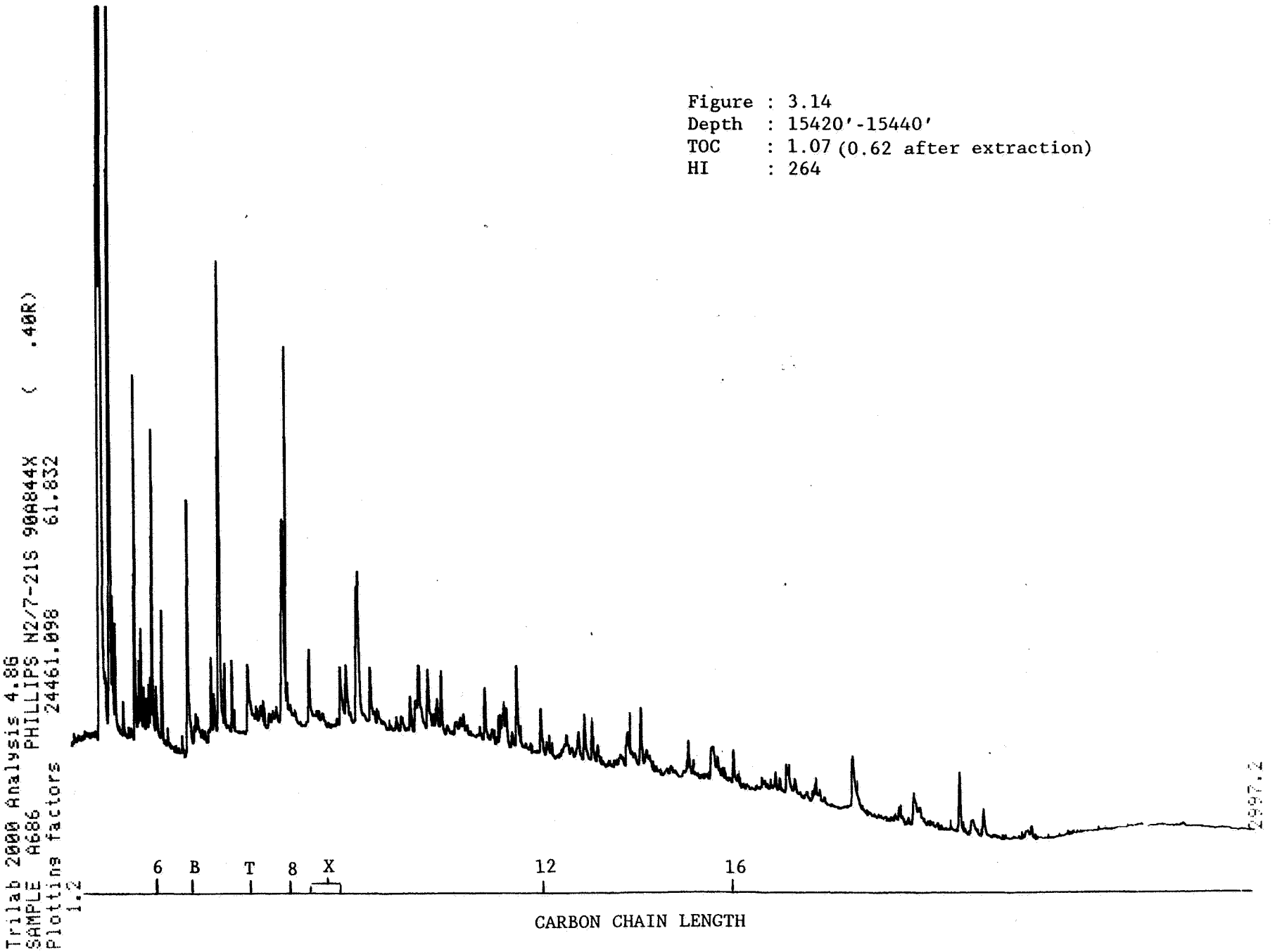


Figure : 3.14
Depth : 15420'-15440'
TOC : 1.07 (0.62 after extraction)
HI : 264

Figure : 3.15
Depth : 15540'-15560'
TOC : 1.16 (0.79 after extraction)
HI : 249

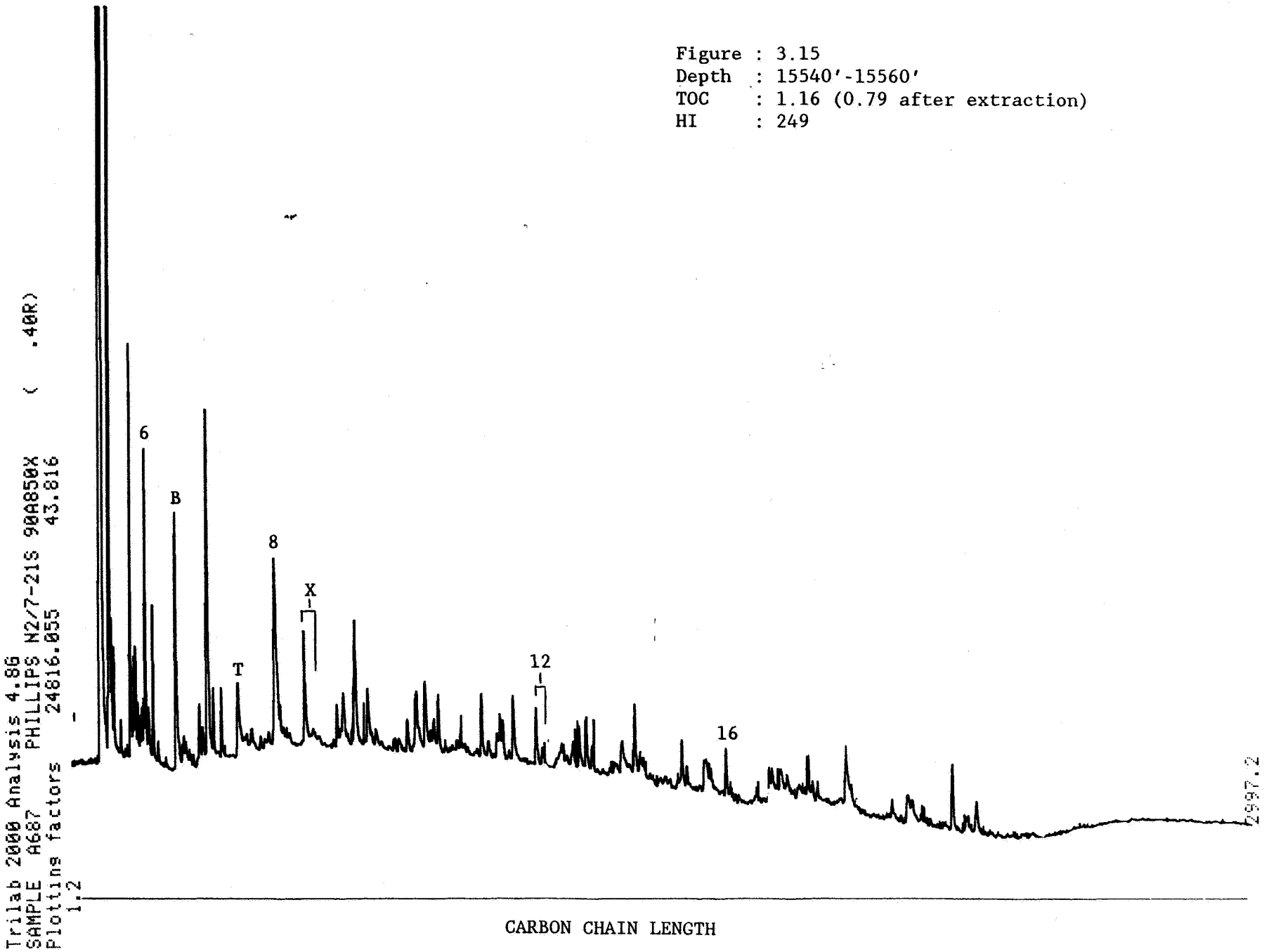


Figure : 3.16
Depth : 15760'-15780'
TOC : 1.00 (0.63 after extraction)
HI : 263

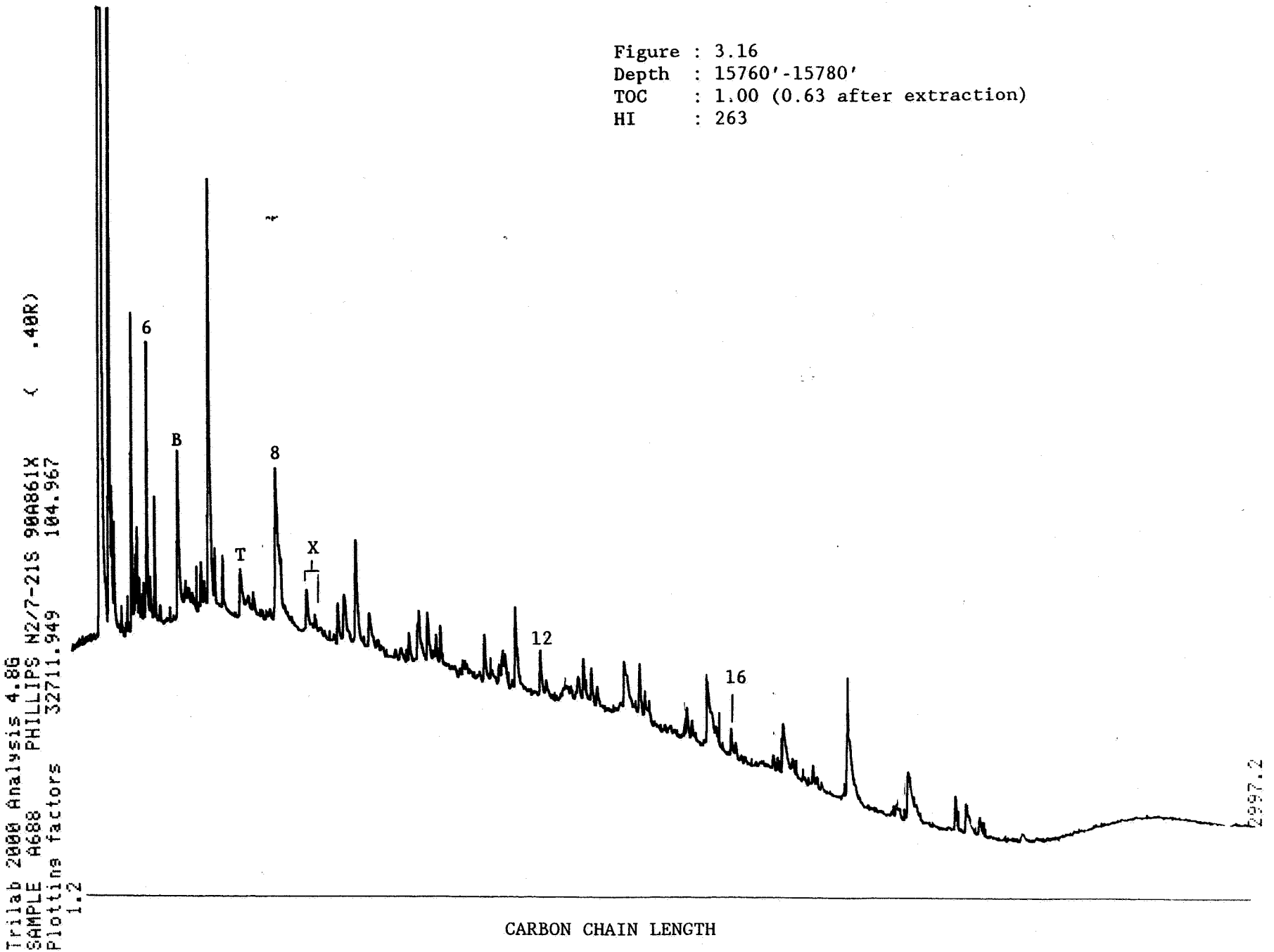


Figure : 3.17
Depth : 15840'-15860'
TOC : 1.24 (0.86 after extraction)
