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Title
PETROLEUM GEOCHEMISTRY

WELL: 30/9-11A

Summary/Conclusion//Recommendation

Immature source rocks with potential for gas generation are found in the Heather and Ness Fms.

Migrated hydrocarbons found in the Ness Fm. are believed to be remnants of a fossil oil leg.

The migrated hydrocarbons in the Ness Fm. are rich in asphaltenes, but can not be classified as an asphalt zone as the one seen on the Oseberg alpha structure.

The migrated hydrocarbons in the Ness Fm. of well 30/9-11A do not correlate with the oil in well 30/9-9.

Keywords

Source Rock Evaluation,
Migrated Hydrocarbons, correlation with 30/9-9.

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Department	F-Geosection
Section	Petroleum Geochemistry
Authors	Elin Rein Elin Rein
Controlled	K. Kjærsrud
Accepted	Eigill Nysæther 3 July, 91
Approved	K. Kjærsrud

Postal Address:
P.O.Box 4313
5028 Nygårdstangen
Norway

Office Address:
Lars Hillesgt. 30
5008 Bergen
Norway

Phone:
National: (05) 99 50 00
Internat.: +47 5 99 50 00

Telefax:
National: (05) 99 61 96
Internat.: +47 5 99 61 96

Telex:
40920 hydro n

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1. INTRODUCTION.

Well 30/9-11A was sidetracked from 910m in well 30/9-11 and deviated from the Oseberg J-East area into the J-Central area. Well 30/9-11A reached T.D. at 3002m RKB in the Lower Jurassic Statfjord Fm. A map indicating the well location is given in Figure 1.1, and a well summary with formation tops is given in Figure 1.2.

The aim of this study was to identify and characterize possible source rocks in well 30/9-11A, and to analyze possible migrated hydrocarbons, with emphasis on maturity and origin. The results on migrated hydrocarbons are to be compared with data from well 30/9-9.

This report comprises the results from petroleum geochemical analysis of 24 SWCs and CCs from well 30/9-11A and 4 samples from well 30/9-9. A list of the samples investigated is given in Table 1.1.

The stable carbon isotope measurements was undertaken by Geolab Nor A/S, Trondheim, Norway. All other analytical work, interpretation of data and compilation of this report was undertaken by Norsk Hydro Research Center, Bergen Norway.

2. SOURCE ROCK EVALUATION WELL 30/9-11A.

Source rock horizons have been identified using Rock Eval pyrolysis and total organic carbon (TOC) measurements. The composition of the organic matter in selected samples have been characterized by pyrolysis gas chromatography, gas chromatography of saturated hydrocarbons and biomarker analysis.

2.1 Source rock screening data.

The results of RockEval/TOC analysis are listed in Table 2.1, and are plotted versus depth in Figure 2.1. A crossplot between Hydrogen Index and T_{max} is given in Figure 2.2.

All samples investigated are from core #1. The core depth for core #1 are shifted +4.1m relative to log depths.

The Heather Fm. samples have an average S_2 value of 4.3 kg/tonne and an average Hydrogen Index of 183 mgHC/gTOC. These values indicate a fair source potential for this section and suggest that the organic matter is of Type III kerogen with a potential mainly for gas generation.

The Ness Fm. coal samples are very rich in organic material and have S_2 values around 180 kg/tonne. Hydrogen indices for these samples are 244 and 263 mgHC/gTOC, suggesting a generation potential for gas and condensate.

T_{max} values are 430°C or below for all samples analysed this indicates that the sections analysed are immature.

2.2 Pyrolysis gas chromatography.

Programmed pyrolysis gas chromatography have been performed on selected samples with a source rock potential. The pyrolysis gas chromatograms are given in Appendix I.

The samples chosen for further analysis in this well are the samples at 2540.5m and 2546.5m. They were chosen based on their relative high S_2 and HI values.

Both samples show presence of n-alkane/alkene homologoues in the C_{25}-C_{30} region, more abundant in the sample at 2546.5m This indicates that the organic matter might have some potential for generation of liquid hydrocarbons. Aromatics are abundant in both samples suggesting a fair amount of terrestrial material in the organic matter.

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2.3 Gas chromatography of saturated hydrocarbons.

The gas chromatograms of the saturated hydrocarbons are given in Appendix II. Molecular ratios are given in Table 2.2.

The n-alkane distributions in both samples are slightly bimodal, and the CPIs range from 1.3 to 1.6 indicating input of terrestrially derived organic material to the organic matter. Pristane/Phytane ratios are around 4 indicating a dysaerobic/aerobic depositional environment.

2.4 Biological markers, saturated hydrocarbons.

The mass chromatograms of the terpanes (m/z 191) and the steranes (m/z 217) are given in Appendix III. Selected biomarker ratios are listed in Table 2.3.

The m/z 191 mass chromatograms of the two samples from Heather Fm. show abundant moretanes. This might indicate both presence of terrestrial material and/or low maturity. The extracts do not contain 28,30-bisnorhopane.

The sterane mass chromatograms, m/z 217, show presence of C_{27} and C_{29} steranes in almost equal amounts indicating a mixed input of both marine and terrestrial organic material. The 20S sterane isomerization is around 20% indicating low maturity for this section.

2.5. Summary.

The Heather Fm. is a fair source rock with a potential mainly for gas generation. It appears to have been deposited in a dysaerobic/aerobic environment.

The coal samples from Ness Fm. might have a potential for gas/condensate generation.

The sections analysed are immature, based on T_{max} and biomarker data.

3. MIGRATED HYDROCARBONS WELL 30/9-11A.

The aim of this part of the petroleum geochemistry study was to identify whether a zone with hydrocarbon shows at 2550-2570m in well 30/9-11A is an asphalt zone as the one seen in the Oseberg Alpha structure.

Identification and characterization of migrated hydrocarbons are based upon several parameters from extraction, Iatroscan, gas chromatograpy, biomarker data and stable carbon isotope measurements.

All samples encountered in this part of the study are from core #2, taken in the Ness Fm. The core depth is shifted -3.2m relative to log depth. Core photos indicating sampling points are given in Appendix IV.

3.1 Extraction and group type separation data.

The extraction yields and group type separation data from Iatroscan are given in Tables 3.1 and 3.2
Extraction and asphaltene contents are plotted in Figure 3.1.

The Ness Fm. sandstone samples (2556.5-2570.1m) contain 400 to 10000 ppm extractable organic matter (EOM). The amount of saturated + aromatic hydrocarbons in percent of EOM ranges from 48 to 85 %, clearly indicating that these hydrocarbons are migrated. The high extraction yields in some of the samples indicate that the hydrocarbons in this section are remnants of a fossil oil leg.

The amount of asphaltenes in these samples varies from 4 to 29 percent of EOM. Asphaltene values above 10% are considered to be quite high, but are still low compared to what was seen in the Oseberg Alpha tar mat (60-80 %).

3.2 Gas chromatography of saturated hydrocarbons.

The gas chromatograms are given in Appendix II, and molecular ratios are listed in Table 2.2.

The gas chromatograms of the migrated hydrocarbons from the Ness Fm. show smooth, unimodal n-alkane distributions. All samples have n-alkane maxima at n-C_{17}, indicating a marine origin. The Pristane/Phytane ratios are around 1.6 indicating a reducing depositional environment for the source rock that generated this oil. The hydrocarbons are probably sourced by a mature Upper Jurassic marine source rock.

3.3 Biological markers, saturated hydrocarbons.

The mass chromatograms of the terpanes (m/z 191) and the steranes (m/z 217) are given in Appendix III.

The distribution of terpanes (m/z 191) in the Ness Fm. is very similar in all the samples of migrated hydrocarbons. The mass chromatograms show low concentration of moretanes, indicating elevated maturity compared to that of the source rocks in the well. All samples contain 28,30-bisnorhopane.

The steranes (m/z 217) show a somewhat unusual distribution compared to what is seen in nearby wells. The concentration of diasteranes is low relative to the regular steranes and this is in contrast to what is usually seen.
%20S sterane isomerization is around 40% indicating peak maturity for the source rock that generated the oil.

3.4 Summary.

Extraction data indicates that the migrated hydrocarbons analysed are remnants of a fossil oil leg.

The oil is rich in asphaltenes, but can not be classified as an asphalt zone as the one seen on the Oseberg alpha structure.

The hydrocarbons are of marine origin and are probably sourced by a mature Upper Jurassic source rock deposited under reducing conditions.

4. CORRELATION 30/9-11A AND 30/9-9.

Four sandstone extracts from the Ness Fm in 30/9-11A (J-Central) were to be correlated with four sandstone extracts from the Shetland Gp., the Heather and the Tarbert Fms. in 30/9-9 (J-West). A well location map is given in Figure 1.1.

4.1. Results from metastable ion monitoring.

Plots of bargraphs indicating the relative distribution of products from metastable transitions are given in Appendix V. Selected biomarker ratios are listed in Table 4.1 and are plotted in Figure 4.2. Score and loading plots from multivariate analysis of the biomarker distributions are given in Figure 4.1.

Saturated hydrocarbons from the interval 2556.5m to 2568.9m in 30/9-11A and the interval 2291.1m to 2299.2m in 30/9-9 have been analysed by metastable ion monitoring on GCMS. For each of the metastable ions monitored, the main peaks were measured and the heights were used as input to multivariate analysis.

The first principal component calculated (using the logarithm of the normalised data) separates the samples into two groups; samples from 30/9-11A in one and samples from 30/9-9 in the other. The main feature separating these samples is the relative concentrations of diasteranes versus regular steranes. The samples from 30/9-11A contains relatively less diasteranes compared to the samples from 30/9-9. The diasterane content is believed to be associated with source rock lithology, but is also affected by maturity. The order of difference between the samples from 30/9-9 and 30/9-11A can presumably not be explained by maturity alone.

Differences are also seen in the relative concentrations of C_{30} neohopane (30F), and Trisnorneohopane (27F). These components are seen in higher concentrations in the samples from 30/9-9 than in the samples from 30/9-11A. The relative concentration of these components is believed to be dependent on the maturity of the hydrocarbons, but is also strongly facies dependent. The biomarker data significantly separates the analysed samples into two groups, and the separation seem to be caused by both maturity and source differences.

4.2 Aromatic steroids.

Mass chromatograms of monoaromatic and triaromatic steroids are given in Appendix VI. Selected maturity parameters are listed in Table 4.2, and T20/T20+T28 is plotted in Figure 4.2.

Selected parameters known to depend on maturity have been calculated for the analysed samples. All data obtained indicate that the migrated hydrocarbons from well 30/9-9 are more mature than the ones found in well 30/9-11A.
This suggests that the migrated hydrocarbons found in 30/9-11A are different from the ones in 30/9-9.

4.3 Stable carbon isotopes.

Results from stable carbon isotope measurements are listed in table 4.3. A crossplot of $\delta^{13}C$ for saturated hydrocarbons versus $\delta^{13}C$ for aromatic hydrocarbons is given in Figure 4.3, and Galimov plots are given in Appendix VII.

Five samples have been analysed for stable carbon isotopes, three samples from 30/9-9, and two samples from 30/9-11A. Isotope measurements have been made on saturated hydrocarbons, aromatic hydrocarbons, polar compounds and asphaltenes. The Galimov plots show that the samples from 30/9-11A are isotopically lighter than the samples from 30/9-9. The isotope values are source dependent, and the differences seen here indicate that the migrated hydrocarbons from 30/9-9 and 30/9-11A have been sourced from different organic facies of the Upper Jurassic. The crossplot of $\delta^{13}C$ of the saturated hydrocarbons versus $\delta^{13}C$ of the aromatic hydrocarbons shows that the samples from each well group together but that the samples from 30/9-9, and especially the aromatic hydrocarbons, are isotopically heavier than the ones from 30/9-11A.

4.4 Summary.

The migrated hydrocarbons in the Ness Fm. of well 30/9-11A seem to be of an Upper Jurassic origin, but are somewhat less mature than most oils in the Oseberg area. The hydrocarbons from 30/9-11A do not correlate with the oil from 30/9-9. There seems to be differences both in source and maturity.

6. CONCLUSIONS.

If the hydrocarbons found in well 30/9-11A have migrated in from the southwest this can be explained by a two phase migration/filling history of the J-area. The first phase giving oils of low maturity filling the J-West and the J-Central, and a second phase of more mature oil migrating into J-West only, thereby washing/mixing with the first phase oil.

Another possibility is that there never has been communication between the J-west and the J-central reservoir zones. If this is the case, the migrated hydrocarbons found in 30/9-11A are possibly sourced from source rocks in the Stord Basin, southeast of the structure.

A third, maybe less probable suggestion, is that the hydrocarbons found in well 30/9-11A might come from the same area as the oils found on the Brage Horst.

LIST OF ABBREVIATIONS AND TERMS

Kerogen

Insoluble organic matter which is preserved in sedimentary rocks. Under the increasing influence of temperature and time (maturation), most kerogen produce hydrocarbons.

TOC

Total Organic Carbon: a measure of the organic carbon in a rock, expressed as weight per cent. Used as a fundamental parameter in source rock classification.

RockEval

A commercial technique for the anhydrous pyrolysis of source rocks developed by IFP. It enables the chemical composition of kerogen and hence its hydrocarbon potential, to be determined.

S_1

This is a measure of the already generated oil in source rocks, or oil content in a reservoir. In units of kg/t rock.

S_2

This is a measure of the remaining hydrocarbon potential. In units of kg/t rock.

Tmax

The temperature, in ^{0}C, at which the pyrolytic yield of hydrocarbons from a rock sample reaches its maximum, using RockEval.

Hydrogen Index (HI)

A parameter derived from RockEval which measures the hydrogen richness of kerogen. $HI=100*S_2/TOC$. It has a direct relationship with the H/C ratio, and is measured in mg of hydrocarbons/g TOC

Production Index (PI)

A maturity parameter derived from RockEval, which is the ratio of already generated hydrocarbons (or migrated hydrocarbons) to potential hydrocarbons. $PI=S_1/S_1+S_2$

Immature samples have values of 0.1 or less, mature samples, 0.1 to 0.4. The PI is high in reservoirs.

Maturation

The process of chemical change in sedimentary organic matter induced by increasing time and temperature. These chemical reactions produce oil and hydrocarbon gases from the appropriate organic matter. The major maturity subdivisons are:

-immature
-early mature
-peak mature
-late mature
-post mature

Vitrinite

The type of organic matter derived from the lignified tissues of higher land plants.

Vitrinite reflectance

A maturity parameter based on the change in the reflectance of polished vitrinite particles with increasing time and temperature. Widely used values for maturity zones are:

$<$0.55 %. immature
0.55-1.3 %. mature for oil generation
$>$1.3 %. post mature for oil generation
0.7-3.0 %. mature for gas generation

EOM (Extractable Organic Matter)

Oil and oil-like products removed from rock samples using organic solvents. The amount of extract may be used to determine the level of maturation.

Saturated Hydrocarbons

Hydrocarbons which contain only carbon-carbon single bonds (alkanes).

Aromatic hydrocarbons

Unsaturated hydrocarbons and containing one or more rings with conjugated carbon-carbon double and single bonds.

NSO compounds

Fraction of oils or extracts containing heteroatoms like sulphur. oxygen and nitrogen.

Asphaltenes

The heavy molecular weight components of crude oils and sediment extracts which is soluble in CS_2 and insoluble in n-pentane.

n-C_{17}

n-alkane with 17 carbon atoms

n-alkane carbon number maximum

n-C_{17} maximum indicates algal input

n-C_{16} to n-C_{24} indicates bacterial input

n-C_{27}. n-C_{29}. n-C_{31} indicates higher plant input

Isoprenoids

Isoprenoids are branched and/or cyclic hydrocarbons built from multiples of the isoprene unit and are dominantly derived from plant and bacterial sources.

Pristane

C_{19} regular acyclic isoprenoid derived from the side chain of chlorophyll.

Phytane

C_{20} regular acyclic isoprenoid derived mainly from the side chain in chlorophyll. but have also been found in methanogenic bacteria and archaebacteria.

Pristane/phytane ratio

>3 = oxic conditions

<0.5 = anoxic conditions

The ratio may be affected by many factors

CPI (**Carbon Preference Index**)

The ratio of abundance of odd carbon number n-alkanes to even number n-alkanes. The preference decreases with increasing maturity until CPI = 1.0.

CPI$>$ 1.1 means oil or extract is of low maturity.

CPI$<$ 1.0 in carbonate source rocks.

Biodegradation

Degradation of oils by bacteria. Normal alkanes are generally the first to be attacked and removed.

GC-MS (**Gas chromatography-mass spectrometry**)

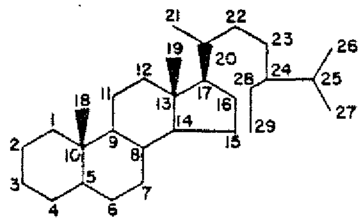
Method for identification of constituents in complex mixtures or for analysis of trace components using Single Ion Monitoring (SIM).

Biomarkers

Compounds found in petroleum or rock extracts which indicate an unambiguous link with a natural product.

Steranes

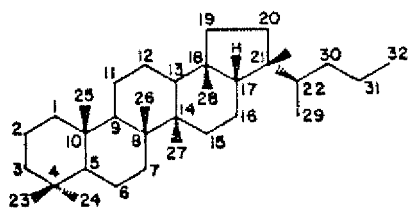
The alkanes derived from steroid natural products. Monitored by GC-MS of M/z 217 and 218.



Sterane

Triterpanes

C_{27} to C_{35} five ring cyclic alkanes derived from triterpenoid hydrocarbons in bacteria, fungi, algae and higher plants. Monitored by GC-MS of M/z 191.



Pentacyclic triterpane

Hopanes

C_{27} to C_{35} pentacyclic alkanes which dominate the triterpanes found in sediments and crude oils. They originate from bacteria.

M/z, m/e

The mass to charge ratio of fragment of molecules from GC-MS.

Table 1.1 List of samples analysed.

