ELF R.E.
D. EXPLOR.
DEPARTEMENT GEOLOGIQUE CENERAL
LABORATOIRES

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2035 n° 6/1324 R
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15/3-1 WELL
(NORWAY)

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GEOCHEMICAL STUDY OF THE JURASSIC

B. PHILIPPE

Boussens - April 1976

Reference : Order n° 031207

LISTE DE DIFFUSION

DESTINATAIRES :

DIRECTION EXPLORATION	1
S.I.D.	2
DIVISION 2	1
DIVISION 2 - NORVEGE	17

C O N T E N T S

1 - INTRODUCTION

The main aims of this study are to characterize the syngenetical hydrocarbons and to estimate the source-rock potential of the Jurassic series. Furthermore a few analyses were carried out on some migrated products extracted from impregnated samples and on crude oils ; only a few analyses were carried out on crude oils as they were not available at the laboratory at the start of the interpretation. The study of all the crude products will be carried out subsequently.

This study takes into account the results of the optical studies on the organic matter carried out by J.F. RAYNAUD (Palynofacies and Thermal Alteration Index) and by P. ROBERT (Vitrinite Reflectance)*. The main results of the geochemical and optical studies are given on plate 6.

The analytical results of the organic inventory and of the hydrocarbon study (compositions of the extracts and oils, n-alkane distributions, etc...) are given in the appendices. The significant chromatograms are on the plates referenced in the text.

Abbreviations used in the text :

IOC = Insoluble organic carbon (weight %)
EOM = Organic matter extracted by chloroform (ppm)
TOC = Total organic carbon (weight %)
BR = Bitumen ratio (EOM/TOC) × 100
Pr = Pristane
Ph = Phytane
MCP = Methylcyclopentane
XI1 = n.C6/MCP
XI3 = (n.C6 + 1/4 (n.C7 - n.C6))/MCP
RR = Reflectance of the vitrinite
TAI = Thermal alteration index.

.../...

* "15/3-1 well, Norway - Laboratory studies on Jurassic and Lower Cretaceous sequences" - Report 2035 n° 5/1259 R, January 1976.

2 - ANALYSES CARRIED OUT ON CORE SAMPLES

2.1 - SYNGENETICAL HYDROCARBONS

One sidewall core sample of grey shale was studied at 3832 m, in the Lower Cretaceous. The vapor analysis shows that there is no light hydrocarbon, so this sample has no source-rock potentiality.

Several non-reservoir rocks of the Jurassic section, core samples between 3947 and 4149.4 m and 4 sidewall core samples at 4226.5, 4800, 4960 and 5050 m were studied.

2.1.1 - Brown black shales - Portlandian-Kimmeridgian

In these shales, between 3939 and 4200 m, the palynofacies is mainly composed of sapropelic amorphous matter.
The results of the organic inventory are given in Appendix 1.
They show that the IOC contents are variables, but that they are generally high.
The average IOC content is approx. 5 %.
The high IOC and the high to medium EOM values suggest that the non-reservoir levels are a good source-rock.
However the ER decreases downward between 3947 and 4149.4 m, this suggests, in view of the relatively homogeneous organic material (Palynofacies and chromatograms) and of the increasing maturation of the matter (chromatograms ; PR and TAI), that the portion of oil migrated from these levels increases downward.

The characterization analyses (cf. Appendices 2 ; chromatograms plate 1) show a few common geochemical characteristics :

- Pristane more abundant than Phytane and (Pr/n.C17)/(Ph/n.C18) $\not\approx$ 1.25 (Fig. 1).
- Predominance of the n-alkanes with even number of carbons between C16 and C24, mainly in the only slightly matured samples (e.g. the 3947 sample).
- Relatively low amount of thiophenic components.
- Relatively high amount of Benzene, Toluene and Xylene, chiefly in the 4149.4 which is more matured and has perhaps a slightly different organic matter (different S/A).
- The S/A ratios are 0.7 - 0.8, apart from 4149.4 (S/A $\not\approx$ 0.4) ; this is possibly due to a slight difference in the composition of the organic material.

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The diagenetical indices, Pr/n.C17 and Ph/n.C18, measured on the chromatograms of the saturates (Fig. 1) show an increase downward in the degree of diagenesis in agreement with the more regular and sharper decrease in the n-alkane distributions ; in particular, there is a considerable change between approx. 3950 and 4150, confirmed by the diagenetical indices measured on the vapor analyses which show a break in the XI1 and XI3 values between 3955 and 4149.4 m :

Core sample	3947	XI1 =	0.80	XI3 =	0.73
"	3948.7		0.81		0.78
"	3950.4		0.83		0.79
Cutting sample	3955		0.82		0.96
Core sample	4149.4		1.54		1.51

This increase of the maturation of the hydrocarbons is in agreement with the one of the kerogen in the same interval :

- alteration of the spores and pollens from 2.5 to 3.5+ ;
- vitrinite reflectance from 0.4 to 0.7 %.

Conclusion :

The shale levels of the Upper Jurassic roughly between 3950 and 4200 m contain, on average, 6 % of TOC. The extractable organic part is medium and decreases downward from 11 to 4 %. This organic inventory and the characterization analyses show that these levels are or have been a good source-rock, in agreement with the palynofacies which is chiefly composed of sapropelic amorphous flocks and with the diagenesis data. The extracts are mainly characterized by the Pr/Ph ratio which is approx. 1.25 together with the relatively low amount of thiophenic components and the abundance of aromatics in the vapor range (Benzene, Toluene and Xylene).

2.1.2 - Shale at 4226.5 m - Oxfordian

The vapor analysis of the sidewall core sample at 4226.5 m shows that there are no significant light hydrocarbons : this sample is not a source-rock level.

2.1.3 - Shales at 4800 and 4960 m - Callovo-Oxfordian

The quantities of the two sidewall core samples at 4800 and 4960 m are not sufficient to undertake a complete geochemical study, but a brief study was carried out.

The vapor analysis of 4800 m shows that there are light components with abundant aromatics (Benzene, Toluene and Xylene). The analysis of the saturated fraction of this sample is not very favourable due to the small quantity of saturates.

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The vapor analysis of 4960 m shows that there are abundant light components with aromatics (Benzene, Toluene and Xylene) ; the decrease in the n-alkane contents is less sharp than at 4090. The chromatogram of the saturated fraction shows that there is a large overall n-alkane content (# 350 ppm). The Pr/Ph ratio is roughly as in the syngenetical extracts from the Upper Jurassic. As the diagenetical index (XI3 = 2.15) is higher than those of the samples of the Upper Jurassic, this suggests a higher diagenesis in accordance with the more buried depth, though the Pr/C17 and Ph/C18 ratios are higher than at 4149.4. This suggests a higher initial isoprenoid content.

The sample from 4960 m is or has been undoubtedly a source-rock.

2.1.4 - Shales at 5050 m - Callovo-Oxfordian

The vapor analysis of the sidewall core sample at 5050 m shows that there are many light hydrocarbons whose content decreases between C4 and C9 ; there are very abundant aromatics (Benzene, Toluene and Xylene) which are probably linked with the nature of the organic material and with the high diagenesis (they are also present, but less abundant, in the Upper Jurassic).

The minianalysis of the saturates shows some well developped n-alkanes whose content decreases slightly in the C17 - C28 range. The total n-alkane content is low (# 30 ppm) but this is possibly due to the high diagenesis.
This sample has probably generated oil and presently perhaps generates gas with condensate or wet gas, in accordance with the high diagenesis.

2.2 - MIGRATED HYDROCARBONS

2.2.1 - Upper Jurassic between 3950 and 4150 m

The quantities of organic matter extracted by chloroform from the reservoir levels are given in Appendix 1.

The EOM values are low, though these reservoir levels are impregnated with oil ; this may be explained by the loss of the major part of the oil during and after the sampling of the core at the well, mainly because this oil is light* and the permeabilities are high (apart from the 3949.2 and 4149.7 levels).

The extract compositions of two samples are :

		3949.2	4.141.5
Asphaltenes	%	10.2	3.5
Resins	%	16.1	11.9
Hydrocarbons HC	%	70.6	82
Saturated HC	%	42.9	58.7
Aromatic HC	%	27.7	23.2
S/A		1.55	2.5

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* J. SAVELLI - December 1975 - Note 5/4/144 -
"Etude des fluides des fit 1, 4, 5bis, 6, 7 de 15/3-1".

These results show that the composition of those two extracts is not that of residual oils and that there is a difference between them, chiefly in the S/A ratios (probably due to the different state of diagenesis). The chromatograms (Plate 2) of the saturated HC fractions (samples 3949.2, 4084.3, 4141.5 and 4143.5) show that the oils are paraffinic and non-degraded and that there is a decrease in the n-alkanes contents about lighter than n.C17 (losses after sampling, always observed on the extract from impregnated samples). Furthermore the chromatograms of the saturates and the Pr/n.C17, Ph/n.C18 ratios plotted on Fig.1 show that the oil from 3949.2 is less evolved than the ones from the 4084.3, 4141.5 and 4143.5 samples which seem to have approx. the same state of maturation.

The oil from 3949.2 shows some analogies with the syngenetical extracts from 3947, 3948.7 and 3950.4, but the Pr/C17 and Ph/C18 are slightly higher. The oils from 4084.3, 4141.5 and 4143.5, more matured than the 3949.2 oil, have some analogies with the syngenetical extracts from 4089.7 and 4149.4, but the Pr/n.C17 and Ph/n.C18 are also slightly higher.

It is therefore probable that the oils have been generated by the adjacent shale levels, in spite of the difference in the Pr/n.C17 and Ph/n.C18 ratios.

2.2.2 - 4991 m core sample - Callovo-Oxfordian

EOM # 200 ppm

The chromatogram (Plate 2) of the saturates shows a relatively sharp decrease in the n-alkane contents ; the values of the Pr/n.C17 and Ph/n.C18 ratios plotted on Figure 1 are lower than the ones of the extracts from impregnated levels studied previously : this product is more matured, but the Pr/Ph is approx. 1.25 as for the other oils. This suggests that the geochemical characteristics of its source rock are approx. the same.

3 - ANALYSES CARRIED OUT ON CUTTING SAMPLES

The cutting samples selected contain a great quantity of shales but they are not always homogeneous, so the extracts studied may be syngenetical, migrated, mixed or even contaminated (cf. Fig. 2). Furthermore, there are probably some caving cuttings in all the samples and also some organic contaminants according to the optical studies.

The vapor analysis carried out on the cutting sample at 3835 m in the Lower Cretaceous shows that there are no significant light hydrocarbons as in the sidewall core sample at 3832 m. The Lower Cretaceous at the 3832 - 3835 m level is not a source-rock.

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3.1 - BROWN BLACK SHALES - PORTLANDIAN - KIMMERIDGIAN

. 3955 m - IOC = 3.7 - EOM = 7500 ppm - BR = 14 %

The vapor analysis Fig.3 shows that there is an enrichment by migrated hydrocarbons (in sandstony cuttings), but the organic material of the shales, in view of the light hydrocarbons, seems comparable, in quality and diagenesis, with the nearby core sample studied at 3950.4 m. The saturates have not been studied.

. 4075 m

The minianalysis of the saturates (Fig.3) shows that this sample is relatively rich (180 ppm of n-alkanes) and that there is a slight difference in the Pr/Ph ratio ($\neq$ 1) to the other extracts from the Upper Jurassic studies (Fig.1). This is possibly due to more reductive deposit conditions. On the other hand, the diagenesis state appears intermediate, between those of the 3950 and 4150 m samples.

3.2 - CUTTING SAMPLES BELOW 4300 m - CALLOVO-OXFORDIAN

According to the organic inventory and to the characterizations analyses, the series can be divided in two main intervals : 4300 - 4550 and 4700 - 5025 m.

3.2.1 - Cutting samples between 4300 and 4550 m

The results of the organic inventory are given in the Appendix 1.

They show that the IOC contents and the BR are relatively high. But the vapor analyses carried out on all these samples (Pl.3) show that there are relatively few abundant hydrocarbons lighter than C7 and then an increase in the n-alkane contents, suggesting that the major part of the matter extracted is migrated and explaining the relatively high BR.

The palynofacies of this interval is chiefly composed of ligneous matter with amorphous (non sapropelic ?) matter.
The source-rock potentiality is difficult to estimate because the cutting samples are not homogeneous, but it appears low.

3.2.2 - Cutting samples between 4700 and 5025 m

The results of the organic inventory are given in Appendix 1.

They show that the IOC contents are relatively high and that the BR are medium. The vapor analyses (Pl.4) show that these samples contain some light hydrocarbons and the chromatograms of the saturates show generally two populations. This is possibly due to two products mixing (caving cuttings of different shales or siltstones with migrated product) or to an heterogeneous kerogen.

.../...

The general histograms of the n-alkanes (saturate and vapor analyses ; see appendices) at 4785, 4915 and 4950 m show that these products are probably mainly syngenetical. The XI1 and XI3 indices are variable and the Pr/C17 and Ph/C18 ratios, slightly higher than at 4149.4 m, are perhaps linked to a slightly different organic material or to a different initial depositive conditions.
The palynofacies is composed of amorphous (sapropel ?) flocks and amorphous "coals" (highly cooked sapropel ?).

If the cuttings are representative the present oil yield of the shales of this interval seems relatively low but it is very probable that these shales have been an oil source-rock. In view of the possible mixing it is difficult to know the exact composition of the syngenetical extract and therefore to characterize it. On the other hand the brief analyses carried out on the 4800 and 4960 sidewall cores (cf. 2.1.3) point out, by comparison, that the extracts from cutting samples are roughly representative of the series drilled.
The main geochemical characteristics appear approximately the same as the ones of the extracts from the Upper Jurassic : the Pr/Ph ratios are approx. 1.25 and there are abundant aromatics in the vapor range (Benzene, Toluene, Xylene), although the initial proportions of isoprenoides were probably higher.

4 - SOME ANALYSES ON CRUDE OILS

We have only recently received the crude oils, it is not possible to study them fully at the present time. Only a few analyses were carried out, viz :

analysis of the vapors on - fit 7 near 4090 m
- fit 6 near 4150 m
- fit 1 near 4445 m
and the composition of the crude oil of fit n° 1.

The chromatograms of the vapor analyses are roughly the same for the 3 crude oils ; there are abundant aromatics (Benzene, Toluene, Xylene) and the XI3 ratios are about 2.4. So it seems that the diagenesis state of generation and the geochemical characteristics are about the same, but a complete study will be necessary to confirm this one way or the other.

The composition of the crude oil of fit n° 1 shows that the S/A ratio is high (≥ 3) by comparison with the S/A (<1) of the possible source-rocks, this shows an enrichment in saturates in the migrated hydrocarbons.
The chromatogram of the saturates of the oil from Fit 1 shows some analogies with the ones of the extracts from the Jurassic (e.g. extracts at 4149.4 and 4960 m), however, in view of its relatively high diagenesis and of the relatively low decrease in n-alkane contents, the source-rock levels of the oil near 4445 m are probably the shales from the approx. 4700 - 5050 m interval.

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5 - MAIN CONCLUSIONS

5.1 - SOURCE-ROCKS

- The shales of the Upper Jurassic, approx. between 3950 and 4200 m, have an average TOC content of about 6 % and the oil yield quality of the organic material is good : they are or have been a good source-rock.

- The intervals of shales between 4200 and 4550 m do not seem to have a source-rock potentiality.

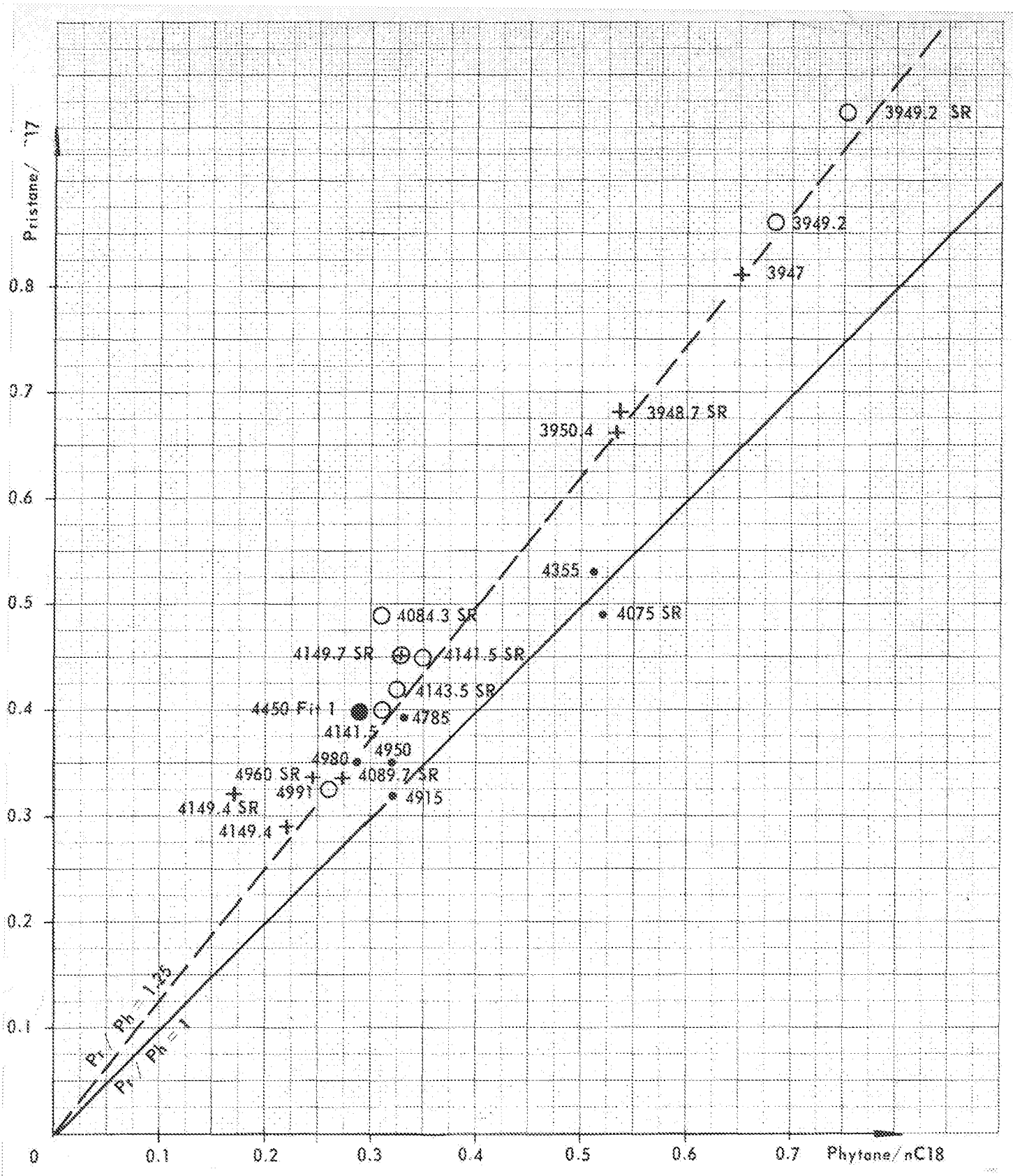
- The shale interval between 4700 and 5050 m contains some levels that have probably been a good oil source-rock.
  It seems that the main geochemical characteristics of the organic matter from these shales are approximately the same as the ones of the Upper Jurassic shales. At the present time no specific characteristic is known to distinguish without doubt the hydrocarbons from the 3950 - 4200 and 4700 - 5050 m intervals.

In view of the high diagenesis downward, the deeper source-rock levels may have generated some gases with condensate or wet gases.

5.2 - MIGRATED PRODUCTS

Only a few analyses were carried out on crude oils and on extracts from impregnated rocks. However, the following data can be underlined :

The migrated products, above 4500, are paraffinic high oils which show some analogies with the extracts from the 2 main source-rock intervals.
It is probable that the crude oils have been generated by the nearest source-rock levels.
On the other hand, the gas shows near the well bottom have probably been generated by the deeper source-rock levels in accordance with their high diagenesis.

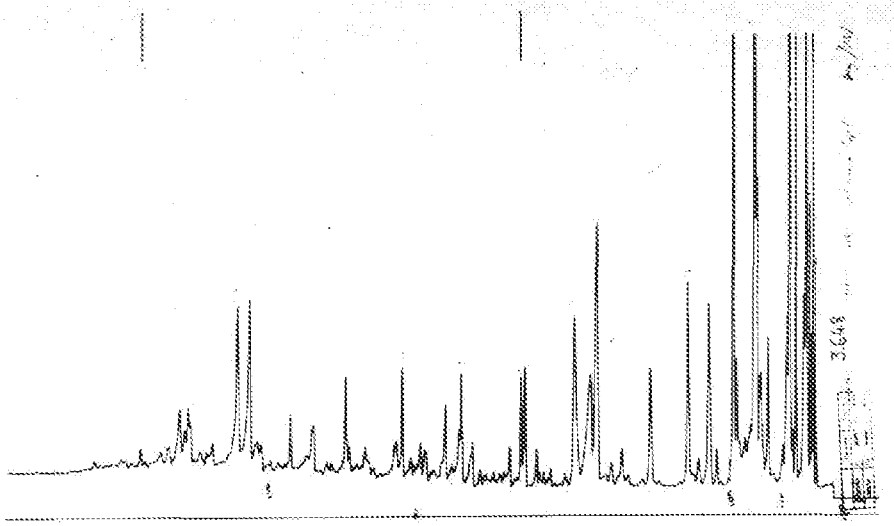


- Crude oil
- Migrated hydrocarbons (reservoir core sample)
- Syngenetical hydrocarbons (non-reservoir core sample)
- Migrated + syngenetical hydrocarbons (Heterogeneous core sample)
- Hydrocarbons from cutting samples (syngenetical, migrated or mixed)

1000 Depth ; measurements carried out on the saturate analysis of the extract by Chloroform

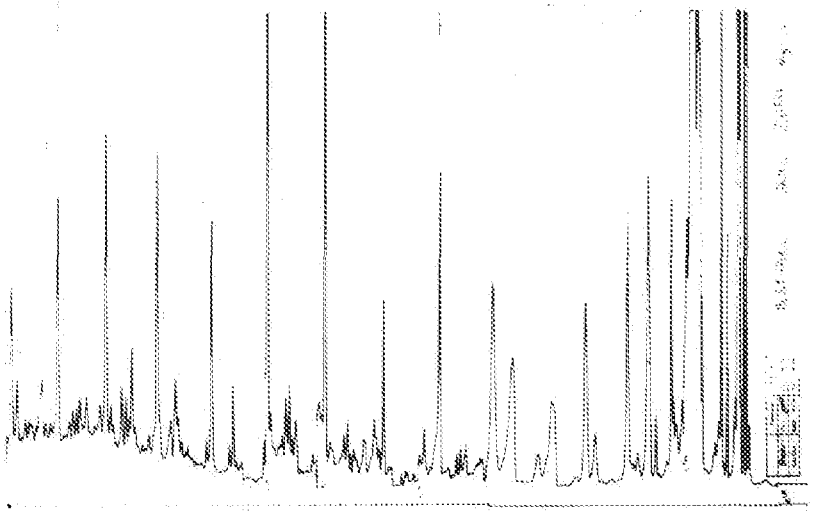
1000 SR Depth ; measurements carried out on the saturate analysis of the extract by Hexane on a small quantity of rock