HI : 306

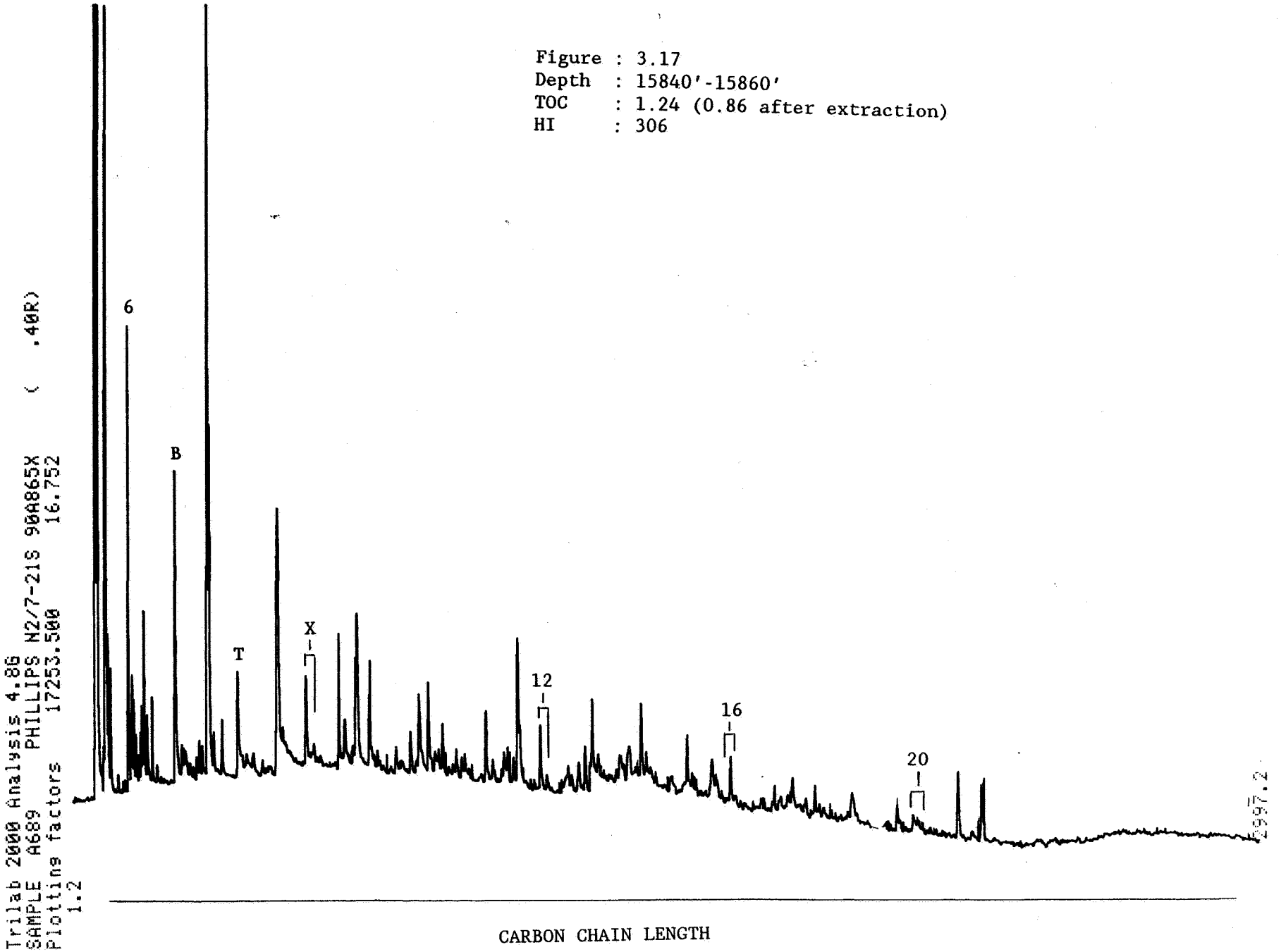


Figure : 3.18
Depth : 15950'-15970'
TOC : 1.24 (0.86 after extraction)
HI : 189

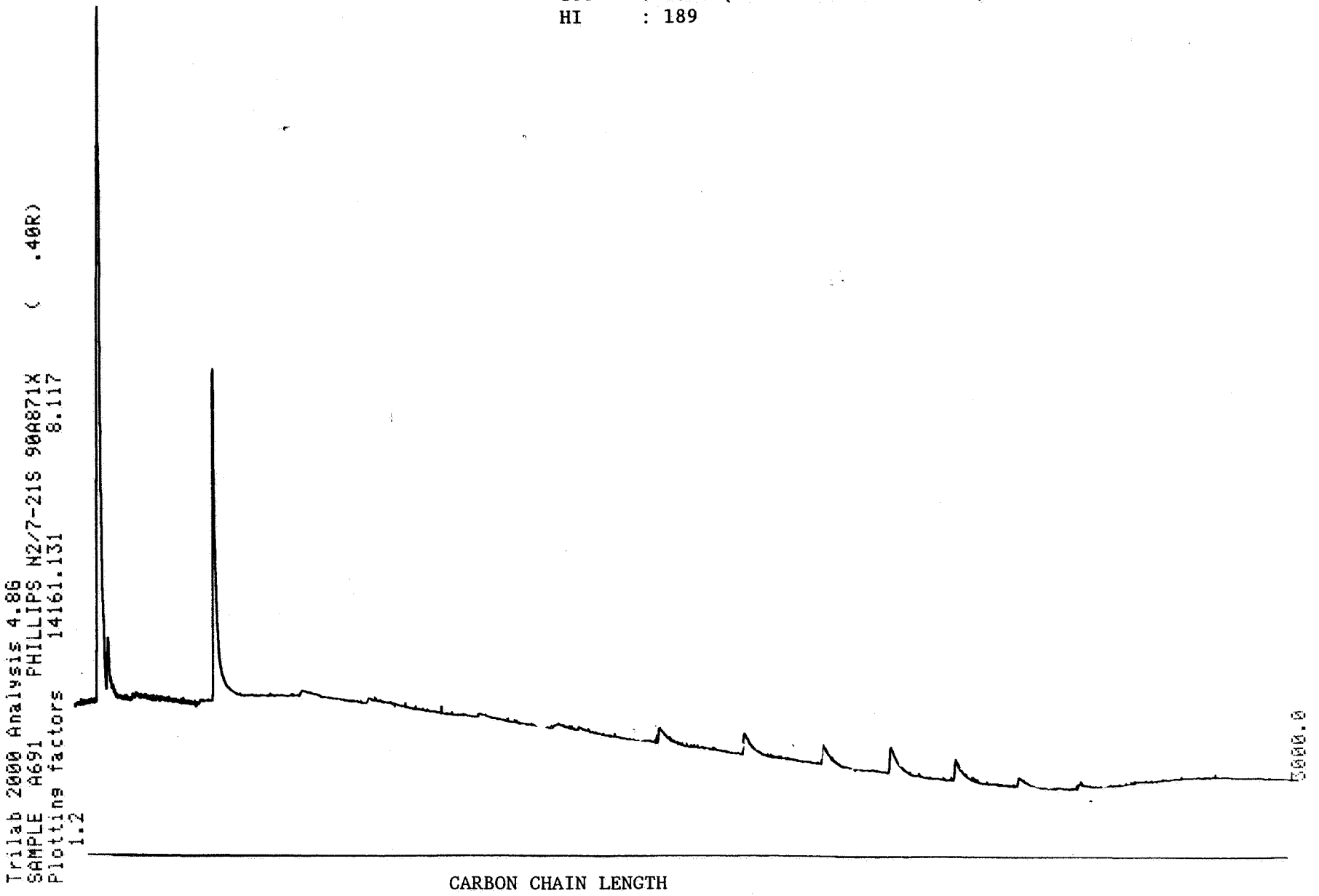


Figure : 3.19
Depth : 16130'-16150'
TOC : 1.20 (0.82 after extraction)
HI : 189

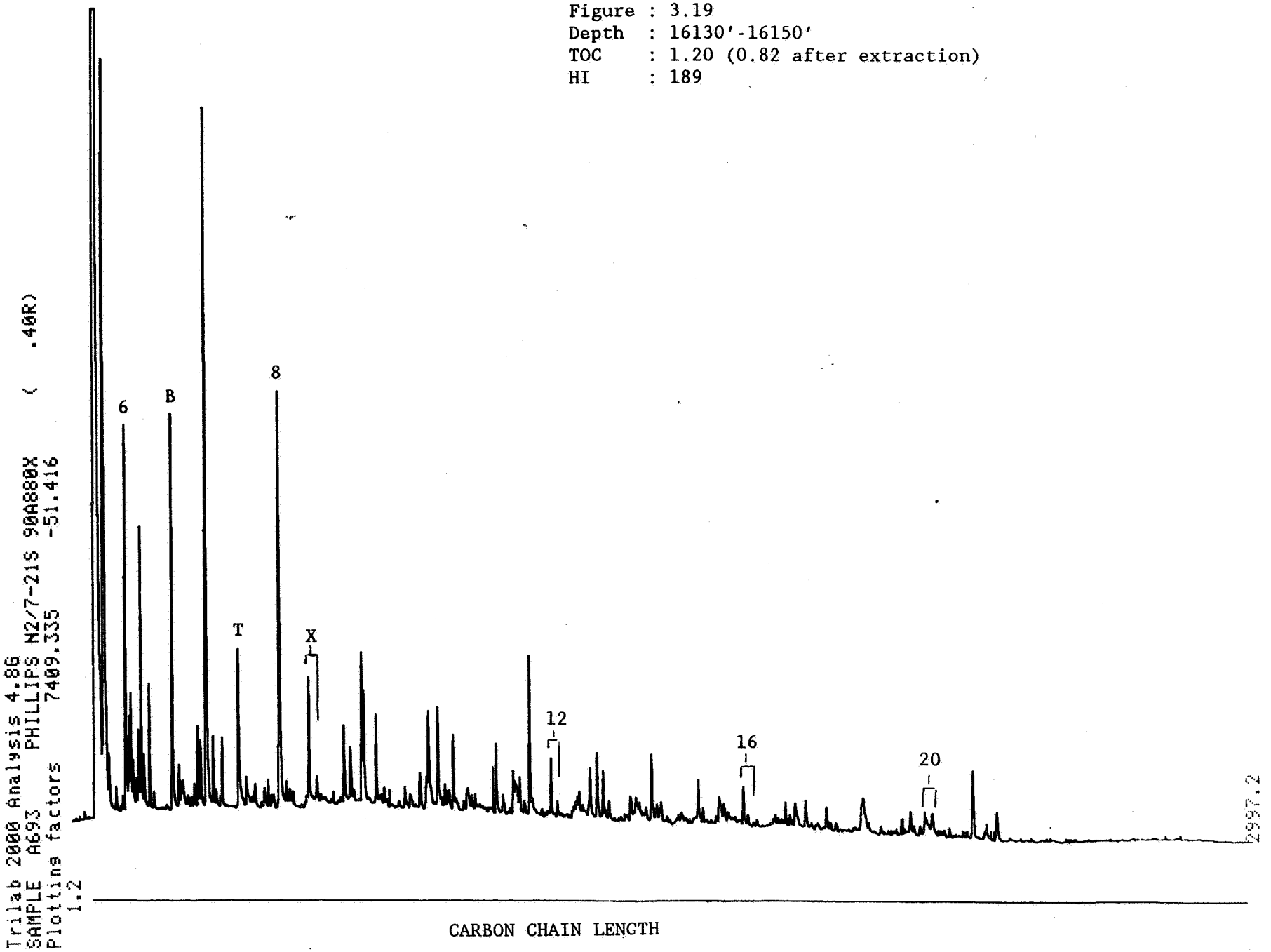


Figure : 3.20
Depth : 16190'-16210'
TOC : 0.80 (0.50 after extraction)
HI : 273

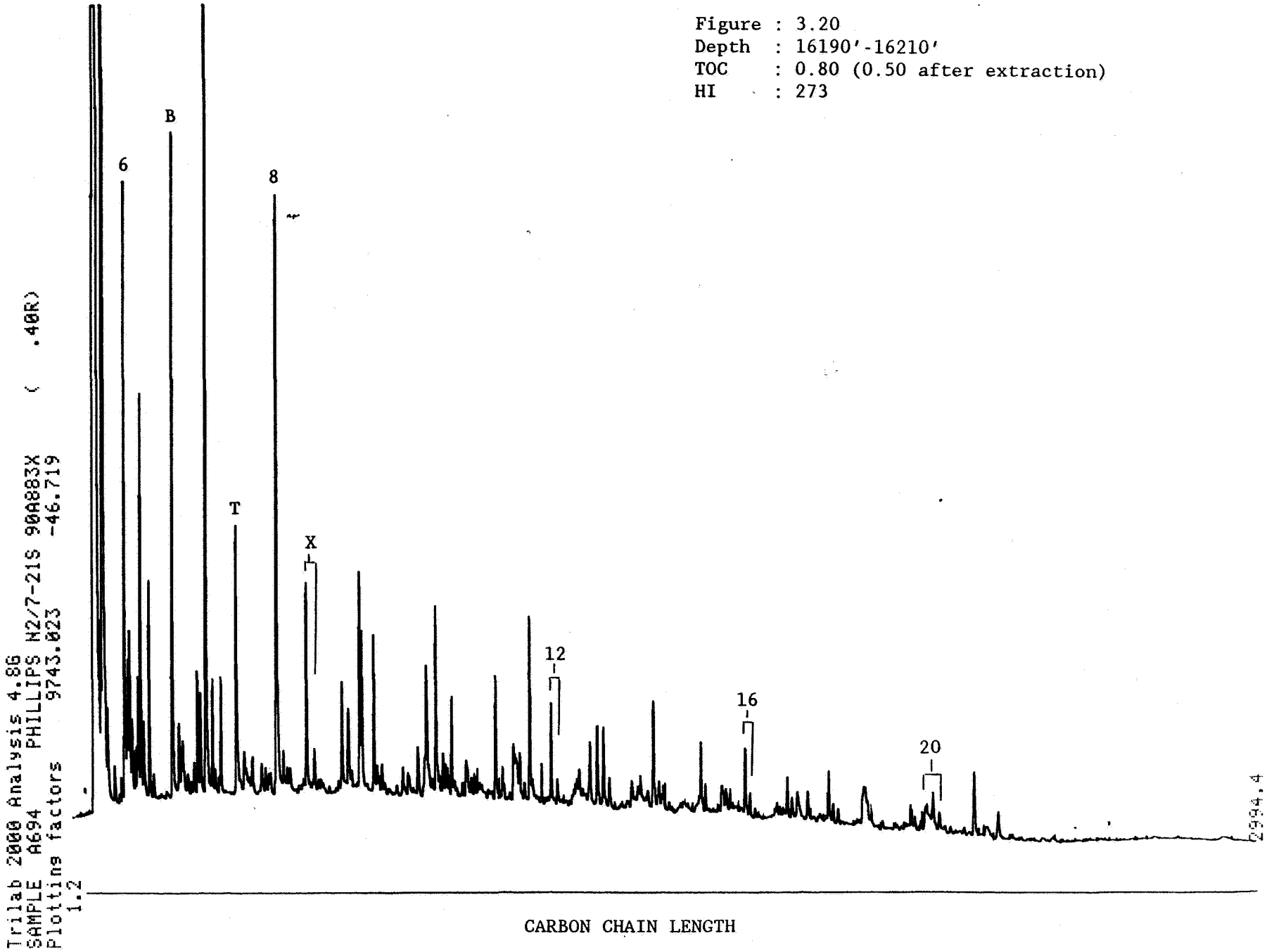
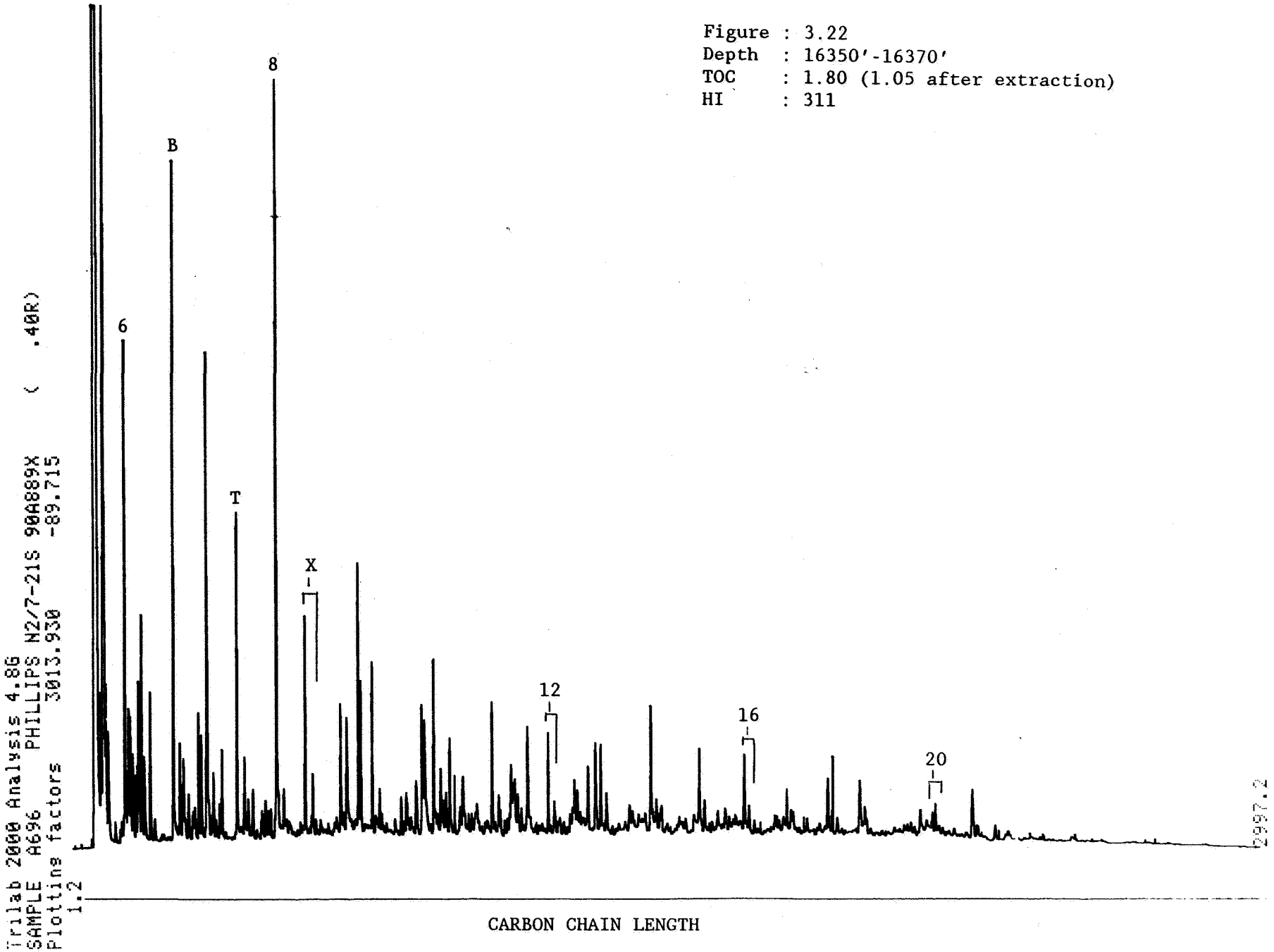