	WELL	DEPTH m	Type	Rock-Eval	TOC	PyGC	Extr.	Iatroscan	GCMSD-Sat	GCMS MIM	AROMATIC STEROIDS	STABLE ISOTOPES
1	30/9-11A	2515.00	SWC	*	*							
2	30/9-11A	2521.00	SWC	*	*							
3	30/9-11A	2527.00	SWC	*	*							
4	30/9-11A	2536.00	SWC	*	*							
5	30/9-11A	2540.50	SWC	*	*	*	*	*	*			
6	30/9-11A	2542.00	SWC	*	*							
7	30/9-11A	2545.80	COCH	*	*		*	*				
8	30/9-11A	2546.50	SWC	*	*	*	*	*	*			
9	30/9-11A	2547.60	COCH	*	*		*	*				
10	30/9-11A	2548.00	SWC	*	*							
11	30/9-11A	2548.80	SWC	*	*							
12	30/9-11A	2549.50	SWC	*	*							
13	30/9-11A	2556.50	COCH				*	*	*	*	*	*
14	30/9-11A	2565.50	COCH				*	*				
15	30/9-11A	2566.60	COCH				*	*				
16	30/9-11A	2568.50	COCH				*	*	*	*	*	
17	30/9-11A	2568.60	COCH				*	*				
18	30/9-11A	2568.70	COCH				*	*	*	*	*	*
19	30/9-11A	2568.80	COCH				*	*				
20	30/9-11A	2568.90	COCH				*	*	*	*	*	
21	30/9-11A	2569.70	COCH				*	*				
22	30/9-11A	2570.00	COCH				*	*				
23	30/9-11A	2570.10	COCH				*	*				
24	30/9-11A	2576.50	COCH				*	*				
25	30/9-9	2291.10	COCH							*	*	*
26	30/9-9	2293.02	COCH							*	*	*
27	30/9-9	2293.70	COCH							*	*	
28	30/9-9	2299.02	COCH							*	*	*

Table 2.1 Source rock screening data.

Table 2.1 **SOURCE ROCK SCREENING DATA WELL 30/9-11A**

Depth (m)	Group/Fm.	%	Lithology	Type	S1 kg/t	S2 kg/t	TOC %	HI	PI	Tmax DegC	Company
2515.00	HEATHER		CLYST	SWC	0.65	3.98	2.4	166	0.14	430	
2521.00	HEATHER		SLST	SWC	2.72	2.62	1.3	202	0.51	425	
2527.00	HEATHER		SLST	SWC	1.08	3.22	1.9	169	0.25	426	
2536.00	HEATHER		CLYST	SWC	0.62	6.39	2.7	237	0.09	426	
2540.50	HEATHER		CLYST	SWC	0.74	13.00	4.5	289	0.05	428	
2542.00	HEATHER		CLYST	SWC	0.07	0.25	0.6	42	0.22	432	
2546.50	HEATHER		CLYST	SWC	0.21	3.71	1.2	309	0.05	434	
2548.00	HEATHER		CLYST	SWC	0.17	1.00	0.9	111	0.15	429	
2548.80	HEATHER		COAL	COCH	31.26	181.53	74.4	244	0.15	421	F BERGEN
2549.50	HEATHER		COAL	COCH	21.13	185.09	70.5	263	0.10	421	F BERGEN

Table 2.2 Molecular ratios.

Table 2.2 **SATURATED FRACTION MOLECULAR RATIOS WELL 30/9-11A**

Depth	Group/Fm.	%	Lithology	Type	Pristane / nC17	Pristane / Phytane	CPI-I	CPI-II	nC15+ / Total	nC20 / nC25
2540.50	HEATHER		CLYST	SWC	3.51	3.79	1.48	1.34		
2546.50	HEATHER		CLYST	SWC	2.80	4.13	1.63	1.61		
2556.50	NESS		SST	COCH	0.85	1.56	1.07	1.00		
2568.50	NESS		SST	COCH	0.91	1.59	1.07	1.00		
2568.70	NESS		SST	COCH	0.91	1.73	1.08	1.00		
2568.90	NESS		SST	COCH	0.89	1.63	1.09	1.02		

Table 3.1 Extraction data I.

Table 3.1 **SOURCE ROCK EXTRACTION DATA WELL 30/9-11A**

Depth (m)	Group/Fm.	%	Lithology	Type	EOM(mg)	EOM(%)	Hydrocarbons SAT(%)	ARO(%)	TOTAL(%)	Non Hydrocarbons NSO(%)	ASPH(%)	TOTAL(%)
2540.50	HEATHER		CLYST	SWC	17.6	0.28	2.00	12.00	14.00	52.00	34.00	86.00
2545.80	HEATHER		SSTL	COCH	32.1	0.17	43.00	25.00	68.00	25.00	7.00	32.00
2546.50	HEATHER		CLYST	SWC	8.0	0.10	5.00	10.00	15.00	38.00	47.00	85.00
2547.60	HEATHER		COAL	COCH	28.4	0.14	40.00	20.00	60.00	13.00	26.00	39.00
2556.50	NESS		SST	COCH	38.0	0.17	49.00	30.00	79.00	9.00	11.00	20.00
2565.50	NESS		SST	COCH	6.8	0.04	44.00	25.00	69.00	15.00	15.00	30.00
2566.60	NESS		SST	COCH	6.9	0.04	46.00	25.00	71.00	16.00	13.00	29.00
2568.50	NESS		SST	COCH	52.7	0.28	51.00	26.00	77.00	12.00	11.00	23.00
2568.60	NESS		SST	COCH	71.5	0.43	51.00	25.00	76.00	13.00	11.00	24.00
2568.70	NESS		SST	COCH	244.8	1.07	52.00	29.00	81.00	10.00	9.00	19.00
2568.80	NESS		SST	COCH	140.4	0.67	53.00	29.00	82.00	11.00	7.00	18.00
2568.90	NESS		SST	COCH	39.8	0.20	44.00	29.00	73.00	18.00	9.00	27.00
2569.70	NESS		SST	COCH	77.7	0.41	52.00	33.00	85.00	10.00	6.00	16.00
2570.00	NESS		SST	COCH	116.9	0.56	47.00	35.00	82.00	11.00	7.00	18.00
2570.10	NESS		SST	COCH	77.0	0.27	47.00	36.00	83.00	13.00	4.00	17.00
2576.50	NESS		SST	COCH	5.6	0.02	39.00	9.00	48.00	23.00	29.00	52.00

Table 3.2 Extraction data II.

Table 3.2 **SOURCE ROCK EXTRACTION DATA WELL 30/9-11A**

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Depth	Group/Fm.	%	Lithology	Type	TOC (%)	EOM(%)/TOC(%)	SAT(%)/TOC(%)	SAT(%)/ARO(%)	HC/Non HC
2540.50	HEATHER		CLYST	SWC	4.50	0.06	0.44	0.17	0.16
2545.80	HEATHER		SSTL	COCH				1.72	2.13
2546.50	HEATHER		CLYST	SWC	1.20	0.09	4.17	0.50	0.18
2547.60	HEATHER		COAL	COCH				2.00	1.54
2556.50	NESS		SST	COCH				1.63	3.95
2565.50	NESS		SST	COCH				1.76	2.30
2566.60	NESS		SST	COCH				1.84	2.45
2568.50	NESS		SST	COCH				1.96	3.35
2568.60	NESS		SST	COCH				2.04	3.17
2568.70	NESS		SST	COCH				1.79	4.26
2568.80	NESS		SST	COCH				1.83	4.56
2568.90	NESS		SST	COCH				1.52	2.70
2569.70	NESS		SST	COCH				1.58	5.31
2570.00	NESS		SST	COCH				1.34	4.56
2570.10	NESS		SST	COCH				1.31	4.88
2576.50	NESS		SST	COCH				4.33	0.92

Table 4.1 Results from metastable ion monitoring.

WELL	Depth	ts/tm	%20s	%abb
30/9-9	2291.10	1.7	45	67
30/9-9	2293.02	1.5	45	66
30/9-9	2293.70	1.6	47	67
30/9-9	2299.02	1.5	47	66
30/9-11A	2568.50	1.0	37	63
30/9-11A	2568.70	1.1	43	67
30/9-11A	2568.90	1.1	40	65
30/9-11A	2556.50	1.0	44	62

Depth start in..	Depth end int.	Sample type	Lith.	Well	Geochem job #	MS-file
2291.10	2291.10	COCH	SST	30_9_9	F-BG	AS22041
2293.02	2293.02	COCH	SST	30_9_9	F-BG	AS22041
2293.70	2293.70	COCH	SST	30_9_9	F-BG	AS22041
2299.02	2299.02	COCH	SST	30_9_9	F-BG	AS22041
2556.50	2556.50	COCH	SST	30_9_11A	F-BG	ES03051
2568.50	2568.50	COCH	SST	30_9_11A	F-BG	AS22041
2568.70	2568.70	COCH	SST	30_9_11A	F-BG	AS22041
2568.90	2568.90	COCH	SST	30_9_11A	F-BG	AS22041

Depth start int	26Y 360-191/2	26YY 360-191/2	25Y 346-191	24Y 332-191/1	24X 330-191	23Y 318-191	22Y 304-191
2291.10	15	13.0	19.0	39.2	42.8	55.0	8.00
2293.02	17	15.0	18.6	72.0	104.0	100.0	22.50
2293.70	14	16.0	15.0	27.0	48.0	44.0	0.01
2299.02	7	7.0	9.0	33.0	50.0	48.0	6.00
2556.50	18	27.6	30.0	69.0	84.0	87.5	0.01
2568.50	12	7.0	14.0	28.5	28.5	28.5	8.00
2568.70	6	4.0	3.5	7.5	6.5	8.0	0.01
2568.90	9	8.6	13.0	21.0	34.5	34.5	2.50

Depth start int	21Y 290-191	20Y 276-191	23a 316-217/1	23k 316-217/2	22a 302-217/1	22k 302-217/2
2291.10	36	57.0	44.0	10.0	108.0	58.5
2293.02	69	99.0	87.5	21.0	187.0	98.0
2293.70	16	55.0	33.0	15.0	87.5	45.5
2299.02	33	57.5	48.0	12.0	117.9	61.2
2556.50	69	84.0	84.0	49.0	189.0	154.0
2568.50	16	25.5	28.5	10.5	57.5	32.5
2568.70	11	16.0	7.0	3.0	20.0	14.0
2568.90	20	19.0	21.2	6.0	50.0	32.0

Depth start int	21a 288-217/1	21k 288-217/2	35A 482-191/1	35B 482-191/2	34A 468-191/1	34B 468-191/2
2291.10	137.5	126.5	16.0	8.0	30	21.0
2293.02	221.0	229.5	43.2	38.0	100	52.0
2293.70	100.0	96.0	18.0	11.0	21	16.0
2299.02	162.0	150.0	33.0	16.5	48	30.0
2556.50	262.5	283.5	75.0	42.0	117	67.5
2568.50	57.5	55.0	42.0	28.0	55	35.0
2568.70	22.0	20.0	8.0	4.0	10	6.0
2568.90	78.0	69.6	22.0	11.2	48	28.0

Depth start in[illegible]	33A 454-191/1	33B 454-191/2	32A 440-191/1	3[illegible] 4[illegible]-191/2	31A 426-191/1	31B 426-191/2
2291.10	84.0	59.5	156.0	132.0	351.0	247.0
2293.02	202.5	135.0	421.6	294.5	742.0	298.2
2293.70	76.8	57.0	148.5	110.0	303.6	176.0
2299.02	104.8	72.0	204.0	150.0	392.0	243.6
2556.50	248.4	171.0	406.0	304.5	756.0	529.2
2568.50	130.0	90.0	183.4	140.0	351.0	236.6
2568.70	36.0	24.0	65.0	46.0	164.4	102.0
2568.90	107.2	72.0	190.4	140.0	378.0	243.0

Depth start int	31C 426-191/3	31D 426-191/4	30F 412-191	30O 412-191	30A 412-191	30H 412-191	30C 412-191
2291.10	10.4	26.0	100.5	0.01	938.0	20.1	33.5
2293.02	15.9	53.0	268.0	0.01	1889.4	53.6	107.2
2293.70	4.4	19.8	75.6	0.01	756.0	21.6	37.8
2299.02	14.0	25.2	102.2	0.01	1029.3	29.2	51.1
2556.50	16.2	43.2	98.7	0.01	2002.2	42.3	98.7
2568.50	5.2	15.6	31.0	0.01	868.0	18.6	37.2
2568.70	6.0	7.2	14.0	0.01	493.5	7.0	14.0
2568.90	5.4	13.5	32.0	0.01	902.4	19.2	44.8

Depth start int	30G 412-191	30E 412-191	29N 398-191	29A 398-191	29F 398-191	29C 398-191	28A 384-191
2291.10	13.40	0.01	0.01	469.2	180.2	40.8	117.0
2293.02	0.01	0.01	25.60	896.0	403.2	96.0	219.2
2293.70	0.01	0.01	5.80	400.2	139.2	29.0	91.0
2299.02	0.01	0.01	27.20	472.6	187.0	51.0	175.5
2556.50	28.20	0.01	14.00	980.0	308.0	133.0	532.0
2568.50	0.01	0.01	0.01	411.0	235.6	111.6	184.8
2568.70	0.01	0.01	0.01	208.5	43.5	21.0	93.8
2568.90	0.01	0.01	0.01	462.0	236.8	39.6	220.8

Depth start int	28N 384-191	27F 370-191	27A 370-191	27E 370-191	30a 414-217	30b 414-217	30c 414-217
2291.10	3.60	217.6	131.2	0.01	31.5	18.0	11.7
2293.02	2.00	444.8	288.0	0.01	40.8	36.0	21.0
2293.70	3.50	171.6	106.6	0.01	19.0	13.0	12.0
2299.02	6.50	232.9	156.4	0.01	16.4	16.4	6.2
2556.50	7.60	315.1	308.2	0.01	49.5	45.0	27.0
2568.50	0.01	112.5	114.3	0.01	23.0	24.5	10.0
2568.70	0.01	49.2	44.0	0.01	12.0	9.2	5.4
2568.90	0.01	135.0	119.0	0.01	20.0	17.6	8.4

Depth start i	30d 414-217	30e 414-217	30f 414-217	30g 414-217	30h 414-217	29a 400-217	29b 400-217
2291.10	10.8	10.2	20.7	29.7	14.7	328.8	211.2
2293.02	13.2	31.2	57.6	76.8	29.4	597.7	430.0
2293.70	7.6	9.0	16.6	20.2	8.4	232.9	156.4
2299.02	5.6	8.6	14.8	20.8	12.8	331.2	220.8
2556.50	22.5	72.9	87.3	118.8	81.0	512.0	372.0
2568.50	12.0	24.0	39.0	58.5	32.5	250.8	167.2
2568.70	6.2	12.0	17.0	21.6	13.6	91.2	61.6
2568.90	11.6	22.0	37.6	48.8	25.6	234.6	159.8

Depth start int	29c 400-217	29d 400-217	29e 400-217	29f 400-217	29g 400-217	29h 400-217	28a 386-217
2291.10	72.0	62.4	72.0	168.0	156.0	88.8	130.0
2293.02	180.6	129.0	167.7	361.2	352.6	206.4	264.6
2293.70	61.2	47.6	61.2	129.2	127.5	68.0	98.4
2299.02	84.0	52.8	69.6	151.2	134.4	79.2	150.0
2556.50	168.0	192.0	296.0	552.0	556.0	372.0	300.8
2568.50	70.3	87.4	104.5	256.5	228.0	176.7	122.2
2568.70	21.6	27.2	44.0	103.2	106.4	57.6	41.5
2568.90	73.1	68.0	95.2	229.5	214.2	141.1	116.4

Depth start int	28aa 386-217	28b 386-217	28bb 386-217	28c 386-217	28d 386-217	28e 386-217	28f 386-217
2291.10	131.0	74.0	100.0	38.0	33.0	39.0	106.0
2293.02	285.6	153.3	176.4	60.9	71.4	67.2	214.2
2293.70	104.8	64.0	78.4	32.0	25.6	30.4	93.6
2299.02	160.8	93.6	100.8	39.6	32.4	34.8	108.0
2556.50	304.0	179.2	211.2	73.6	89.6	166.4	444.8
2568.50	120.9	65.0	79.3	28.6	37.7	53.3	171.6
2568.70	43.5	20.5	29.0	11.5	12.0	22.0	65.0
2568.90	118.8	68.4	74.4	25.2	30.0	54.0	162.0

Depth start int	28g 386-217	28h 386-217	27a 372-217	27b 372-217	27c 372-217	27d 372-217	27e 372-217
2291.10	95.0	40.0	444.8	268.8	54.4	89.6	76.8
2293.02	189.0	86.1	831.9	513.3	118.0	188.8	165.2
2293.70	72.8	32.8	361.4	213.2	44.2	78.0	70.2
2299.02	87.6	36.0	476.0	306.0	57.8	102.0	71.6
2556.50	396.8	211.2	784.0	476.0	112.0	190.4	336.0
2568.50	161.2	67.6	342.5	205.0	42.5	75.0	107.5
2568.70	58.0	28.0	136.0	83.0	13.0	25.0	52.0
2568.90	138.0	63.6	364.0	213.2	39.0	75.4	124.8

Depth start in.	27f 372-217	27g 372-217	27h 372-217
2291.10	137.6	118.4	89.6
2293.02	253.7	230.1	200.6
2293.70	114.4	98.8	80.6
2299.02	119.0	98.6	78.2
2556.50	492.8	436.8	364.0
2568.50	185.0	167.5	130.0
2568.70	87.0	68.0	58.0
2568.90	202.8	161.2	132.6

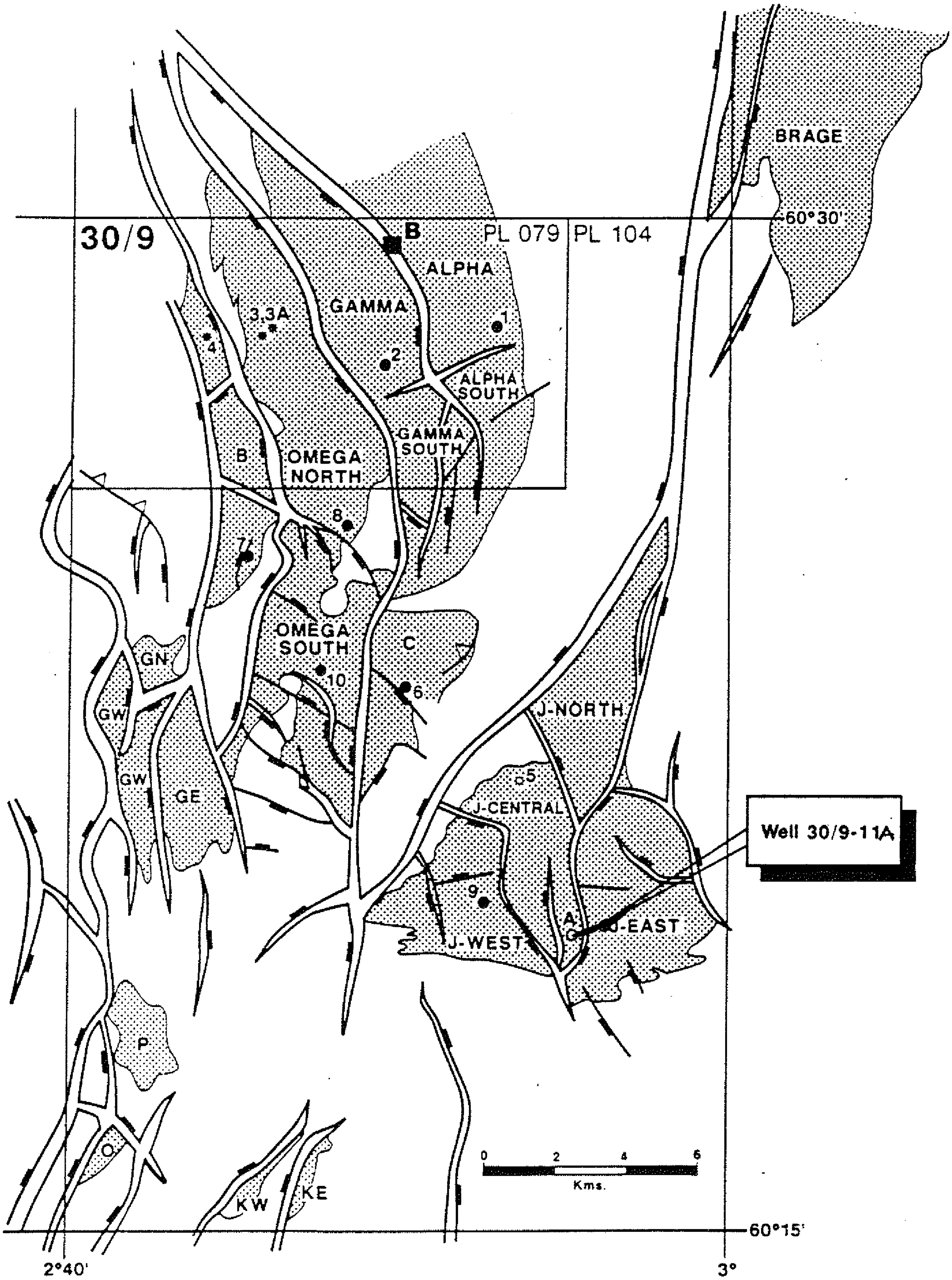
Table 4.2 Maturity parameters calculated from aromatic steroids.