Fig.1 : 15/3-1 WELL - PRISTANE / nC17 VERSUS PHYTANE / nC18



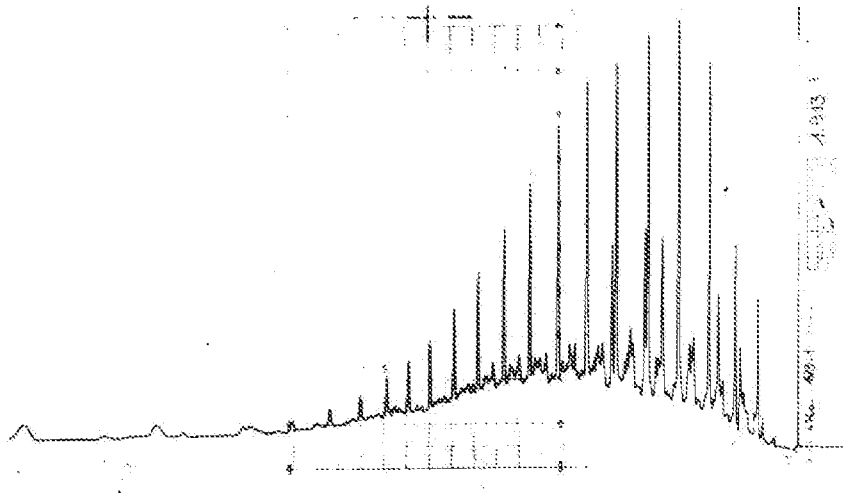
Vapor analysis

4760 m
Cutting sample washed
Syngenetical hydrocarbons



Vapor analysis

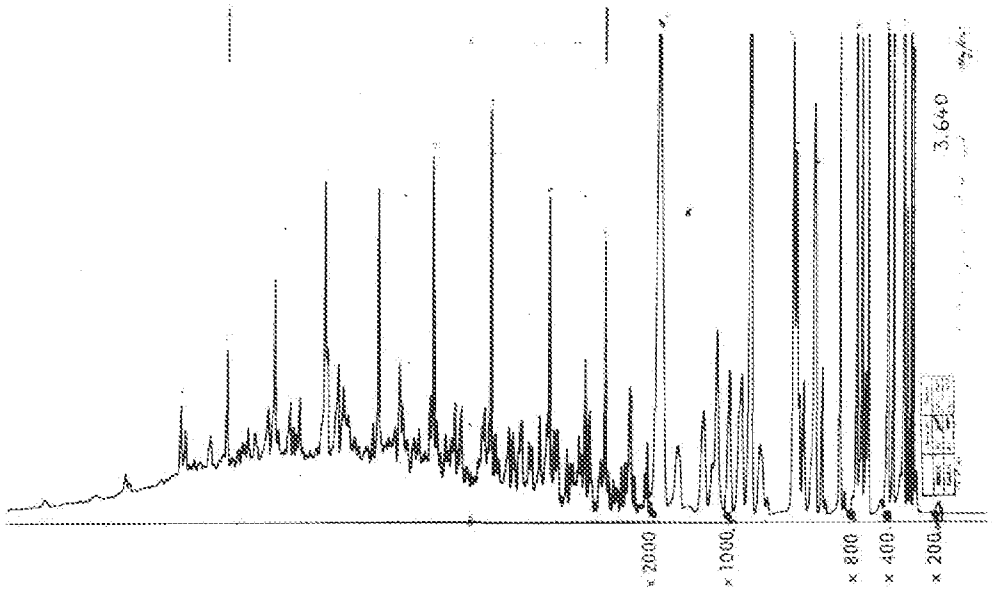
4760 m
Cutting sample unwashed
Light syngenetical HC
+ contamination by gas-oil



Minianalysis

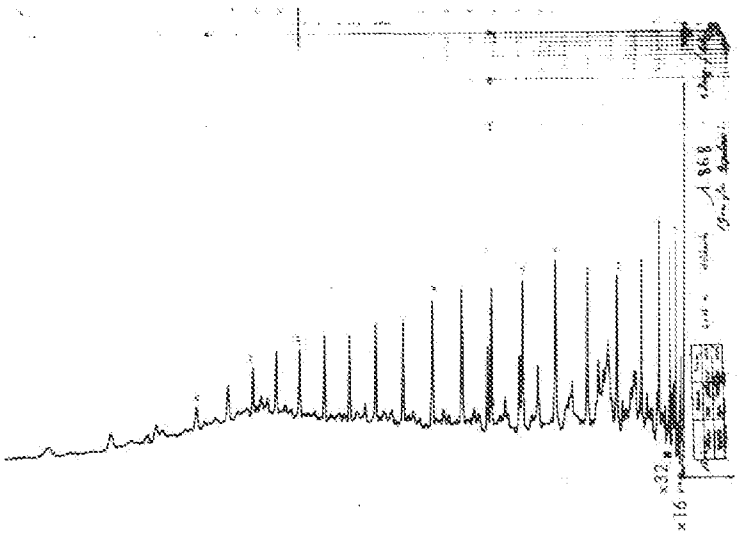
4760 m
Mud

Fig.2 : WELL 15/3-1 - PROBABLE CONTAMINATION BY GAS-OIL ADDED TO THE MUD



Cutting sample at 3955 m

Vapor analysis



Cutting sample at 4075 m

Minianalysis of saturates

Fig.3 : WELL 15/3-1 - CUTTING SAMPLES AT 3955 AND 4075 m

A P P E N D I X 1

RESULTS OF THE ORGANIC INVENTORY

depth (m)	sample	TOC %	EOM ppm	BR %
3835	cuttings	0.6	200	2.6
3947	core	8.2	13,300	11
3947.10	"	5.5		
3947.25	"	6.3		
3947.60	"	6.8		
3947.80	"	3.4		
3948	"	3.9		
3948.50	"	1.4		
3948.70	"	9	12,800	10
3948.75	"	>10		
3949.20	" (sandstone)	0.3	9,000	70
3949.75	"	5.5		
3950.25	"	0.25		
3950.40	"	7	10,200	10
3955	cuttings	3.7	7,500	14
4084.3	core (sandstone)	0.2	5,400	65
4085	"	5.5		
4085.75	"	0.4		
4088	"	6.1		
4088.25	"	4.8		
4088.50	"	1.2		
4088.75	"	3.7		
4089	"	4.8		
4089.25	"	6.2		
4089.50	"	7.0		
4089.70	"	2.5	2,300	7
4090	"	6.6		
4141.5	" (sandstone)	0.4	8,300	63
4143.50	" (sandstone)	0.2	6,200	72
4146	"	7.7		
4146.50	"	5.6		
4147	"	3.5		
4147.30	"	7.9		
4149.40	"	9.5	5,000	4
4149.70	" (shale + sandstone)	2.5	2,600	8
4355	cuttings	6.5	12,200	13
4405	"	4.5	8,300	13
4455	"	1.5	2,500	11
4535	"	0.4	1,100	18
4760	"	4	3,200	6
4785	"	8	4,000	4
4855	"	3		
4915	"	2.5	2,100	7
4950	"	2.5	1,500	4.5
4980	"	3	2,700	7
4991	core		170	
5025	cuttings	1.5		

A P P E N D I X 2

RESULTS OF THE HYDROCARBONS STUDIES

ROCK SAMPLES

A1	B1	3947 m	core
A2	B2	3948.7	core (minianalysis)
A3	B3	3949.2	core (minianalysis)
A4	B4	"	"
A5	B5	3950.4	core
	B6	3955	cuttings
A7	B7	4075	" (minianalysis)
A8	B8	4084.3	core (minianalysis)
A9	B9	4089.7	" (minianalysis)
A10	B10	4141.5	" (minianalysis)
A11	B11	"	"
A12	B12	4143.5	" (minianalysis)
A13	B13	4149.4	" (minianalysis)
A14	B14	"	"
A15	B15	4149.7	" (minianalysis)
A16	B16	4355	cuttings
	B17	4405	"
	B18	4455	"
	B19	4535	"
A20	B20	4760	cuttings (minianalysis on mud)
	B21	"	" (vapor analysis on washed cutting)
A22	B22	4785	"
A23	B23	4800	sidewall core (minianalysis)
	B24	4855	cuttings
A25	B25	4915	"
A26	B26	4950	"
A27	B27	4960	sidewall core (minianalysis)
A28	B28	4980	cuttings
A29	B29	4991	core
	B30	5025	cuttings
A31	B31	5050	sidewall core (minianalysis)

CRUDE OILS

	B32	Fit 7 at 4090
	B33	Fit 6 at 4150
A34	B34	Fit 1 at 4445 m.

A.4

MODVECP EXTRACT

ACT SAMPLE CORE DEPTH 3547 M WELL 15-3-1 LITHOLOGY *SHALE*

COMPONENTS

SAMPLE WEIGHT 149 MG

ASPHALTENES	7.90					
RESINES	27.60					
HYDROCARBONS	67.30	HEAVY SAT.	30.10	AROMATICS	37.20	LIGH
	S/A	0.81				

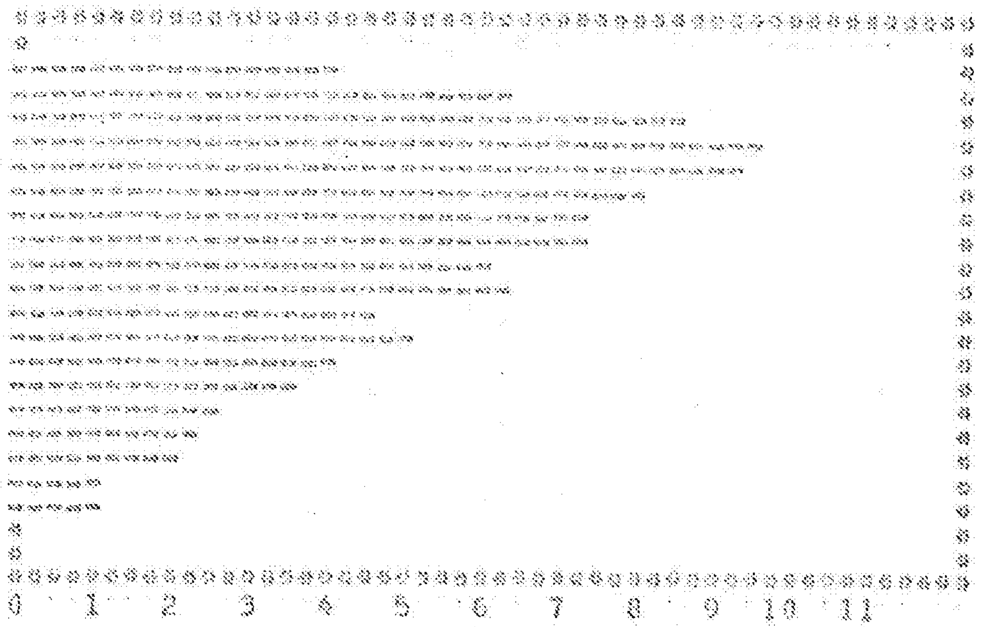
ANALYSIS OF SATURATES BY G.P.C.

N ALKANES (0/0 SATURATES) 9.60
ISOP C18 0.52
PRISTANE 0.72
PHYTANE 0.51

RATIOS PRISTANE/PHYTANE 1.42 PRISTANE/C17 0.81 PHYTANE/C18 0.64
RATIO 1.25

N ALKANES DISTRIBUTION

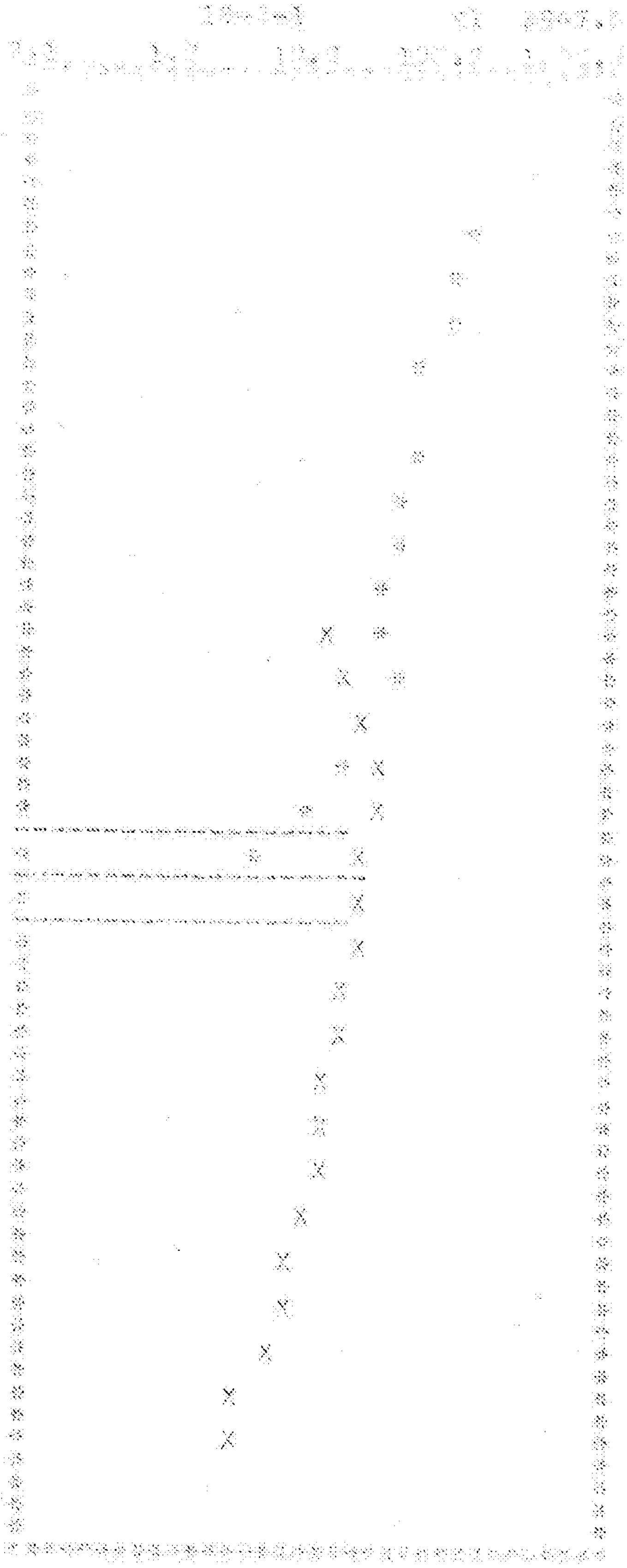
N C12	
N C13	4.04
N C14	6.45
N C15	8.62
N C16	9.71
N C17	9.21
N C18	8.18
N C19	7.34
N C20	7.29
N C21	6.19
N C22	6.20
N C23	4.80
N C24	5.10
N C25	4.05
N C26	3.54
N C27	2.64
N C28	2.35
N C29	2.03
N C30	1.10
N C31	1.10
N C32	
N C33	



CPI FROM NC16 TO NC20 0.967
CPI FROM NC20 TO NC30 0.958
CPI MAXIMUM (NC29) 1.202

C.OT $ 0/0
EOM 11950.00 PPM
HP 44 %

C1			
C2			
C3			
IC4		10.78	
C4		125.79	
IC5		72.68	
C5		116.[illegible]	
IC6		177.[illegible]	
C6		104.[illegible]	
IC7		290.02	
C7		70.[illegible]	
IC8		[illegible]	
C8			
IC9		321.69	
C9		66.06	
IC10		428.69	
C10		47.[illegible]	
IC11		639.67	
C11		56.91	
IC12		679.72	
C12		39.54	
IC13		535.72	
C13		34.91	13.96
IC14		491.71	
C14		48.78	23.27
C15		24.74	29.76
C16		19.61	33.53
C17		18.00	32.15
IC18			18.72
C18		4.56	29.23
IC19			25.59
C19			28.24
IC20			15.24
C20			28.16
C21			31.35
C22			21.61
C23			16.15
C24			17.72
C25			14.11
C26			12.22
C27			8.81
C28			3.13
C29			7.17
C30			3.81
C31			3.81
C32			
C33			



S IC1 A IC14 MAX= 719.74
S IC1 A IC14 MAX=4091.33

4811.07   N O/O TOTAL 16.96

XI1= 0.80

XI3= 0.73

NORVEGE MINTSAT.

ACS SAMPLE	DEPTH	2948.70	M	WELL	15/3-1	LITHOLOGY *SHALE*
	Core no 1					

COMPONENTS

ASPHALTENES
RESINES
HYDROCARBONS S/A HEAVY SAT. AROMATICS LIGH

ANALYSIS OF SATURATES BY G.P.C.

N ALKANES (PPM ROCK) 337.63
ISOP C18 19.59
PRISTANE 17.89
PHYTANE 11.60

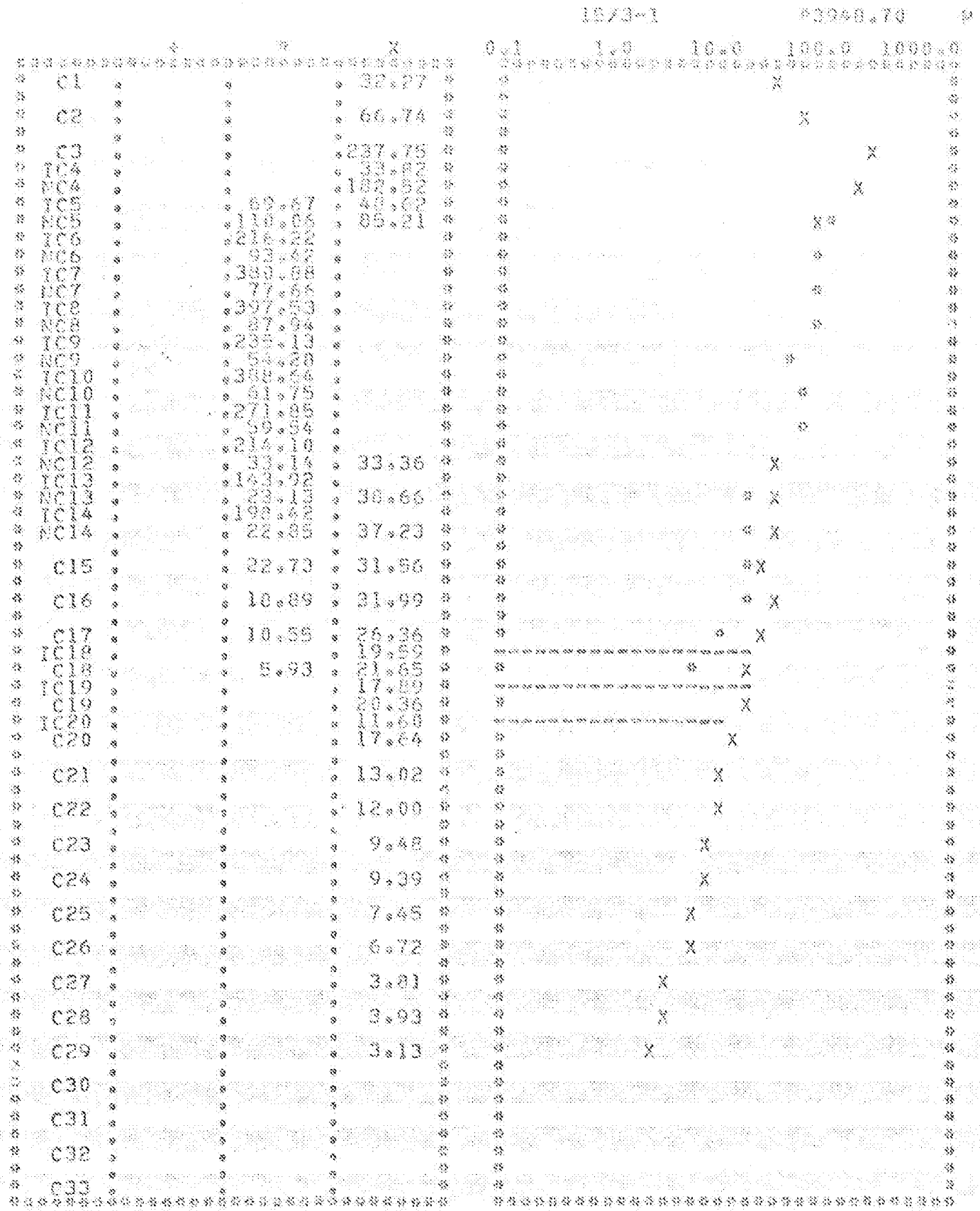
RATIOS PRISTANE/PHYTANE 1.54 PRISTANE/C17 0.67 PHYTANE/C18 0.53
RATIO 1.26

N ALKANES DISTRIBUTION

N C12	10.17
N C13	11.64
N C14	11.35
N C15	9.02
N C16	9.76
N C17	8.04
N C18	6.60
N C19	6.21
N C20	5.38
N C21	3.97
N C22	3.46
N C23	3.09
N C24	2.86
N C25	2.27
N C26	2.05
N C27	1.16
N C28	1.20
N C29	0.95
N C30	
N C31	
N C32	
N C33	

CPI FROM NC14 TO NC20 0.966
CPI FROM NC20 TO NC30 0.862
CPI MAXIMUM (NC19) 1.036

TOC 9 0/0
EOM 12,400 PPM
HC 41 %


IC/3-1
*30*0.70
0.1
1.0
10.0
100.0
1000.0
C1 32.27
C2 66.74
C3 237.75
C4 33.82
C5 182.62
C6 40.02
C7 85.21
C15 22.73 31.86
C16 10.89 31.99
C17 10.55 26.36
C18 5.93 21.65
C19 17.59
C20 20.36
C20 11.69
C21 17.64
C22 13.02
C23 12.00
C24 9.48
C25 9.39
C26 7.45
C27 6.72
C28 3.01
C29 3.93
C30 3.13
S NC1 A NC14 MAX=1173.24
S IC1 A IC14 MAX=2590.22
3723.46
N 0/0 TOTAL 31.51
XI1= 0.82
XI3= 0.78

SERVICES ANALYSIS

SAMPLE CORE DEPTH 3945.20 M WELL 16/3-1 LITHOLOGY SAMPLE TY

CONSTITUTS

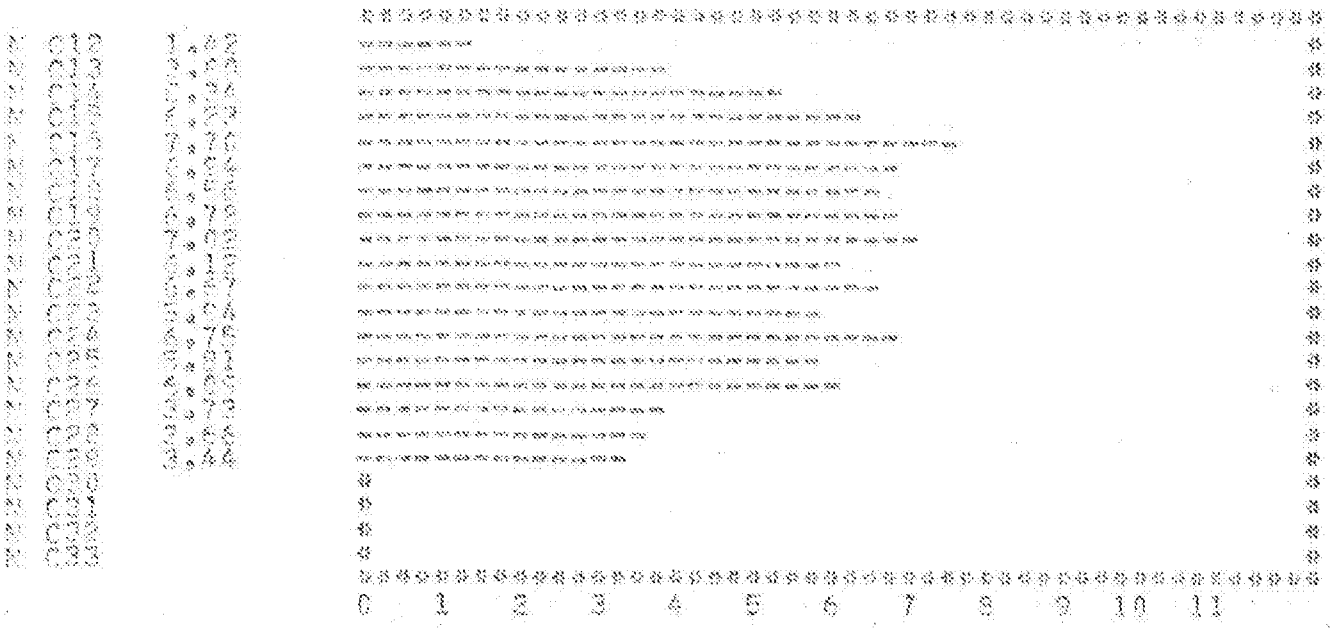
ASPHALTENES
RESINS
HYDROCARBONS S/A HEAVY SAT. AROMATICS LIGHT HC

ANALYSIS OF SATURATES BY G.P.C.