Figure : 3.22
Depth : 16350'-16370'
TOC : 1.80 (1.05 after extraction)
HI : 311



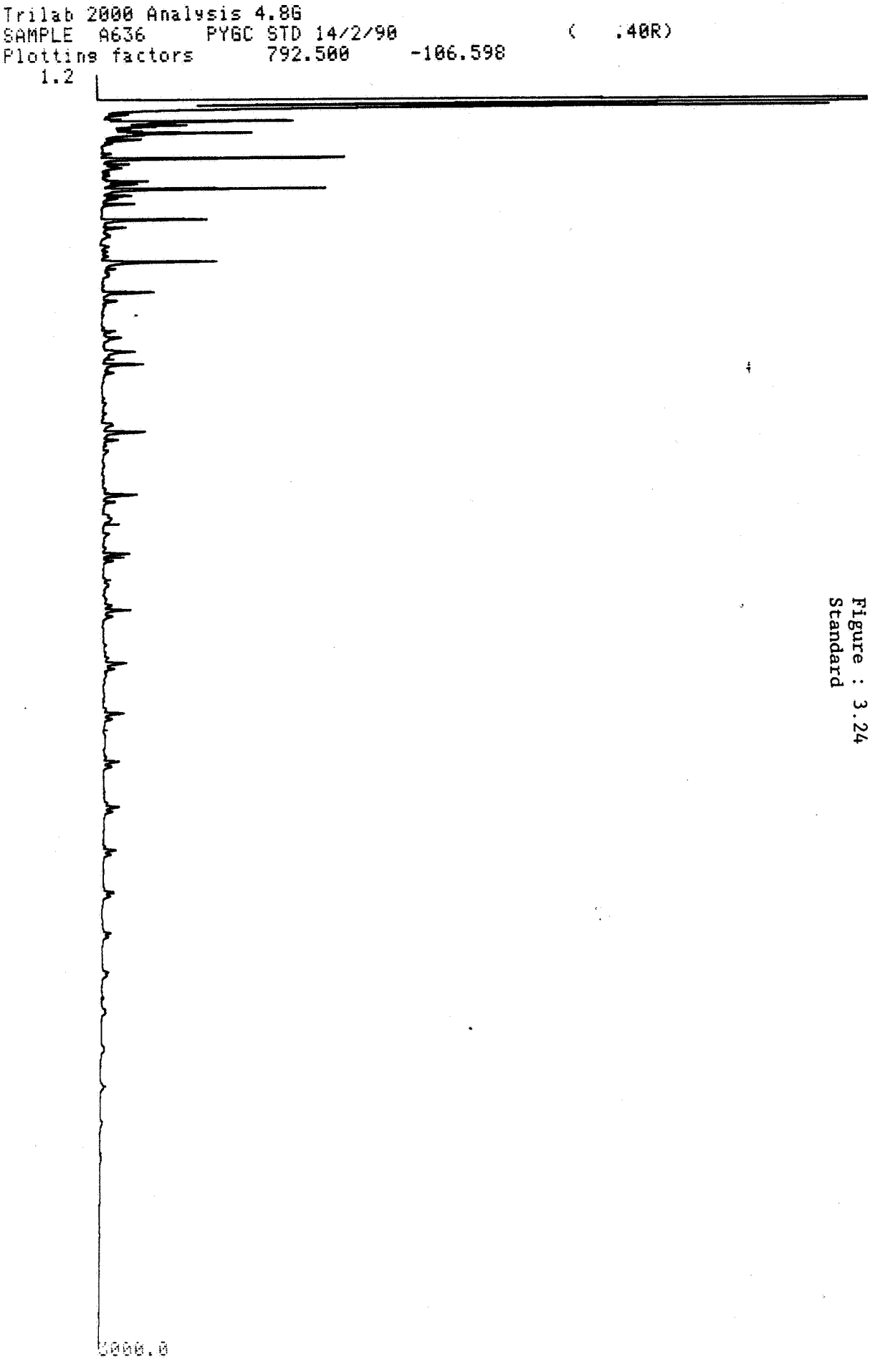


Figure : 3.24
Standard

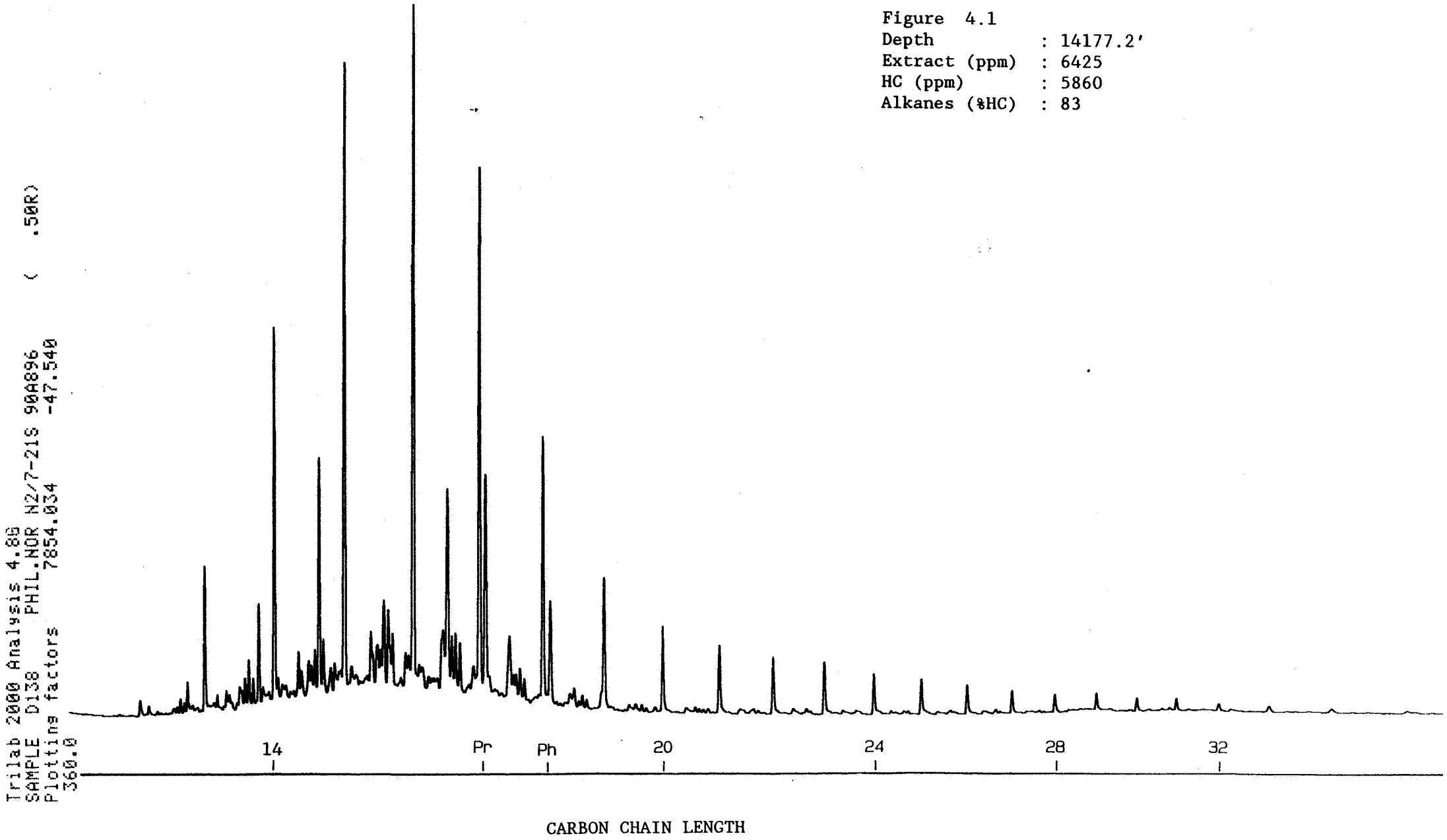


Figure 4.1
Depth : 14177.2'
Extract (ppm) : 6425
HC (ppm) : 5860
Alkanes (%HC) : 83
Trilab 2000 Analysis 4.86
SAMPLE D138 PHIL.NOR N2/7-21S 90A896
Plotting factors 7854.034 -47.540
360.0 (.50R)
14
Pr
Ph
20
24
28
32
CARBON CHAIN LENGTH