WELL	DEPTH	TRI/ MONO+TRI	TRI 20/ 20 + 28
30/9-9	2299.02	0.72	0.33
30/9-9	2293.70	0.72	0.38
30/9-9	2293.02	0.69	0.32
30/9-9	2291.10	0.68	0.33
30/9-11A	2568.90	0.64	0.17
30/9-11A	2568.70	0.61	0.12
30/9-11A	2568.50	0.61	0.13
30/9-11A	2556.50	0.67	0.12

Table 4.3 Stable carbon isotopes.

WELL	DEPTH	SAT	ARO	NSO	ASPH
30/9-9	2291.10	-28.31	-27.29	-27.33	-26.66
30/9-9	2293.02	-28.31	-27.33	-27.32	-27.00
30/9-9	2299.02	-28.48	-27.22	-27.20	-25.88
30/9-11A	2556.50	-28.84	-28.37	-28.07	-27.01
30/9-11A	2568.70	-29.05	-28.61	-28.47	-27.92
30/11-4		-28.46	-27.26	-27.26	-27.73

Figure 1.1 Well location map.



Location map, Well 30/9-11A

HYDRO
TNI047/OH/BM/06.90

Figure 1.2 Well summary with formation tops.

HYDRO **WELL: 30/9-11A**

DEPTH RKB: ELEVATION KB: 25m NB! Not to scale All depth in meters

CHRONOSTRATIGRAPHY

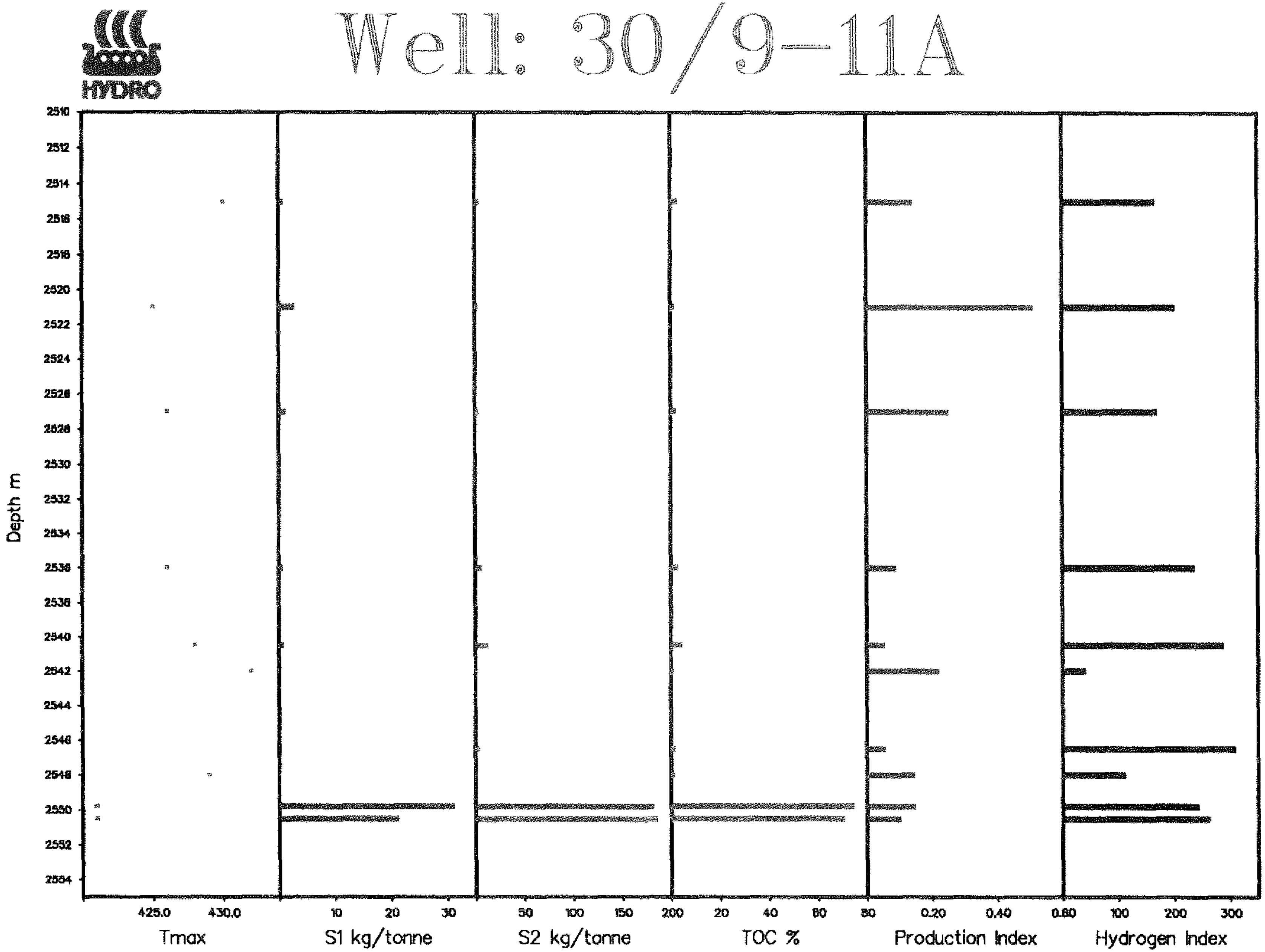
SYSTEM	SERIES/STAGE	DEPTH m	THICKNESS m
	WELL SIDETRACKED	FROM 910m	
	Early Miocene	930	10m
		940 960	20m
	Late Oligocene		210m
		1170 1180	10m
	Early Oligocene		370m
		1550 1560	10m
	?Early Oligocene-Late Oligocene		140m
		1700 1720	20m
	Late-Middle Eocene		130m
		1850 1870	20m
	Middle Eocene		150m
		2020 2030	10m
	Early Eocene		50m
		2080 2090	10m
	Late Paleocene		265m
		2355 2360	5m
	Early Paleocene	2365	5m
		2370	5m
	Maastrichtian-Late Campanian		102m
		2472 2495	23m
	Early Campanian		2m
		2497	
	Albian-Early Barremian/Hauterivian	2505.5	18m
		2515	
	Early Kimmeridgian		12m
		2527 2536	9m
	Late-Middle Oxfordian	2540.5	4.5m
	E.Oxfordian-L.Callovian	2542	6m
		2546.5	
	? Middle Callovian		1.5m
		2548.0 2548.3	0.3m
	Bajocian-?Aalenian		111.5m
		2659.8 2670	10.2m
	Aalenian-Late Toarcian		57m
		2727	
	Toarcian		78m
		2805	
	Late Pliensbachian		155m
		2960 2970	10m
	Pliensbachian - ? Sinemurian	3002 (T.D)	32m

LITHOSTRATIGRAPHY

GROUP	FORMATION/MEMBER	
Hordaland Group		2092
Rogaland Group	Balder Fm.	2137
	SeleFm.	2195
	Lista Fm.	2360
	Våle Fm.	2365
Shetland Group		2498
Cromer Knoll Gp.		2513
Viking Group	Heather Fm.,	2551
Brent Group	Tarbert Fm.	2553
	Ness Fm.	2667
	Etive/Rannoch Fm.	2679
	Oseberg Fm.	2680
Dunlin Group	Drake Fm.	2804.5
	"Fault Zone"	2836
	Burton Fm.	2874.5
	Amundsen Fm.	2973
	Statfjord Fm.	3002 (T.D.)

Figure 2.1 Screening data versus depth.

Well: 30/9-11A



HYDRO
Depth m
2510
2512
2514
2516
2518
2520
2522
2524
2526
2528
2530
2532
2534
2536
2538
2540
2542
2544
2546
2548
2550
2552
2554
425.0
430.0
Tmax
10
20
30
S1 kg/tonne
50
100
150
200
S2 kg/tonne
20
40
60
80
TOC %
0.20
0.40
0.60
Production Index
100
200
300
Hydrogen Index

Well: 30/9-11A - Heather Fm.

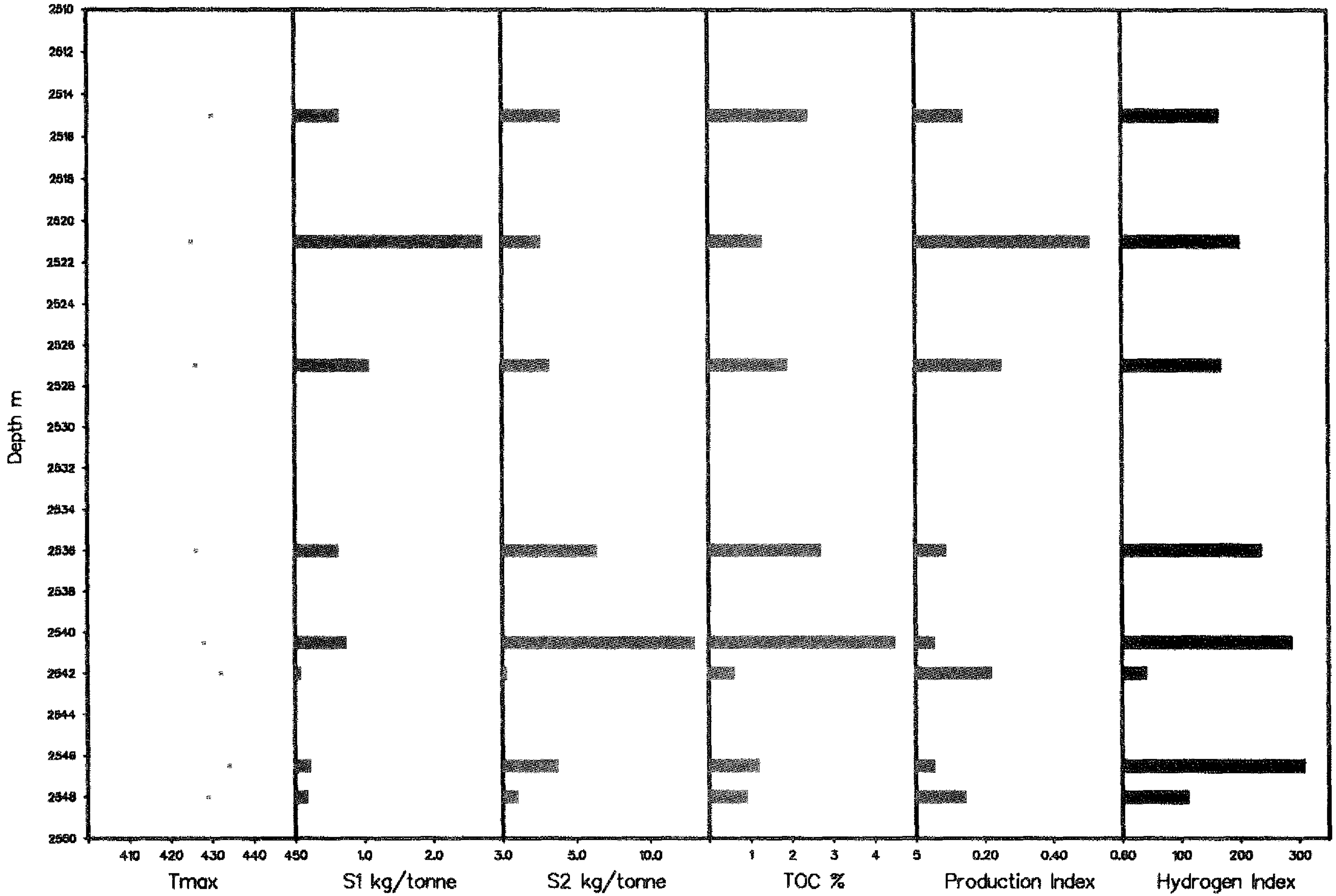
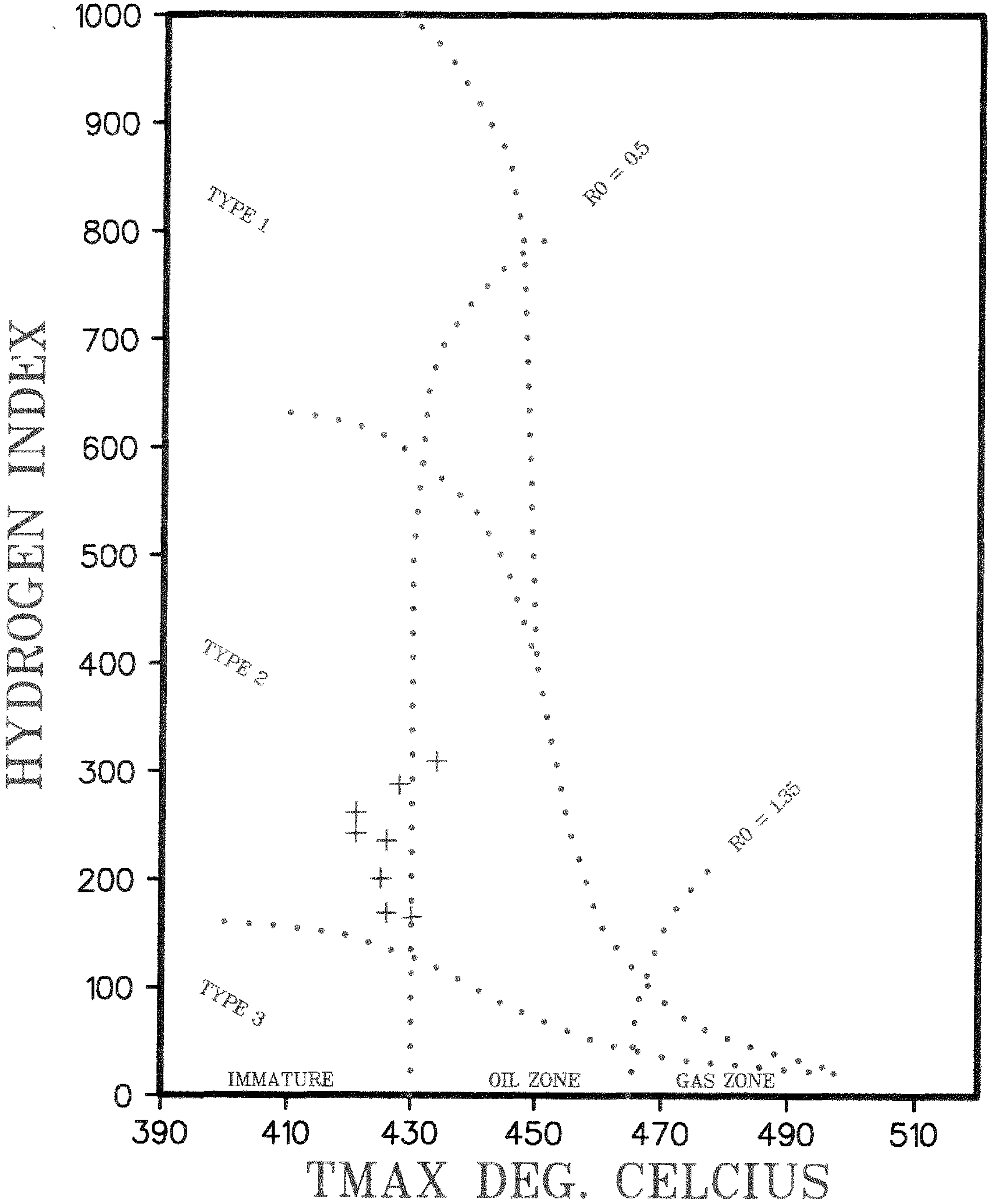


Figure 2.2 Hydrogen Index versus T_{max}.