N ALKANES (PPM ROCK) 407.75
YSCP C19
PRISTANE
PHYTANE

RATIOS PRISTANE/PHYTANE 1.36 PRISTANE/C17 0.97 PHYTANE/C18 0.75
RATIO 1.29

N ALKANTS DISTRIBUTION

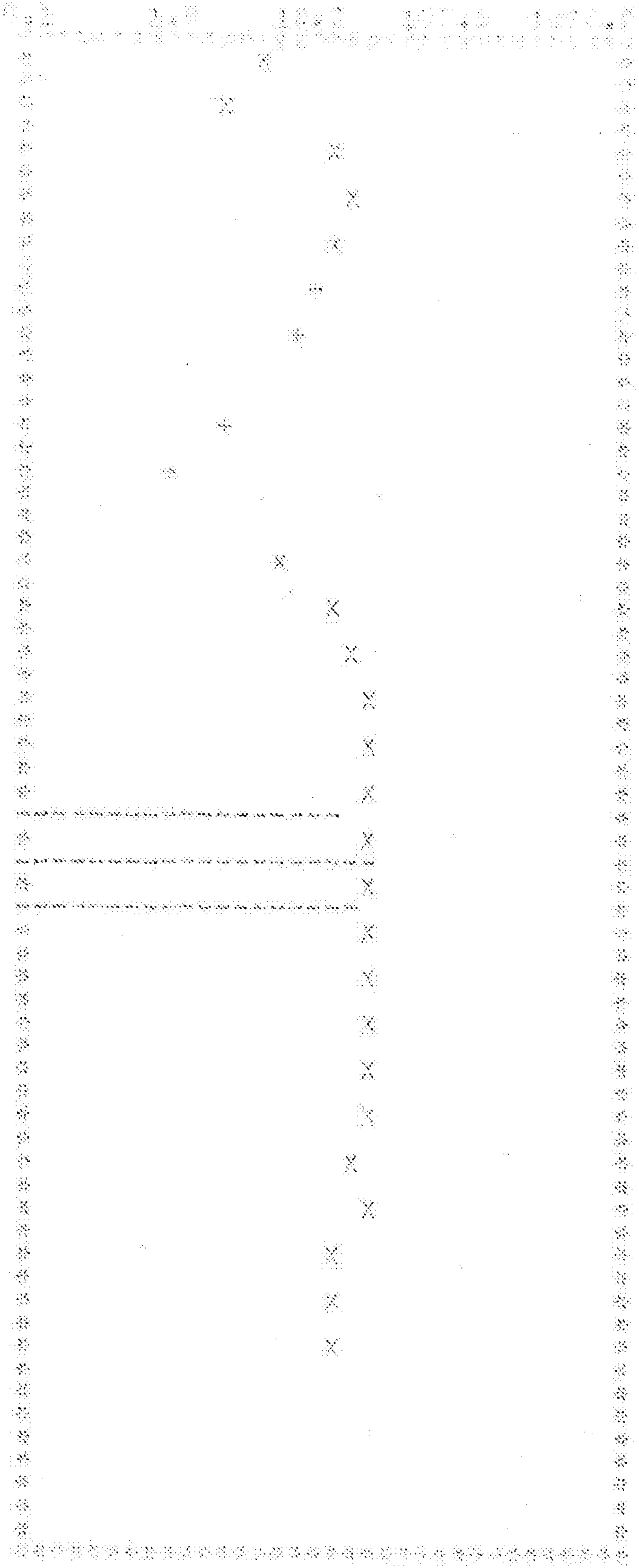


CPI FROM NC16 TO NC20 0.956
CPI FROM NC20 TO NC30 0.882
CPI MAXIMUP (NC19) 1.606

Ecc 0.3 0/0
Zn 9000 PPM

19-5-1 K14 3029.9

C1			4.02
C2			2.96
C3			14.02
IC4			13.40
NC4			19.20
IC5	8.32		9.33
NC5	13.26		18.95
IC6	13.40		
NC6	10.19		
IC7	32.97		
NC7	2.05		
IC8	35.80		
NC8			
IC9	19.20		
NC9	2.40		
IC10	22.86		
NC10	1.93		
IC11			
NC11			
IC12			Whianalyse
NC12			7.95
IC13			
NC13			13.49
IC14			
NC14			21.79
C15			29.41
C16			31.98
C17			28.90
IC18			17.41
C18			24.78
IC19			27.40
C19			27.66
IC20			25.10
C20			23.41
C21			24.97
C22			27.19
C23			24.20
C24			27.84
C25			23.71
C26			24.81
C27			10.21
C28			14.90
C29			14.04
C30			
C31			
C32			
C33			



S NC1 A NC14 MAX= 123.63
S IC1 A IC14 MAX= 127.14

250.77 % C/O TOTAL 49.39

XI1= [redacted]

XI3= [redacted]

SOURCE EXTRACT

ACP SAMPLE CORE DEPTH 3949.20 M WELL 15-3-3 LITHOLOGY Sandstone

COMPONENTS

SAMPLE WEIGHT 232 MG

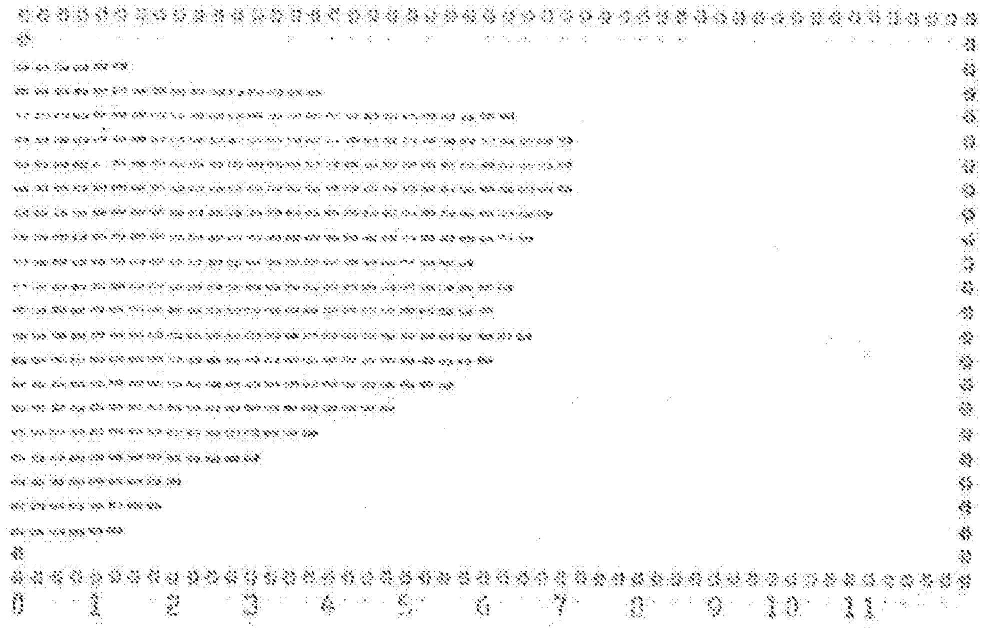
ASPHALTENES	10.20						
RESINS	16.10						
HYDROCARBONS	70.60	HEAVY SAT.	42.00	AROMATICS	27.70	LIGH
	S/A	1.52					

ANALYSIS OF SATURATES BY G.P.C.

N ALKANES (O/O SATURATES) 11.37
ISOP C18 0.38
PRISTANE 0.69
PHYTANE 0.54
RATIOS PRISTANE/PHYTANE 1.27 PRISTANE/C17 0.85 PHYTANE/C18 0.68
RATIO 1.25

N ALKANES DISTRIBUTION

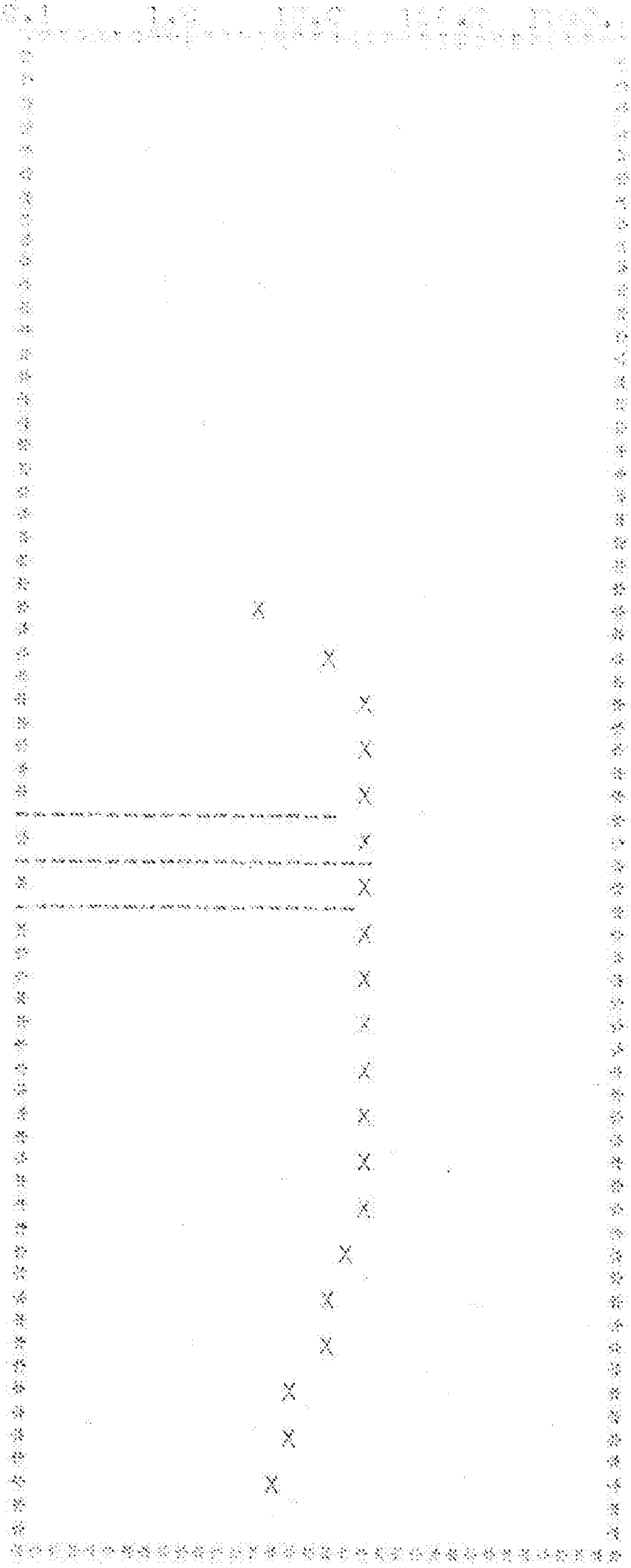
N C12	
N C13	1.29
N C14	3.91
N C15	6.35
N C16	6.95
N C17	7.16
N C18	7.08
N C19	6.78
N C20	6.02
N C21	5.20
N C22	6.47
N C23	6.07
N C24	6.59
N C25	6.00
N C26	5.60
N C27	4.58
N C28	3.94
N C29	3.19
N C30	1.97
N C31	1.76
N C32	1.43
N C33	



CPI FROM NC16 TO NC20 0.970
CPI FROM NC20 TO NC30 0.993
CPI MAXIMUM (NC29) 1.070

TOC 0.3 O/O
SOM 0898.00 PPM
PR

C1	
C2	
C3	
IC4	
NC4	
IC5	
NC5	
IC6	
NC6	
IC7	
NC7	
IC8	
NC8	
IC9	
NC9	
IC10	
NC10	
IC11	
NC11	
IC12	
NC12	
IC13	
NC13	9.40
IC14	
NC14	15.98
C15	27.55
C16	33.33
C17	31.06
IC18	14.69
C18	30.61
IC19	26.21
C19	29.38
IC20	20.59
C20	28.72
C21	25.56
C22	28.04
C23	26.32
C24	28.58
C25	26.00
C26	24.69
C27	21.14
C28	17.09
C29	13.92
C30	8.55
C31	7.63
C32	6.18
C33	



S NC1 A NC14 MAX= 22.39
S IC1 A IC14 MAX= 0.00
22.39 N O/O TOTAL 100.00

SOURCE EXTRACT

ACC DEPTH 3950.40 M WELL 15-3-1
SAMPLE CORE LITHOLOGY SHALE

CONSTITUENTS SAMPLE WEIGHT 185 MG

ASPHALTENES	10.30					
RESINS	22.30					
HYDROCARBONS	64.70	HEAVY DIT.	26.00	AROMATICS	37.00	LIGH
	S/A	0.71				

ANALYSIS OF SATURATES BY G.C.-G.S.

N-ALKANES (%) SATURATES)	14.91					
ISOP C18	0.36					
PRISTANE	0.26					
PHYTANE	0.53					
RATIOS	PRISTANE/PHYTANE	1.37	PRISTANE/C17 RATIO	0.66	PHYTANE/C18 RATIO	0.83
				1.23		

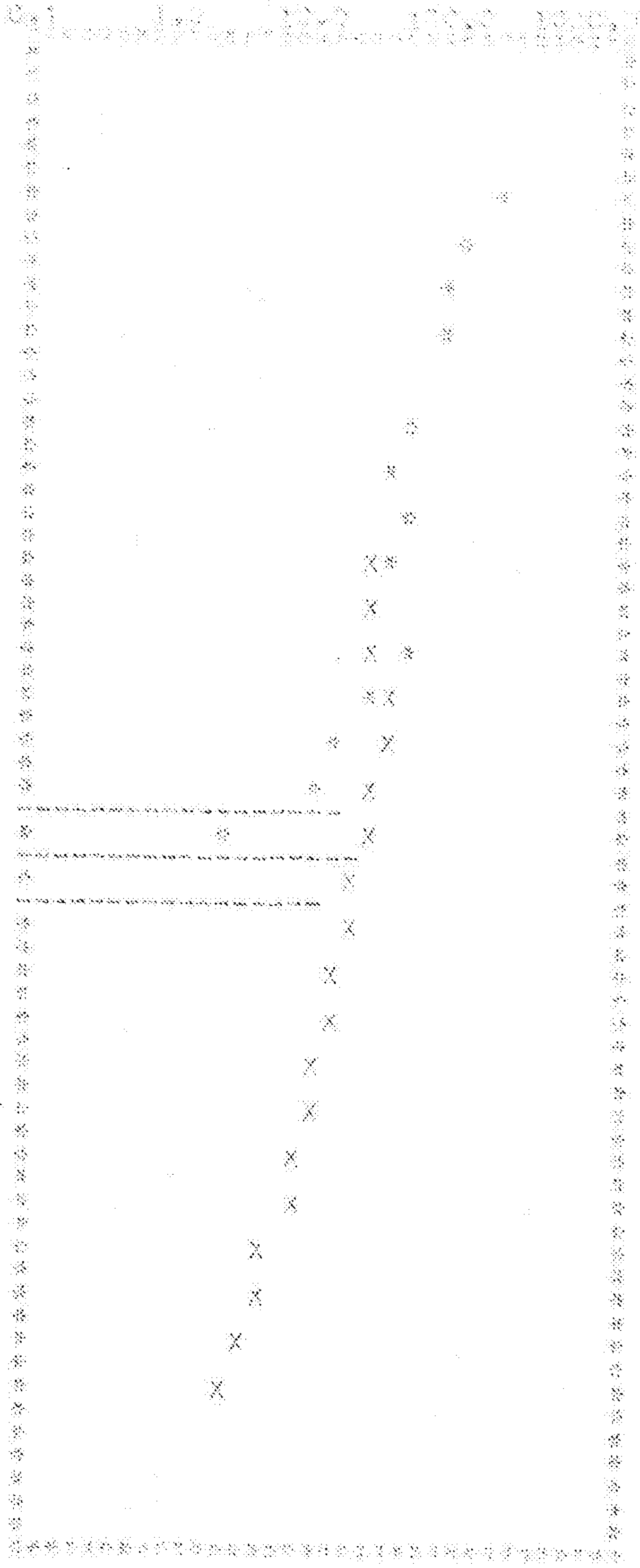
N-ALKANES DISTRIBUTION

CPI FROM NC15 TO NC20 0.942
CPI FROM NC20 TO NC30 0.928
CPI MAXIMUM (NC17) 0.962

ROC 7.2 %/O
TOC 9035.00 PPM
PR 40.5 %

15-3-1 X1 [illegible]

C1			
C2			
C3			
IC4		42.45	
NC4		193.00	
IC5		74.28	
NC5		120.87	
IC6		124.08	
NC6		51.90	
IC7		255.48	
NC7		78.99	
IC8		473.21	
NC8			
IC9		959.72	
NC9		61.02	
IC10		317.59	
NC10		40.55	
IC11		300.42	
NC11		44.61	
IC12		272.95	
NC12		38.93	23.75
IC13		317.19	
NC13		21.23	27.55
IC14		319.46	
NC14		43.97	30.81
C15		24.38	31.72
C16		15.77	22.97
C17		10.09	29.06
IC18			13.55
C18		3.01	25.30
IC19			14.40
C19			21.55
IC20			13.31
C20			20.39
C21			15.70
C22			14.85
C23			11.65
C24			12.49
C25			9.79
C26			9.23
C27			4.48
C28			4.77
C29			3.44
C30			2.57
C31			
C32			
C33			



S NC1 A NC14 MAX= 718.97
S IC1 A IC14 MAX=2855.70
3575.38 % C/O TOTAL 20.10

XI1= 0.83

XI3= 0.79

C1	22.39
C2	16.69
C17	2.41
C18	2.96

S NC1 à NC14 MAX= 226.66
S IC1 à IC14 MAX=1140.71

1376.18 N O/O TOTAL 16.49

XI1= 0.92

XI2= 0.06

A-7

NORSK HYDRO

AGE
SAMPLE cuttings DEPTH 4075.00 M WELL 16/3-1 LITHOLOGY

COMPONENTS

ASPHALTENES
RESINS
HYDROCARBONS S/A HEAVY SAT. AROMATICS LIGHT

ANALYSIS OF SATURATES BY G-P-C

N ALKANES (PPM ROCK) 178.39
TOTAL C15 5.59
PRISTANE 2.36
PHYTANE 2.72

RATIOS PRISTANE/PHYTANE 1.11 PRISTANE/C17 RATIO 0.49 PHYTANE/C18 0.52
0.93

N-ALKANES DISTRIBUTION

CPI FROM NC16 TO NC28 0.952
CPI FROM NC29 TO NC38 1.071
CPI MAXIMUM (NC29) 1.497

OC %/O
EOM PPM
EP

0.1
1.0
10.0
100.0
1000.0
C1 18.71
C2 16.95
C3 15.07
C4 16.46
C5 16.20
C6 12.88
C7 5.50
C8 10.07
C9 6.34
C10 9.50
C11 5.71
C12 8.85
C13 6.05
C14 6.31
C15 5.25
C16 5.17
C17 4.36
C18 3.66
C19 2.47
C20 2.29
C21 2.35
C22 0.65
C23
NC1 A NC14 MAX= 50.74
IC1 A IC14 MAX= 0.00
50.74
N O/O TOTAL 100.00

NORWEGE AINISAT.

SOF DEPTH 4084.30 M WELL 15/3-1
SAMPLE CORE 02 LITHOLOGY SANDSTONE

FRACTIONS

ASPHALTENES
RESINES
HYDROCARBURES

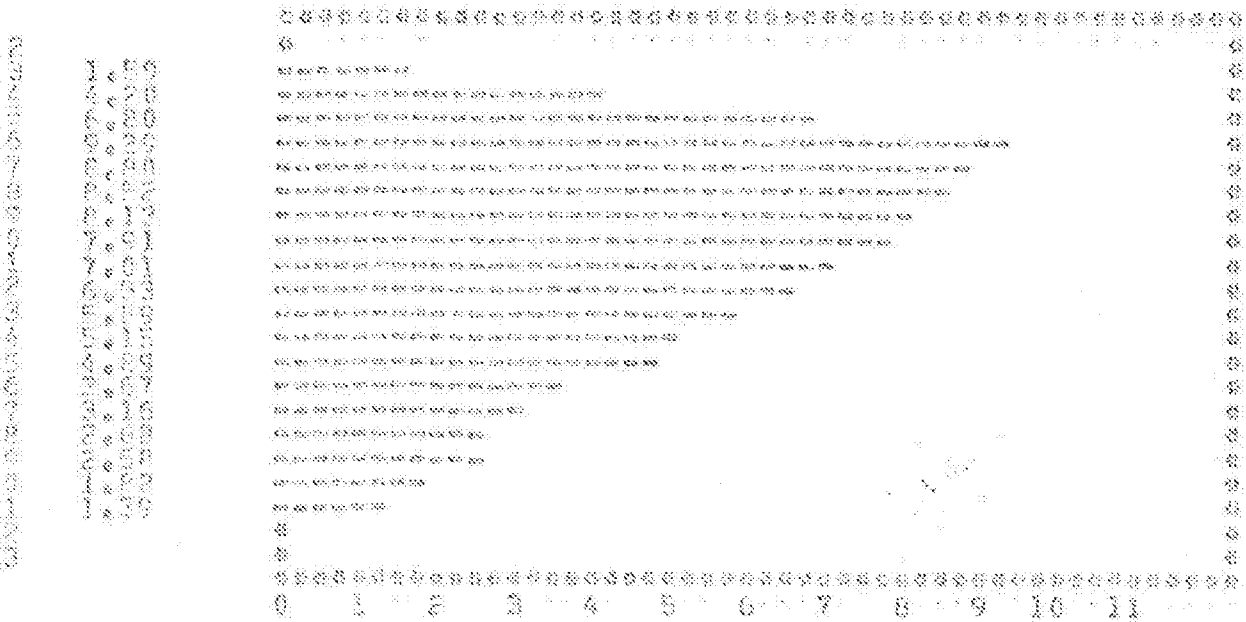
HEAVY SAT. AROMATICS LIGH
S/A

ANALYSIS OF SATURATES BY G.P.C.