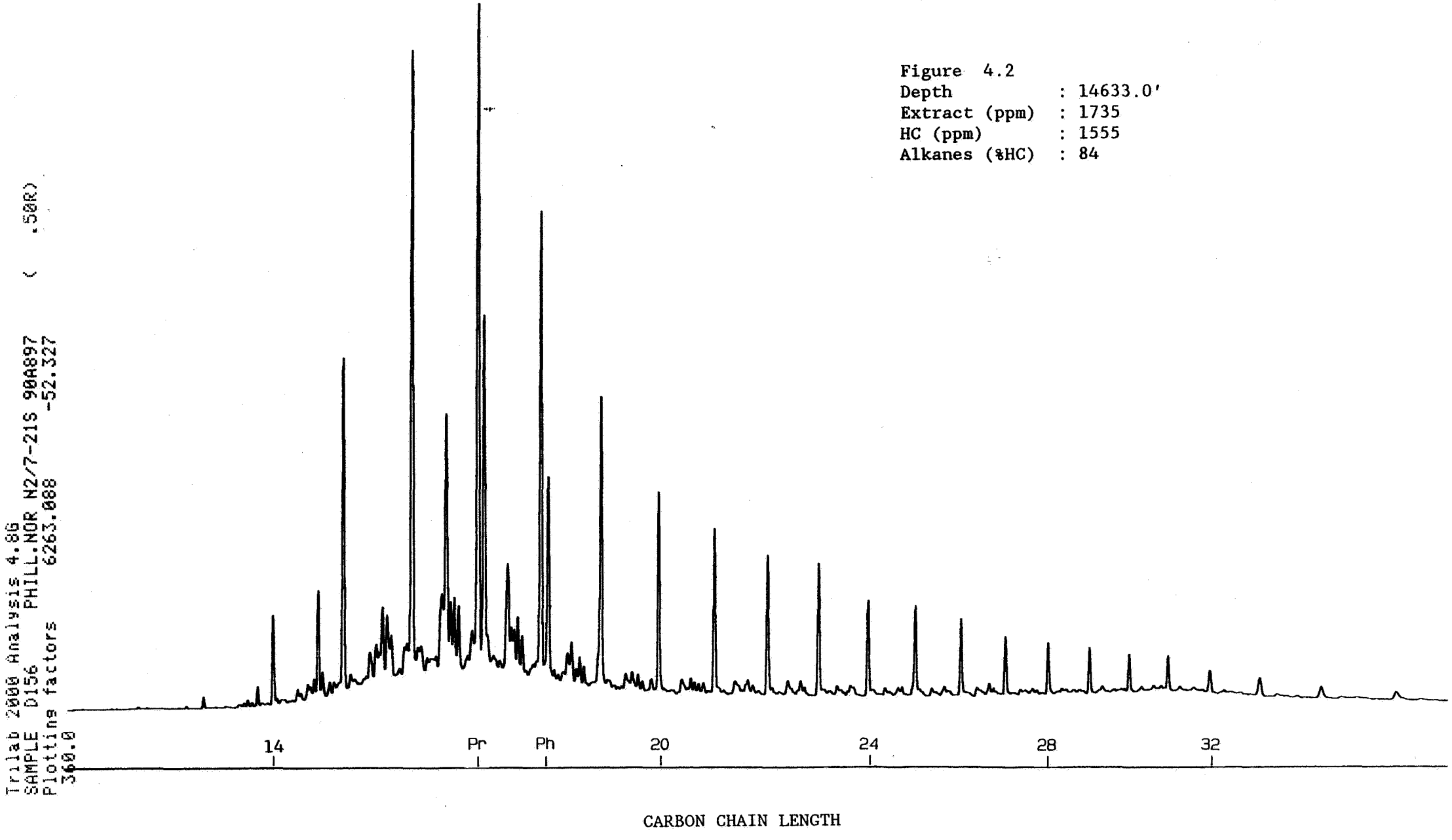
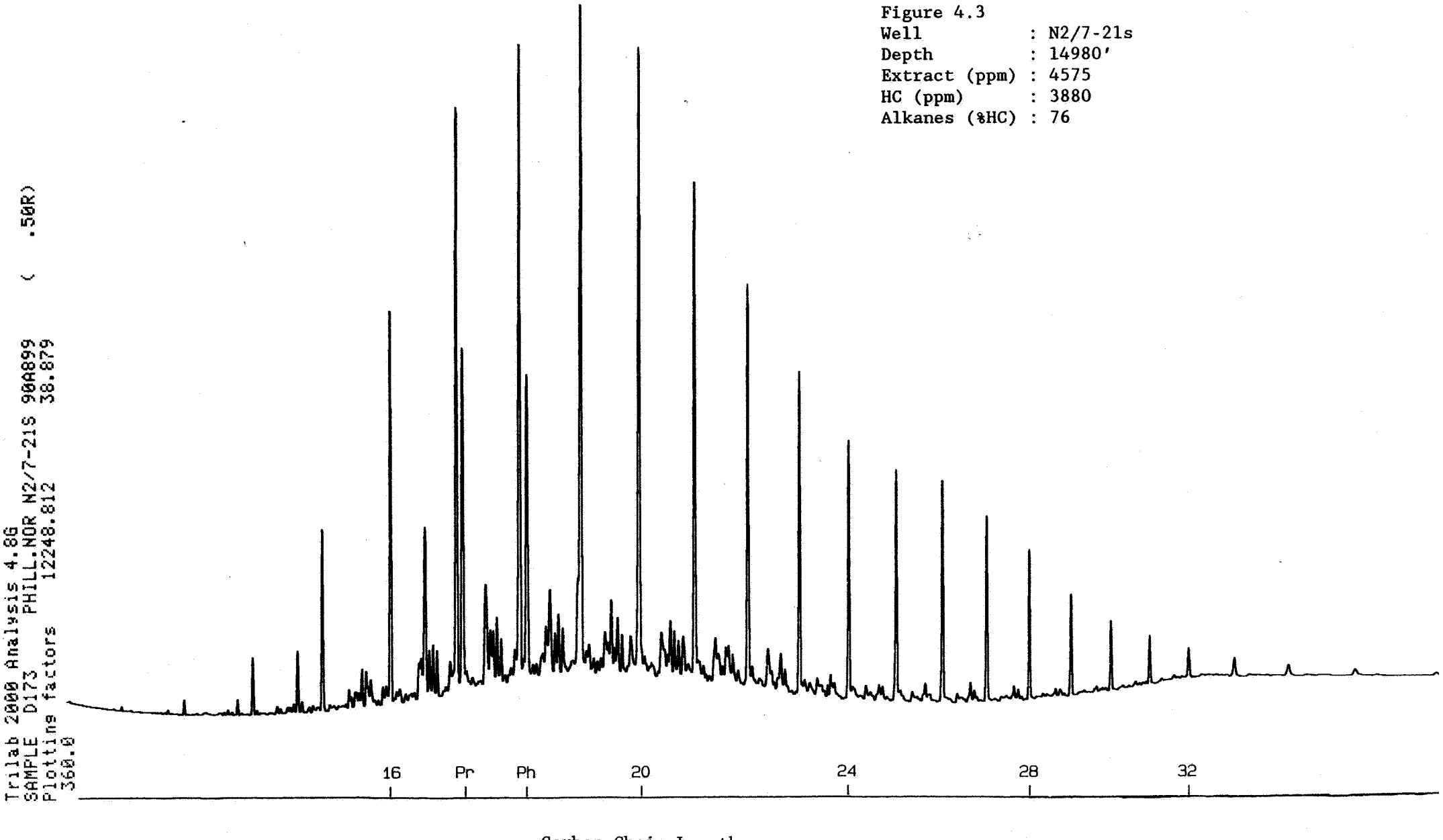


Figure 4.2
Depth : 14633.0'
Extract (ppm) : 1735
HC (ppm) : 1555
Alkanes (%HC) : 84

Figure 4.3
Well : N2/7-21s
Depth : 14980'
Extract (ppm) : 4575
HC (ppm) : 3880
Alkanes (%HC) : 76



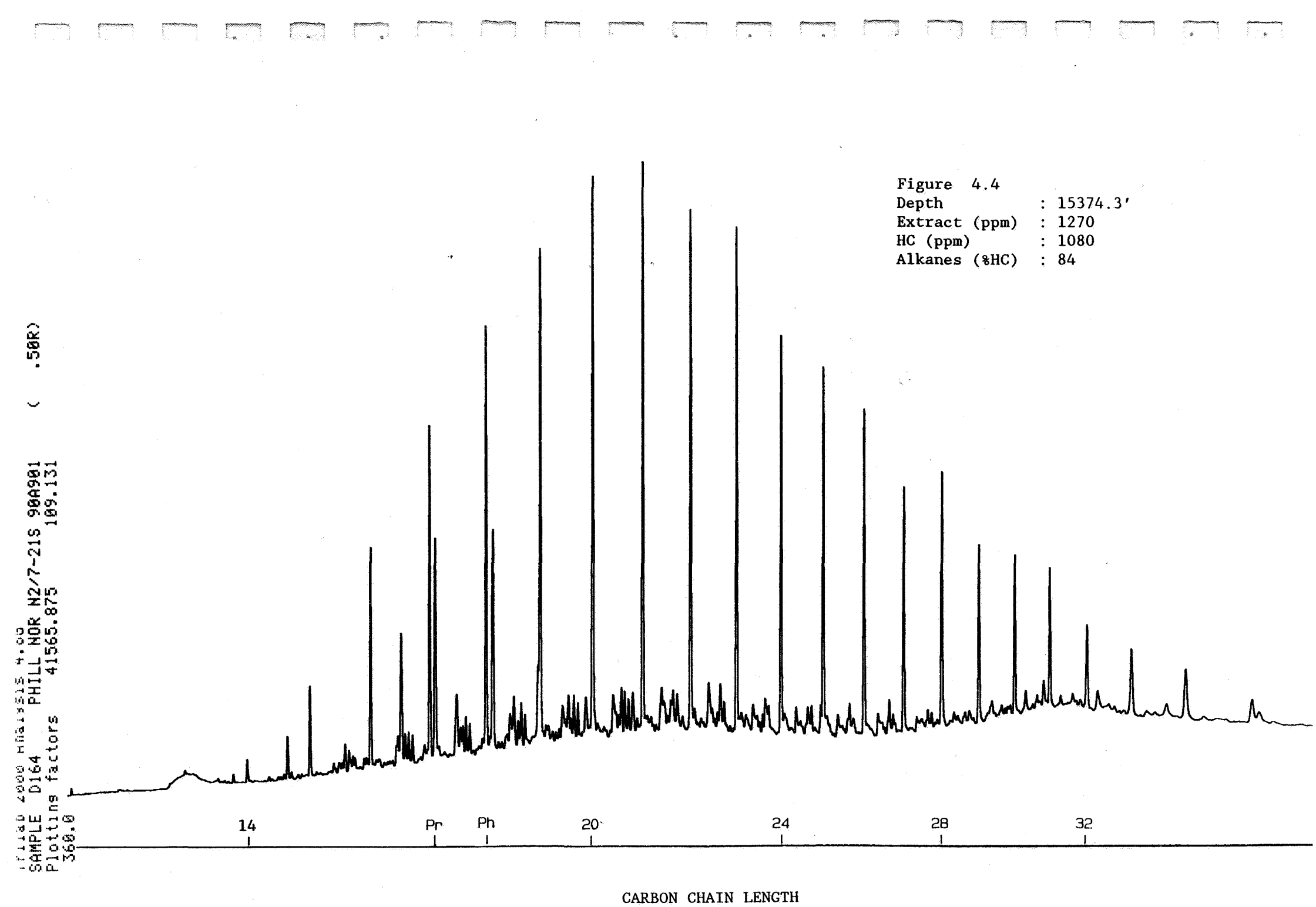


Figure 4.4
Depth : 15374.3'
Extract (ppm) : 1270
HC (ppm) : 1080
Alkanes (%HC) : 84
SAMPLE D164 PHILL NOR N2/7-21S 90A901
Plotting factors 41565.875 109.131
360.0
14
Pr
Ph
20
24
28
32
CARBON CHAIN LENGTH