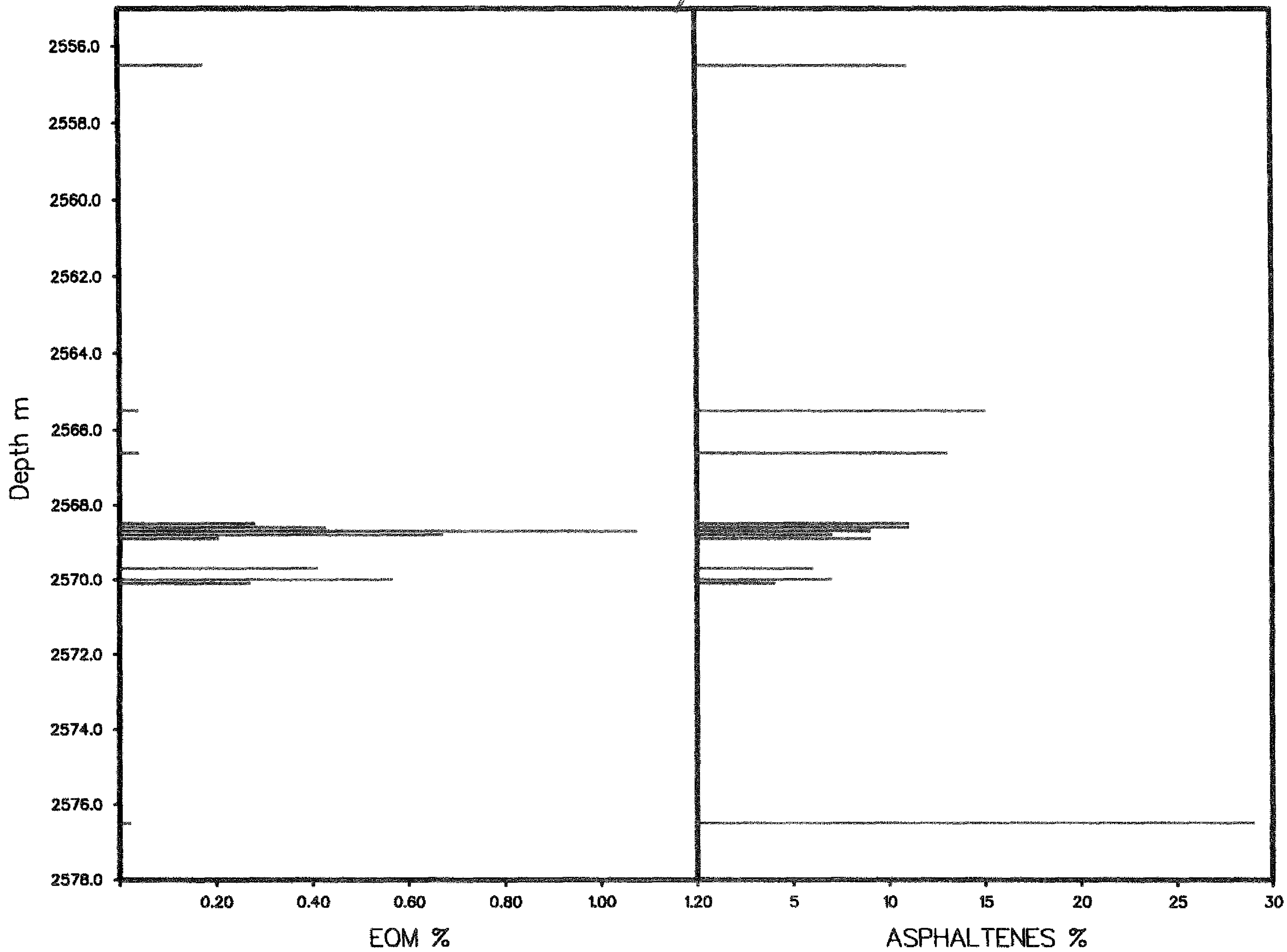
Well: 30/9-11A



1000
900
800
700
600
500
400
300
200
100
0
HYDROGEN INDEX
TYPE 1
TYPE 2
TYPE 3
RO = 0.5
RO = 1.35
IMMATURE
OIL ZONE
GAS ZONE
390
410
430
450
470
490
510
TMAX DEG. CELCIUS

Figure 3.1 EOM and asphaltenes versus depth.

Well: 30/9-11A



Depth m
2556.0
2558.0
2560.0
2562.0
2564.0
2566.0
2568.0
2570.0
2572.0
2574.0
2576.0
2578.0
0.20
0.40
0.60
0.80
1.00
1.20
EOM %
5
10
15
20
25
30
ASPHALTENES %

Figure 4.1   Score and loading plots.

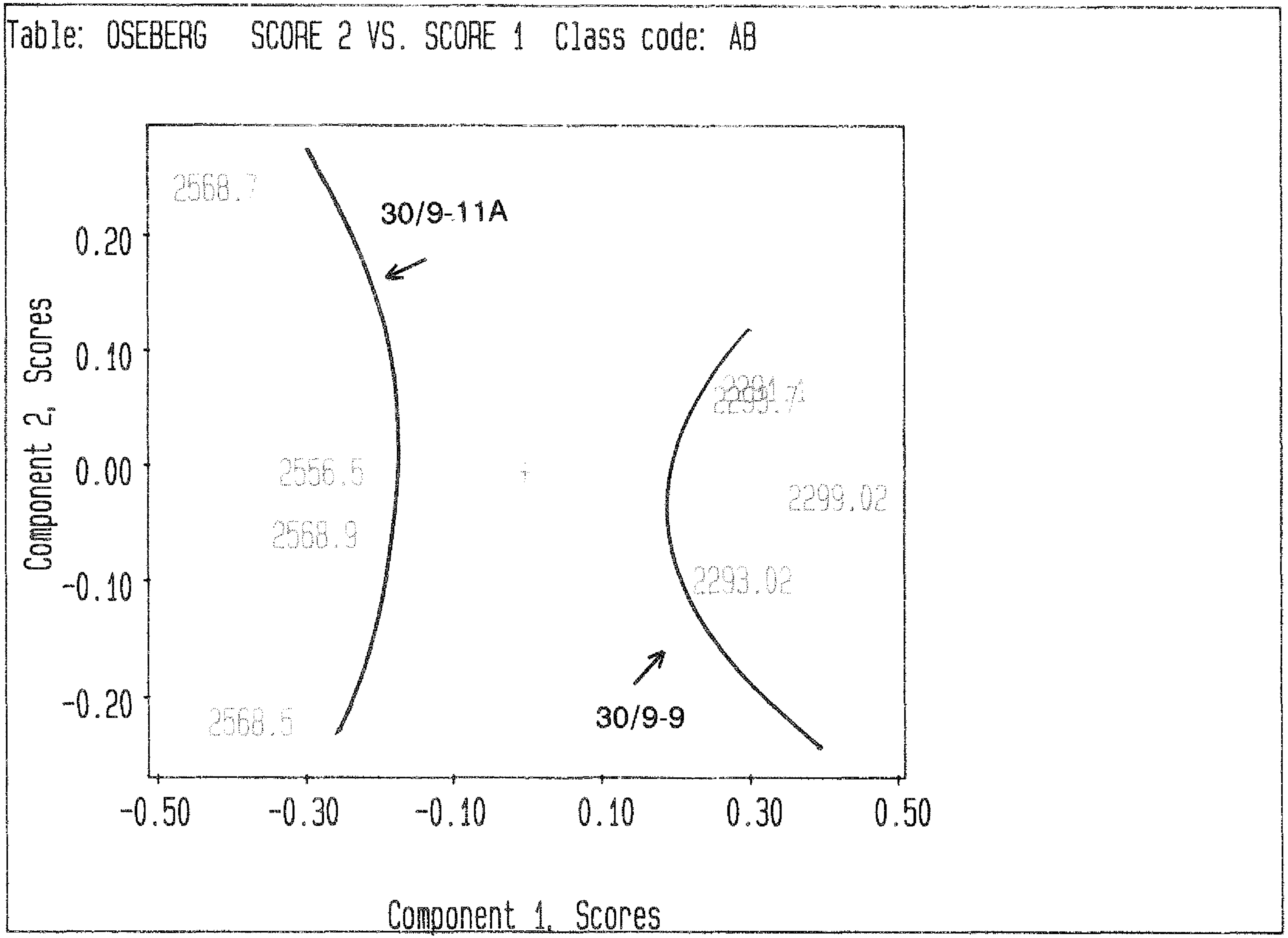


Table: OSEBERG SCORE 2 VS. SCORE 1 Class code: AB
30/9-11A
30/9-9
2568.7
2556.5
2568.9
2568.5
2299.02
2293.02
0.20
0.10
0.00
-0.10
-0.20
-0.50
-0.30
-0.10
0.10
0.30
0.50
Component 2, Scores
Component 1, Scores

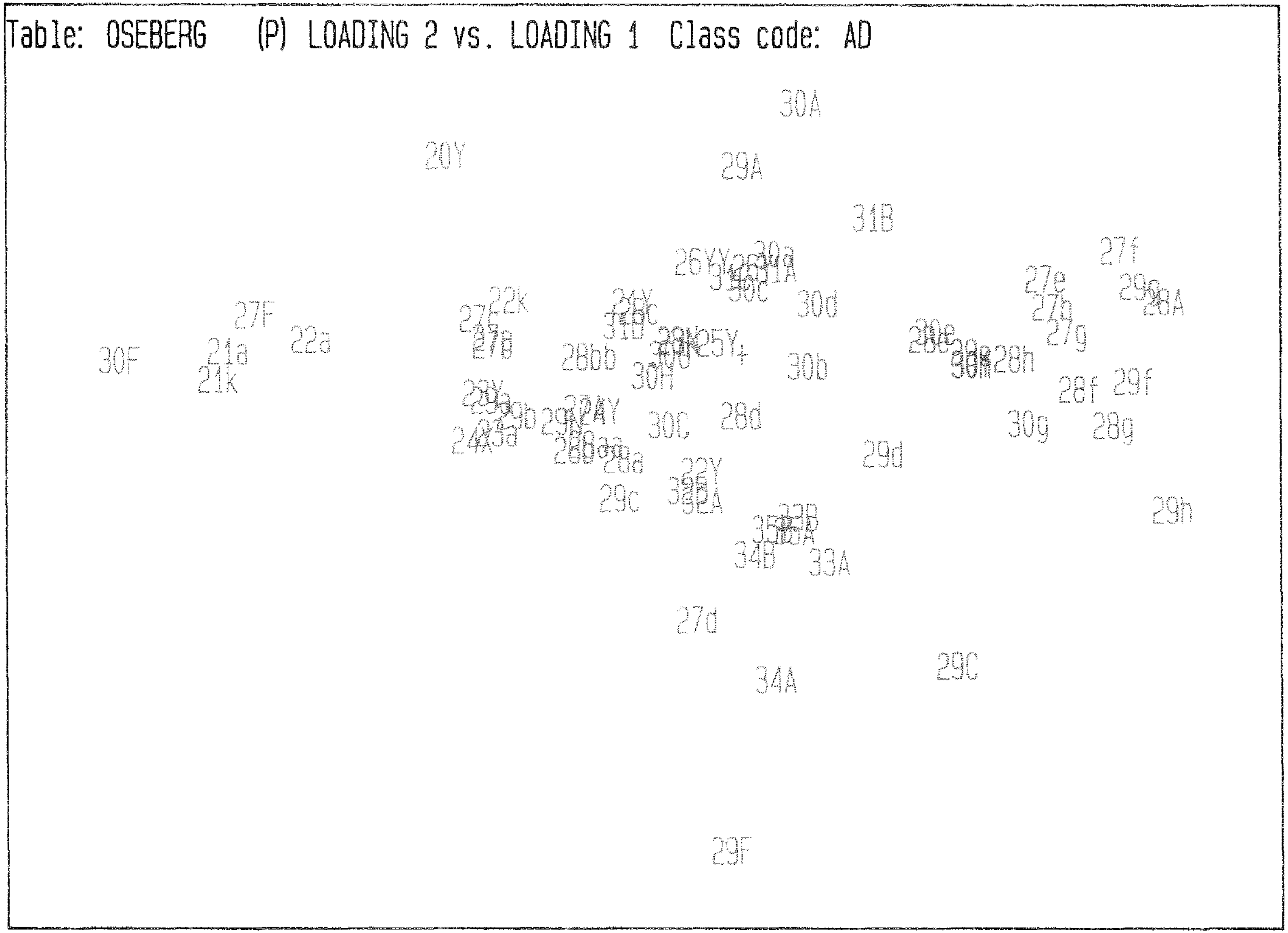


Table: OSEBERG (P) LOADING 2 vs. LOADING 1 Class code: AD
30A
20Y
29A
31B
27f
27e
28A
22k
30d
27F
22a
27g
30F
21a
21k
28bb
30b
28h
28f
29f
28d
30C
30g
28g
29d
29c
29h
33A
27d
34A
29C
29F

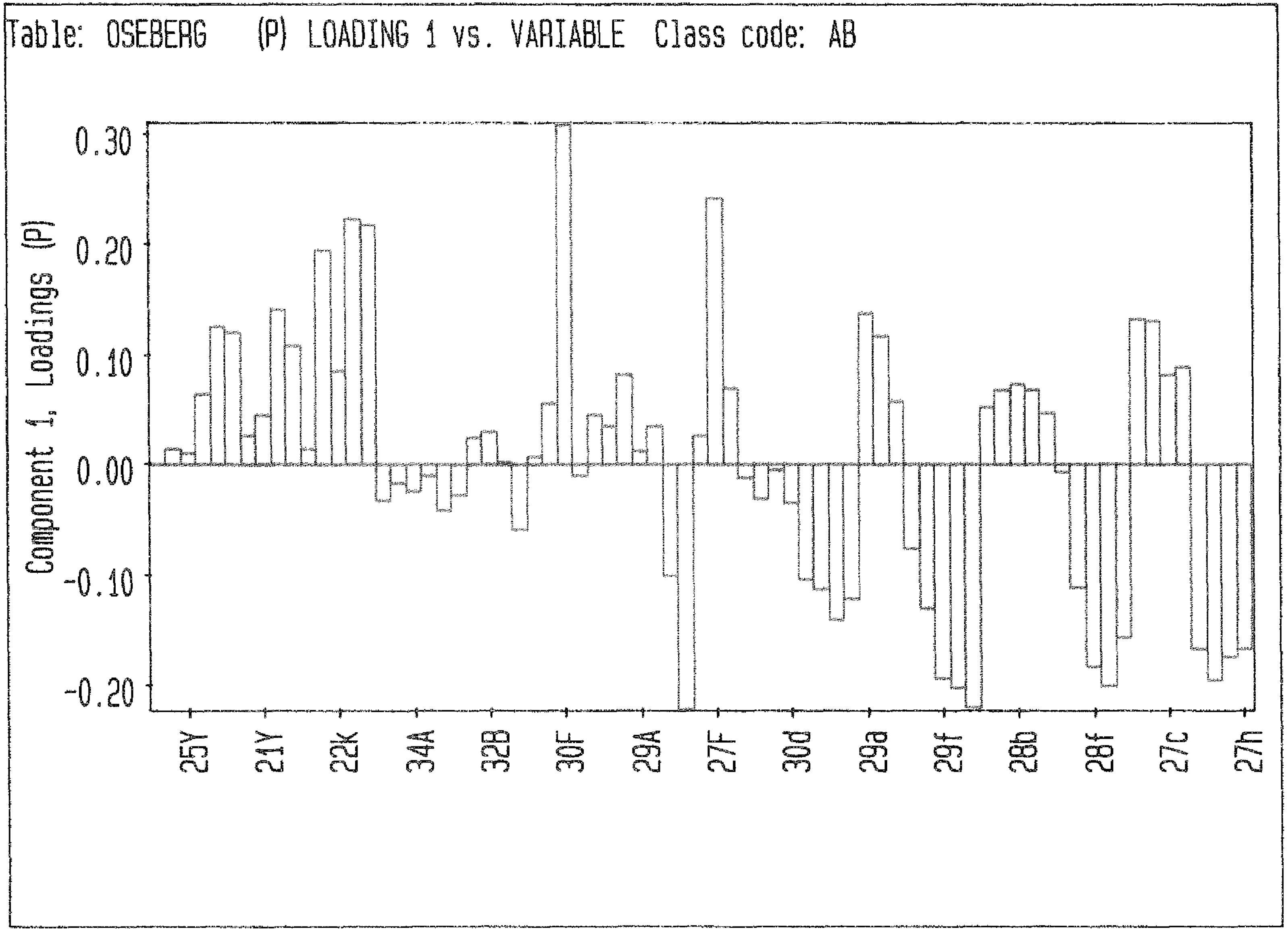
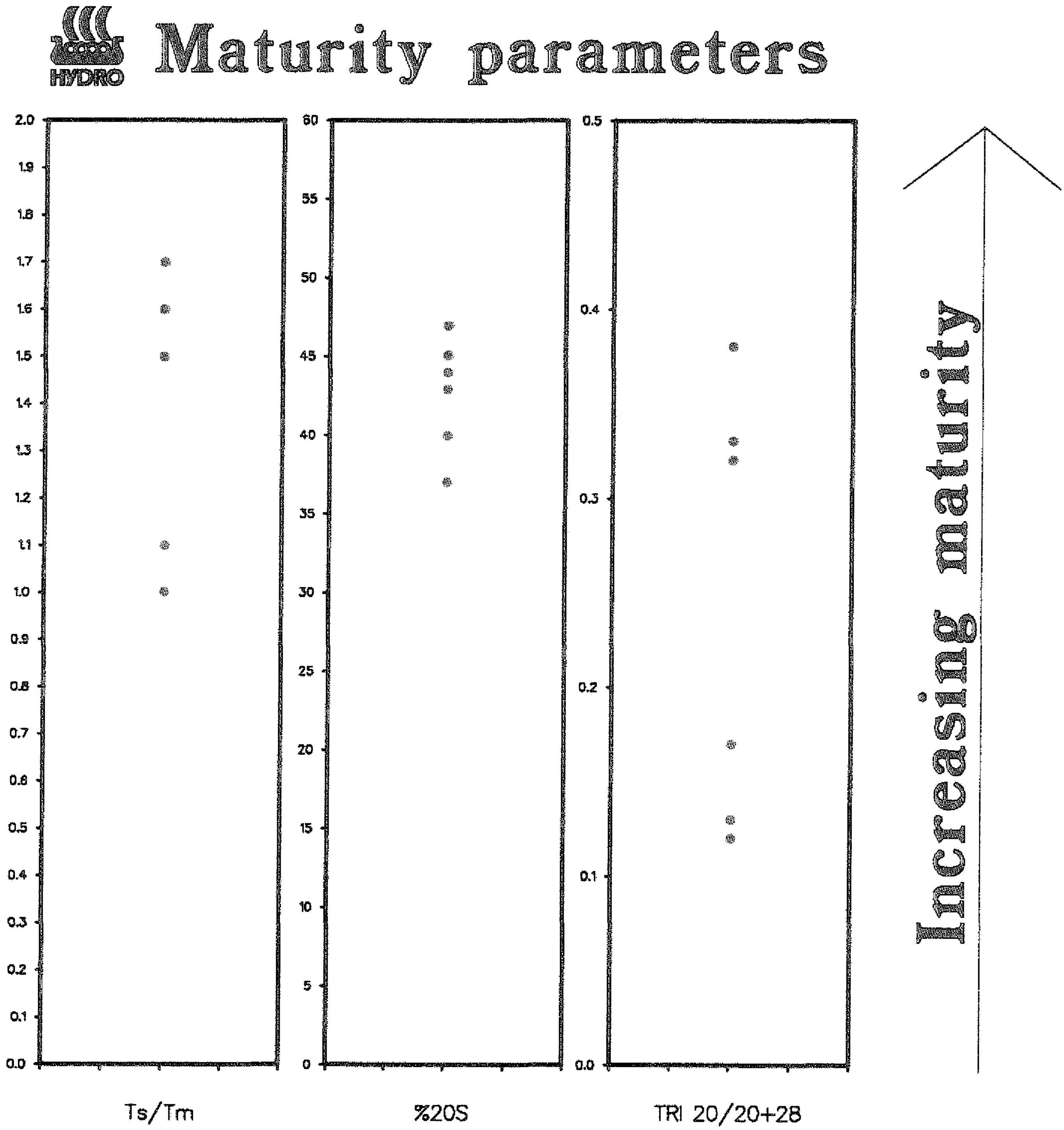


Table: OSEBERG (P) LOADING 1 vs. VARIABLE Class code: AB
Component 1, Loadings (P)
0.30
0.20
0.10
0.00
-0.10
-0.20
25Y
21Y
22K
34A
32B
30F
29A
27F
30d
29a
29f
28b
28f
27c
27h

Figure 4.2   Maturity parameters.