N ALKANES FROM ROCK 1 294.77
ISOF C18 7.79
PRISTANE 10.73
PHYTANE 0.00

RATIOS PRISTANE/PHYTANE 1.59 PRISTANE/C17 0.98 PHYTANE/C18 0.21
RATIO 1.54

N ALKANES DISTRIBUTION

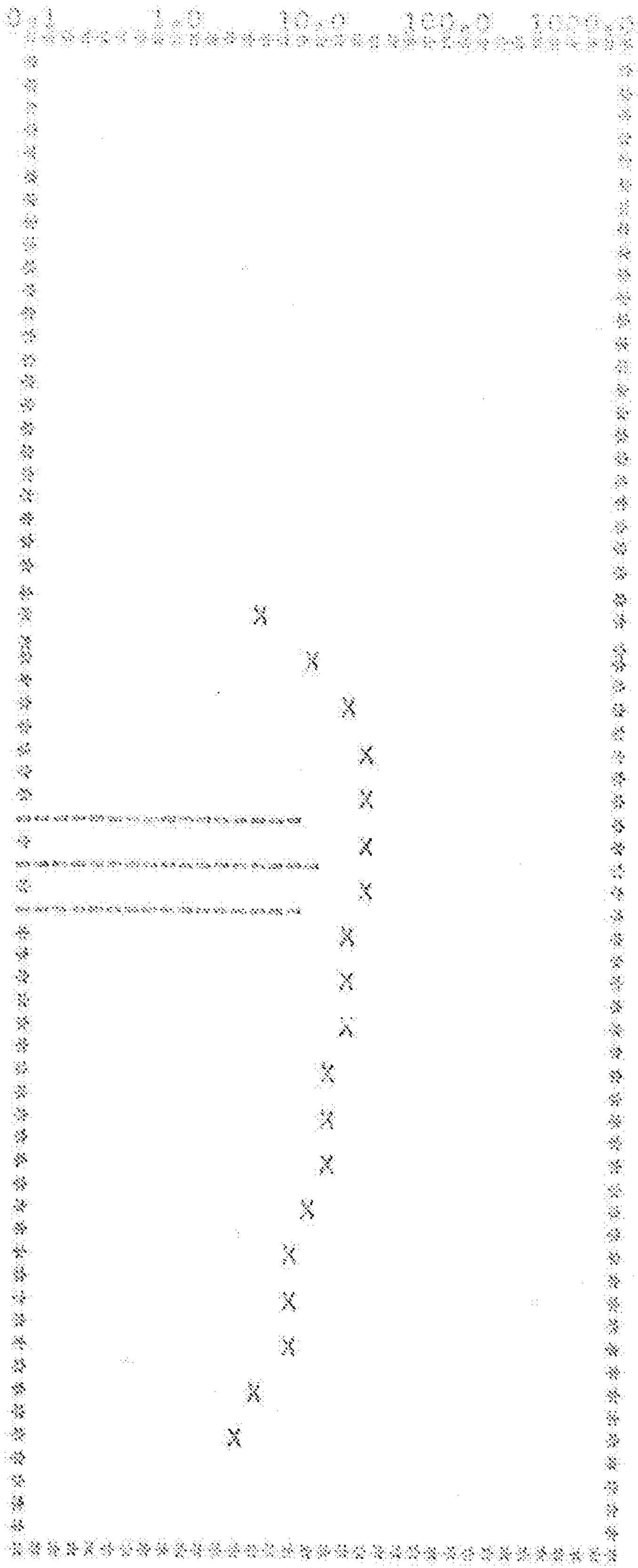


CPI FROM NC15 TO NC20 0.973
CPI FROM NC20 TO NC30 1.054
CPI MANTPUP (NC29) 1.146

TOC 0.2 %
TOM 574 PPM
PP

1973-1 * 4024.3

	*	*	X
C1			
C2			
C3			
IC4			
NC4			
IC5			
NC5			
IC6			
NC6			
IC7			
NC7			
IC8			
NC8			
IC9			
NC9			
IC10			
NC10			
IC11			
NC11			
IC12			
NC12			
IC13			
NC13			4.68
IC14			
NC14			12.37
C15			20.04
C16			27.37
C17			25.95
IC18			7.78
C18			25.11
IC19			12.72
C19			23.07
IC20			8.00
C20			23.30
C21			20.69
C22			19.26
C23			17.36
C24			15.19
C25			14.40
C26			10.82
C27			9.30
C28			7.91
C29			7.60
C30			5.35
C31			4.10
C32			
C33			



S NC1 A NC14 MAX= 17.05
S IC1 A IC14 MAX= 0.00

17.05 N O/O TOTAL 100.00

MONSIEUR PINICAT.

AGP
SAMPLE Core n°2 DEPTH 4085.70 M WELL 15/3-1 LITHOLOGY SHALE

COMPONENTS.

ASPHALTENES
RESINES
HYDROCARBONS S/A HEAVY SAT. AROMATICS LIGH

ANALYSIS OF SATURATES BY G.P.C.

N ALKANES (PPM ROCK) 58.76
ISOP C18 1.09
PRISTANE 1.51
PHYTANE 1.12

RATIOS PRISTANE/PHYTANE 1.35 PRISTANE/C17 0.33 PHYTANE/C18 0.27
RATIO 1.22

N ALKANES DISTRIBUTION

N	C12	5.00
N	C13	9.02
N	C14	9.31
N	C15	9.61
N	C16	8.84
N	C17	7.95
N	C18	7.23
N	C19	6.61
N	C20	5.36
N	C21	4.91
N	C22	4.03
N	C23	3.81
N	C24	3.58
N	C25	2.63
N	C26	2.25
N	C27	2.20
N	C28	1.82
N	C29	1.70
N	C30	1.14
N	C31	0.77
N	C32	0.79
N	C33	

CPI FROM NC16 TO NC20 0.999
CPI FROM NC20 TO NC30 1.043
CPI MAXIMUM (NC29) 1.148

TOC 9.4 0/0
EOM 2300 PPM
RR 7%

C1			0.54
C2			0.13
C3			0.29
C4			0.68
C5			0.24
C6			0.37
C7			0.36
C8			
C9			
C10			
C11			
C12			
C13			
C14			
C15			5.35
C16			5.14
C17			5.31
C18			5.48
C19			5.04
C20			4.83
C21			2.90
C22			2.30
C23			2.17
C24			2.04
C25			1.60
C26			1.28
C27			1.30
C28			1.04
C29			0.97
C30			0.63
C31			0.44
C32			0.45
C33			

S VC1 & VC14 MAX= 20.89
S IC1 & IC14 MAX= 39.93

60.82 N O/O TOTAL 34.35

X11= ▒▒▒

X13= ▒▒▒

NORWEGIAN? ... ?

SAMPLE [illegible] DEPTH 4141.10? M WELL 25/2-1? LITHOLOGY: SANDSTONE?

COMPONENTS

ASPHALTENES
RESINS
HYDROCARBONS S/A HEAVY SAT. AROMATICS LIGN

ANALYSIS OF SATURATES BY G.P.C.

N ALKANES (PPM ROCK) 613.59
ISOP C19 16.77
PRISTANE 22.22
PHYTANE 20.52

RATIOS PRISTANE/PHYTANE 1.22 PRISTANE/C17 0.49 PHYTANE/C18 0.35
RATIO 1.27

N ALKANES DISTRIBUTION

N C12	
N C13	0.78
N C14	3.52?
N C15	6.33?
N C16	9.01?
N C17	8.97?
N C18	9.30?
N C19	8.75?
N C20	7.86?
N C21	7.13
N C22	6.03?
N C23	5.37?
N C24	4.93?
N C25	4.01?
N C26	3.05?
N C27	2.58?
N C28	2.72?
N C29	2.33?
N C30	1.75?
N C31	1.70?
N C32	1.41
N C33	

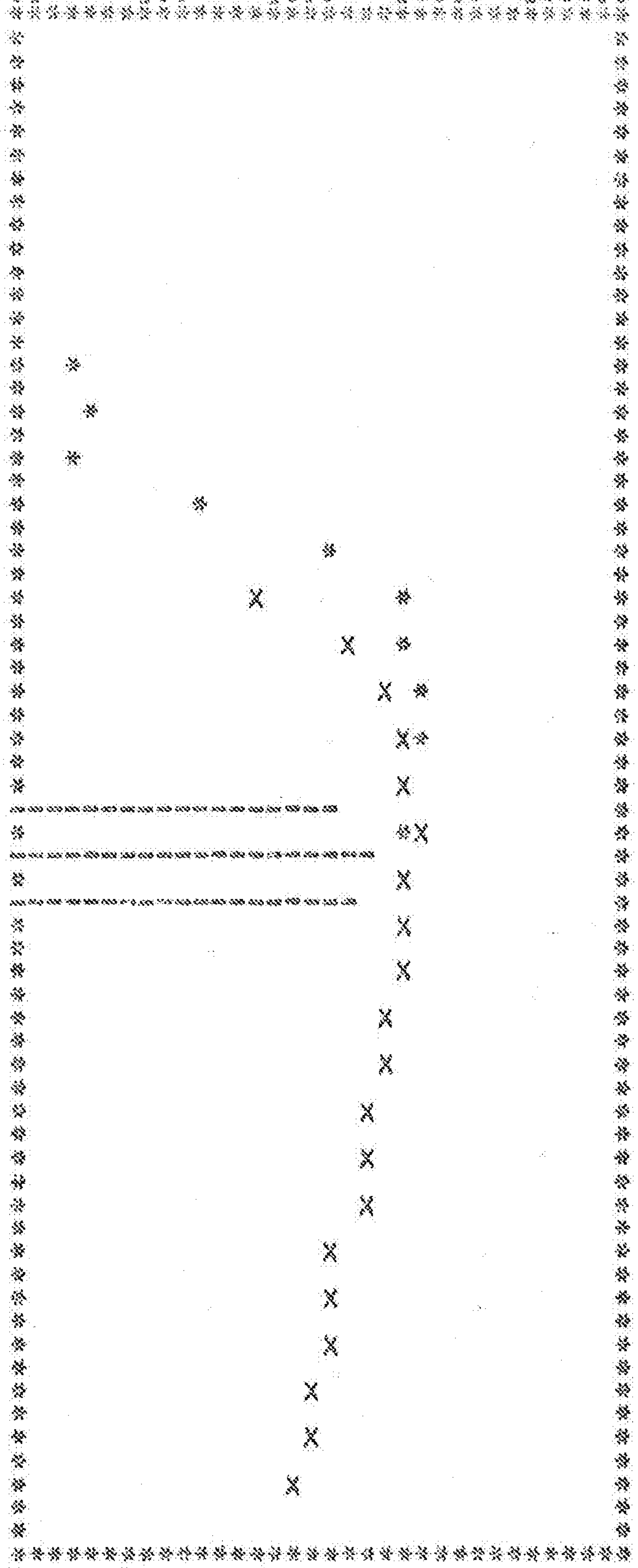
CPI FROM NC14 TO NC20 0.991
CPI FROM NC20 TO NC30 0.993
CPI MAXIMUM (NC25) 1.083

TOC 0.4 0/0
EOM 83.0 PPM
OP

15/3-1 * 4141.5

	+	*	X
C1			
C2			
C3			
IC4			
NC4			
IC5			
NC5			
IC6			
NC6			
IC7			
NC7			
IC8		0.91	
NC8		0.31	
IC9		0.50	
NC9		0.40	
IC10		0.36	
NC10		0.24	
IC11		0.78	
NC11		1.89	
IC12		4.88	
NC12		17.25	
IC13		42.25	
NC13		44.10	4.77
IC14		59.55	
NC14		51.90	21.57
C15		56.57	38.83
C16		61.37	55.32
C17		55.99	55.04
IC18			16.76
C18		44.79	57.08
IC19			25.21
C19			53.69
IC20			20.51
C20			50.71
C21			43.76
C22			36.98
C23			32.94
C24			30.28
C25			29.51
C26			24.23
C27			17.68
C28			16.68
C29			14.32
C30			10.73
C31			11.04
C32			8.68
C33			

0.1 1.0 10.0 100.0 1000.0



S NC1 A NC14 MAX= 116.11
S IC1 A IC14 MAX= 109.27

225.39 N 0/0 TOTAL 51.51

A 11

[illegible] EXTRACT

AGE DEPTH 4441.8 M WELL 15/3-1
SAMPLE [illegible] CORE No3 LITHOLOGY SANDSTONE

COMPONENTS

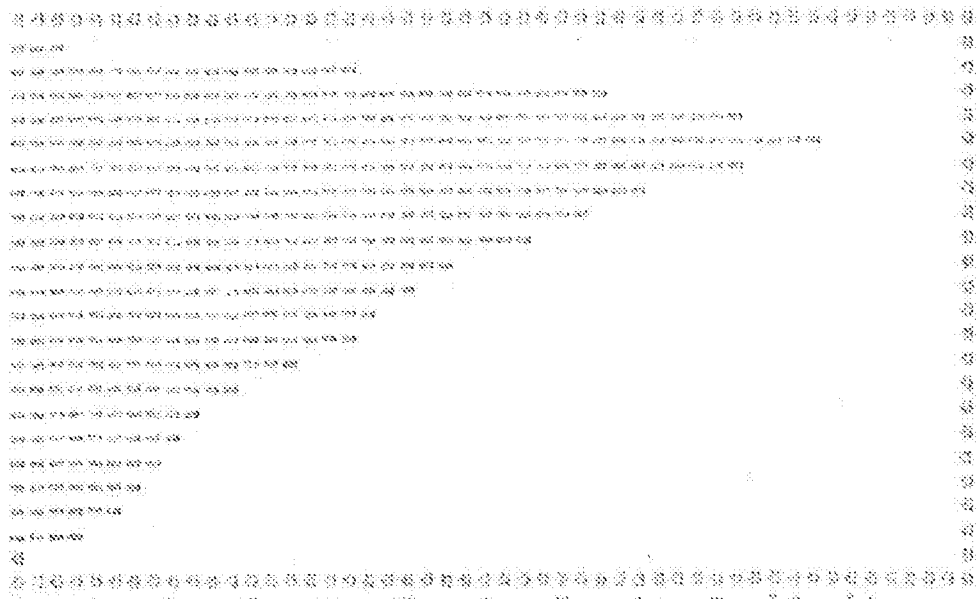
ASPHALTENES	3.80						
RESINS	11.30						
HYDROCARBONS	85.00	HEAVY SAT.	58.70	AROMATICS	23.20	LIGH[illegible]	
	S/A	2.50					

ANALYSIS OF SATURATES BY G.P.C.

N ALKANES (O/O SATURATES) 19.32
ISOP C18 0.91
PRISTANE 0.72
PHYTANE 0.49
RATIOS PRISTANE/PHYTANE 1.45 PRISTANE/C17 0.80 PHYTANE/C18 0.31
RATIO 1.27

N ALKANES DISTRIBUTION

N C12	0.69
N C13	4.36
N C14	7.51?
N C15	9.63
N C16	10.27
N C17	8.78?
N C18	8.10
N C19	7.53?
N C20	6.94?
N C21	5.61
N C22	5.31?
N C23	4.60
N C24	4.32?
N C25	3.68?
N C26	2.97
N C27	2.46?
N C28	2.20?
N C29	1.92?
N C30	1.51?
N C31	1.32?
N C32	0.80
N C33	

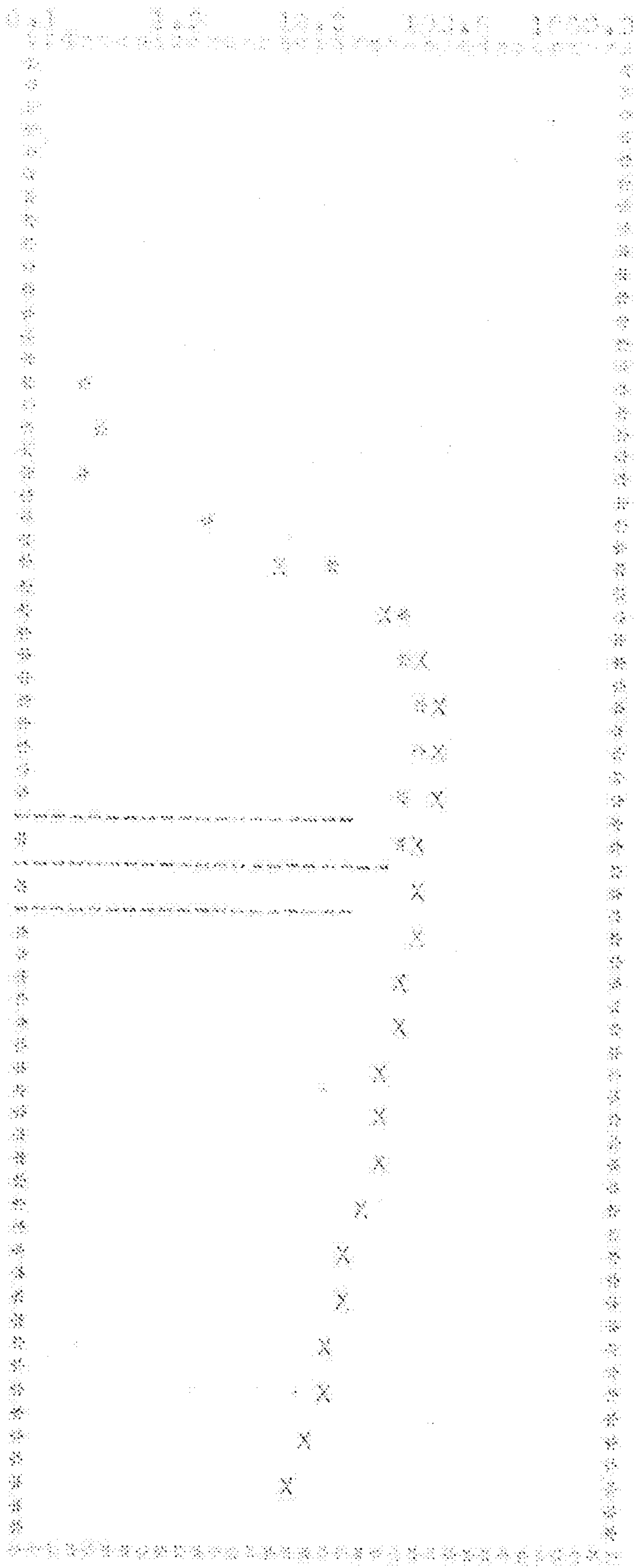


CPI FROM NC16 TO NC30 0.996
CPI FROM NC20 TO NC30 1.000
CPI MAXIMUM (NC29) 1.034

TOC 0.4 O/O
EOM 8930.00 PPM
S8

10-9-1 5141.5

C1			
C2			
C3			
IC4			
NC4			
IC5			
NC5			
IC6			
NC6			
IC7			
NC7			
IC8		0.91	
NC8		0.91	
IC9		0.50	
NC9		0.40	
IC10		0.33	
NC10		0.24	
IC11		0.78	
NC11		1.89	
IC12		4.83	
NC12		17.25	8.04
IC13		42.25	
NC13		64.10	38.77
IC14		92.83	
NC14		91.90	66.75
C15		56.07	83.81
C16		61.37	91.35
C17		55.09	92.19
IC18			23.47
C18		44.79	71.49
IC19			23.13
C19			60.09
IC20			22.35
C20			53.30
C21			49.93
C22			45.12
C23			40.91
C24			37.56
C25			32.71
C26			26.37
C27			21.90
C28			19.52
C29			17.03
C30			13.43
C31			11.70
C32			7.86
C33			



S NC1 A NC14 MAX= 130.96
S IC1 A IC14 MAX= 109.27
240.24 % C/O TOTAL 54.51

ANC DEPTH 4143.00 M WELL 15/3-1
SAMPLE CORE #3 LITHOLOGY SANDSTONE

COMMENTS

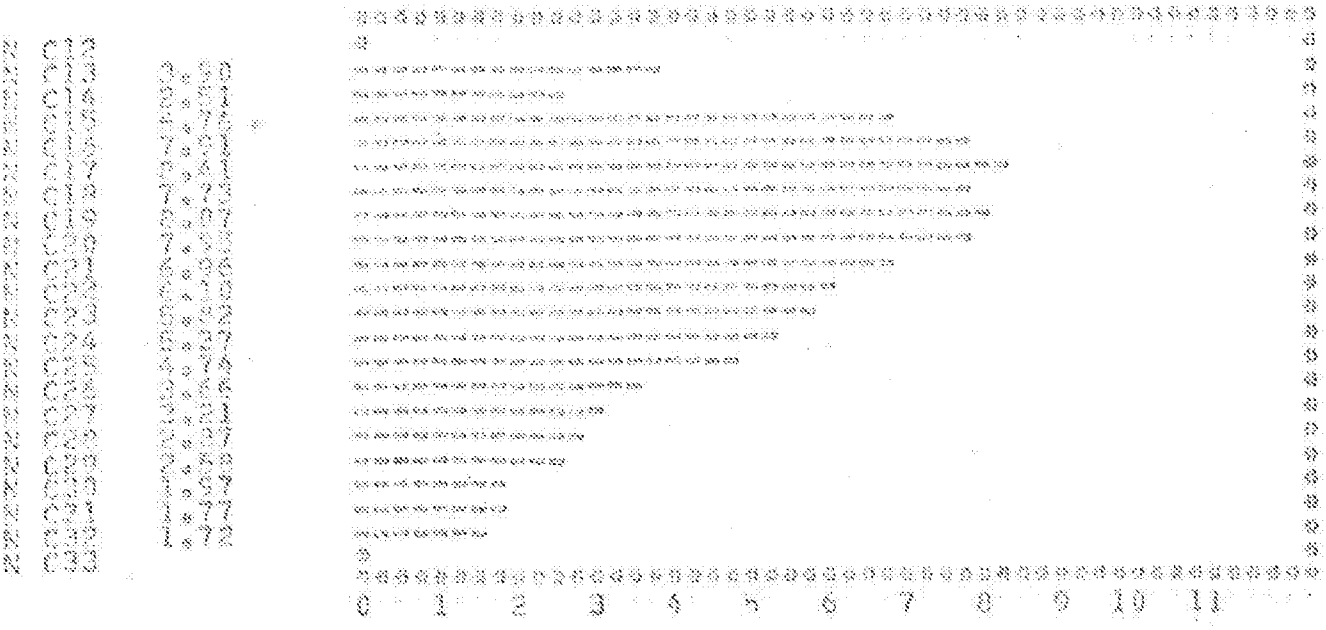
ASPHALTENES
RESINS
HYDROCARBONS HEAVY SAT. AROMATICS LIGHT SAT.

ANALYSIS OF SATURATES BY G.C.