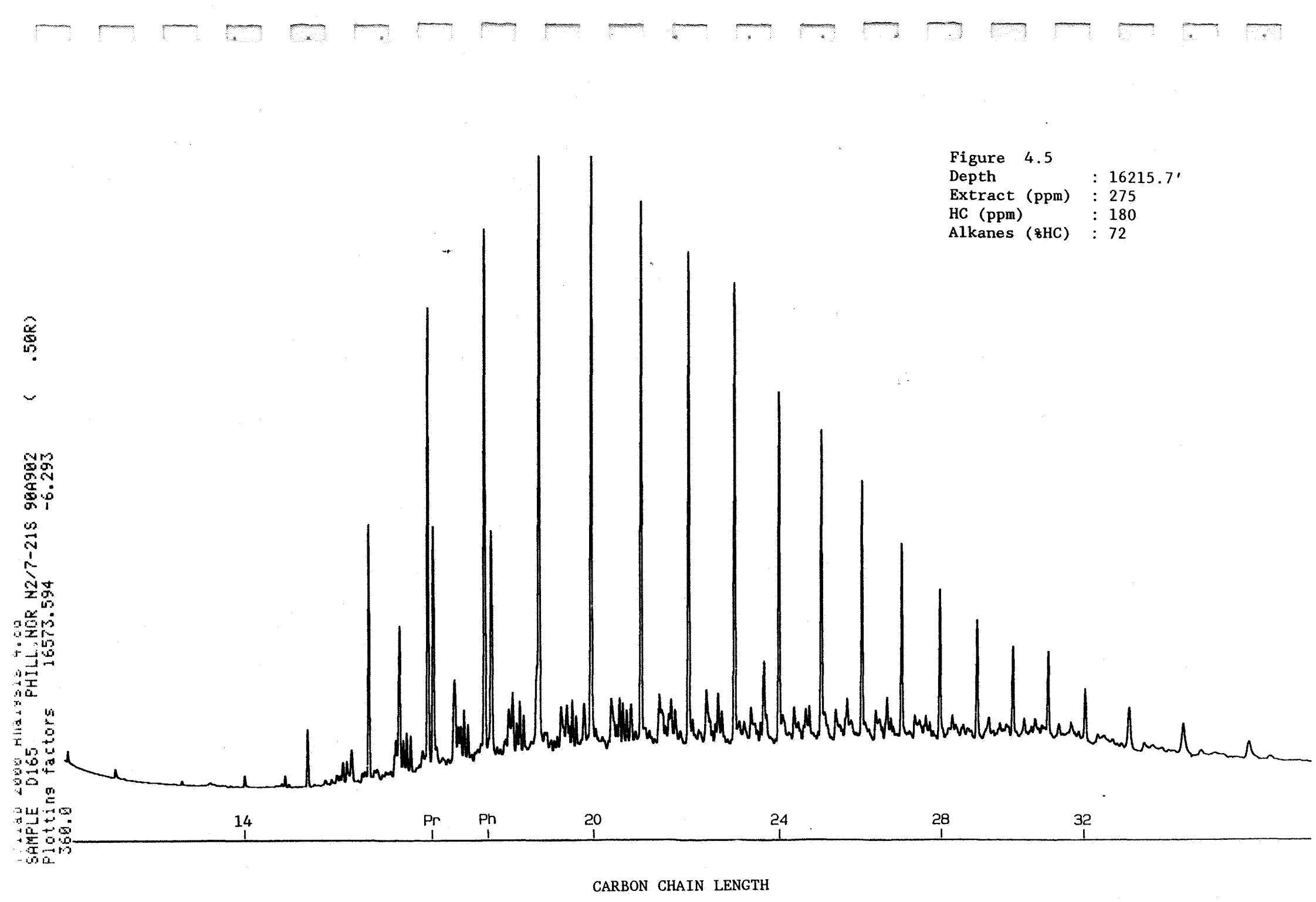


Figure 4.5
Depth : 16215.7'
Extract (ppm) : 275
HC (ppm) : 180
Alkanes (%HC) : 72
SAMPLE D165 PHILL,NOR N2/7-21S 90A902
Plotting factors 16573.594 -6.293
360.0
14
Pr
Ph
20
24
28
32
CARBON CHAIN LENGTH

Steranes m/e 217, 218

Peak No.	Assignment
1	C_{27} 5β(H)14α(H)17α(H) 20R cholestane
2	C_{27} 5α(H)14α(H)17α(H) 20S cholestane
3	C_{27} 5α(H)14β(H)17β(H) 20R isocholestane and coeluting
	C_{29} 24-ethyl-13β(H)17α(H) 20S diacholestane
4	C_{27} 5α(H)14β(H)17β(H) 20S isocholestane
5	C_{27} 5α(H)14α(H)17α(H) 20R cholestane
6	C_{28} 24-methyl-5β(H)14α(H)17α(H) 20R cholestane
7	C_{28} 24-methyl-5α(H)14α(H)17α(H) 20S cholestane
8	C_{28} 24-methyl-5α(H)14β(H)17β(H) 20R isocholestane and coeluting
	C_{29} 24-methyl-13α(H)17β(H) 20R diacholestane
9	C_{28} 24-methyl-5α(H)14β(H)17β 20S isocholestane
10	C_{28} 24-methyl-5α(H)14α(H)17α 20R cholestane
11	C_{29} 24-ethyl-5β(H)14α(H)17α 20R cholestane
12	C_{29} 24-ethyl-5α(H)14α(H)17α 20S cholestane
13	C_{29} 24-ethyl-5α(H)14β(H)17β 20R isocholestane
14	C_{29} 24-ethyl-5α(H)14β(H)17β 20S isocholestane
15	C_{29} 24-ethyl-5α(H)14β(H)17β 20R cholestane

All steranes listed are likely to be 24R and 24S epimers which cannot be separated with the chromatography conditions used.

Rearranged Steranes (Diasteranes) m/e 259

Peak No.	Assignment
16	C_{27} 13β(H)17α(H) 20S diacholestane
17	C_{27} 13β(H)17α(H) 20R diacholestane
18	C_{27} 13α(H)17β(H) 20S diacholestane
19	C_{27} 13α(H)17β(H) 20R diacholestane
20	C_{28} 24-methyl-13β(H)17α(H) 20S diacholestane (24R and 24S)
21	C_{28} 24-methyl-13β(H)17α(H) 20R diacholestane (24R and 24S)
22	C_{28} 24-methyl-13α(H)17β(H) 20S diacholestane
3	C_{29} 24-ethyl-13β(H)17α(H) 20R diacholestane and coeluting
	C_{27} 5α(H)14β(H)17β(H) 20R isocholestane
23	C_{29} 24-ethyl-13β(H)17α(H) 20R diacholestane
24	C_{29} 24-ethyl-13β(H)17α(H) 20S diacholestane
8	C_{29} 24-ethyl-13α(H)17β(H) 20R diacholestane and coeluting
	C_{28} 24-ethyl-5α(H)14β(H)17β(H) 20R isocholestane

All rearranged steranes listed are likely to be 24R and 24S epimers which, with the exception of C_{28} 24-methyl-13β(H)18α(H) diacholestanes, cannot be separated with the chromatography conditions used.

Methylsteranes m/e 231

Peak No.	Assignment
25	C_{28} 4α(H)-methyl-5β(H)14α(H)17α(H) 20R cholestane
26	C_{28} 4α(H)-methyl-5α(H)14α(H)17α(H) 20R cholestane
27	C_{28} 4β(H)-methyl-5α(H)14α(H)17α(H) 20R cholestane
28	C_{29} 4α(H)-methyl-24-methyl-5β(H)14α(H)17α(H) 20R cholestane
29	C_{29} 4α(H)-methyl-24-methyl-5α(H)14α(H)17α(H) 20R cholestane
30	C_{29} 4β(H)-methyl-24-methyl-5α(H)14α(H)17α(H) 20R cholestane
31	C_{30} 4α(H)-methyl-24-methyl-5β(H)14α(H)17α(H) 20R cholestane
32	C_{30} 4α(H)-methyl-24-methyl-5α(H)14α(H)17α(H) 20R cholestane
33	C_{30} 4β(H)-methyl-24-methyl-5α(H)14α(H)17α(H) 20R cholestane

Tricyclic and Tetracyclic terpanes m/e 191

Peak No.	Assignment
34	C_{19} tricyclic terpane
35	C_{20} tricyclic terpane
36	C_{21} tricyclic terpane
37	C_{22} tricyclic terpane
38	C_{23} tricyclic terpane
39	C_{24} tricyclic terpane
40	C_{25} tricyclic terpane
41	C_{26} tricyclic terpane
42	C_{28} tricyclic terpane
43	C_{29} tricyclic terpane
44	C_{30} tricyclic terpane
45	C_{24} tricyclic terpane

Regular Pentacyclic and Triterpanes (Hopanes) m/e 191

Peak No.	Assignment
46	C_{27} 18α(H)-22, 29, 30-trisnorneohopane
47	C_{27} 17α(H)-trisnorhopane
48	C_{28} 17α(H)21β(H)-28, 30-bisnorhopane
49	C_{29} 17α(H)21β(H)-28, 30-norhopane
50	C_{29} 17α(H)21β(H)-30-normoretane
51	C_{30} 17β(H)21α(H)-30-hopane
52	C_{30} 17α(H)21β(H)-30-moretane
53	C_{31} 17β(H)21α(H)-30, 31-homohopane (22S and 22R)
54	C_{32} 17α(H)21β(H)-30, 31-bishomohopane (22S and 22R)
55	C_{33} 17α(H)21β(H)-30, 31-trishomohopane (22S and 22R)
56	C_{34} 17α(H)21β(H)-30, 31-tetrakishomohopane (22S and 22R)
57	C_{35} 17α(H)21β(H)-30, 31-pentakishomohopane (22S and 22R)

Other Pentacyclic Triterpenoids

Peak No.	Assignment
58	C_{27} 17β(H) trisnorhopane
59	unidentified compound X (Philp and Gilbert, 1986)
60	unidentified compound Y (Philp and Gilbert, 1986)
62	unidentified
63	unidentified
64	C_{30} neohop-19(18)-ene
65	C_{29} 17β(H) norhopane
66	C_{31} hop-17(21)-enes (22R and 22R)
67	C_{30} gammacerane
68	C_{30} 18α(H) oleanane
69	C_{30} 17β(H)21α(H) hopane
70	C_{32} 17β(H)21α(H) moretanes
71	C_{31} 17β(H)21α(H) homohopane

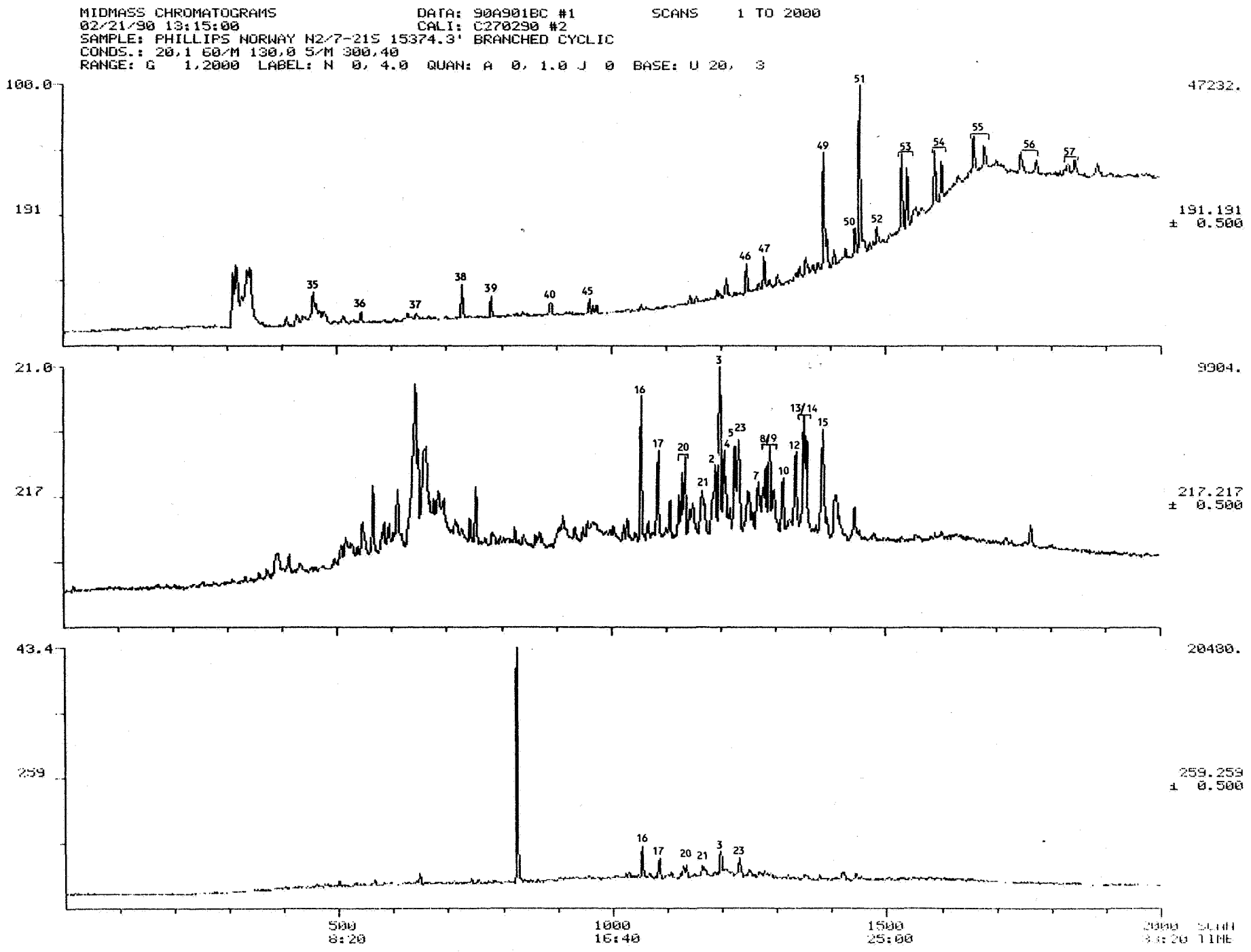


FIGURE 5.1 15374.3'(CORE)