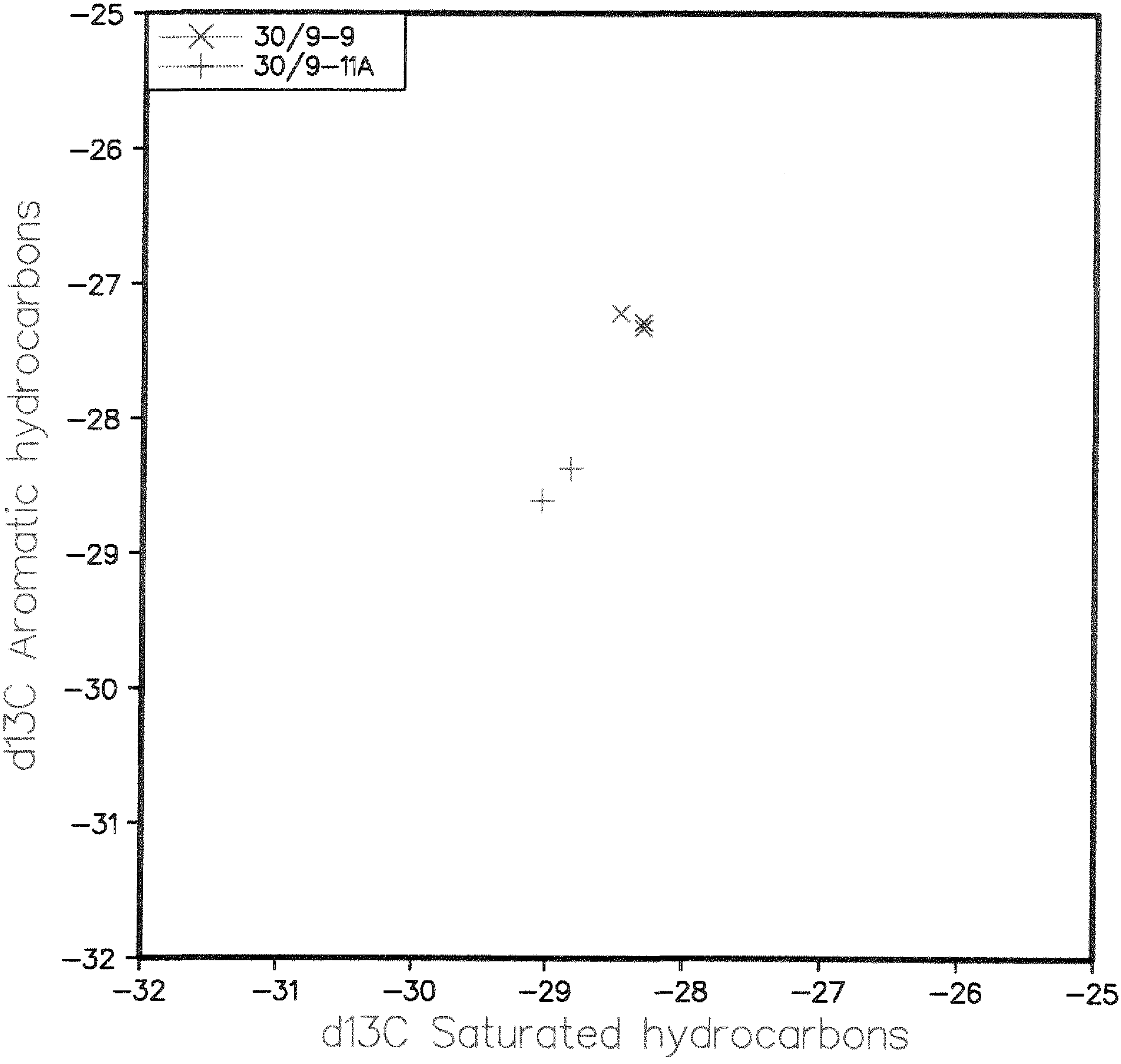
Maturity parameters



Well 30/9-9 Well 30/9-11A

Figure 4.3 δ13C SAT versus δ13C ARO.

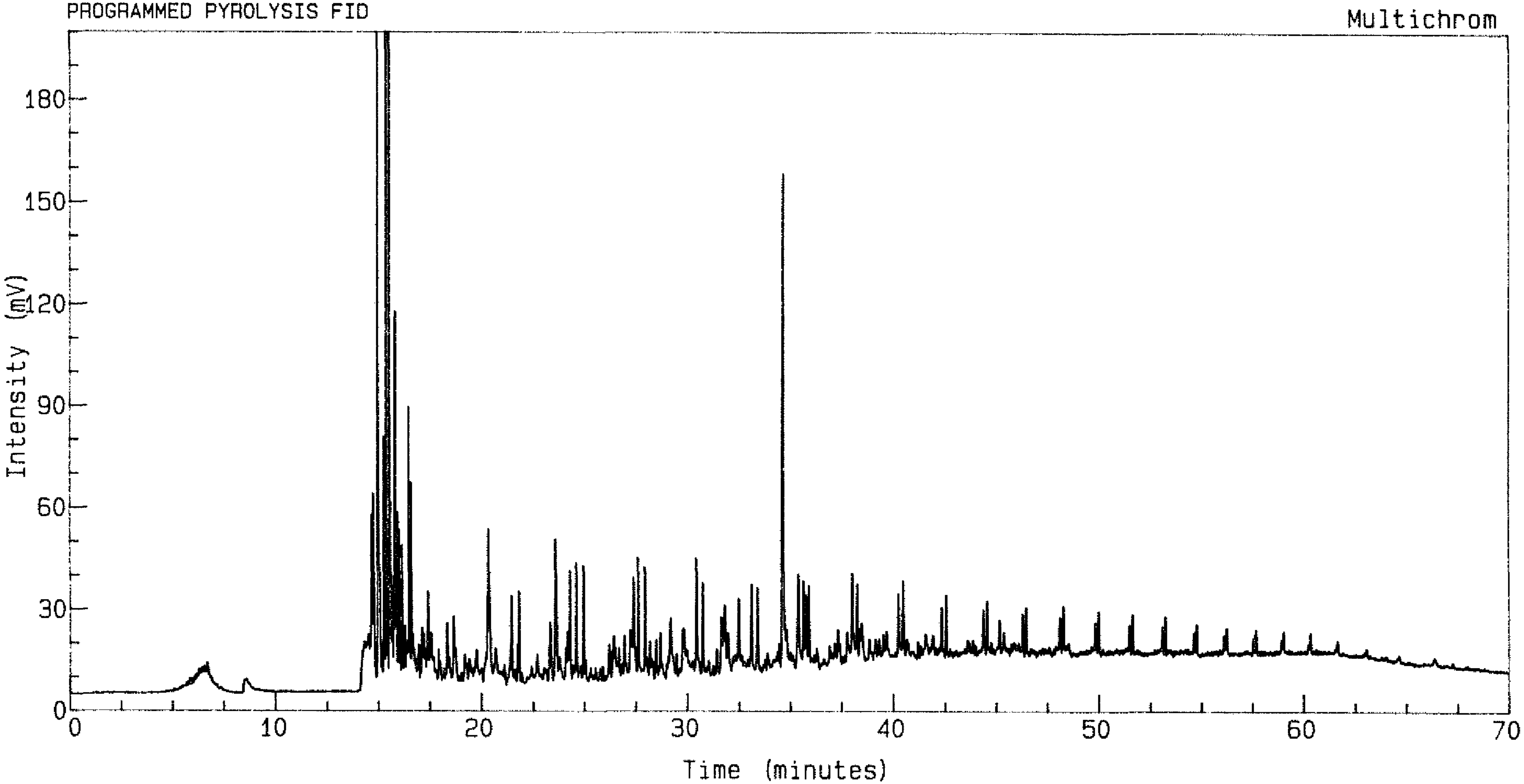
Stable carbon isotopes



APPENDIX I

Pyrolysis Gas Chromatograms.

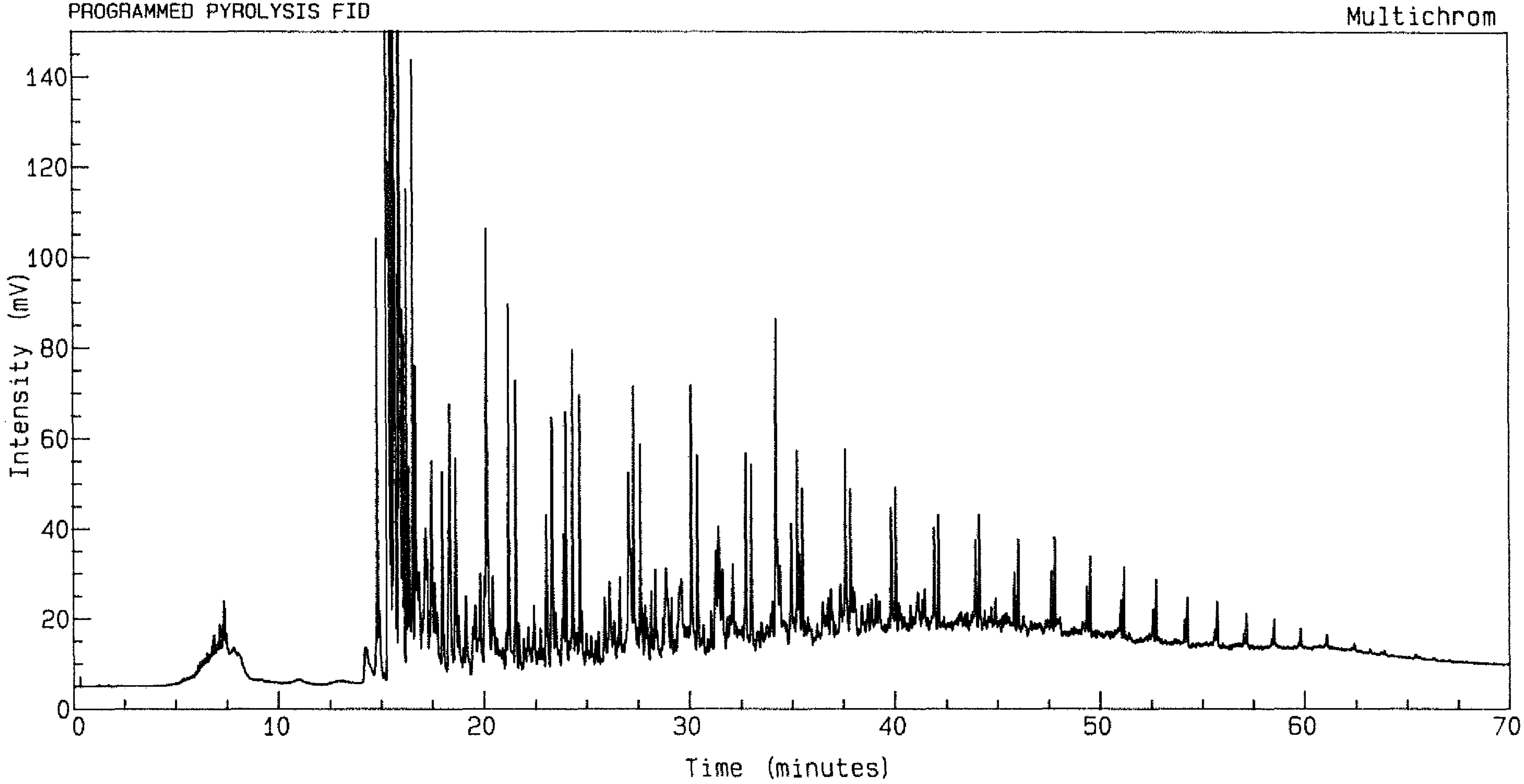
Analysis Name : [PETRO] 6 A390911P, 4, 1.
30/9-11A 2540.5 M SWC Amount : 29.900
PROGRAMMED PYROLYSIS FID



Instrument : V 3700
Channel Title : PYROLYSIS FID
Lims ID :
Acquired on 18-MAR-1991 at 18:11
Reported on 19-MAR-1991 at 12:13

Method : PYRO
Calibration : PYRO
Run Sequence : PYRO

Analysis Name : [PETRO] 6 A390911P, 5, 1.
30/9-11A 2546.5 M SWC Amount : 78.900
PROGRAMMED PYROLYSIS FID



Instrument : V 3700
Channel Title : PYROLYSIS FID
Lims ID :
Acquired on 18-MAR-1991 at 19:46
Reported on 19-MAR-1991 at 12:05

Method : PYRO
Calibration : PYRO
Run Sequence : PYRO

APPENDIX II

Gas Chromatograms of Saturated Hydrocarbons.

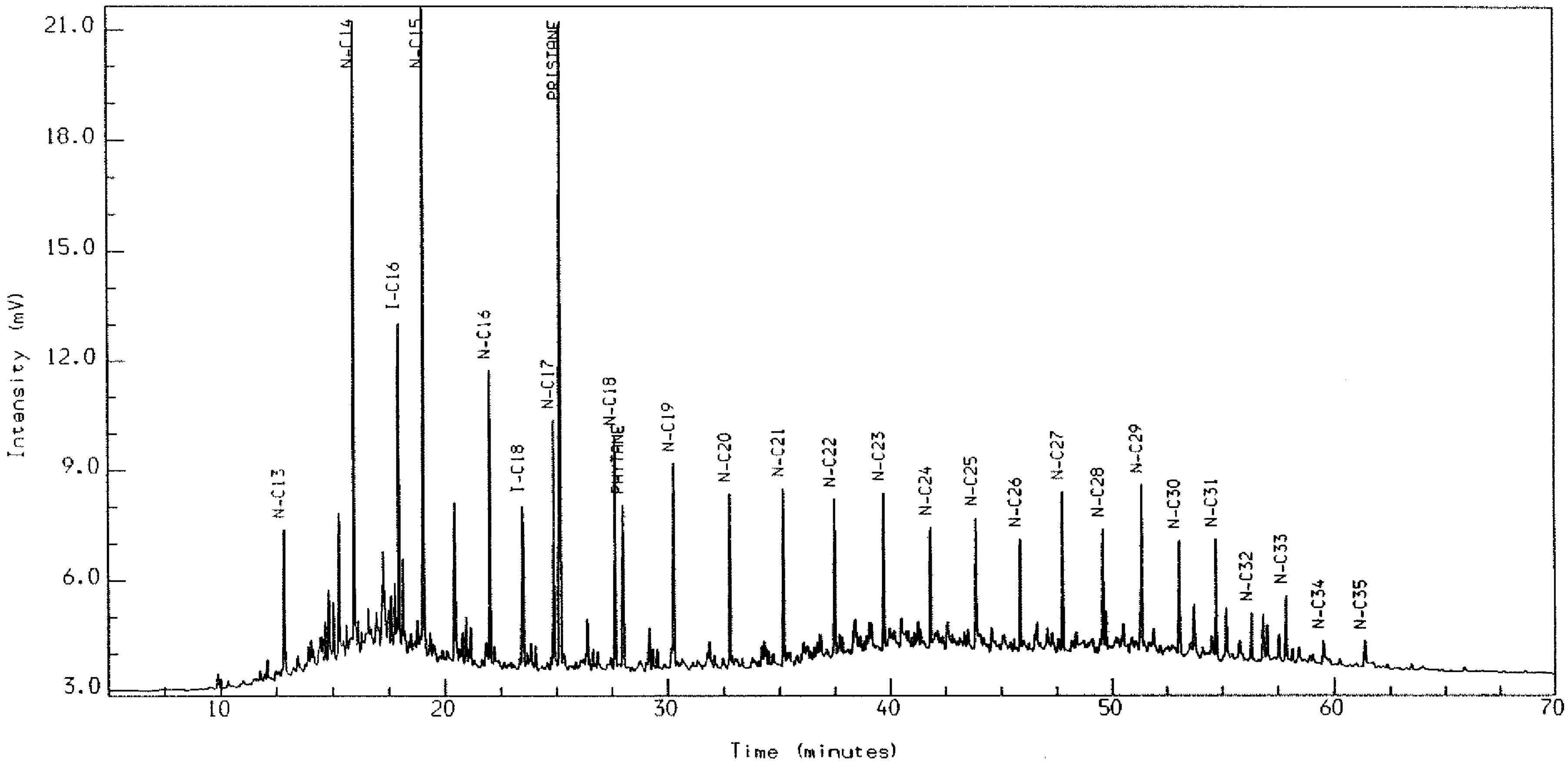
NORSK HYDRO RESEARCH CENTRE

Analysis Name : [PETRO] 7 w300911.2.1.