N ALKANES (FROM ROCK) 515.98
TSCP C18 12.58
PRISTANE 18.01
PHYTANE 13.25

RATIOS PRISTANE/PHYTANE 1.40 PRISTANE/C17 0.62 PHYTANE/C18 0.33
RATIO 1.29

N.ALKANES DISTRIBUTION



CPI FROM NC18 TO NC28 1.022
CPI FROM NC23 TO NC30 1.029
CPI MAXIMUM (NC17) 1.075

TOC 0.2 %W
TOC 625. PPM
RR

13/3-1
0.1
1.0
10.0
100.0
1000.0
C1
C2
C15
C16
C17
C18
C19
C20
C21
C22
C23
C24
C25
C26
C27
C28
C29
C30
C31
C32
C33
20.10
12.94
34.20
40.80
43.37
12.37
30.37
15.00
41.62
13.25
41.01
35.91
31.48
30.09
27.68
24.46
18.86
16.56
14.02
13.31
10.14
9.14
0.55
NC1 A NC14 MAX= 33.05
IC1 A IC14 MAX= 0.00
33.05
N 0/0 TOTAL 100.00

NORVEGE MINISAT

AGE
SAMPLE CORE W3 DEPTH 4149.40 M WELL 15/3-1 LITHOLOGY SHALE

COMPONENTS

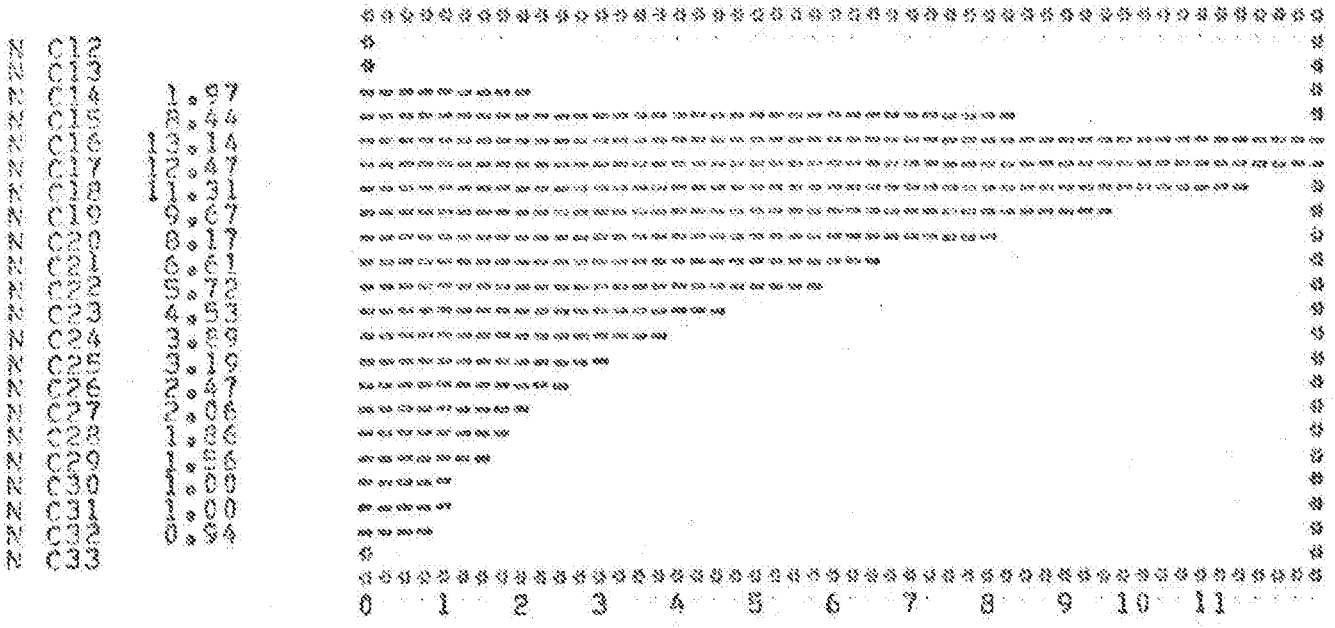
SAMPLE WEIGHT 221 MG

ASPHALTENES	23.10					
RESINES	28.30					
HYDROCARBONS	48.40	HEAVY SAT.	13.40	AROMATICS	35.00	LIGHT
S/A	0.38					

ANALYSIS OF SATURATES BY G.P.C.

N ALKANES (PPM ROCK)	107.03					
ISOP C18	2.42					
PRISTANE	2.12					
PHYTANE	0.88					
RATIOS	PRISTANE/PHYTANE	2.40	PRISTANE/C17 RATIO	0.32	PHYTANE/C18	0.17
				1.36		

N.ALKANES.DISTRIBUTION



CPI FROM NC16 TO NC20 0.988
CPI FROM NC20 TO NC30 0.996
CPI MAXIMUM (NC29) 1.087

ICC 9.4 O/O
ECN 4850.00 PPM
SR

$\chi \Sigma 4 = 4.54$

$\chi \Sigma 3 = 4.61$

SOLVENT EXTRACT

A/S SAMPLE   CORE   DEPTH 4749.40 M   WELL 15-3-1 ??   LITHOLOGY *Shale*

COMPONENTS

SAMPLE WEIGHT 921 MG

ASPHALTENES	23.10						
RESINS	28.50						
HYDROCARBONS	48.40	HEAVY SAT.	13.40	AROMATICS	35.00	LIGH	
	S/A	0.38					

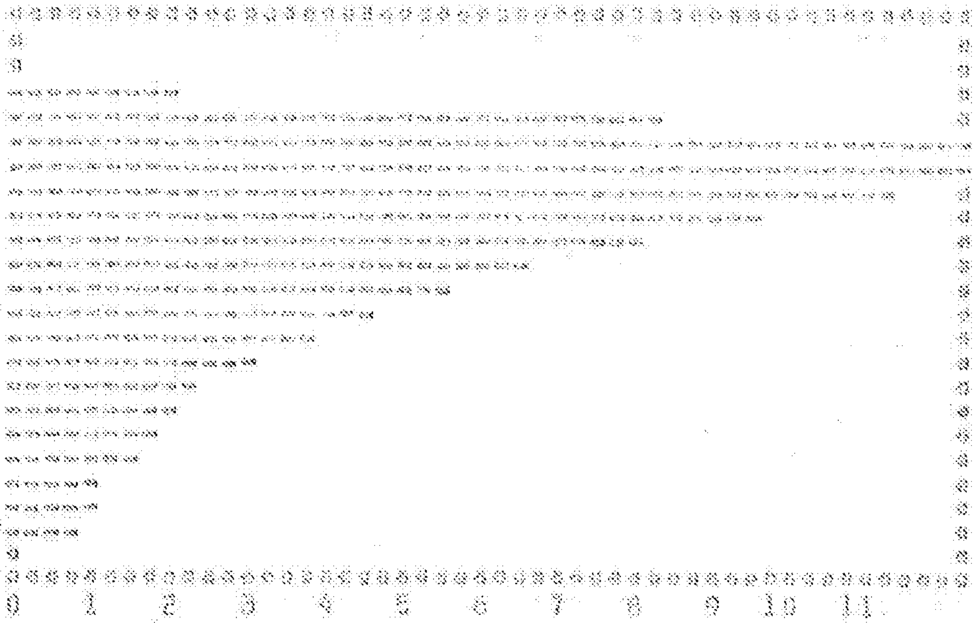
ANALYSIS OF SATURATES BY G.P.C.

N ALKANES (O/O SATURATES) 20.10
ISOP C19 0.67
PRISTANE 0.73
PHYTANE 0.50

RATIOS   PRISTANE/PHYTANE 1.46   PRISTANE/C17 0.20   PHYTANE/C18 0.22
RATIO 1.32

N ALKANES DISTRIBUTION

N C12	
N C13	
N C14	1.97
N C15	6.35
N C16	12.13
N C17	12.55
N C18	11.30
N C19	9.60
N C20	8.15
N C21	6.95
N C22	5.75
N C23	4.94
N C24	3.83
N C25	3.20
N C26	2.64
N C27	2.08
N C28	1.86
N C29	1.56
N C30	1.01
N C31	1.01
N C32	0.93
N C33	



CPI FROM NC16 TO NC20   0.990
CPI FROM NC20 TO NC30   0.979
CPI MAXIMUM (NC29)   1.086

TOC 9.5 O/O
TOP 4950.00 PPM
SR 5 %

C1			[illegible]
C2			[illegible]
C3			[illegible]
IC4			[illegible]
IC4			[illegible]
IC5	10.40	88.[illegible]	31.37
IC5	21.03	76.[illegible]	[illegible]
IC6	[illegible]	33.[illegible]	
IC6	19.8[illegible]	73.[illegible]	
IC7	[illegible]	118.[illegible]	
IC7	[illegible]	48.31	
IC8	109.48		
IC8	71.03	208.[illegible]	
IC9		31.82	
IC10		298.44	
IC10		47.[illegible]	
IC11		223.81	
IC11		[illegible]	
IC12		93.65	
IC12		41.[illegible]	
IC13		71.[illegible]	
IC13		33.60	
IC14		117.[illegible]	
IC14		23.97	0.72
C15		10.49	3.09
C16		8.00	4.33
C17			4.08
IC16			[illegible]
C18			[illegible]
IC19			[illegible]
C19			[illegible]
IC20			[illegible]
C20			2.98
C21			2.42
C22			3.09
C23			1.49
C24			1.42
C25			1.17
C26			1.00
C27			0.78
C28			0.69
C29			0.57
C30			0.37
C31			0.37
C32			0.34
C33			

S IC1 A IC14 MAX= 329.03
S IC1 A IC14 MAX=1029.04

2204.28 % C/O TOTAL 23.09

XI1= 1.84

XI3= 1.51

A 15

SHELL INTERNATIONAL

AGE
SAMPLE Core #3 DEPTH 6646.73 ft WELL 15/3-1 LITHOLOGY
SANDSTONE + SHALE

COMPONENTS

ASPHALTENES
RESINS
HYDROCARBONS HEAVY SAT. AROMATICS LIGH
S/A

ANALYSIS OF SATURATES BY G.P.C.

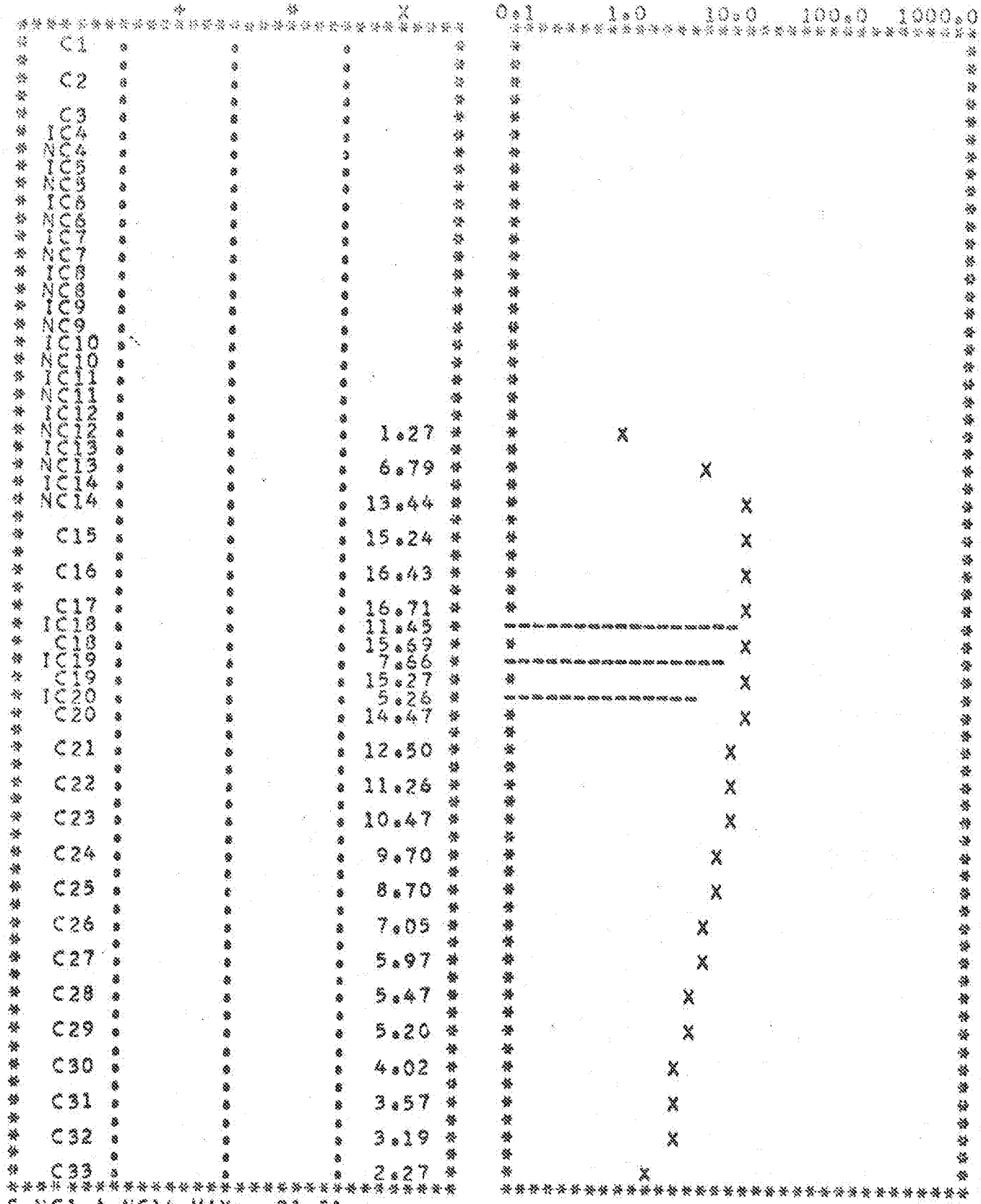
	% ALKANES (PPM ROCK)	204.79					
	I800 C18	11.95					
	PRISTANE	7.87					
	PHYTANE	5.27					
RATIOS	PRISTANE/PHYTANE	1.45	PRISTANE/C17 RATIO	0.88 1.36	PHYTANE/C18	0.33	

N-ALKANES DISTRIBUTION

CPI FROM NC15 TO NC20 1.002
CPI FROM NC21 TO NC30 1.005
CPI MAXIMUM (NC29) 1.095

Ioc 2.5 0/0
EOM 2.600 PPM
EP

15/3-1 * 4149.7


0.1
1.0
10.0
100.0
1000.0
C1 1.27
C2 6.79
C3 13.44
C4 15.24
C5 16.43
C6 16.71
C7 11.45
C8 15.99
C9 7.66
C10 15.27
C11 5.26
C12 14.47
C13 12.50
C14 11.26
C15 10.47
C16 9.70
C17 8.70
C18 7.05
C19 5.97
C20 5.47
C21 5.20
C22 4.02
C23 3.57
C24 3.19
C25 2.27
S NC1 A NC14 MAX= 21.51
S IC1 A IC14 MAX= 0.00
21.51
N 0/0 TOTAL 100.00

A-10

ACHYEGE EXTRACT

AGE DEPTH 4355 M WELL 15-3-1
SAMPLE CUTTINGS LITHOLOGY

COMPONENTS
SAMPLE WEIGHT 272 MG

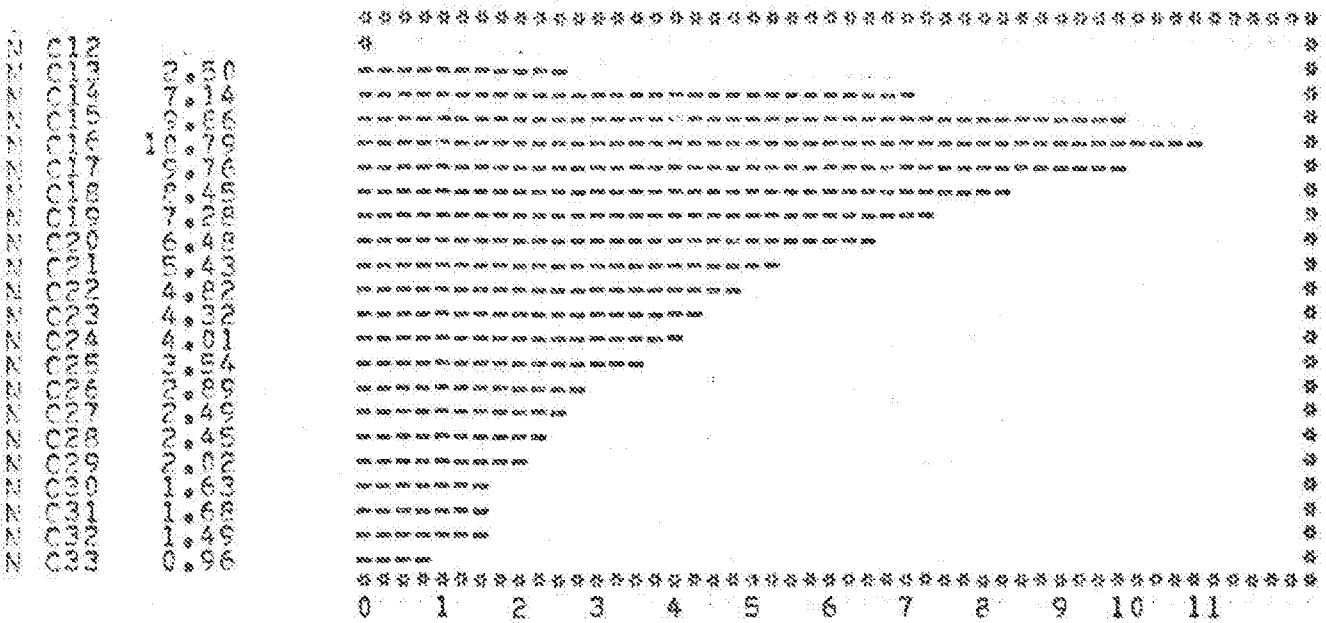
ASPHALTENES	15.60					
RESINES	15.90					
HYDROCARBONS	69.30	HEAVY SAT.	30.00	AROMATICS	29.30	LIGHT
	S/A 1.02					

ANALYSIS OF SATURATES BY G.P.C.

N ALKANES (O/O SATURATES) 20.13
TSCP C18 0.62
PRISTANE 1.04
PHYTANE 0.86

RATIOS	PRISTANE/PHYTANE	1.20	PRISTANE/C17	0.53	PHYTANE/C18	0.50
			RATIO	1.04		

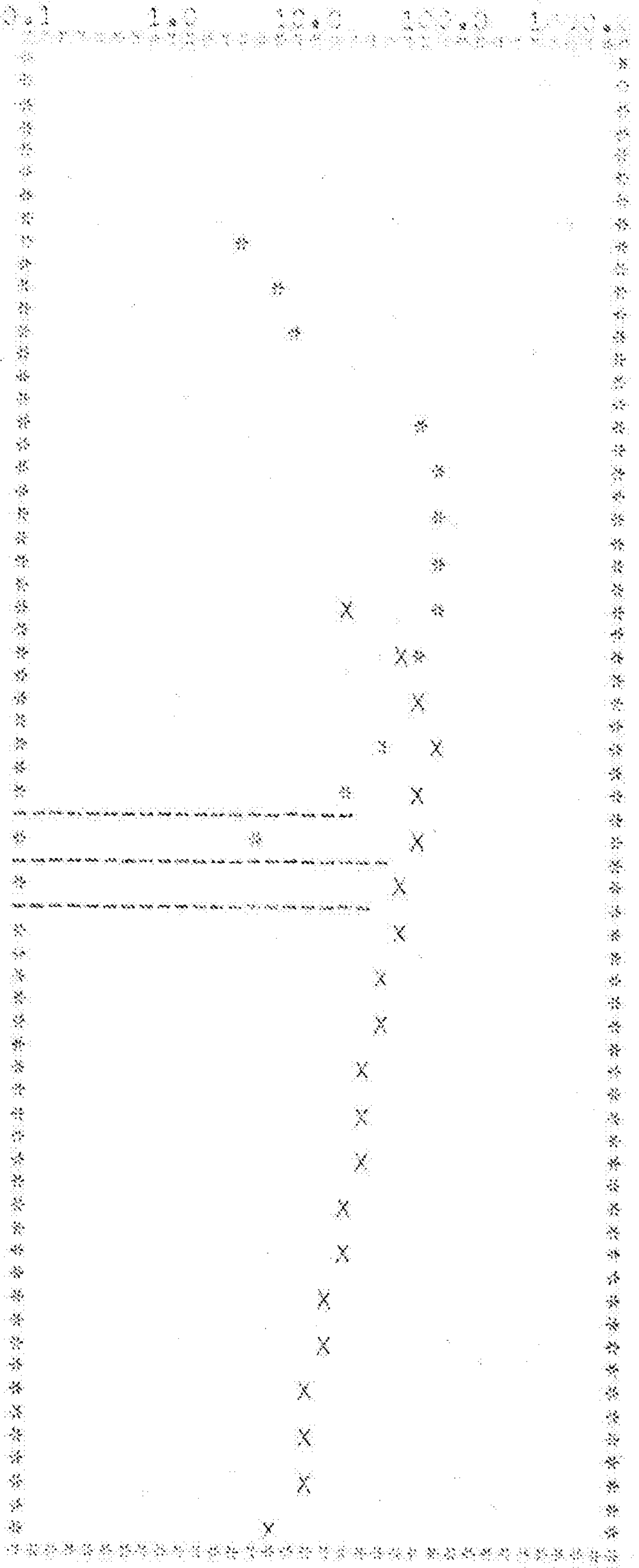
N ALKANES DISTRIBUTION



CPI FROM NC16 TO NC20 0.983
CPI FROM NC22 TO NC30 0.981
CPI MAXIMUM (NC25) 1.026

H.C. 6.6 O/O
PCM 11840.00 PPM
OS 13 %

	+	*	X
C1			
C2			
C3			
IC4			
NC4			
IC5		1.16	
NC5		7.97	
IC6		8.79	
NC6		7.21	
IC7		21.05	
NC7		8.54	
IC8		51.05	
NC8			
IC9		47.66	
NC9		56.44	
IC10		149.09	
NC10		94.75	
IC11		201.22	
NC11		80.64	
IC12		257.45	
NC12		86.05	
IC13		193.09	
NC13		76.03	17.91
IC14		180.69	
NC14		73.72	51.03
C15		59.96	70.52
C16		32.25	77.18
C17		19.79	69.81
IC18			22.02
C18		5.32	50.44
IC19			36.94
C19			52.04
IC20			30.54
C20			45.32
C21			38.82
C22			34.48
C23			30.90
C24			28.71
C25			25.33
C26			20.67
C27			17.82
C28			17.54
C29			14.42
C30			11.66
C31			12.03
C32			10.62
C33			6.89



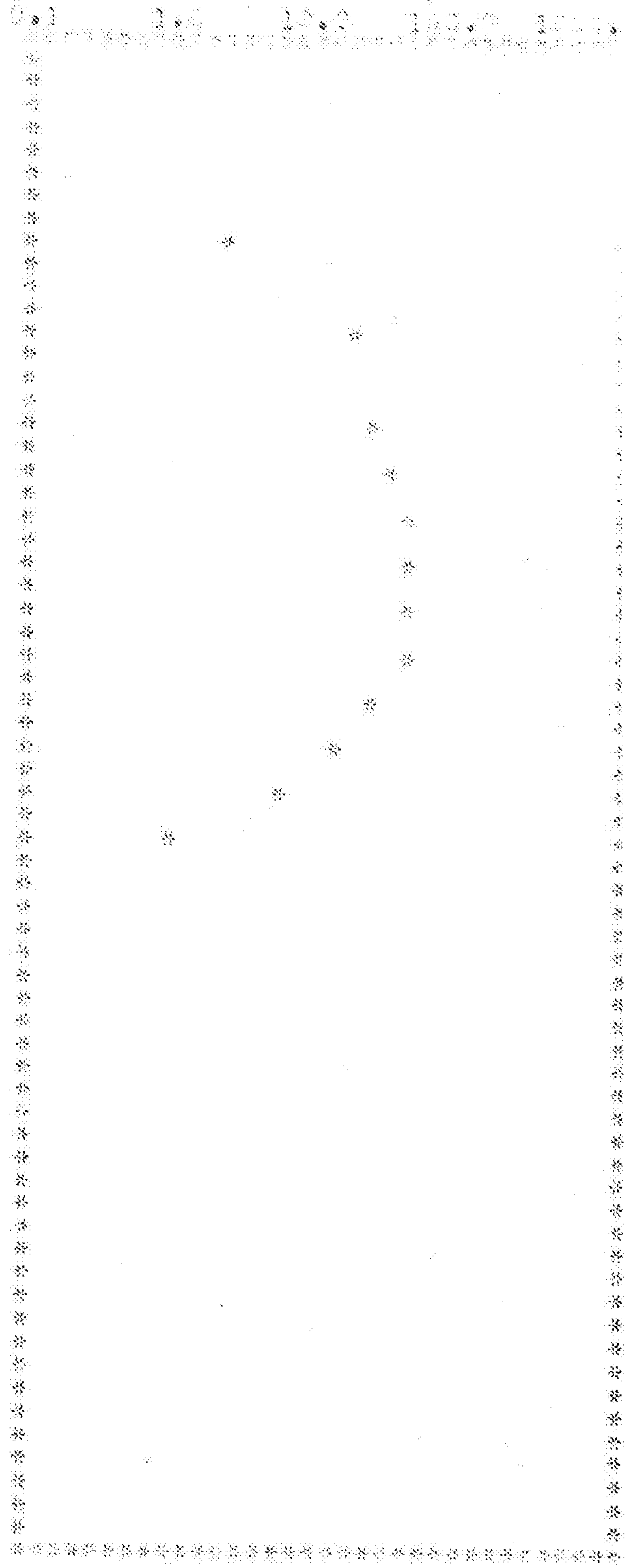
S NC1 A NC14 MAX= 496.40
S IC1 A IC14 MAX=1121.22

1617.63   N O/O TOTAL 30.69

B17

15-3-1 cultings DO 6405.