APPENDIX I
ABBREVIATIONS USED IN ANALYTICAL DATA SHEETS

a/a	-	as above
Ac	-	acritarchs
ADD	-	mud additive
Al	-	algae
Am	-	amorphous
ang	-	angular
ANH	-	anhydrite
aren	-	arenaceous
arg	-	argillaceous
BAS	-	basalt
bd	-	bedded/bedding
B(IT)	-	bitumen/bituminous
bl	-	blue
bld	-	bleached
blk	-	black
bri	-	brilliant
brn	-	brown
calc	-	calcareous
CALT	-	calcite
carb	-	carbonaceous
CGL	-	conglomerate
CHK	-	chalk
CHT	-	chert
CLYST	-	claystone
CMT	-	cement
Comp	-	composite
crs	-	coarse
CSG	-	casing point/shoe
Ctgs	-	ditch cuttings
Cu	-	cuticle
C(vd)	-	caved
decarb	-	decarbonated
Di	-	dinocysts
dk	-	dark
DLT	-	dolerite
DOL/dol	-	dolomite/dolomitic
dsk	-	dusky
Ex	-	exinite
Exs	-	exsudatinite
extr	-	extracted
f	-	fine
fel	-	feldspathic
fer	-	ferruginous
flu	-	fluorescence
fm	-	formation
foss	-	fossils/fossiliferous
fr	-	friable
frac	-	fracture
frags	-	fragments
Fu	-	fusinite
GLC/glc	-	glauconite/glauconitic
gn	-	green
grd	-	graded/grading to
grns	-	grains
gy	-	grey
GYP	-	gypsum
HAL	-	halite
hd	-	hard
hor	-	horizontal
H(RV)	-	high reflecting vitrinite
i-	-	iso-
i/b	-	inter-bedded
IGN	-	igneous rocks
inc	-	including
Inert	-	inertinite
lam	-	laminae/laminated
LCM	-	lost circulation material
LIG/Lig	-	lignite/lignitic
lns	-	lens(es)
L(RV)	-	low reflecting vitrinite
LST	-	limestone
lt	-	light
mass	-	massive
MDST	-	mudstone
med	-	medium
MET	-	metamorphic rocks
mic	-	mica/micaceous
micr	-	micritic
min	-	mineral
mnr	-	minor
mod	-	moderate
mtl	-	mottled
n-	-	normal
NA	-	not available
nod	-	nodule/nodular
NS	-	no sample
occ	-	occasional
ol	-	olive
ool	-	oolitic
orng	-	orange
OS	-	oil stain
P	-	picked lithology
pal	-	pale
Ph	-	phytane
pnk	-	pink
por	-	porous/porosity
pp	-	purple
Pr	-	pristane
pred	-	predominantly
Prt	-	present
PYR/pyr	-	pyrite/pyritic
QTZ(T)	-	quartz(ite)
Re	-	resin
R(ew)	-	reworked
rnd	-	round(ed)
Sap	-	sapropel
sbng	-	subangular
sbrd	-	subrounded
SCI	-	spore colour index
Sf	-	semifusinite
sft	-	soft
SH	-	shale
shly	-	shaly
sil	-	siliceous
sks	-	slickenside surface
SLA	-	slate
SLT(ST)	-	silt(stone)
slty	-	silty
SND	-	sand
sndy	-	sandy
Sp	-	spores
SST	-	sandstone
st	-	stained
stks	-	streaks
suc	-	sucrosic
surf	-	surface
SWC	-	side wall core
TD	-	total depth
TOC	-	total organic carbon
tr	-	trace(s)
trns	-	transparent
v	-	very
vgt	-	variegated
Vit	-	vitrinite
vn	-	vein
VOLC	-	volcanic rocks
VR	-	vitrinite reflectivity
wht	-	white
xln	-	crystalline
yel	-	yellow
-	-	no analysis carried out
*	-	analysed but no data obtained
gy-gn	-	greyish green
gy/gn	-	grey-green (gradation)
gn-gy	-	greenish grey

Note: (Maturity data tables only). Number in brackets refers to number of reflectivity values averaged to give quoted result. Preferred values for indigenous phytoclasts are listed first.

APPENDIX 2

ANALYTICAL PROCEDURES AND TECHNIQUES

This appendix summarises the main steps in the analyses carried out in the Robertson Research International Ltd. petroleum geochemistry laboratories. Analytical pathways are shown on the flow chart (Appendix Figure 1) and details of laboratory procedures and techniques are given in the text. These may in certain circumstances be adapted to suit particular samples or conditions. Interpretation guidelines are also defined.

1. Sample Preparation

General

Samples are received into the laboratories in the forms of well-site canned ditch cuttings, bagged ditch cuttings in various stages of preparation from wet, unwashed to dried, washed; sidewall cores, conventional cores, outcrop samples, crude oil samples and gas samples. Each sample is assigned a number which is entered into a computer system to monitor sample selection and progress. Preparation techniques are directed towards obtaining clean samples, free of drilling mud and mud additives, obvious caving contamination and indeterminate fine material. Washing with cold water is standard but further washing with solvent (dichloromethane, DCM) is carried out if oil-based mud is present, after which samples are dried, described and individual lithologies hand-picked where practicable. Samples are rough crushed to approximately pea-sized fragments for kerogen preparation or finely milled for chemical analysis.

Kerogen Preparation

Kerogen concentrates for microscopic examination and elemental analysis are prepared using standard palynological procedures but omitting oxidation or acetolysis. Acid maceration involves the use of hot hydrochloric acid (HCl) to remove carbonates and hot 60% hydrofluoric acid (HF) to remove or break down silicates. Mineral residues are separated from the kerogen by a combination of ultrasonic vibration and zinc bromide flotation. Kerogen samples for spore colour and kerogen typing are mounted on glass slides in glycerin jelly, those for vitrinite reflectivity are dried and mounted in epoxy resin. Kerogen residues are stored in methanol.

2. Maturity Evaluation

The techniques employed for interpreting maturity and thermal history in these laboratories are based mainly on spore colouration and vitrinite reflectivity measurement, supplemented by data obtained from airspace gas and gasoline analysis, pyrolysis Tmax, and hydrocarbon analysis including gas chromatography and gas chromatography-mass spectrometry.

Spore Colouration

Sporomorph colour is assessed using a >20µ sieved kerogen fraction viewed in transmitted light on a standard palynological microscope. Unusual hues are checked using incident blue/UV light fluorescence. Measurement is made by eye against reference sets of single grain spore mounts and trained operators achieve a high degree of accuracy and reproducibility. The 1 to 10 Spore Colour Index (SCI) scale was designed for linearity with increasing depth and temperature and correlates approximately with the following zones of oil generation: 1.0 to 3.5, immature; 3.5 to 5.0, early mature, generation of low gravity oils (28 to 35 °API); 5.0 to 7.0, middle mature, generation of medium gravity oils (35 to 42°API); 7.0 to 8.5, late mature, generation of light oils (>42°API) and condensates; 8.5 to 10, post mature, generation of condensate, wet gas and, ultimately, dry gas. Linearity of scale is of great value in prediction, by extrapolation, of the depth to any part of the oil generation sequence. The value of SCI measurement lies in the objective selection of measured grains, so minimising problems of caving and reworking, and in its more direct correlation against oil generation than vitrinite reflectivity measurement. Limitations in its use concern the difficulty of correlation against other colour scales and the insensitivity of the scale in the late to post mature region. Anomalous colours may result from bleaching or staining during deposition and diagenesis. The correlation of SCI against Thermal Alteration Index (TAI) given on the SCI versus depth plot in the reports was made by direct comparison of Staplin's standard slides with SCI standard slides.

Vitrinite Reflectivity

The majority of preparations examined under reflected light in these laboratories are made using >20µ sieved kerogen, mounted in resin blocks and polished with carborundum and alumina although total kerogen may be used when sample size is

limited. Picked coals, organic-rich shales or limestones containing solid bitumen are mounted directly in resin blocks and polished in the usual way. Measurement is made on a Leitz Orthoplan microscope fitted with an MPV Compact photometer which feeds values direct to a desk top computer for data processing from each sample. The system is calibrated against glass standards and reflectance values are expressed as arithmetic means of measurements taken in oil immersion (R_o or $R_{m\ oil}$). R_{max} and R_{min} may be measured and quoted in certain circumstances but the difference is insignificant below about R_o 1.0%. Some operator selection of particles during measurement is essential and obvious contaminants or non-vitrinitic material are noted but not necessarily quoted. The value quoted on data tables is that which is interpreted as most appropriate, but other possibilities may also be given. Plotted figures assume a logarithmic increase of reflectance with depth. R_o 0.5% is a widely accepted threshold value for the onset of oil generation, although as the kinetics of oil generation may not be identical to those of vitrinite reflectivity development this must be seen only as a general guide. The floor for oil generation is characterised by a reflectance value of about 1.3%. Wet gas generation peaks at a value of about 1% and ceases at the 2% level. Dry gas generation peaks at a reflectance of about 1.5% and ceases at the 3% to 4% level. Correlation of reflectance values with other maturity parameters may not be universal because of time-temperature factors and is best made on a local basis.

Reflectivity measurement is a widely used and versatile tool which may be readily calibrated against easily obtained standards. It is applicable over a wide range of maturity stages from immature to post mature (0.2% to 5% R_o). High surface intercepts on plotted figures and discordances at faults and unconformities can give realistic estimates of the amount of section missing. It is of limited value in Early Palaeozoic sections where land plant material is absent, although a general guide to maturity may be obtained from chitinous organic matter. Even a skilled operator may have difficulty in distinguishing indigenous vitrinite from some forms of inertinite, anomalously reflecting "pseudovitrinite", cavings and reworked fragments.

Airspace Gas Analysis

Wet cuttings are collected at the well site and sealed in partly full cans containing bactericide. In the laboratory, the airspace (headspace) gas is extracted using a can piercer fitted with a septum and analysed by gas chromatography. The proportions of methane, ethane, propane, iso- and n-butane are calculated from integrated peak areas by comparison with a standard mixture of these gases. Methane is the dominant gas in immature and post mature sediments, comprising 90-100% of total gas, falling to 30-70% in mature sediments. The onset of maturity for oil generation (SCI 3.5) is characteristically marked by an increase in wet gas (C_2-C_4) to between 10 and 20% with further increases in maturity indicated by a decrease in the ratio of iso- to n-butane. Ratios of >1.0 are typical for immature sediments and <0.5 are usual in mature sediments. Departures from composition versus depth trends may be useful in indicating migrant gas at faults, unconformities or reservoir rocks but limit the method as a reliable maturity indicator. Airspace gas analysis is an inexpensive and rapidly executed method of screening samples for further maturity and hydrocarbon content determinations.

Gasoline Analysis and Cuttings Gas Analysis

Cuttings samples received wet, preferably in sealed containers, are suitable for gasoline and cuttings gas analysis. portion of the washed cuttings sample is retained wet, pulverised in a sealed shaker and warmed to expel the C_1 to C_7 hydrocarbon components into the shaker airspace. A sample of this airspace gas is then removed and analysed by gas chromatography either for cuttings gas (C_1 to C_4) or gasolines (C_4 to C_7). Up to 28 hydrocarbon components are identified in the C_4 to C_7 range and their relative proportions calculated from integrated peak areas with reference to standard mixtures. Immature source rocks yield low total abundances and limited numbers of components whereas mature source rocks usually contain a full complement of identified hydrocarbons with the onset of maturity indicated by a rapid rise in total gasoline abundances with depth. Anomalous amounts of gasolines may mark the presence of oil stain. Gasolines may be used in oil to oil or oil to source rock correlations but the concentration of some of the measured components is not only a function of source but also depends on maturity, migration and alteration in the reservoir. Using the most stable compounds, pairs with similar chemical structure and boiling points are reduced to pair ratios and compared with the same pair ratios in other oils or possible source rocks. Gasoline analysis is a valuable tool in that it measures directly the hydrocarbons being generated from a sediment but its sensitivity in detecting traces of oil places constraints on its use as a maturity indicator.

Rock-Eval Pyrolysis, Gas Chromatography (GC) and Gas Chromatography-Mass Spectrometry (GC-MS) in Maturity Analysis

These three analytical processes measure parameters which are functions of both maturity and kerogen type. Data from them may give a general guide to maturity but if the kerogen types are known, more specific conclusions may be drawn. From Rock-Eval data, the temperature of maximum rate of pyrolysis, Tmax, is the most useful datum; gas chromatograms of alkanes, separated from source rock extracts or oils, yield carbon preference indices (CPI) and isoprenoid ratios; GC-MS quantitative fragmentograms provide abundance ratios for specific compounds which are particularly useful in assessing the level of maturity at which source rock hydrocarbons or oils have been generated. All these supplementary data may be used to confirm results from visual analysis or supplant them if poor or unavailable.

3. Source Rock Evaluation

Total Organic Carbon Content (TOC)

Organic carbon values are obtained by treating 0.1g of crushed rock sample with hot, concentrated HCl to remove carbonates. The washed residue is filtered on to a glass fibre pad and ignited in a Leco carbon analyser. For screening purposes, samples are analysed singly but where further analyses, such as pyrolysis or solvent extraction are anticipated, a duplicate sample is run. Blanks and standards are run as routine and where values from duplicated samples do not concur within strict accuracy limits, they are rerun. Where samples are heavily stained with oil, either from natural deposits or drilling mud, TOC is repeated on the dried, solvent extracted sample.

TOC measurement is fundamental in assessing source rock quality since when combined with kerogen type and maturity, a full description of the potential to generate oil may be given. It is found in practice that sediments containing less than 0.3% TOC are unlikely to have any source potential, those containing between 0.3% and 1% may be marginal sources but the better quality sources contain in excess of 1% TOC. Screening by TOC is therefore an inexpensive and rapid method of selection of samples for further analysis in source potential evaluation.