2540.5m

GC SATURATED HYDROCARBONS

Multichrom



Instrument : HP5890

Channel Title : MSD

Lims ID :

Acquired on 19-MAR-1991 at 17:40

Reported on 19-MAR-1991 at 19:02

Method : MSDS

Calibration : MSDS

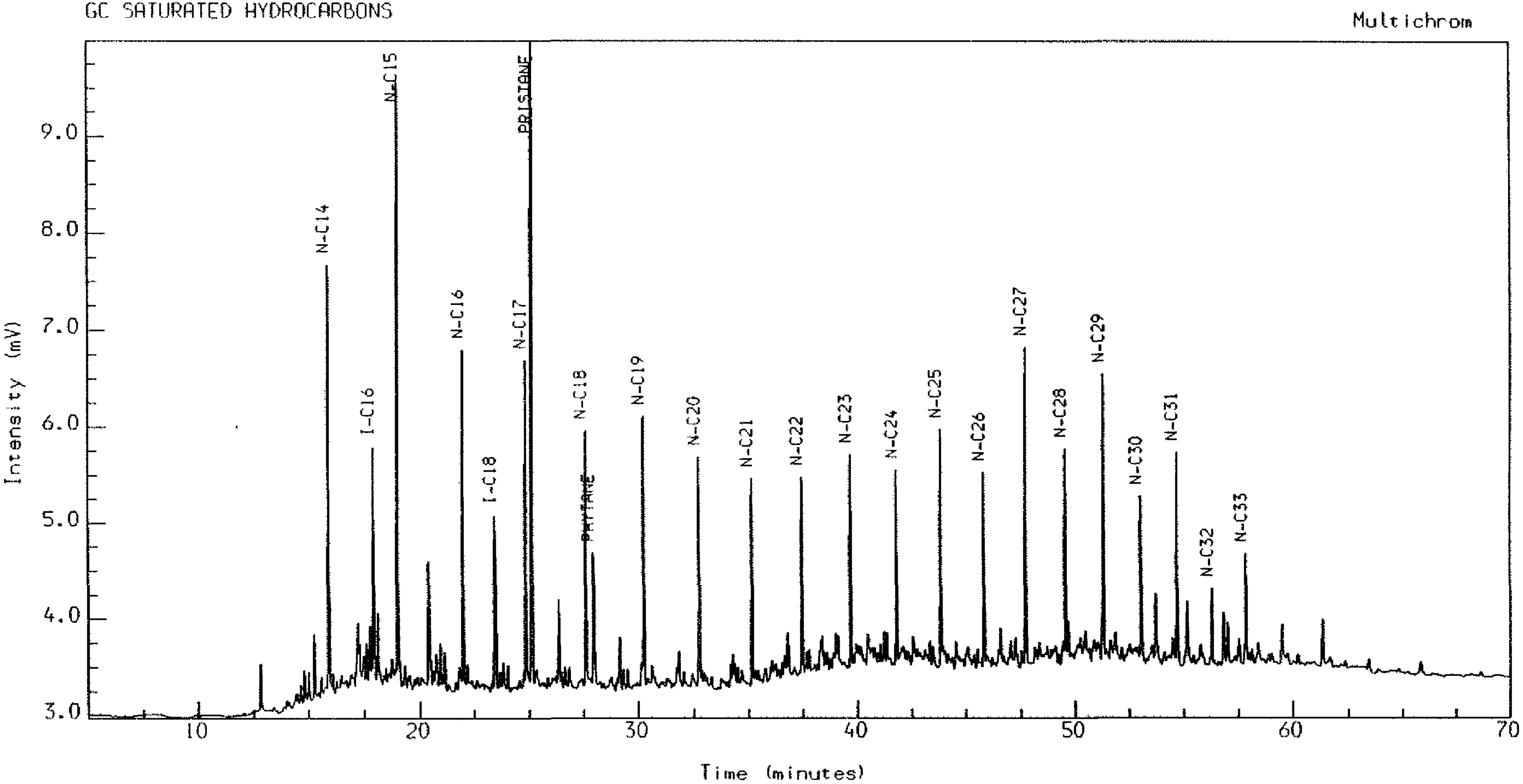
Run Sequence : MSDS

NORSK HYDRO RESEARCH CENTRE

Analysis Name : [PETRO] 7 w300911.3.1.

2546.5m

GC SATURATED HYDROCARBONS



Instrument : HP5890

Channel Title : MSD

Lims ID :

Acquired on 19-MAR-1991 at 19:11

Reported on 19-MAR-1991 at 20:33

Method : MSDS

Calibration : MSDS

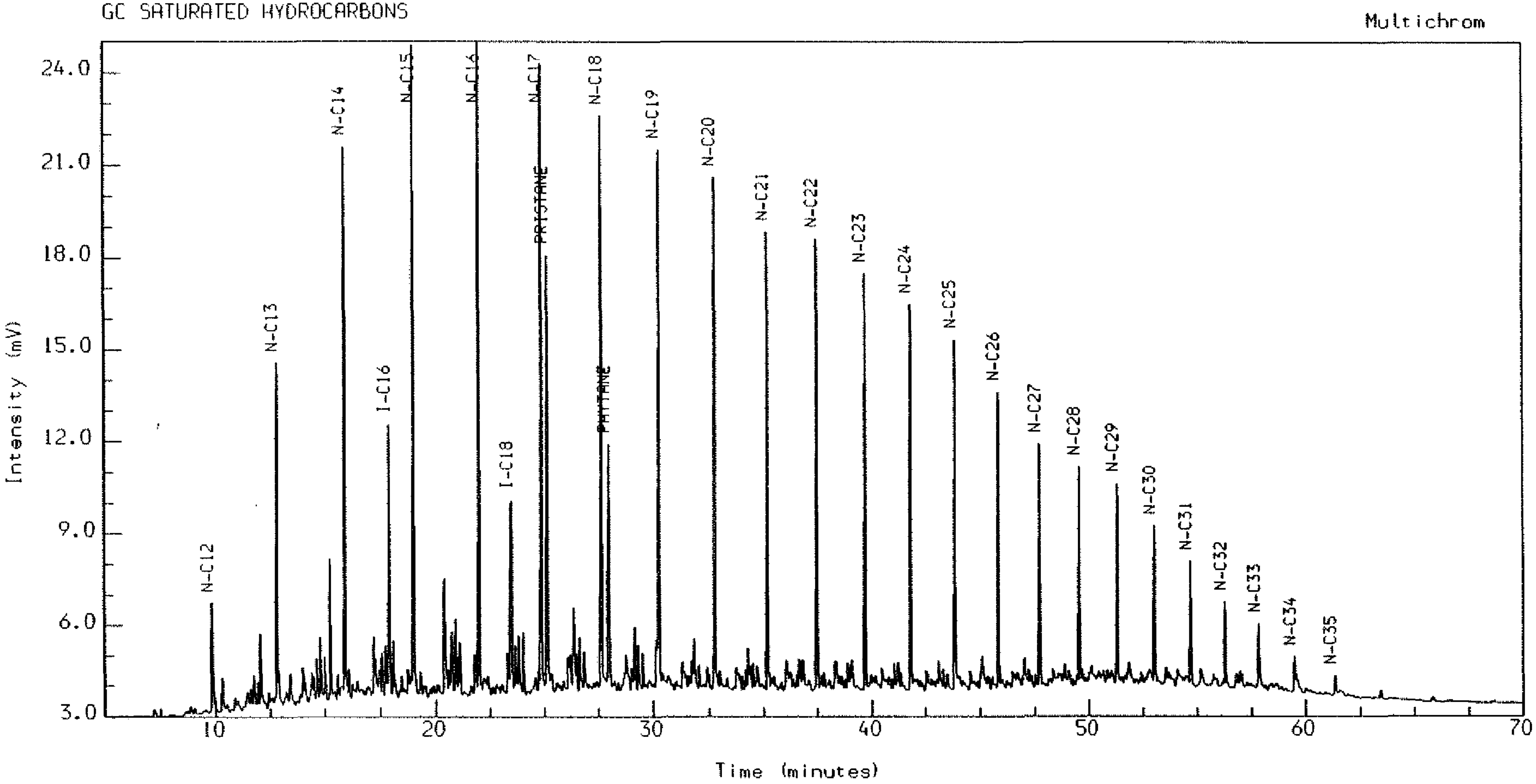
Run Sequence : MSDS

NORSK HYDRO RESEARCH CENTRE

Analysis Name : [PETRO] 7 w300911.4.1.

2556.5m

GC SATURATED HYDROCARBONS



Instrument : HP5890

Channel Title : MSD

Lims ID :

Acquired on 19-MAR-1991 at 20:43

Reported on 19-MAR-1991 at 22:07

Method : MSDS

Calibration : MSDS

Run Sequence : MSDS

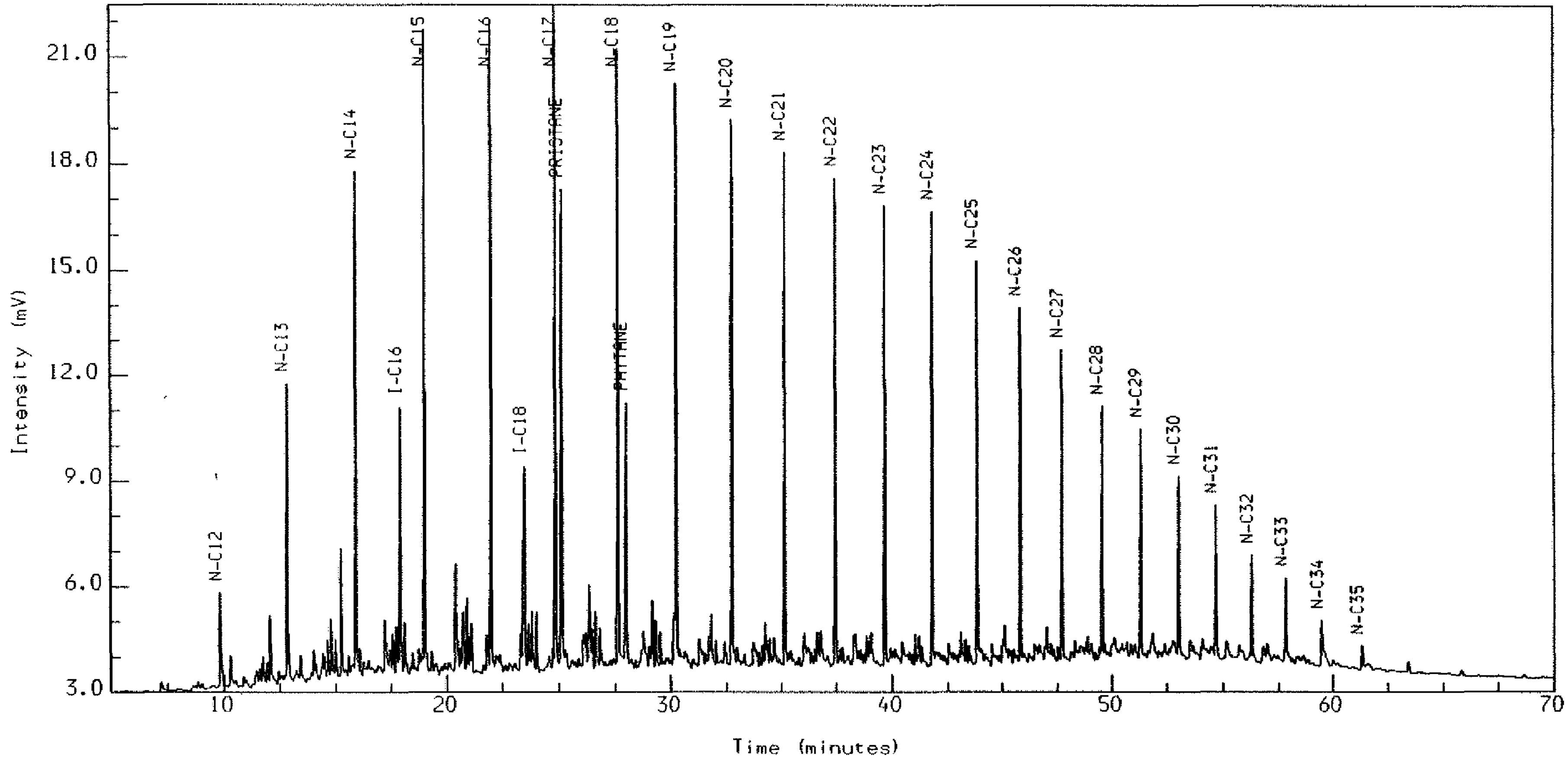
NORSK HYDRO RESEARCH CENTRE

Analysis Name : [PETRO] 7 w300911.5.1.

2568.5m

GC SATURATED HYDROCARBONS

Multichrom



Instrument : HP5890

Channel Title : MSD

Lims ID :

Acquired on 19-MAR-1991 at 22:14

Reported on 19-MAR-1991 at 23:36

Method : MSDS

Calibration : MSDS

Run Sequence : MSDS

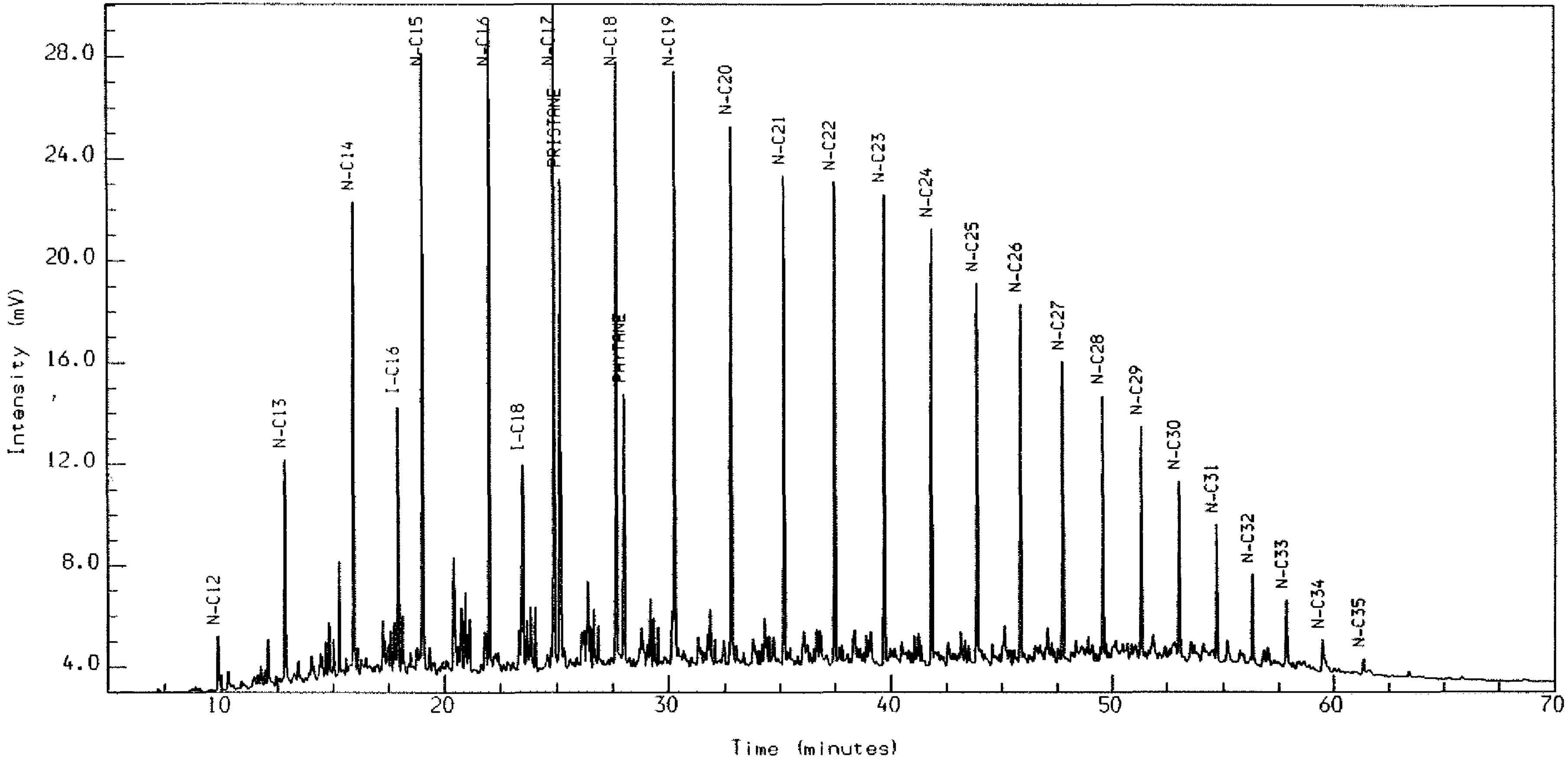
NORSK HYDRO RESEARCH CENTRE

Analysis Name : [PETRO] 7 w300911.6.1.

2568.7m

GC SATURATED HYDROCARBONS

Multichrom



Instrument : HP5890

Channel Title : MSD

Lims ID :

Acquired on 19-MAR-1991 at 23:45

Reported on 20-MAR-1991 at 01:07

Method : MSDS

Calibration : MSDS

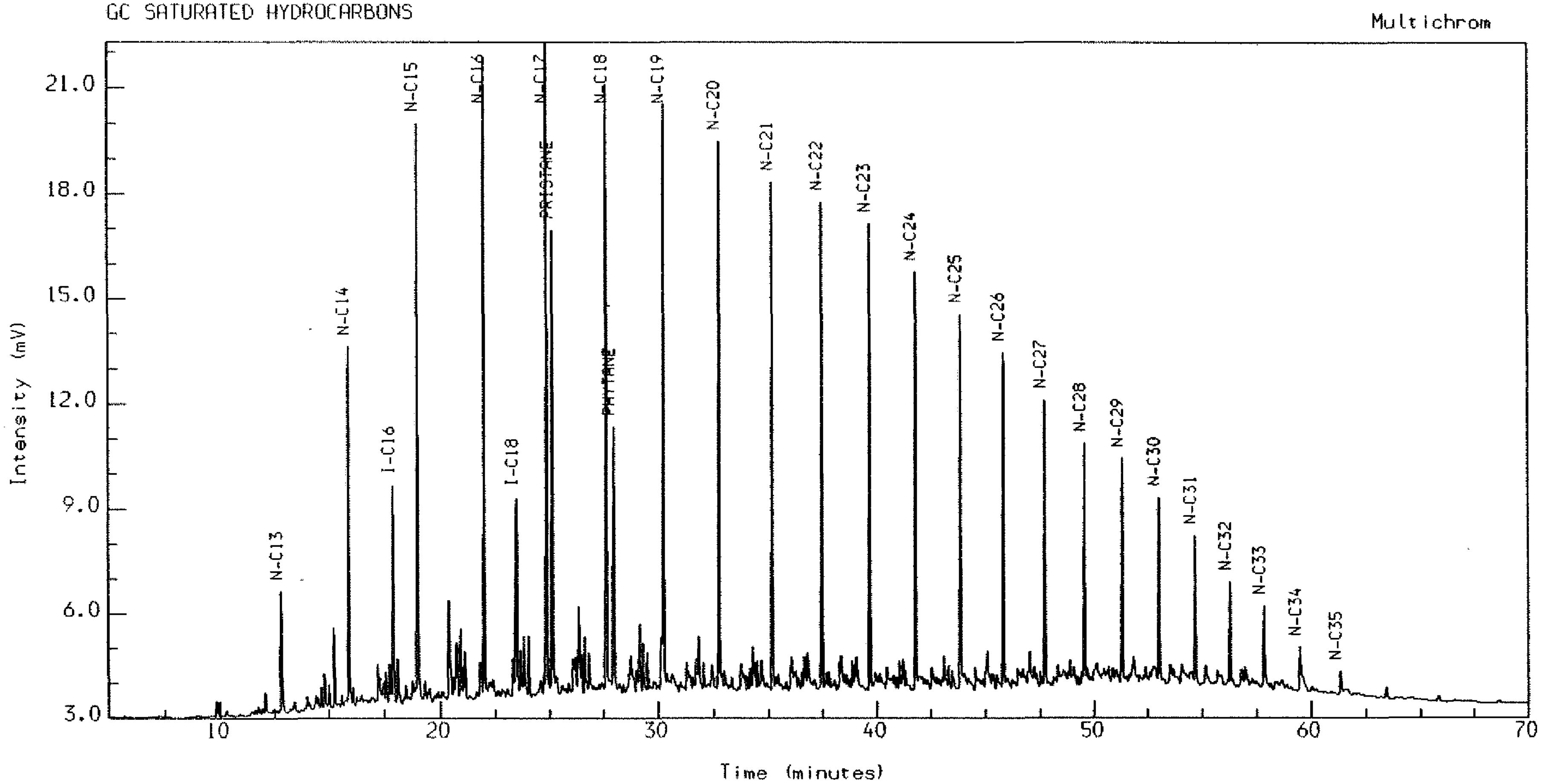
Run Sequence : MSDS

NORSK HYDRO RESEARCH CENTRE

Analysis Name : [PETRO] 7 w300911.7.1.