C1	
C2	
C3	
IC4	
NC4	
IC5	0.92
NC5	3.11
IC6	30.27
NC6	
IC7	26.54
NC7	19.06
IC8	85.53
NC8	
IC9	52.07
NC9	27.22
IC10	70.23
NC10	38.82
IC11	102.97
NC11	52.35
IC12	92.56
NC12	50.49
IC13	90.41
NC13	46.77
IC14	104.07
NC14	45.47
C15	25.38
C16	14.10
C17	6.29
IC18	
C18	1.27
IC19	
C19	
IC20	
C20	
C21	
C22	
C23	
C24	
C25	
C26	
C27	
C28	
C29	
C30	
C31	
C32	
C33	

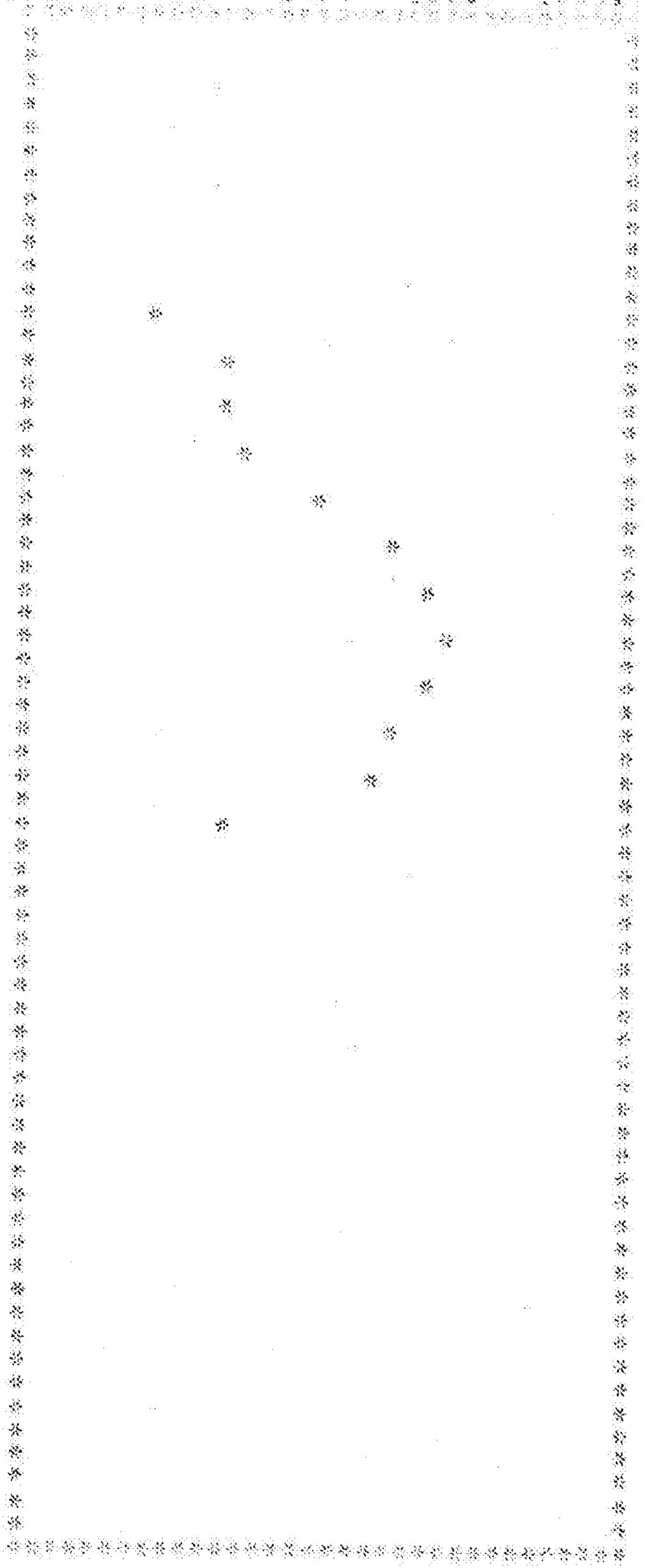


S NC1 A NC14 MAX= 282.33
S IC1 A IC14 MAX= 653.16
935.49 N O/O TOTAL 30.17

B18

13-3-1 cullmige.

C1	
C2	
C3	
IC4	
NC4	
IC5	
NC5	
IC6	
NC6	
IC7	1.05
NC7	0.83
IC8	5.40
NC8	2.40
IC9	1.57
NC9	2.81
IC10	3.08
NC10	3.93
IC11	6.03
NC11	11.51
IC12	24.06
NC12	34.11
IC13	70.52
NC13	68.14
IC14	123.31
NC14	79.06
C15	56.24
C16	35.12
C17	25.27
IC18	2.80
C18	
IC19	
C19	
IC20	
C20	
C21	
C22	
C23	
C24	
C25	
C26	
C27	
C28	
C29	
C30	
C31	
C32	
C33	



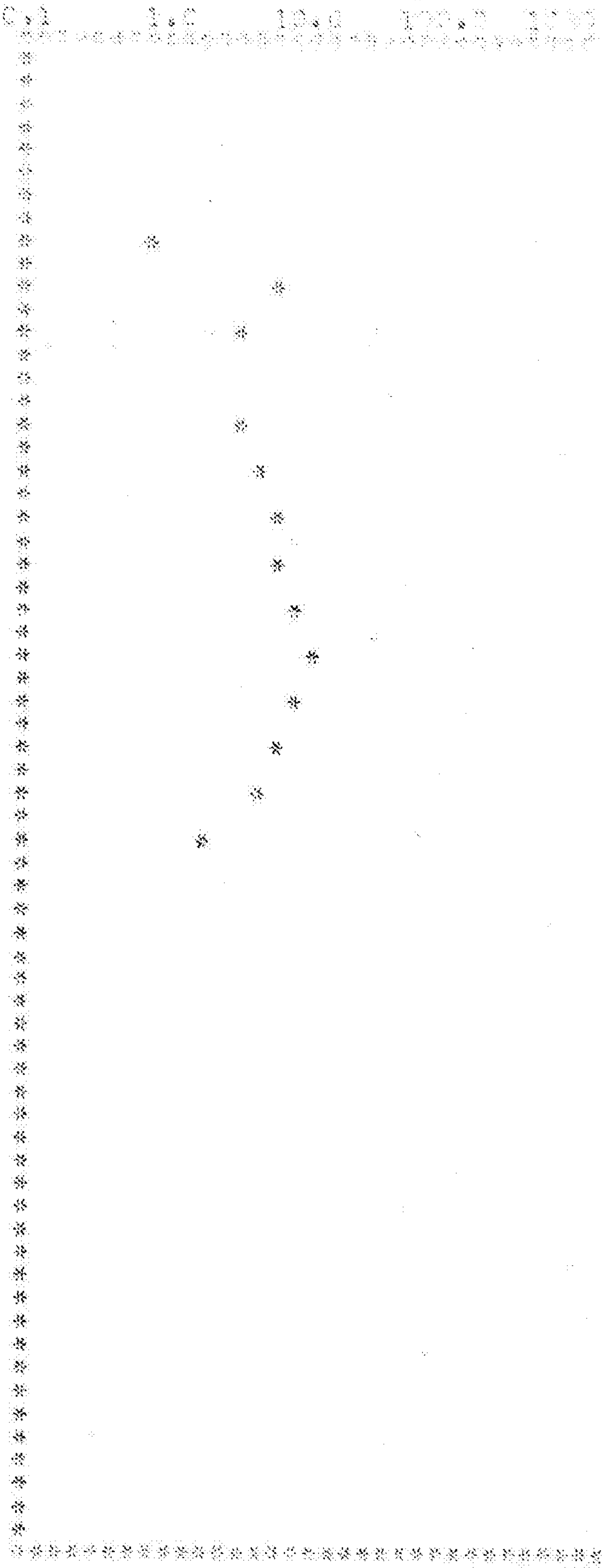
S NC1 A NC14 MAX= 202.87
S IC1 A IC14 MAX= 234.87
437.74

N O/C TOTAL 46.34

G. 3.

15-3-1 Allinger OD 48…

	[illegible]	[illegible]	X
C1			
C2			
C3			
IC4			
NC4			
IC5		0.86	
NC5		0.97	
IC6		4.37	
NC6		8.99	
IC7		10.04	
NC7		3.72	
IC8		26.66	
NC8			
IC9		4.02	
NC9		4.02	
IC10		11.41	
NC10		5.20	
IC11		20.93	
NC11		6.11	
IC12		13.25	
NC12		6.35	
IC13		11.06	
NC13		8.21	
IC14		17.16	
NC14		11.13	
C15		8.95	
C16		7.25	
C17		4.72	
IC18			
C18		2.10	
IC19			
C19			
IC20			
C20			
C21			
C22			
C23			
C24			
C25			
C26			
C27			
C28			
C29			
C30			
C31			
C32			
C33			



S NC1 A NC14 MAX= 51.72
S IC1 A IC14 MAX= 119.49

171.22 N O/O TOTAL 30.21

KONTOR MINISAT.

AGE
SAMPLE DEPTH 4760 M WELL 15/3-1
LITHOLOGY

COMPONENTS

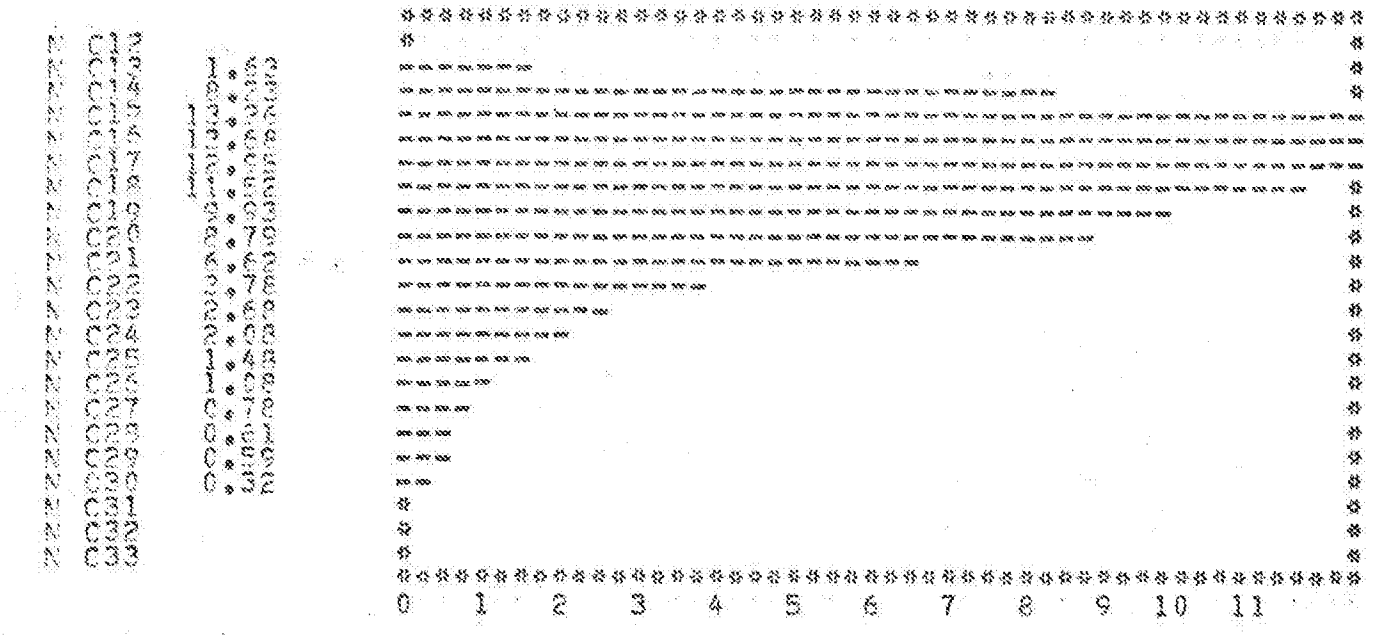
ASPHALTENES
RESINES
HYDROCARBONS S/A HEAVY SAT. AROMATICS LIGHT HC

ANALYSIS OF SATURATES BY G.P.C.

N ALKANES (PPM ROCK) 732.62
ISOP C18
PRISTANE
PHYTANE

RATIOS PRISTANE/PHYTANE 1.14 PRISTANE/C17 RATIO 0.45 PHYTANE/C18 1.01 0.45

N ALKANES DISTRIBUTION



CPI FROM NC15 TO NC20 1.020
CPI FROM NC20 TO NC30 1.013
CPI MAXIMUM (NC29) 1.261

CC % C
CCM PPM
PPB

C1	11.92		
C2	60.33		
C15	84.31	97.12	
C16	70.31	100.25	
C17	32.15	94.84	
C21		48.48	
C22		27.65	
C23		19.65	
C24		15.22	
C25		10.83	
C26		7.90	
C27		5.69	
C28		4.47	
C29		4.34	
C30		2.30	
C31			
C32			
C33			

S IC1 A IC14 MAX= 212.40
S IC1 A IC14 MAX= 477.20

690.21 N O/O TOTAL 30.77

S XC1 A XC14 MAX= 134.75
S YC1 A YC14 MAX= 405.71

840.47 N O/O TOTAL 24.93

X11= 1.67

X13= 1.84

NORVEGE EXTRACT
****

ACE
SAMPLE CUTTINGS DEPTH 4795 M WELL 15-3-1 LITHOLOGY

COMPONENTS
****

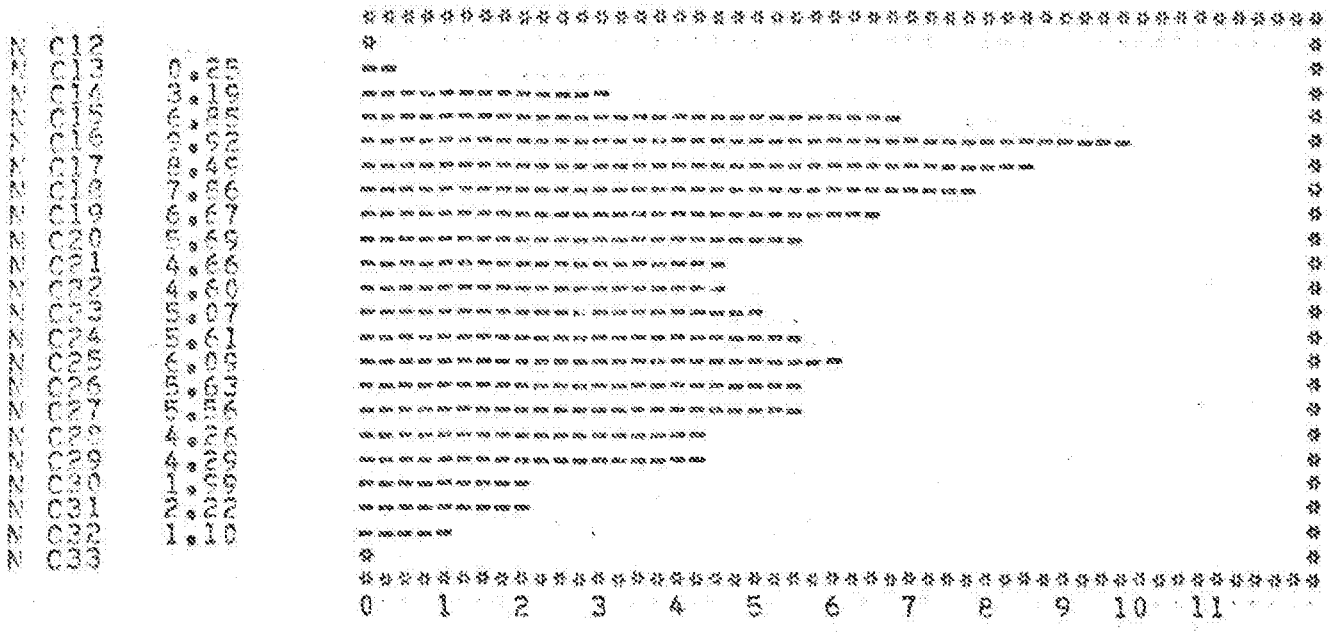
SAMPLE WEIGHT 124 MG

ASPHALTENES	6.80					
RESINS	34.80					
HYDROCARBONS	32.20	HEAVY SAT.	10.60	AROMATICS	21.60	LICH
	S/A	0.49				

ANALYSIS OF SATURATES BY G.P.C.
****

	N ALKANES (0/0 SATURATES)	27.71					
	ISOP C18	0.80					
	PRISTANE	0.93					
	PHYTANE	0.72					
RATIOS	PRISTANE/PHYTANE	1.29	PRISTANE/C17	0.39	PHYTANE/C18	0.33	
			RATIO	1.19			

N-ALKANES DISTRIBUTION
****



CPI FROM NC16 TO NC20 0.948
CPI FROM NC20 TO NC30 1.144
CPI MAXIMUM (NC29) 1.373

CC 0/0
FCP 3460.00 PPM
EE

	C1					
	C2					
	C3					
	C4					
	C5					
	C6					
	C7					
	C8					
	C9					
	C10					
	C11					
	C12					
	C13					
	C14					
	C15		8.00		6.98	
	C16		2.69		10.07	
	C17				8.62	
	C18				2.93	
	C19				7.08	
	C20				3.41	
	C21				6.77	
	C22				2.64	
	C23				6.78	
	C24				4.73	
	C25				4.67	
	C26				5.15	
	C27				5.70	
	C28				6.19	
	C29				5.72	
	C30				5.65	
	C31				4.33	
	C32				4.36	
	C33				2.02	
					2.25	
					1.12	

S NC1 & NC14 MAX= 83.39
S IC1 & IC14 MAX= 873.75

657.15 N O/O TOTAL 12.69

MOBVEDE MINISAT.
****

AGE
SAMPLE Sidewall core DEPTH 4300 M WELL 15-3-1 CLAB
LITHOLOGY

COMPONENTS
****

ASPHALTENES
RESINES
HYDROCARBONS

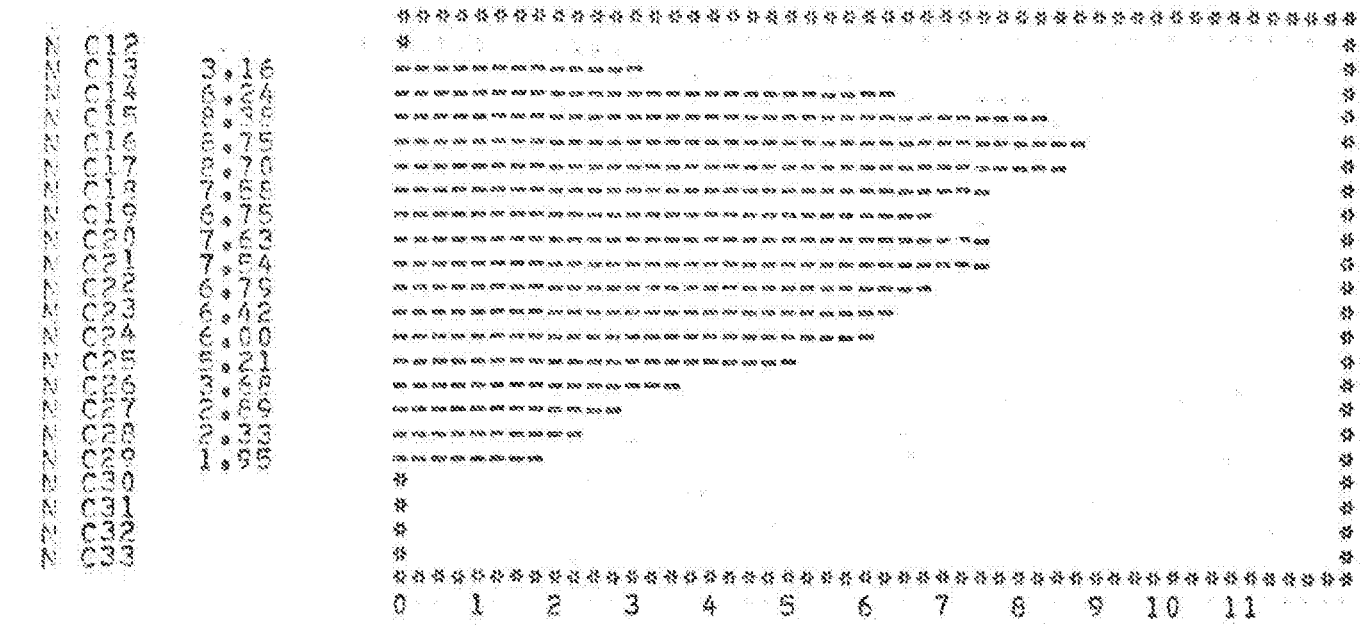
S/A HEAVY SAT. AROMATICS LIGHT

ANALYSIS OF SATURATES BY G.P.C.
****

N ALKANES (PPM ROCK) 21.56
ISOP C18
PRISTANE
PHYTANE

RATIOS PRISTANE/PHYTANE PRISTANE/C17 PHYTANE/C18
RATIO

N ALKANES DISTRIBUTION
****

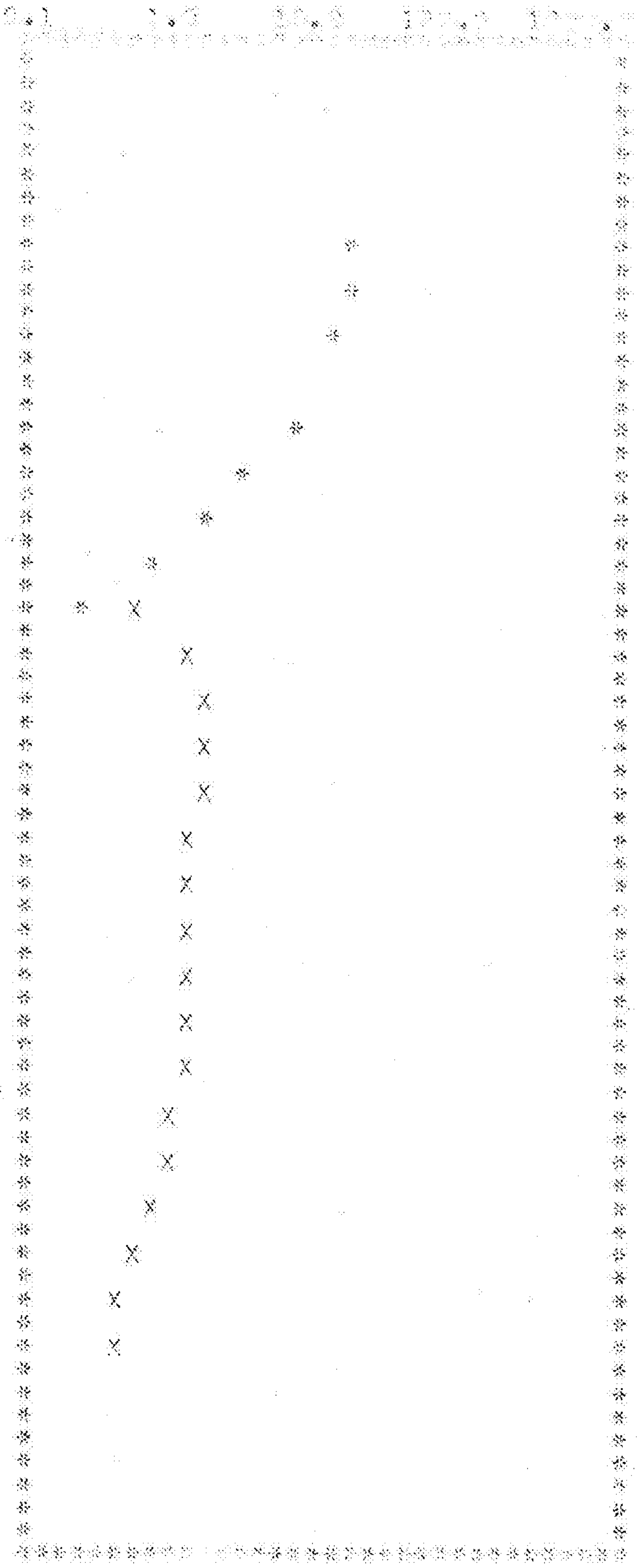


CPI FROM NC16 TO NC20 0.899
CPI FROM NC22 TO NC30 1.014
CPI MAXIMUM (NC25) 1.077

OC C/O
EOM PPM
RE

19-3-1 CLAP * ...