Rock-Eval Pyrolysis

Pyrolysis data are obtained using the IFP-Fina Rock-Eval apparatus. 100 mg of crushed, whole rock either from bulk sample or picked lithology is weighed accurately into a crucible and introduced into a furnace at 250°C. Free hydrocarbons (roughly equivalent to solvent extractable hydrocarbons) are volatilised and quantified by flame ionisation detector (FID) to give Peak 1 (S_1, ppm). The furnace temperature is increased to 550°C at 25°C/minute and within this range, kerogens crack to give hydrocarbons, measured by FID to give Peak 2 (S_2, ppm) and carbon dioxide, measured by thermal conductivity detector (TCD) to give Peak 3 (S_3, ppm). The temperature at the maximum rate of evolution of cracked volatiles (Tmax) is measured automatically but can also be monitored visually. The instrument is calibrated daily using standards both at the beginning of the work period and at regular intervals thereafter and crucible blanks are run as routine. The tabulated data in reports comprise the following parameters:

Tmax °C - temperature of maximum rate of Peak 2 hydrocarbon evolution.

Hydrogen Index (HI) - S_2/TOC (mg/g) or ratio of released hydrocarbon to organic carbon content. This is a measure of the hydrocarbon generating potential remaining in the kerogen as opposed to that of the whole rock.

Oxygen Index (OI) - S_3/TOC (mg/g) or ratio of released carbon dioxide to organic carbon content.

Production Index (PI)- S_1/S_1+S_2, or ratio of the amount of hydrocarbons released in the first stage of heating to the total amount of hydrocarbons released and cracked during pyrolysis.

Potential Yield (PY) - S_2 (ppm) or total of hydrocarbons released during cracking of kerogen compared to original weight of rock.

Tmax, hydrogen index and oxygen index are each functions of both maturity and kerogen type. Using published and empirical data, it has been possible to assemble a model to show the relationships of these factors to maturity as measured by spore colouration and vitrinite reflectivity for a selection of pure kerogen types. The kerogen types used are algal sapropel (type I), waxy sapropel (type II), vitrinite (type IIIA) and inertinite (type IIIB) and a computer program has been devised by which the amounts of these components may be calculated from the HI, OI, Tmax and maturity

data for any sample. These are the values expressed in the "kerogen composition by calculation" columns tabulated in the reports.

The hydrogen index is a measure of the hydrocarbon generating potential of the kerogen and is analogous to the atomic H/C ratio. Immature, organically rich source rocks and oil shales give values above 500, mature oil source rocks give values between 200 and 550. For a given kerogen type, these values progressively diminish with increasing maturity.

The temperature of maximum rate of pyrolysis depends partly on the kerogen type but the transition from immature to mature organic matter is marked by temperatures between 415° and 435°C. The maturity transition from oil and wet gas generation to dry gas generation is marked by temperatures between 455° and 460°C. In practice, greater variation than these ideal temperature ranges may be seen, but they are nevertheless useful as general guides to the level of maturity attained by the sediment.

The production index increases with maturity from values near zero for immature organic matter to maximum values of 0.15 during the late stages of oil generation. Anomalously high values indicate the presence of oil or contaminants. The potential yield is an indication of the predicted yield of hydrocarbons from the source rock at optimum maturity and is a measure of the quality of the source rock. For immature sediments, values of 0 to 2000 ppm of hydrocarbon characterise a poor source rock, 2000 to 6000 ppm fair, 6000 to 20 000 ppm good and above 20 000 ppm very good.

Pyrolysis techniques have in recent years provided a major advance in the assessment of source rock quality and generating potential. Hydrocarbon yields from immature source beds examined on-structure may be translated into actual oil productivity from the same beds in mature basinal, off-structure situations. Models relating maturity and kerogen type may be used to define original source rock quality grades which are of great value in mapping organic facies. Amorphous kerogen types, indistinguishable in microscopic preparations over a wide range of chemical properties, may be readily differentiated by pyrolysis. The problem of analysing bulk samples containing mixed kerogens has been largely overcome by the kerogen type/maturity model and anomalous results arising from the presence of caving contamination and drilling mud additives can usually be explained by inspection. High oxygen indices sometimes occur as a result of the presence of metastable carbonates and in such cases the sample is acid decarbonated and re-run.

Visual Examination of Kerogen Concentrates

All palynological preparations on which SCI determinations are made are also examined for kerogen type. Visual estimations of the relative abundance of the broad groups vitrinite, inertinite and sapropel are made on the total kerogen slide mount but reference is also made to the >20μ sieved fraction to assist in identification. The scheme of identification is shown in Appendix Table 1. Full use is made of incident blue or UV light in distinguishing immature or early mature oil-prone kerogen from gas-prone kerogen.

Extract Analysis

The soluble organic materials present in rocks can be extracted with organic solvents, fractionated and analysed. The type and amount of material extracted depends largely upon the nature of the contained kerogen and its maturity, although the presence of migrant oil or drilling contamination may be the determining factors.

A maximum of 40g of crushed sample is extracted for a minimum of 12 hours in a Soxhlet apparatus using laboratory redistilled DCM. The solvent and the more volatile components (approximately up to $\underline{n}$-C_{15}) are lost by evaporation in an air flow and the resulting total extract is weighed, dissolved in hexane and separated into alkane (saturate) hydrocarbon, aromatic hydrocarbon, resene and asphaltene (polar) fractions by silica adsorption chromatography in the Iatroscan process.

Larger fractions, suitable for further analysis, are obtained by column chromatography. The extract is run through a short glass column packed with silica and alumina and eluted with hexane (to give the saturate fraction), (3:1 hexane: toluene mixture (to give the aromatic fraction) and methanol (to give the polar, or resene and asphaltene, fraction). A small proportion of non-eluted polar compounds usually remains on the column.

The data tabulated in reports comprise the following parameters:

Total extract - soluble organic matter, heavier than about n-C_{15+}, expressed as ppm of weight of rock.

Hydrocarbons - sum of alkane and aromatic hydrocarbons, expressed as ppm of weight of rock.

Extract % of organic carbon (EPOC) - $\frac{\text{total extract ppm}}{\text{TOC} \times 100}$; the extractability.

Hydrocarbons mg/g of organic carbon - total hydrocarbons normalised to 1g of organic carbon.

Hydrocarbons % extract - total hydrocarbons as a proportion of total extract.

Alkanes % hydrocarbons - the proportion of alkanes (saturates) in the total hydrocarbons. The proportion of aromatics is (100 minus this value) expressed as a percentage.

The extractability of oil-prone sapropelic organic matter increases rapidly in the oil generation zone and diminishes to very low values in post mature sediments. Overall the extractability of sapropelic organic matter is greater than that of gas-prone humic organic matter for similar levels of maturity. Samples with extractabilities of greater than 20% generally contain migrant oil or are contaminated with mud additives.

As maturation proceeds in the oil generation zone the proportion of hydrocarbons in the total extract increases from less than 20% to a maximum in the most productive horizons of around 60%. This trend is reversed as the oil-condensate zone is entered. The relative proportions of alkanes to aromatics can be used as a check for low levels of contamination. Fractions of the extract, separated by column chromatography are retained for further analysis by gas chromatography or for stable carbon isotope determination.

Capillary Gas Chromatography of C_{15+} Alkanes

A portion of the Soxhlet extract is eluted with hexane through a short silica column to yield the saturate hydrocarbon fraction. This fraction is evaporated in a stream of dry nitrogen at room temperature. A small portion of the fraction is then taken up in hexane and introduced into a 25 metre, wall-coated, open tubular glass capillary column coated with OV-1, or equivalent, mounted in a Carlo Erba gas chromatograph which is temperature programmed from 70°C to 270°C at 3°C/minute.

C_{15+} chromatograms are inspected for the distributions of n-alkanes, and the presence and abundance of isoprenoids (particularly pristane and phytane), steranes and triterpanes and unresolved envelopes of naphthenic compounds. The ratios pristane:phytane and pristane:n-C_{17} are calculated. Carbon Preference Index (CPI) values quoted are those as defined by Philippi as the ratio $2C_{29}$ to $(C_{28}+C_{30})$ unless otherwise stated. Chromatography may reveal information about the kerogen type of the source rock, its maturity and condition of deposition and, if migrant oil is present, whether this has been water-flushed or biodegraded. Contaminant drilling mud additives may be identified.

Capillary Gas Chromatography of Aromatic and Branched/Cyclic Alkanes

The aromatic portion of the Soxhlet extract is eluted from a short silica/alumina column by a hexane/toluene mixture. The dried fraction is taken up in DCM and introduced into a 25 metre, wall-coated, open tubular glass capillary column coated with OV-1, or equivalent, mounted in a Carlo Erba gas chromatograph which is temperature programmed from 70°C to 270°C at 3°C/ minute.

Branched chain alkanes are separated from normal alkanes by urea adduction and treated as for total alkanes.

Gas Chromatography-Mass Spectrometry

Mass spectrometry is a technique in which molecules are bombarded with high energy electrons causing ionisation and fragmentation of the molecules into ions of varying mass(m) and charge(z). The way in which a molecule fragments into ions of various m/z value is known as its fragmentation pattern, or mass spectrum and is unique. When linked to a gas chromatograph the mass spectrometer can be used in two different modes:

1. Full Scan Mode: A mass spectrum is obtained of each peak eluting from the gas chromatograph and a structural identification of the compound producing that peak can be made.

2. Multiple or Single Ion Monitoring Mode: The mass spectrometer is tuned to certain m/z values to detect whether a compound, eluting from the gas chromatograph, fragments to give an ion at that value. Certain fragmentations are indicative of specific compound types and the most commonly monitored fragment ions used in petroleum geochemistry are those with m/z values of 191, 217 and 259 which are the principal fragment ions obtained from groups of alkanes known as triterpanes, regular steranes and rearranged steranes respectively. These are compounds containing 27 to 35 carbon atoms arranged in a polycyclic, normally 4 or 5 ring, structure, occurring in the $\underline{n}$-C_{26} to $\underline{n}$-C_{35} region of a gas chromatogram. The basic molecular skeletons of these compounds are very similar to those of the original organic matter deposited in the sediment and so these 191, 217 and 259 distribution plots, known as mass fragmentograms or mass chromatograms, form a pattern characteristic of the source material. This technique of "fingerprinting" is also one of the more exact methods of correlating an oil to its source, or to another oil.

Carbon Isotope ($^{13}C/^{12}C$) Ratio Analysis

Carbon has two stable isotopes, the more abundant ^{12}C isotope and the heavier ^{13}C isotope, which in nature forms about 1% of carbon. Deviations from the $^{13}C/^{12}C$ ratio are extremely small and carbon isotope ratios, as measured by mass spectrometry, are expressed as deviations from a standard, the Pee Dee Belemnite carbonate (PDB standard) in parts per thousand (parts per mil; $^{o}/oo$). Positive deviations indicate ^{13}C enrichment and conversely, negative deviations indicate ^{13}C impoverishment.

While the carbon isotope ratios of oils and rock extracts can range from -20 to -32 $^{o}/oo$ depending on the source organic matter type, the difference between a specific oil and its source is small. Measurements are usually made on the C_{15+} alkane and aromatic hydrocarbon fractions separately and there should be no more than 1 $^{o}/oo$ difference between the oil and its source for either fraction. If there is any doubt that the source rock extracts are not indigenous to the source rock kerogen, the carbon isotope ratio of the extracted source rock kerogen can be measured.

Pyrolysis-Gas Chromatography

The hydrocarbon pyrolysate derived from thermal, anhydrous cracking of kerogen is analysed by capillary gas chromatography. A few mg of rock, kerogen or asphaltene is heated to 600°C for 20 seconds in the injector of a gas chromatograph. The chromatograph oven is kept at -30°C during pyrolysis and then raised to 300°C at a programmed rate of 7.5°C/minute. Chromatograms produced this way are often very different from those of source rock extracts or oils in that branched and cyclic isomers are generated freely giving numerous, closely spaced peaks, along with unsaturated, alkene (olefin) hydrocarbons. The "doublet" peaks often observed in these chromatograms comprise alkene-alkane pairs, the first eluting, and usually smaller peak, being the alkene. The chromatograms range from C_1 to C_{30} or above and although variable, are broadly characteristic of source rock type. Gas-prone kerogen cracks to give a more limited molecular weight range of products, concentrated towards the light ends, whereas oil-prone kerogen gives more prominent alkene-alkane doublets in the C_{12} to C_{30} region. The largest peak from both types is usually methane.

Elemental Analysis

Total (unsieved) kerogen is prepared as described in Section 1. The dried material is combusted in oxygen in an elemental analyser and the oxides of carbon, hydrogen, nitrogen and sulphur are measured. The unburnt residue is the ash content. Oxygen is usually calculated by difference but can be determined separately if required. Results are quoted as percentage weights of C, H, O, N, S and Ash with the atomic ratio H/C and O/C calculated and plotted on the standard van Krevelen diagram. The relative amounts of C, H and O present in organic matter are dependent on both source and maturity. At known maturity levels, some measure of source quality may be determined. Limitations of the method in source rock assessment involve the difficulty of obtaining pure kerogen (in particular, free from pyrite) and the lack of a simple, direct determination of oxygen content.

4. Oil Analysis

RRI laboratories offer a wide range of oil analyses both for geochemical purposes and industrial use. Physical property determinations are based mainly on IP methods and are available for lubricating oils, fuels and greases as well as crudes. Frequently measured properties of crude oils presented in geochemistry reports include: API gravity, pour point, viscosity and contents of water, sulphur, wax, asphaltene, nickel, vanadium and other metals. Chemical analysis of oils involves the following:

Whole oil gas chromatography - using split syringe injection and a temperature programme from -20°C or -30°C up to 270°C at 4°C/minute.