2568.9m

GC SATURATED HYDROCARBONS



Instrument : HP5890

Channel Title : MSD

Lims ID :

Acquired on 20-MAR-1991 at 01:17

Reported on 20-MAR-1991 at 02:39

Method : MSDS

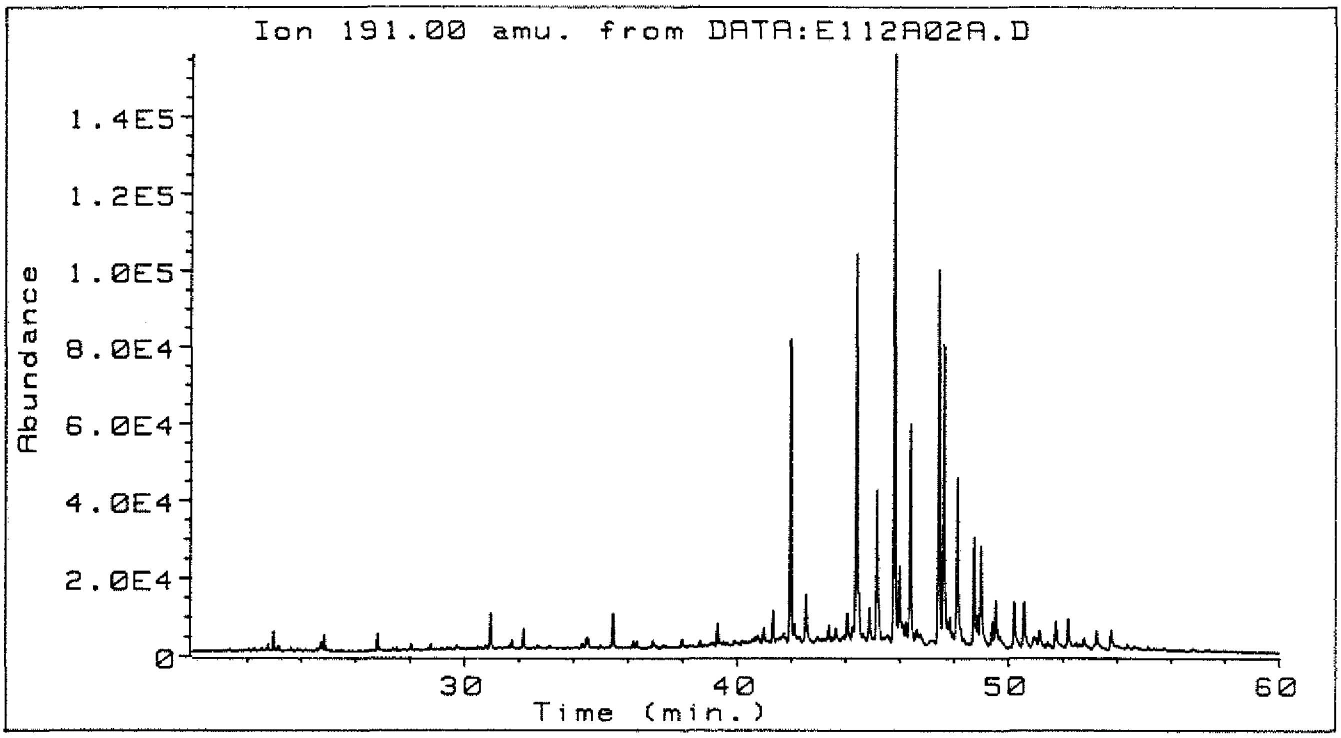
Calibration : MSDS

Run Sequence : MSDS

APPENDIX III

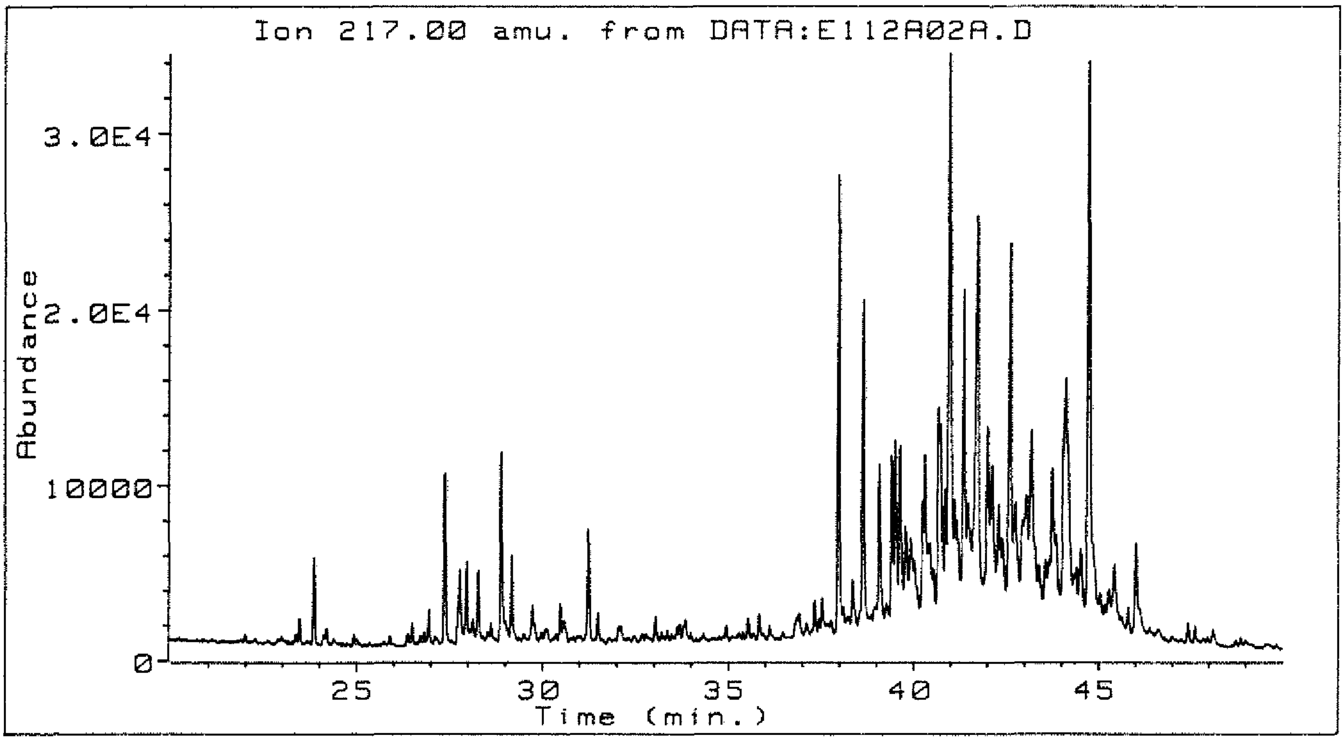
Fragmentograms of Terpanes, (Ion 191 m/z).

Fragmentograms of Steranes, (Ion 217 m/z).