C1		
C2		
C3		
IC4		
NC4		
IC5	18.78	
NC5	19.41	
IC6	20.14	
NC6	19.28	
IC7	50.78	
NC7	16.44	
IC8	111.17	
NC8		
IC9	30.13	
NC9	9.04	
IC10	15.59	
NC10	3.54	
IC11	4.27	
NC11	2.02	
IC12	1.26	
NC12	0.73	
IC13	0.34	
NC13	0.29	0.68
IC14		
NC14		1.34
C15		1.90
C16		1.93
C17		1.87
IC18		
C18		1.63
IC19		
C19		1.45
IC20		
C20		1.44
C21		1.62
C22		1.46
C23		1.38
C24		1.29
C25		1.12
C26		0.79
C27		0.62
C28		0.50
C29		0.42
C30		
C31		
C32		
C33		



S NC1 A NC14 MAX= 69.73
S IC1 A IC14 MAX= 255.49

325.22 * O/O TOTAL 21.24

XI1= 2.20

XI3= 2.15

S NC1 A NC14 MAX= 93.60
S IC1 A IC14 MAX= 325.80

419.50 N O/O TOTAL 22.31

XI1= 1.16

XI3= 1.20

ASPHALTENES / RESINES / HYDROCARBONS / EXTRACT
****

ACE
SAMPLE CUTTINGS DEPTH 4915 M WELL 15-3-1 DD LITHOLOGY

COMPONENTS
****

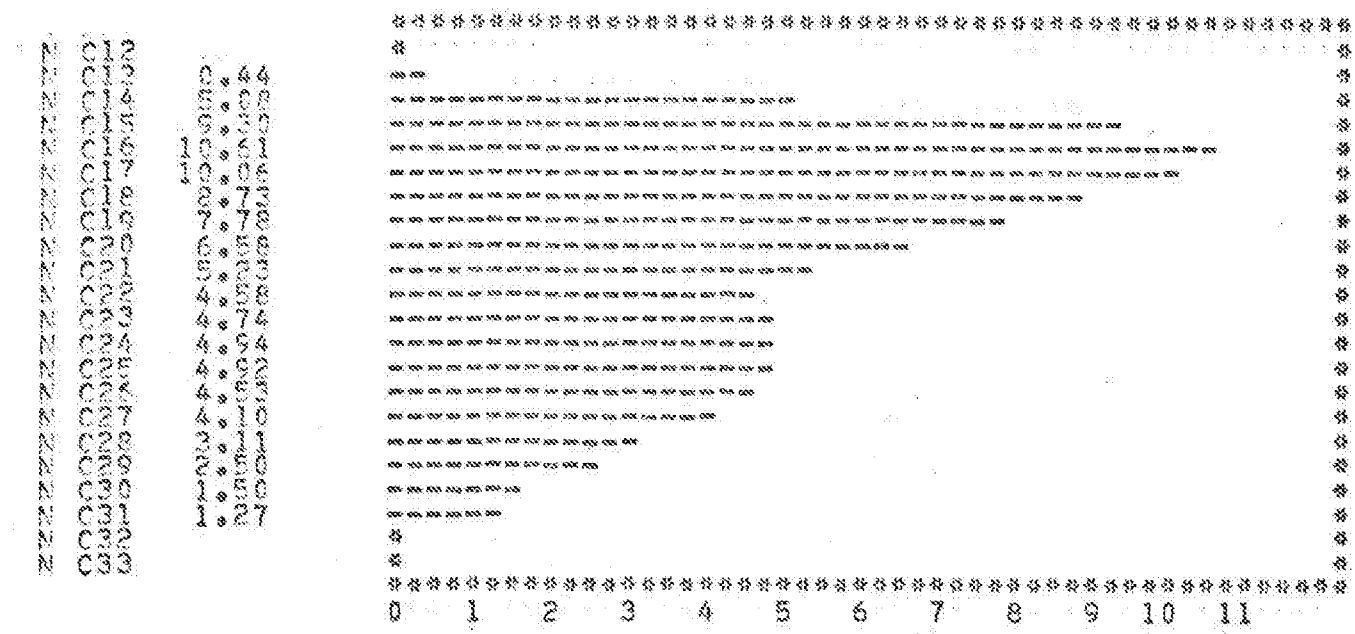
SAMPLE WEIGHT 125 MG

ASPHALTENES	5.30					
RESINES	24.70					
HYDROCARBONS	62.10	HEAVY SAT.	27.50	AROMATICS	34.60	LIGHT
S/A	0.79					

ANALYSIS OF SATURATES BY G.P.C.
****

N ALKANES (%/% SATURATES)	18.53					
ISOR C18	0.57					
PRISTANE	0.59					
PHYTANE	0.52					
RATIOS	PRISTANE/PHYTANE	1.13	PRISTANE/C17	0.32	PHYTANE/C18	0.32
			RATIO	0.98		

N ALKANES DISTRIBUTION
****



CPI EPCM NC16 TO NC20	0.998
CPI EPCM NC20 TO NC30	1.048
CPI MAXIMUM (NC29)	1.085

CC %/%
EPCM 1760.00 PPM
EP

0.1
1.0
10.0
100.0
C1
C2
C15
C16
C20
C21
C22
C23
C24
C25
C26
C27
C28
C29
C30
C31
C32
C33
0.39
4.55
8.33
9.51
9.01
7.88
5.97
5.90
4.69
4.10
4.25
4.43
4.41
4.06
3.67
2.79
2.24
1.34
1.14
S NC1 A NC14 MAX= 52.89
S IC1 A IC14 MAX= 305.94
358.83
N O/O TOTAL 14.73

NORVEGE EXTRACT
****

ACE DEPTH 4950 M WELL 15-3-1
SAMPLE CUTTINGS LITHOLOGY

COMPONENTS
****

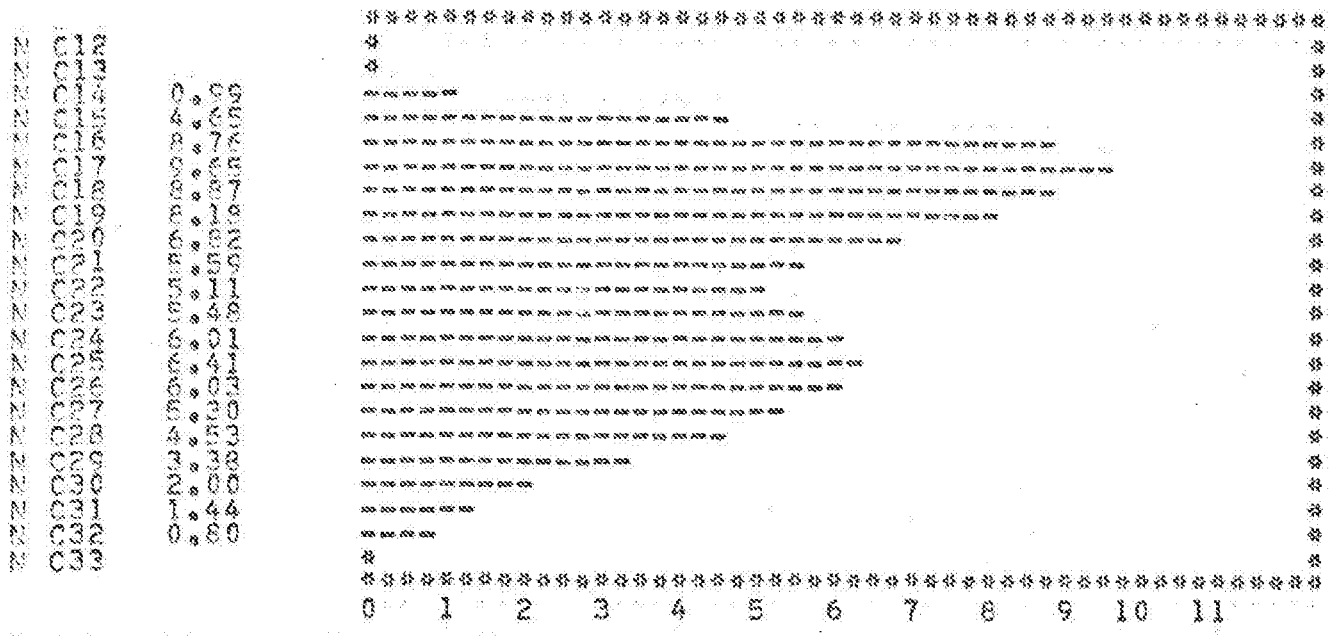
SAMPLE WEIGHT 65 MG

ASPHALTENES	9.10					
RESINES	41.00					
HYDROCARBONS	46.90	HEAVY SAT.	16.20	AROMATICS	30.40	LIGH
S/A	0.53					

ANALYSIS OF SATURATES BY G.P.C.
****

N ALKANES (0/0 SATURATES)	26.61					
ISOP C18	0.73					
PRISTANE	0.90					
PHYTANE	0.77					
RATIOS	PRISTANE/PHYTANE	1.17	PRISTANE/C17	0.35	PHYTANE/C18	0.32
			RATIO	1.08		

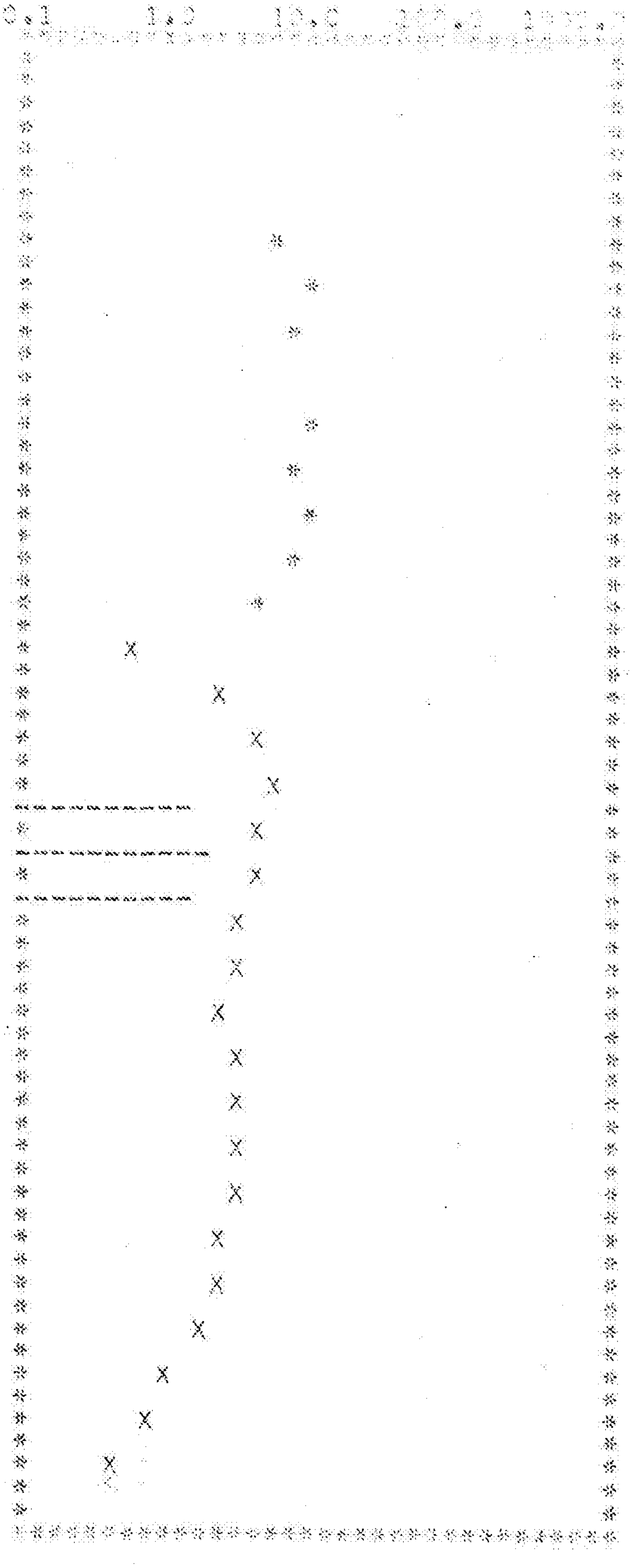
N-ALKANES DISTRIBUTION
****



CPI FROM NC16 TO NC20	1.025
CPI FROM NC20 TO NC30	1.022
CPI MAXIMUM (NC17)	1.095

CC 0/0
POR 1360.00 PPM
BP

	*	*	X
C1			
C2			
C3			
IC4			
NC4			
IC5		4.02	
NC5		6.98	
IC6		8.13	
NC6		12.40	
IC7		37.62	
NC7		9.95	
IC8		49.98	
NC8			
IC9		24.74	
NC9		11.34	
IC10		25.10	
NC10		9.37	
IC11		51.66	
NC11		10.09	
IC12		22.78	
NC12		8.32	
IC13		13.97	
NC13		5.20	
IC14		27.90	
NC14			0.58
C15			2.72
C16			5.13
C17			5.55
IC18			1.50
C18			3.19
IC19			1.98
C19			4.79
IC20			1.69
C20			3.99
C21			3.27
C22			2.99
C23			3.21
C24			3.52
C25			3.75
C26			3.53
C27			3.10
C28			2.65
C29			1.98
C30			1.17
C31			0.84
C32			0.47
C33			



S NC1 A NC14 MAX= 73.18
S IC1 A IC14 MAX= 265.91

339.09 N O/O TOTAL 21.58

XI1= 0.72

XI3= 0.67

KONOCO FINISAT.

AGE
SAMPLE Sidewall core DEPTH 4960 M WELL 15-3-1 CLAR
LITHOLOGY

COMPONENTS

ASPHALTENES
RESINES
HYDROCARBONS

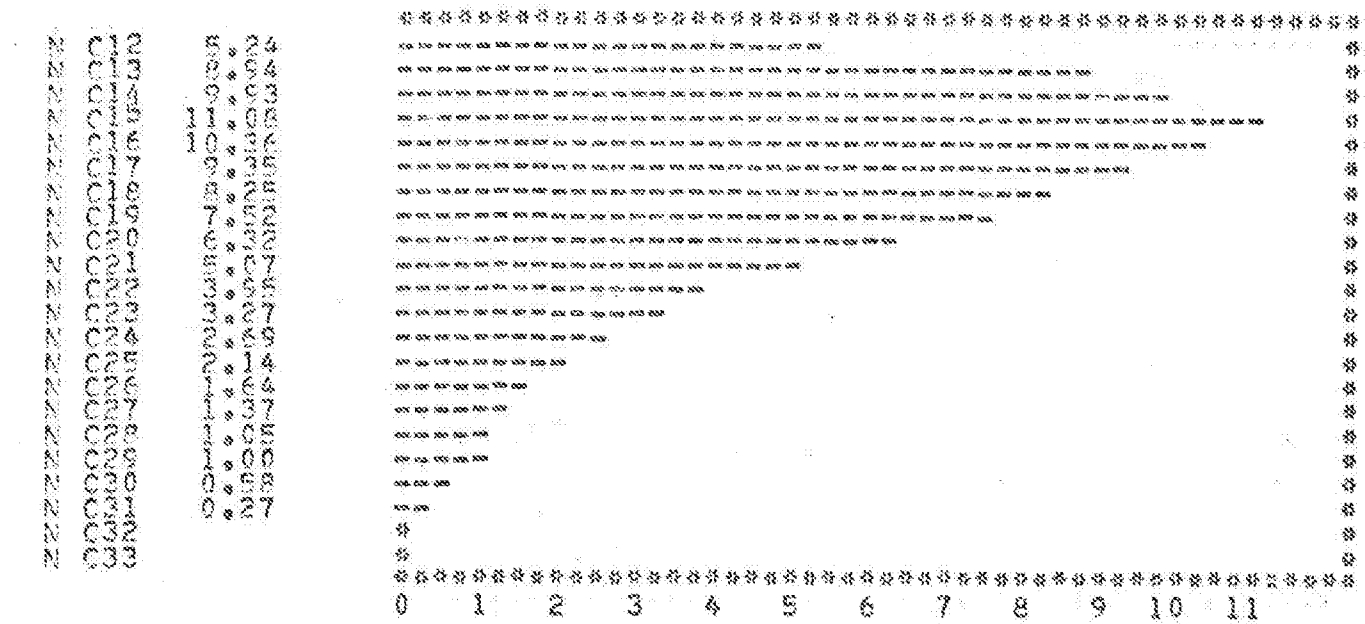
HEAVY SAT. AROMATICS LIGHT
S/A

ANALYSIS OF SATURATES BY G.P.C.

N ALKANES (PPM ROCK) 335.33
ISOP C18 9.96
PRISTANE 10.61
PHYTANE 6.05

RATIOS PRISTANE/PHYTANE 1.54 PRISTANE/C17 0.33 PHYTANE/C18 0.24
RATIO 1.36

N.ALKANES DISTRIBUTION



CPI FROM NC16 TO NC20 1.009
CPI FROM NC20 TO NC30 1.055
CPI MAXIMUM (NC29) 1.232

CC O/O
ECN PPM
ER

C1			
C2			
C3			
C4			
C5			
C6			
C7			
C8			
C9			
C10			
C11			
C12			
C13			
C14			
C15	6.43	37.16	
C16	3.18	34.73	
C17		31.33	
C18		9.95	
C19		27.66	
C20		25.21	
C21		17.01	
C22		13.23	
C23		10.96	
C24		9.01	
C25		7.16	
C26		5.51	
C27		4.59	
C28		3.51	
C29		3.35	
C30		1.93	
C31		0.91	
C32			
C33			

S NC1 A NC14 MAX= 191.52
S IC1 A IC14 MAX= 746.62

938.14 N C/C TOTAL 20.41

XI1= 2.18

XI3= 2.14

NORWEGE EXTRACT

ACE DEPTH 4990 M WELL 15-3 1 OD
SAMPLE CUTTINGS WASHED LITHOLOGY

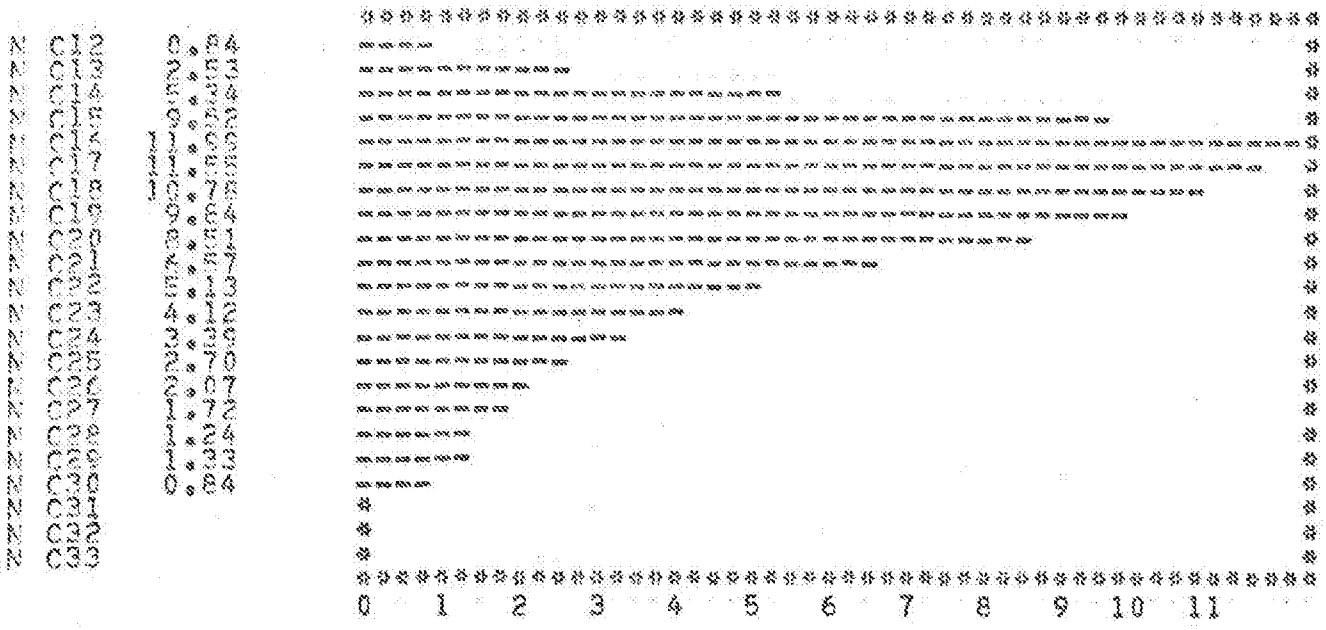
COMPONENTS

ASPHALTENES	17.80					
RESINES	20.60					
HYDROCARBONS	36.20	HEAVY SAT.	15.00	AROMATICS	21.20	LIGHT
S/A	0.70					

ANALYSIS OF SATURATES BY G.P.C.