Associated gas - if oil has high gas/oil ratio.

Gasoline analysis - as for gasolines in rock samples but a weighed quantity of oil is used.

Topping of the oil - this is equivalent to the removal of the fraction boiling below about 210°C and gives a more standardised product for comparison of gas chromatograms of the C_{15+} fraction.

Column chromatography and gas chromatography - as for solvent extracts. Analysis is carried out on topped oil.

5. Gas Analysis

The hydrocarbon gases, C_1 to C_4, may be collected from the airspace of sealed canned samples or may be received from well-site tests in a special sealed gas cylinder (gas mouse). Chromatographic separation of the C_1 to C_4 gases is effected as described under airspace gas analysis. In addition, the separated gas components may be analysed for stable carbon and hydrogen isotope composition which may provide valuable clues to the origin of the gas.

6. Solid Bitumen Analysis

In some oil fields, problems are encountered where bitumen developments form continuous or patchy layers within reservoirs, dividing the pay zones and acting as barriers to natural fluid movement or inhibiting enhanced oil recovery techniques. Integrated geochemical and sedimentological studies aim to produce geological models capable of predicting the occurrence of bitumen layers and their likely thickness and ability to act as permeability barriers. Of further concern are the past or present relationships between the bitumen and reservoired oil, their source rocks and the timing of bitumen formation.

Analysis schemes involve screening of samples by assessing the amount of bitumen in polished core pieces using reflected light microscopy, followed by solvent extraction of control samples to estimate the proportion of solvent soluble bitumen. Different phases of bitumen formation are differentiated by reflectance measurement as described for vitrinite reflectance measurement. Soluble extracts are fractionated to give alkane, aromatics, asphaltene and resene components. Separated bitumens may be subjected to elemental analysis.

Kerogen Typing Scheme for Transmitted White and Incident Blue/U.V. Light

General Properties	RRI Report Data Tables	Type *
Sapropelic (Oil-prone gas-prone at high maturity)	Algal Sapropel	Type I
	Waxy Sapropel	Type II
Humic (Gas-prone)	Vitrinite	Type IIIA
	Inertinite	Type IIIB

Amorphous		Structured	
Non-Fluorescent	Fluorescent	Non-fluorescent	Fluorescent
Type I/II at high maturity (SCI >7.5)	Type I Sapropel Type II (degraded spores) Soft bitumens	Vitrinite (Type IIIA) brown/black, woody tissue	Cuticle Spores Pollen Dinocysts (Type II)
Type IIIA/B			
Oil residues (bitumens) Mineral (undigested) Grease contamination Mud additives		Inertinite (Type IIIB) very dark brown/black, woody tissue	Resinite Algae (Tasmanites, Botryococcus etc.)
		Solid bitumen - brown/ black (oil residue) often with crystal imprints	(Type I)
		Microforaminifera, chitinozoa etc. (Not usually important)	
		Spores, cuticle etc. at high maturity levels	
		Mud Additives - walnut etc.	

* Types I, II, III approximately sensu Tissot et al but Type III subdivided into IIIA (vitrinite) and IIIB (inertinite)

APPENDIX TABLE 1

APPENDIX 3 . 1

HISTOGRAMS, DATA AND STATISTICS
FOR VITRINITE REFLECTIVITY

COMPANY : PHILLIPS NORWAY
WELL : N2/7-12S
LOCATION : NORWEGIAN NORTH SEA

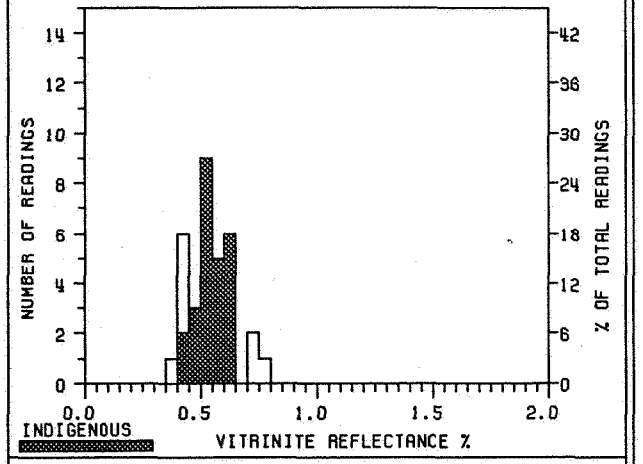
SAMPLE DATA
DEPTH: 13640.0-860.0 FT
CODE :
TYPE : CTGS
PROJECT : 21883
SAMPLE : 9L0044
BLOCK: BLOC KEROGEN

STATISTICS

POPN 1 - INDIGENOUS
MEAN VALUE : .54 %
STD DEVIATION : .06 %
NO. OF VALUES : 25
RANGE : .44 TO .63 %

POPN 2 - SEMIFUS/REWORK
MEAN VALUE : .73 %
STD DEVIATION : .05 %
NO. OF VALUES : 3
RANGE : .70 TO .79 %

POPN 3 - CAVED
MEAN VALUE : .41 %
STD DEVIATION : .01 %
NO. OF VALUES : 5
RANGE : .39 TO .42 %

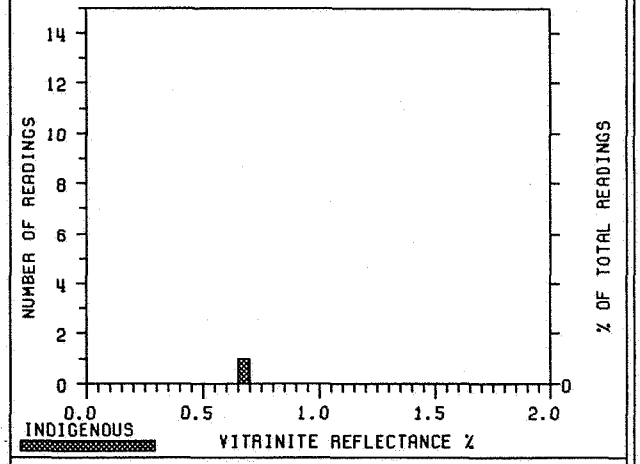


.39	.45	.52	.56	.62
.40	.48	.52	.56	.63
.41	.48	.52	.57	.70
.42	.50	.54	.60	.71
.42	.50	.54	.60	.79
.44	.51	.55	.60	
.44	.52	.56	.62	

SAMPLE DATA
DEPTH: 14320.0-340.0 FT
CODE :
TYPE : CTGS
PROJECT : 21883
SAMPLE : 9L0063
BLOCK: BLOC KEROGEN

STATISTICS

POPN 1 - INDIGENOUS
MEAN VALUE : .65 %
STD DEVIATION : ----
NO. OF VALUES : 1
RANGE : .65 TO .65 %



.65

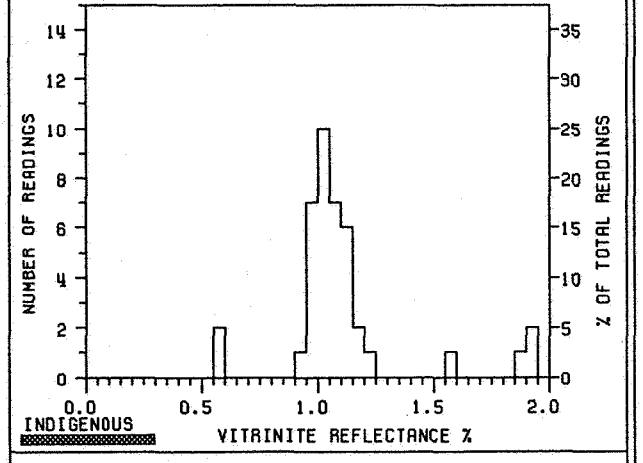
SAMPLE DATA
DEPTH: 14267.3 FT
CODE :
TYPE : CORE
PROJECT : 21883
SAMPLE : OA0898PB
BLOCK: BLOC WHOLE ROCK

STATISTICS

POPN 1 - BITUMEN
MEAN VALUE : .57 %
STD DEVIATION : .01 %
NO. OF VALUES : 2
RANGE : .56 TO .58 %

POPN 2 - BITUMEN
MEAN VALUE : 1.05 %
STD DEVIATION : .07 %
NO. OF VALUES : 34
RANGE : .92 TO 1.22 %

POPN 3 - BITUMEN
MEAN VALUE : 1.82 %
STD DEVIATION : .17 %
NO. OF VALUES : 4
RANGE : 1.56 TO 1.92 %



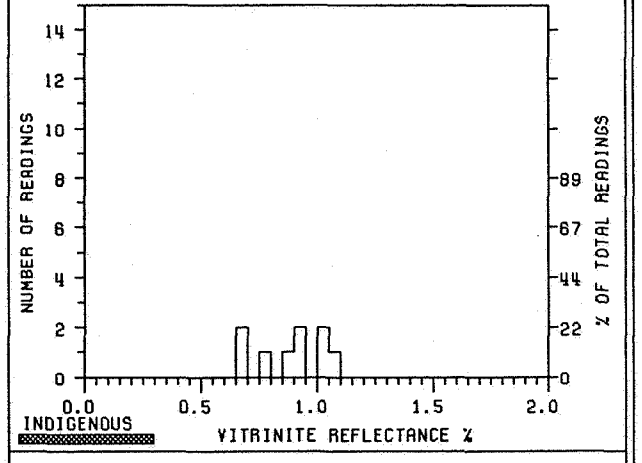
.56	.99	1.02	1.05	1.12	1.22
.58	.99	1.03	1.05	1.12	1.56
.92	.99	1.03	1.07	1.12	1.88
.96	1.00	1.03	1.08	1.14	1.90
.96	1.01	1.04	1.09	1.14	1.92
.97	1.01	1.04	1.09	1.15	
.97	1.01	1.05	1.12	1.18	

SAMPLE DATA
DEPTH: 14456.0 FT
CODE :
TYPE : SWC
PROJECT : 21883
SAMPLE : OA1287
BLOCK: BLOC KEROGEN

STATISTICS

POPN 1 - BITUMEN
MEAN VALUE : .70 %
STD DEVIATION : .05 %
NO. OF VALUES : 3
RANGE : .66 TO .76 %

POPN 2 - BITUMEN
MEAN VALUE : .98 %
STD DEVIATION : .07 %
NO. OF VALUES : 6
RANGE : .88 TO 1.06 %



.66	1.03
.68	1.06
.76	
.88	
.93	
.94	
1.03	

APPENDIX 3 . 2

COMPANY : PHILLIPS NORWAY
WELL : N2/7-21S
LOCATION : NORWEGIAN NORTH SEA

HISTOGRAMS, DATA AND STATISTICS FOR VITRINITE REFLECTIVITY

SAMPLE DATA
DEPTH: 14520.0 FT
CODE :
TYPE : SWC
PROJECT : 21883
SAMPLE : DA1288
BLOCK: BLOC KEROGEN

STATISTICS

POPN 1 - BITUMEN
MEAN VALUE : .93 %
STD DEVIATION : .07 %
NO. OF VALUES : 11
RANGE : .85 TO 1.06 %

.85 .94
.86 .98
.87 .99
.87 1.06
.90
.93
.93

SAMPLE DATA
DEPTH: 15220.0-240.0 FT
CODE :
TYPE : CTGS
PROJECT : 21883
SAMPLE : DA0840
BLOCK: BLOC KEROGEN

STATISTICS

POPN 1 - BITUMEN
MEAN VALUE : .87 %
STD DEVIATION : ----
NO. OF VALUES : 1
RANGE : .87 TO .87 %

.87

SAMPLE DATA
DEPTH: 14980.0-000.0 FT
CODE :
TYPE : CTGS
PROJECT : 21883
SAMPLE : 9L0092
BLOCK: BLOC KEROGEN

STATISTICS

POPN 1 - INDIGENOUS
MEAN VALUE : .70 %
STD DEVIATION : .02 %
NO. OF VALUES : 3
RANGE : .69 TO .72 %

.69
.70
.72

SAMPLE DATA
DEPTH: 15294.5 FT
CODE :
TYPE : CORE
PROJECT : 21883
SAMPLE : DA0900PB
BLOCK: BLOC WHOLE ROCK

STATISTICS

POPN 1 - BITUMEN
MEAN VALUE : .57 %
STD DEVIATION : ----
NO. OF VALUES : 1
RANGE : .57 TO .57 %

POPN 2 - BITUMEN
MEAN VALUE : .98 %
STD DEVIATION : .06 %
NO. OF VALUES : 4
RANGE : .93 TO 1.04 %

POPN 3 - BITUMEN
MEAN VALUE : 1.30 %
STD DEVIATION : .09 %
NO. OF VALUES : 34
RANGE : 1.12 TO 1.46 %

POPN 4 - BITUMEN
MEAN VALUE : 1.58 %
STD DEVIATION : ----
NO. OF VALUES : 1
RANGE : 1.58 TO 1.58 %

.57	1.14	1.27	1.31	1.34	1.41
.93	1.16	1.27	1.31	1.34	1.42
.94	1.17	1.27	1.32	1.37	1.44
1.02	1.23	1.28	1.32	1.38	1.46
1.04	1.23	1.29	1.32	1.38	1.58
1.12	1.24	1.29	1.32	1.40	
1.13	1.25	1.30	1.32	1.40	