N.ALKANES (0/0 SATURATES)	17.17						
ISOP C18	0.60						
PRISTANE	0.70						
PHYTANE	0.55						
RATIOS	PRISTANE/PHYTANE	1.26	PRISTANE/C17 RATIO	0.35	PHYTANE/C18	0.29	
				1.18			

N.ALKANES DISTRIBUTION



CPI FROM NC16 TO NC20	0.999
CPI FROM NC20 TO NC30	1.069
CPI MAXIMUM (NC29)	1.279

TOC 3. 0/0
ECM 2700.00 PPM
EP 7.2 %

15-3-1 OFFLAIS C 4980.0

C1		0.55
C2		1.66
C3		3.50
C4		5.24
C5		7.86
C6		7.57
C7		7.29
C8		7.07
C9		6.57
C10		6.45
C11		5.10
C12		5.59
C13		4.31
C14		3.36
C15		2.70
C16		2.22
C17		1.77
C18		1.36
C19		1.13
C20		0.81
C21		0.87
C22		0.55
C23		
C24		
C25		
C26		
C27		
C28		
C29		
C30		
C31		
C32		
C33		

S NC1 A NC14 MAX= 5.73
S IC1 A IC14 MAX= 0.00

5.73 N O/O TOTAL 100.00

NORWEGE EXTRACT
****

AGE
SAMPLE CORE DEPTH 4991 M WELL 15/3-1 K4 CPE
LITHOLOGY SANDS

COMPONENTS
****

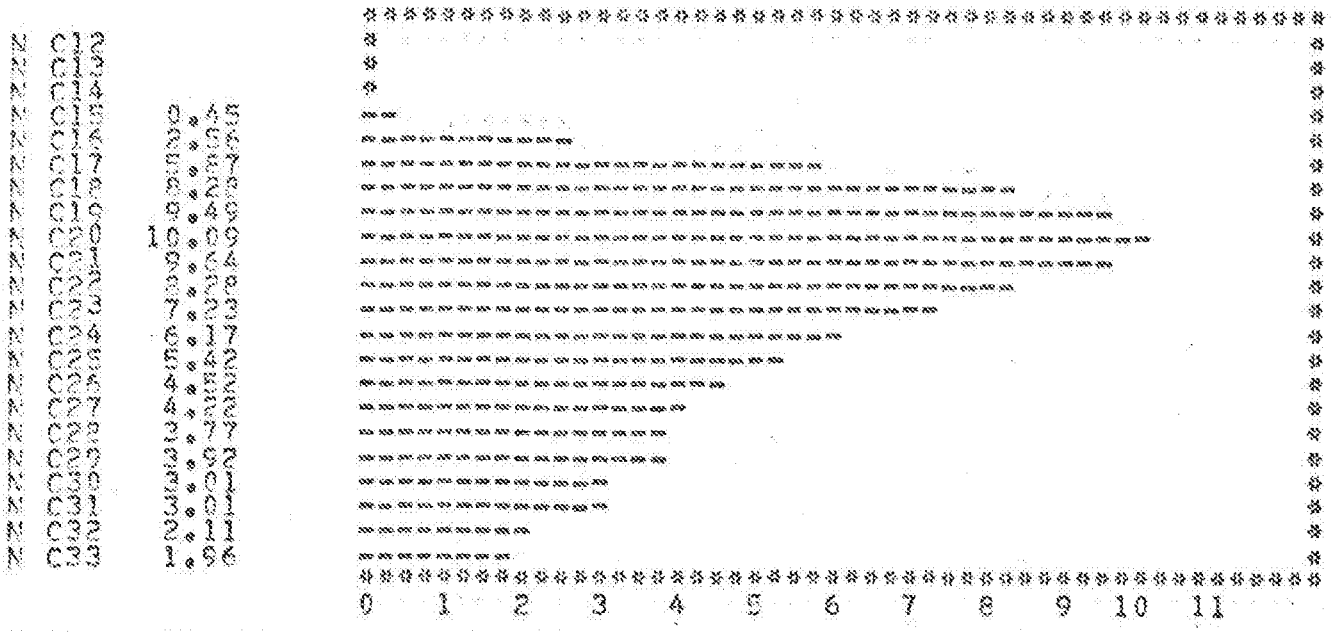
SAMPLE WEIGHT 34 MG

ASPHALTENES	19.20					
RESINES	23.40					
HYDROCARBONS	37.00	HEAVY SAT.	20.70	AROMATICS	16.30	LIGH
	S/A	1.27				

ANALYSIS OF SATURATES BY G.P.C.
****

	N ALKANES (0/0 SATURATES)	19.10					
	ISOP.C12	0.20					
	PRISTANE	0.37					
	PHYTANE	0.41					
RATIOS	PRISTANE/PHYTANE	0.90	PRISTANE/C17	0.33	PHYTANE/C18	0.26	
			RATIO	1.28			

N ALKANES DISTRIBUTION
****



CPI FROM NC16 TO NC20	1.055
CPI FROM NC20 TO NC30	1.047
CPI MAXIMUM (NC29)	1.156

CC 0/0
ECM 170.00 PPM
BR

	+	*	X	0.1 1.0 10.0 100.0 1000.0
C1				
C2				
C3				
IC4				
NC4				
IC5				
NC5				
IC6				
NC6				
IC7				
NC7				
IC8				
NC8				
IC9				
NC9				
IC10				
NC10				
IC11				
NC11				
IC12				
NC12				
IC13				
NC13				
IC14				
NC14				
C15			0.03	
C16			0.17	X
C17			0.39	X
IC18			0.07	
C18			0.55	X
IC19			0.13	-
C19			0.63	X
IC20			0.14	--
C20			0.67	X
C21			0.64	X
C22			0.55	X
C23			0.48	X
C24			0.41	X
C25			0.36	X
C26			0.30	X
C27			0.28	X
C28			0.25	X
C29			0.26	X
C30			0.20	X
C31			0.20	X
C32			0.14	X
C33			0.13	X

S NC1 A NC14 MAX= 0.00
S IC1 A IC14 MAX= 0.00

0.00 N O/O TOTAL 0.00

S VC1 A VC14 MAX= 492.31
S IC1 A IC14 MAX=2433.08

2925.89 N O/O TOTAL 16.84

XI1= 1.81

XI3= 1.69

NORVEGE PINTSAT.

AGE
SAMPLE SIDEWALL DEPTH 5050 N WELL 15/3-1 LITHOLOGY

COMPONENTS

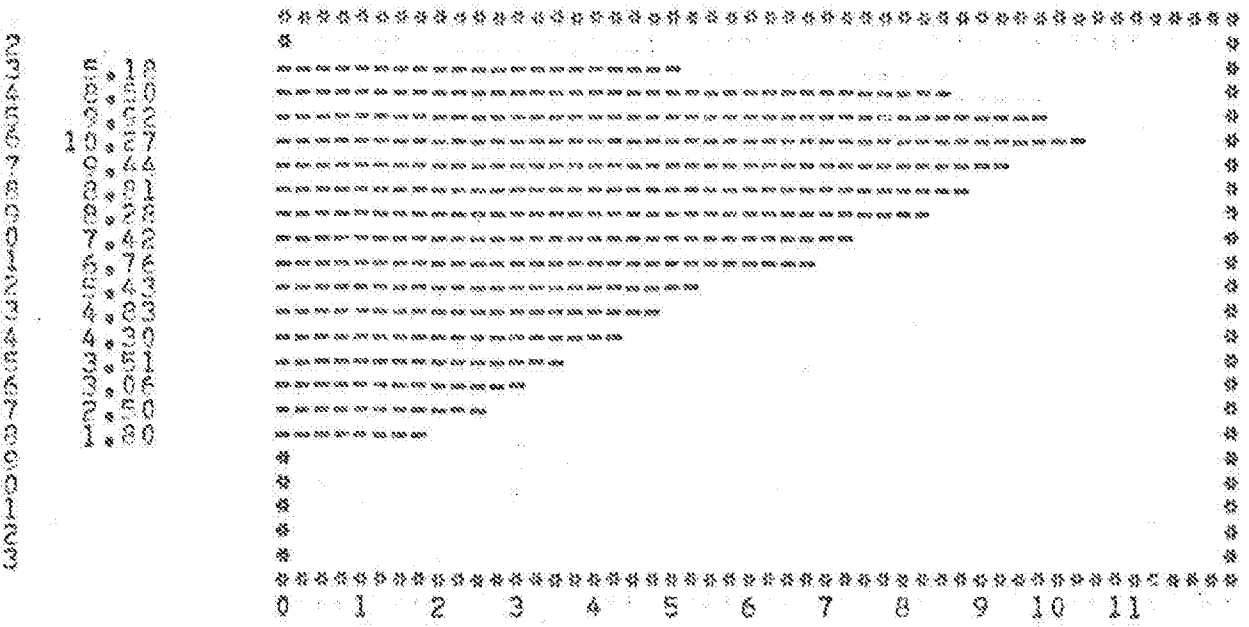
ASPHALTENES
RESINES
HYDROCARBONS S/A HEAVY SAT. AROMATICS LIGHT

ANALYSIS OF SATURATES BY G.P.C.

N ALKANES (PPM ROCK) 31.65
ISOP C18 1.01
PRISTANE 1.50
PHYTANE 1.27

RATIOS PRISTANE/PHYTANE 1.49 PRISTANE/C17 [illegible] PHYTANE/C18 [illegible]
RATIO

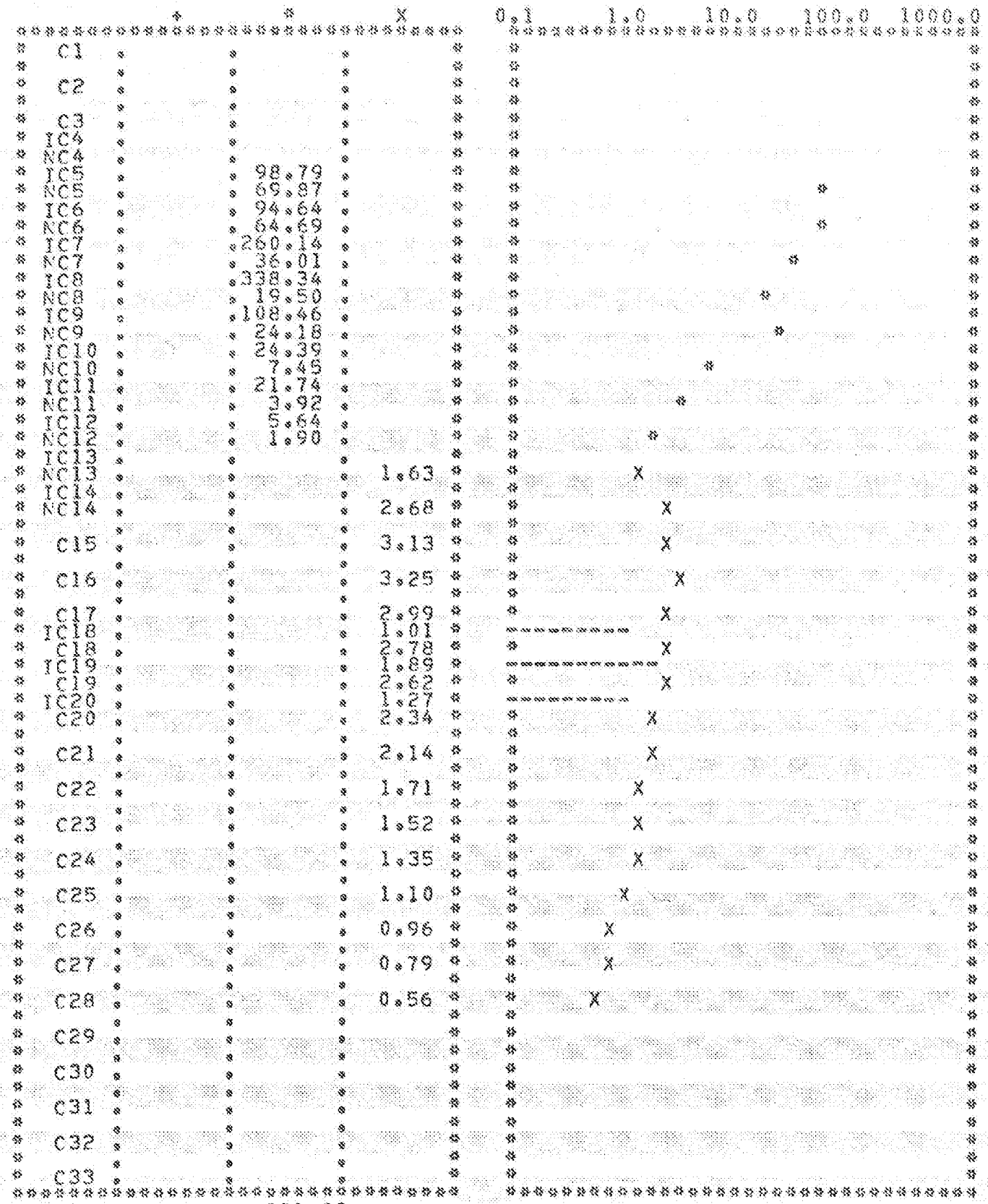
N.ALKANES DISTRIBUTION



CPI FROM NC16 TO NC20 1.020
CPI FROM NC20 TO NC30 0.991
CPI MAXIMUM (NC21) 1.052

OC 0/0
FCN PPM
BR

15/3-1 *S050 M



S NC1 A NC14 MAX= 231.88
S IC1 A IC14 MAX= 952.18

1184.06 N 0/0 TOTAL 19.58

XI1= 2.62

XI3= 2.33

S NC1 A NC14 MAX= 90.07
S IC1 A IC14 MAX= 287.33

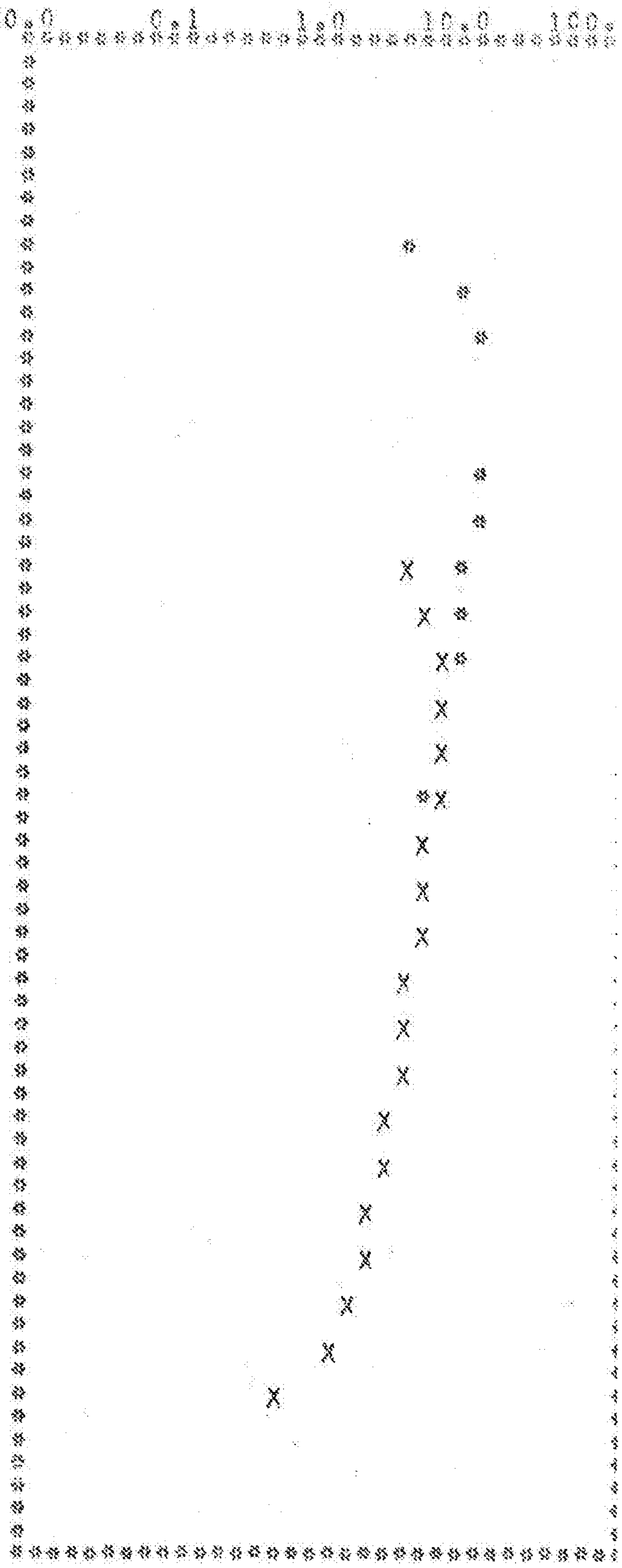
377.40 N 0/0 TOTAL 23.87

XI1= 2.35

XI3= 2.41

15/3-1 FIT 6 4150

C1		
C2		
C3		
IC4		
NC4		
IC5	2.02	
NC5	4.60	
IC6	8.27	
NC6	10.45	
IC7	36.09	
NC7	14.42	
IC8	78.87	
NC8		
IC9	61.14	
NC9		
IC10	41.24	
NC10	14.90	
IC11	31.19	
NC11	15.04	
IC12	17.21	
NC12	13.13	4.90
IC13	14.82	
NC13	12.04	6.19
IC14	14.48	
NC14	12.95	7.50
C15	9.99	8.65
C16	8.84	9.09
C17	6.38	8.82
IC18		
C18		7.33
IC19		
C19		6.26
IC20		
C20		5.62
C21		4.99
C22		4.74
C23		4.28
C24		4.16
C25		3.58
C26		3.14
C27		2.63
C28		2.05
C29		1.35
C30		0.62
C31		
C32		
C33		



S NC1 A NC14 MAX= 97.56
S IC1 A IC14 MAX= 305.33

402.89 N 0/0 TOTAL 24.22

XI1= 2.19

XI3= 2.40

NORVEGE OIL

ACE
SAMPLE DEPTH 4445m. WELL 15-3-1 FIT 1
LITHOLOGY

COMPONENTS

TOPPING RESIDUE 64.00

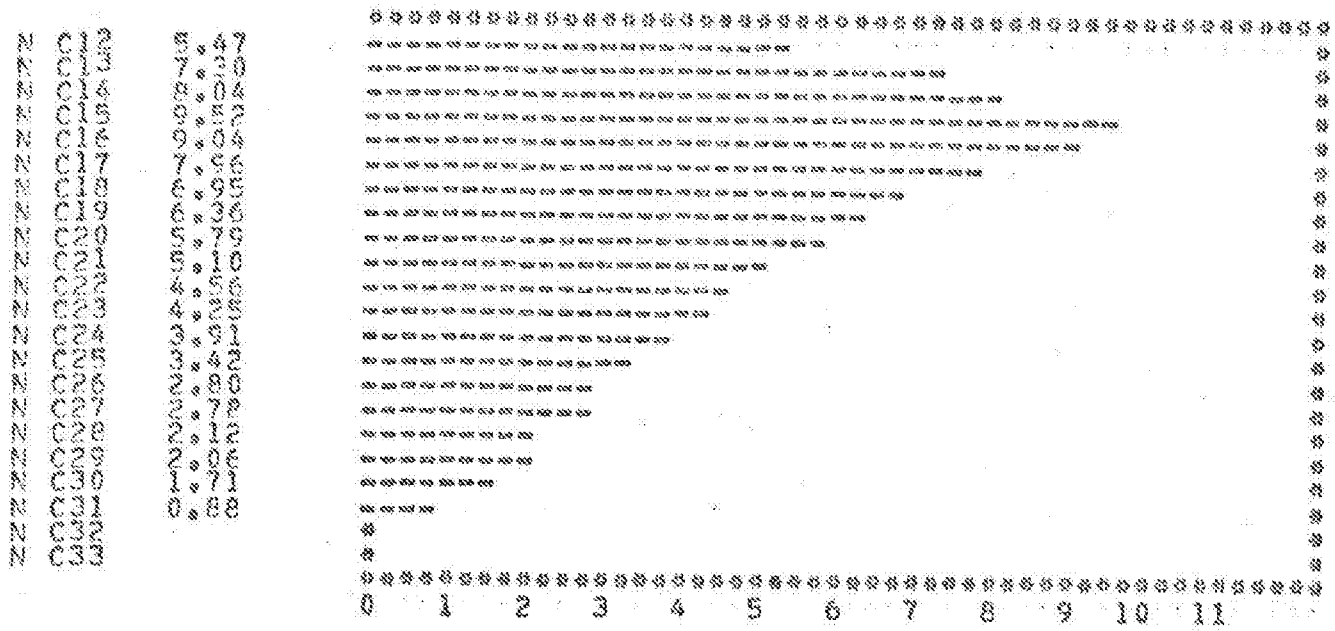
ASPHALTENES
RESINES 6.60
HYDROCARBONS 91.90 HEAVY SAT. 70.40 AROMATICS 21.50 LIGH
S/A 3.26

ANALYSIS OF SATURATES BY G.P.C.

N ALKANES (0/0 SATURATES) 29.14
ISOP C18 0.59
PRISTANE 0.94
PHYTANE 0.57

RATIOS PRISTANE/PHYTANE 1.63 PRISTANE/C17 0.40 PHYTANE/C18 0.28
RATIO 1.43

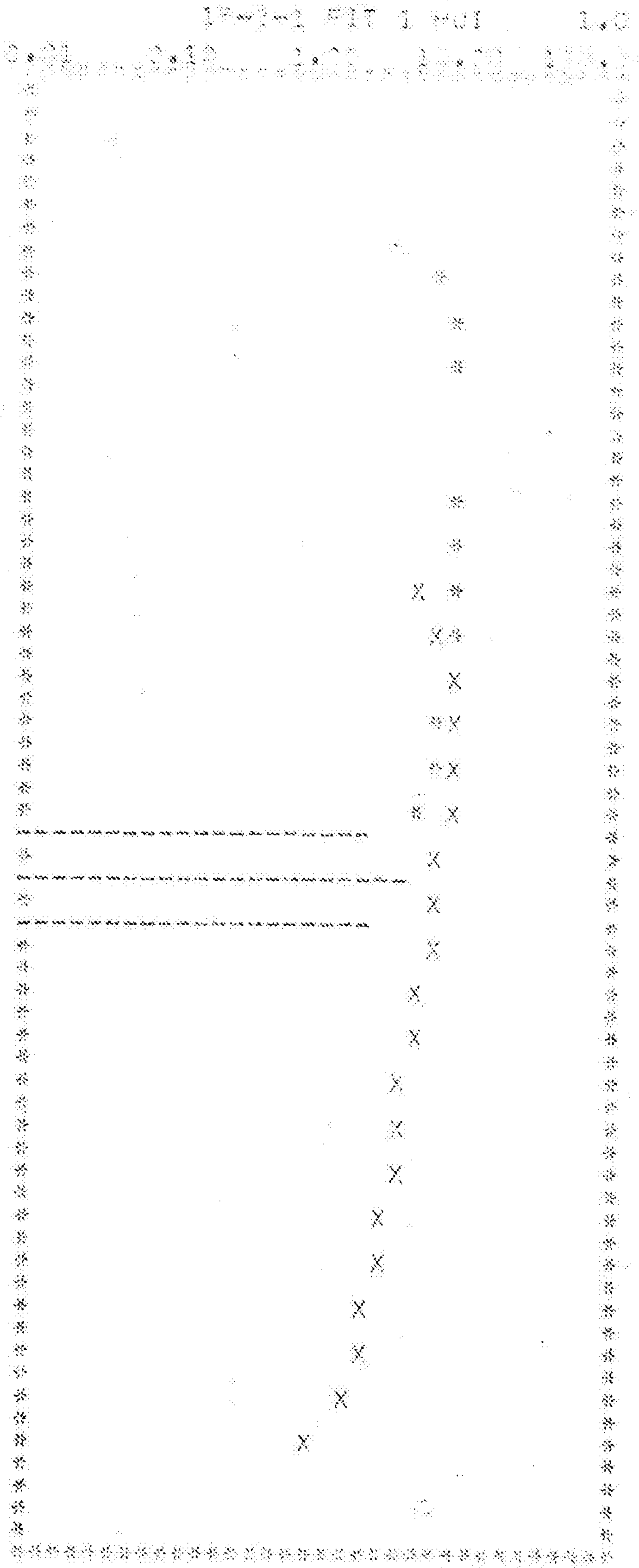
N.ALKANES.DISTRIBUTION



CPI FROM NC16 TO NC20 0.993
CPI FROM NC20 TO NC30 1.057
CPI MAXIMUM (NC27) 1.130

OC o/o
EOM PPM
ER

C1			
C2			
C3			
IC4			
NC4			
IC5		6.53	
NC5		3.77	
IC6		10.91	
NC6		11.72	
IC7		35.15	
NC7		12.63	
IC8		73.12	
NC8			
IC9		47.65	
NC9			
IC10		29.41	
NC10		12.83	
IC11		28.60	
NC11		13.15	
IC12		15.18	
NC12		11.94	7.18
IC13		13.12	
NC13		11.04	9.59
IC14		13.20	
NC14		11.68	10.56
C15		9.26	12.51
C16		7.56	11.97
C17		5.96	10.46
IC18			2.66
C18			9.13
IC19			4.23
C19			3.36
IC20			2.57
C20			7.61
C21			5.70
C22			5.99
C23			5.58
C24			5.14
C25			4.49
C26			3.68
C27			3.65
C28			2.78
C29			2.70
C30			2.24
C31			1.15
C32			
C33			



S NC1 A NC14 MAX= 93.50
S IC1 A IC14 MAX= 270.93

364.44 N 0/0 TOTAL 25.65

XI1= 2.29

XI3= 2.34