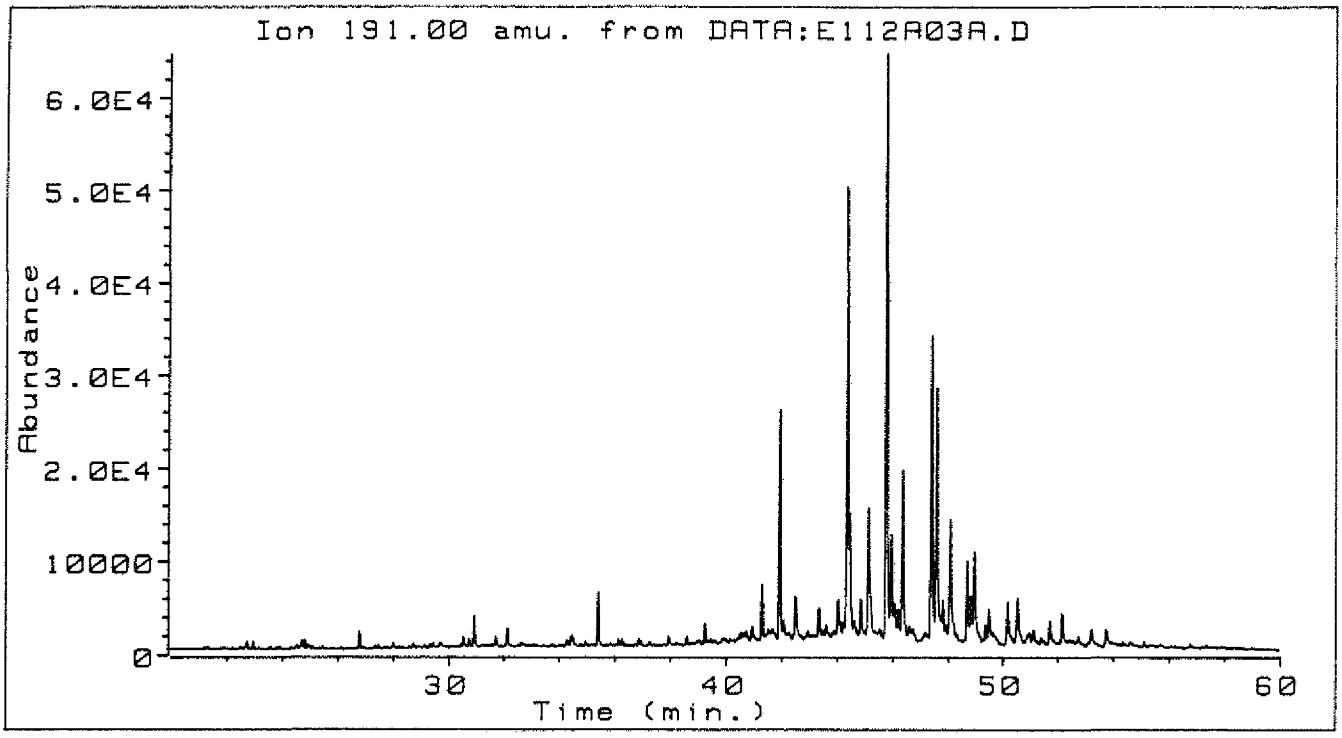
30/9-11A

2540.5 M



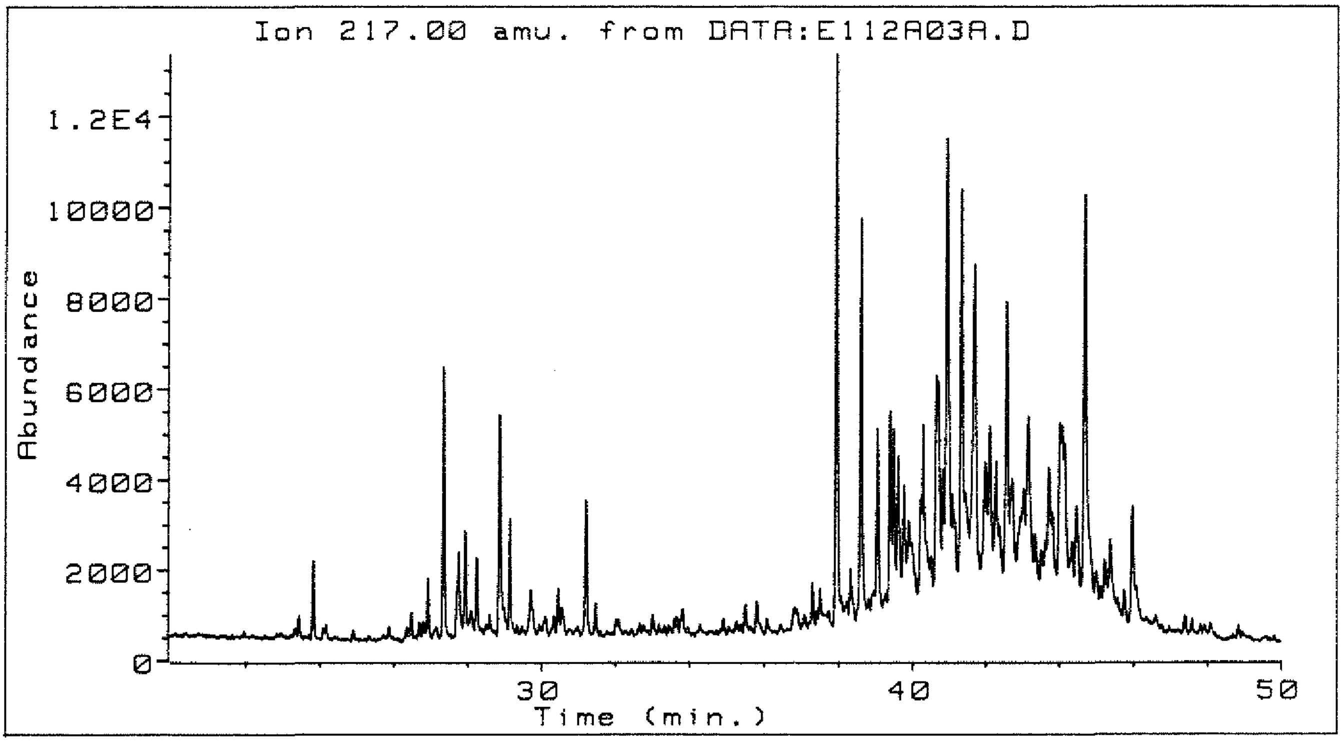
30/9-11A

2540.5 M



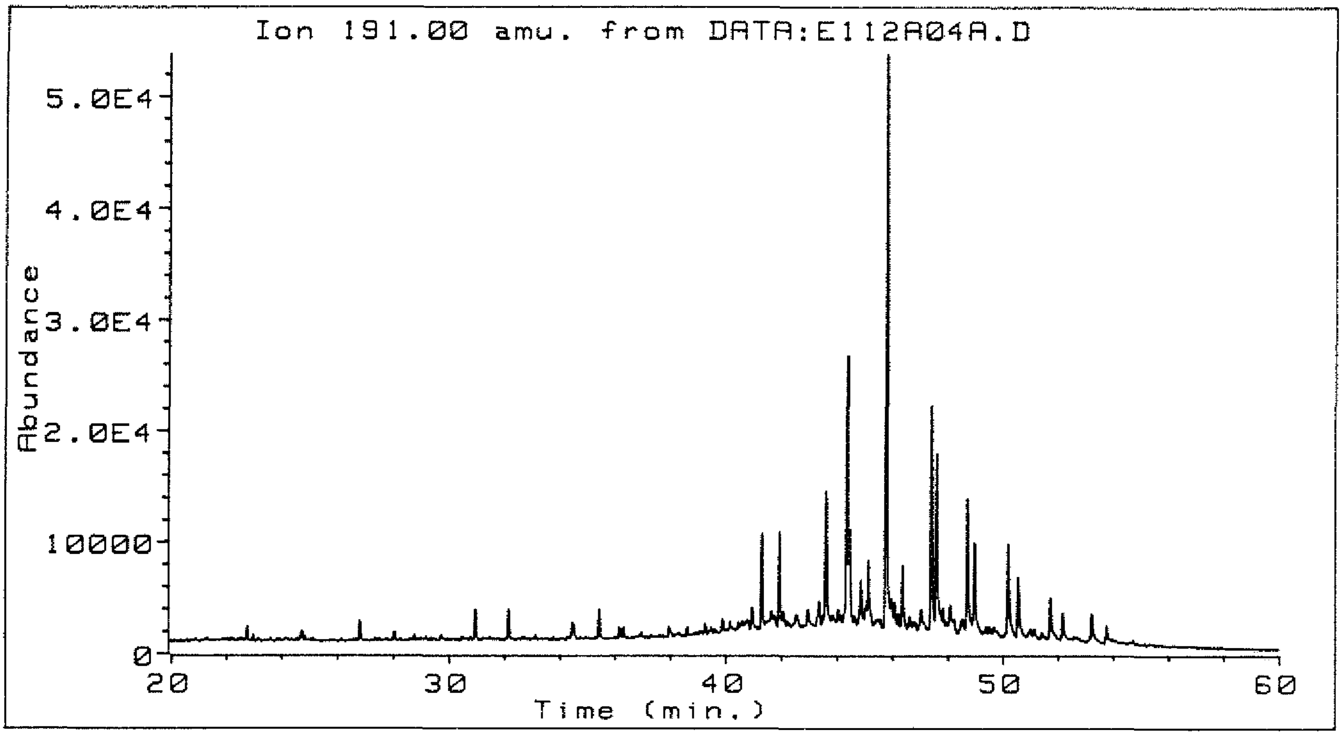
30/9-11A

2546.5 M



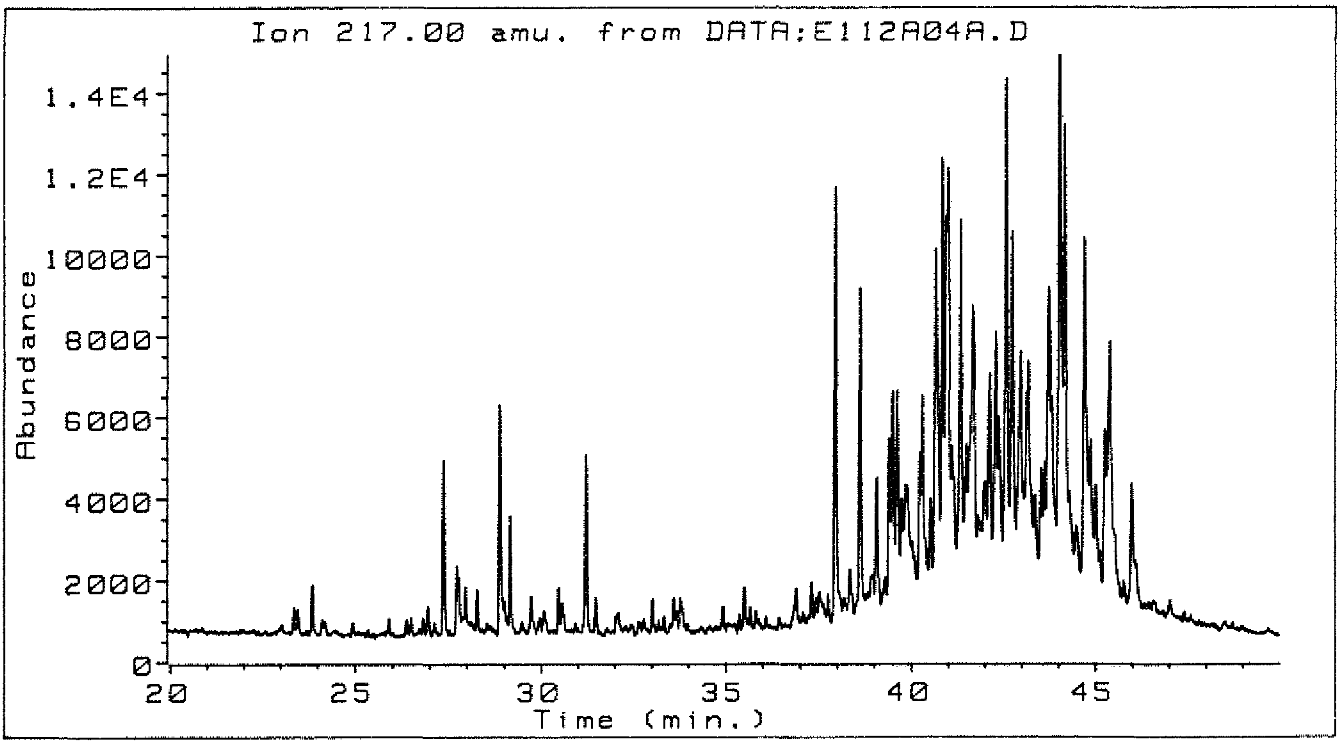
30/9-11A

2546.5 M



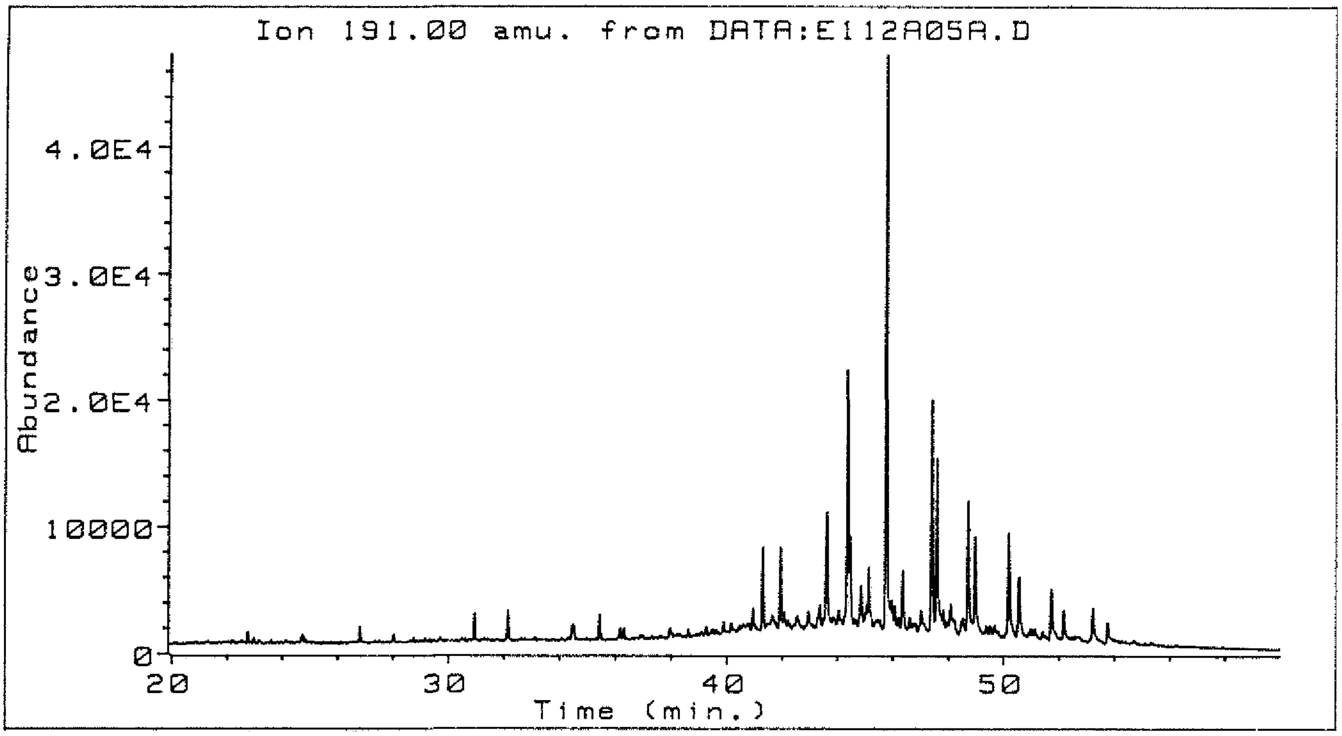
30/9-11A

2556.5 M



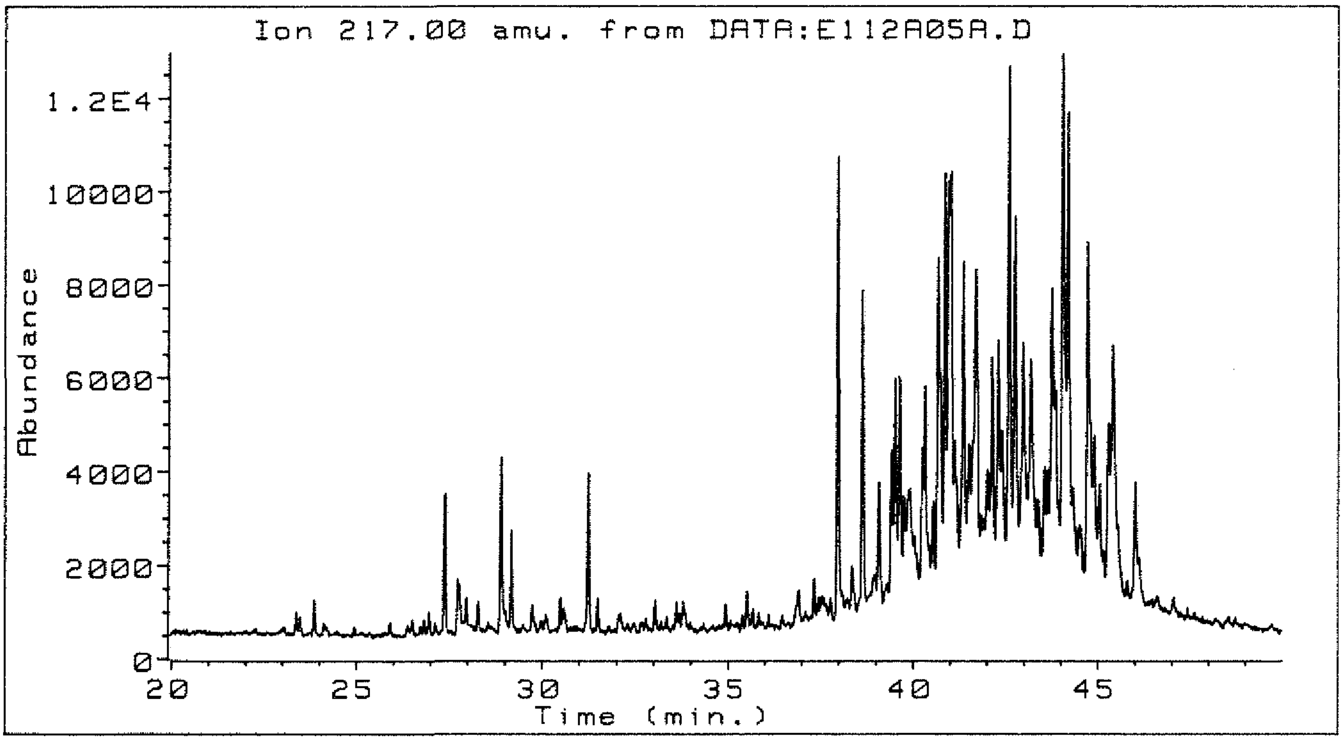
30/9-11A

2556.5 M



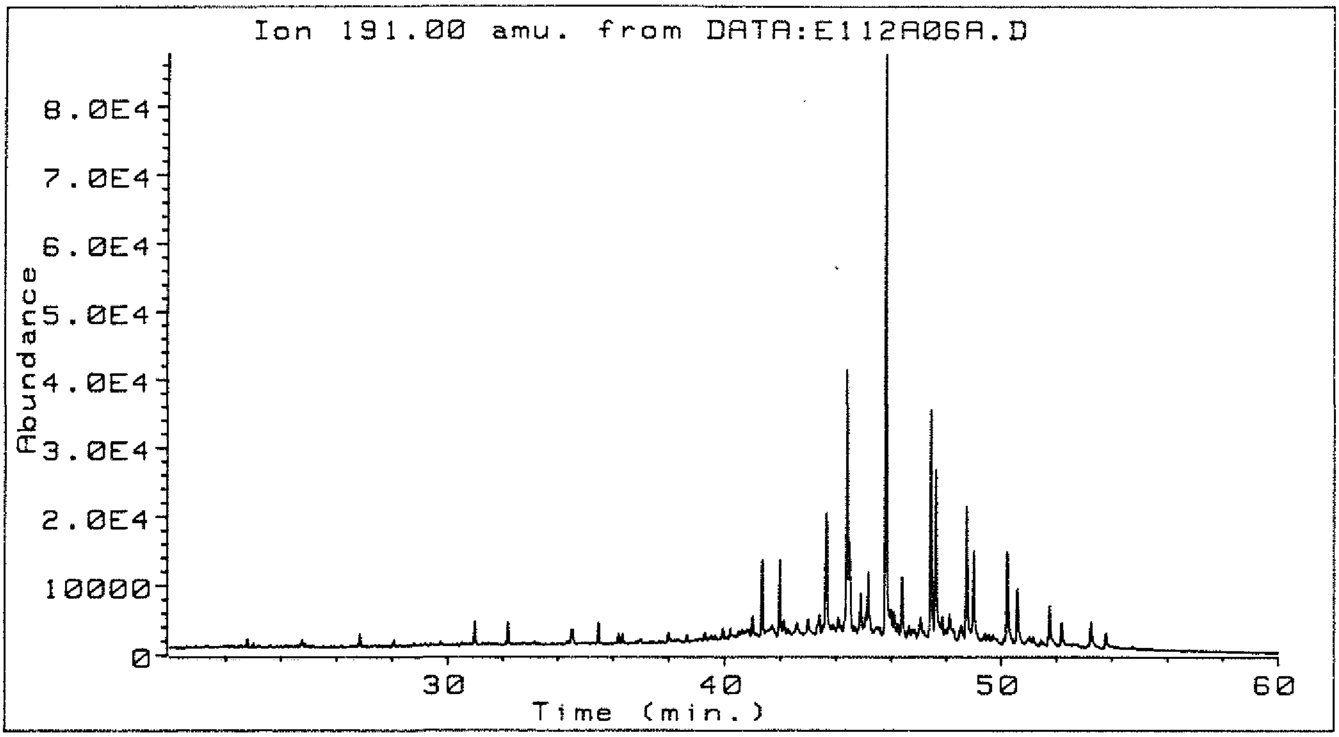
30/9-11A

2568.5 M



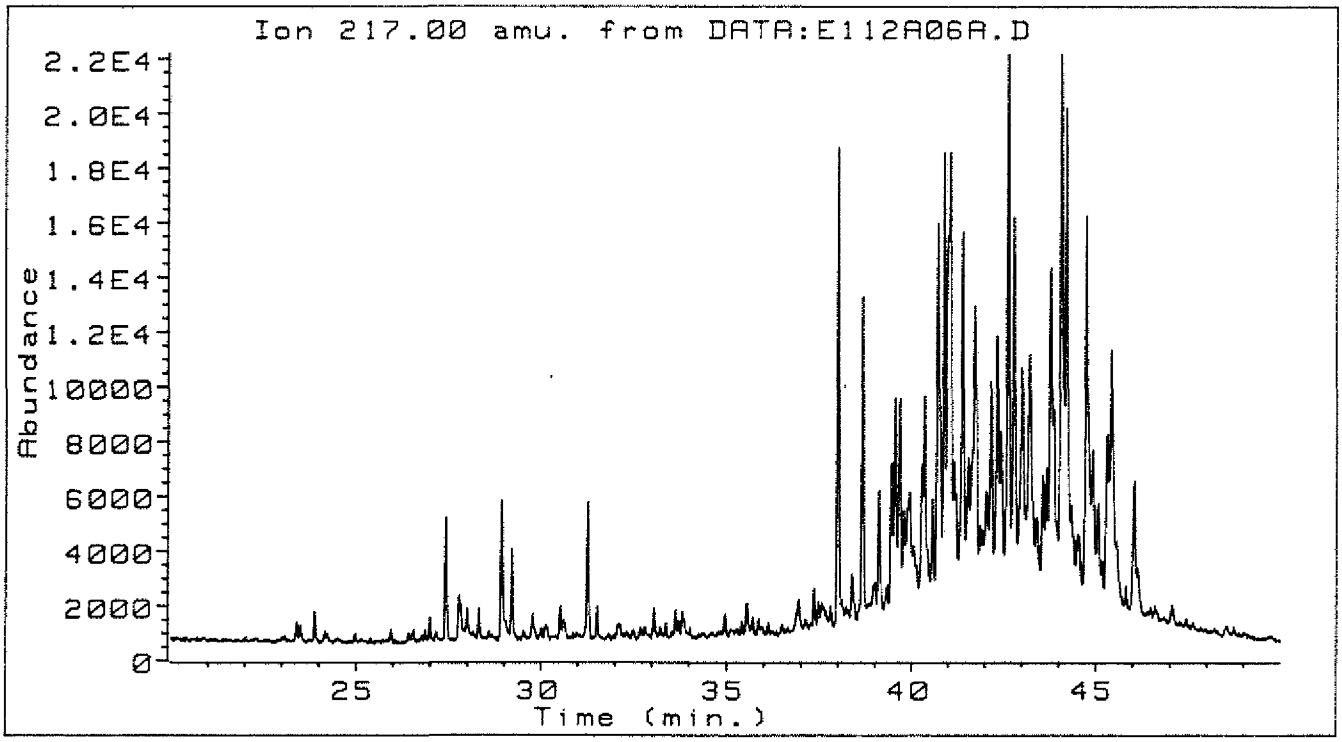
30/9-11A

2568.5 M



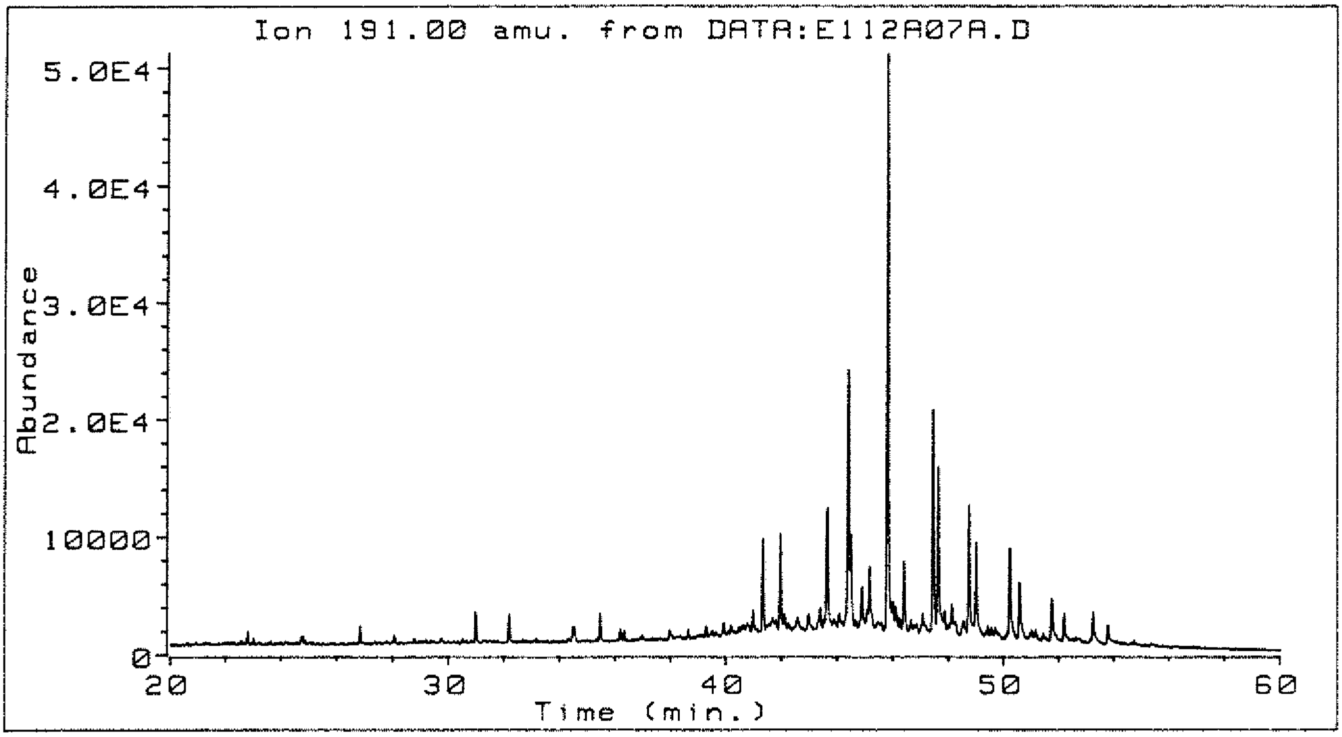
30/9-11A

2568.7 M



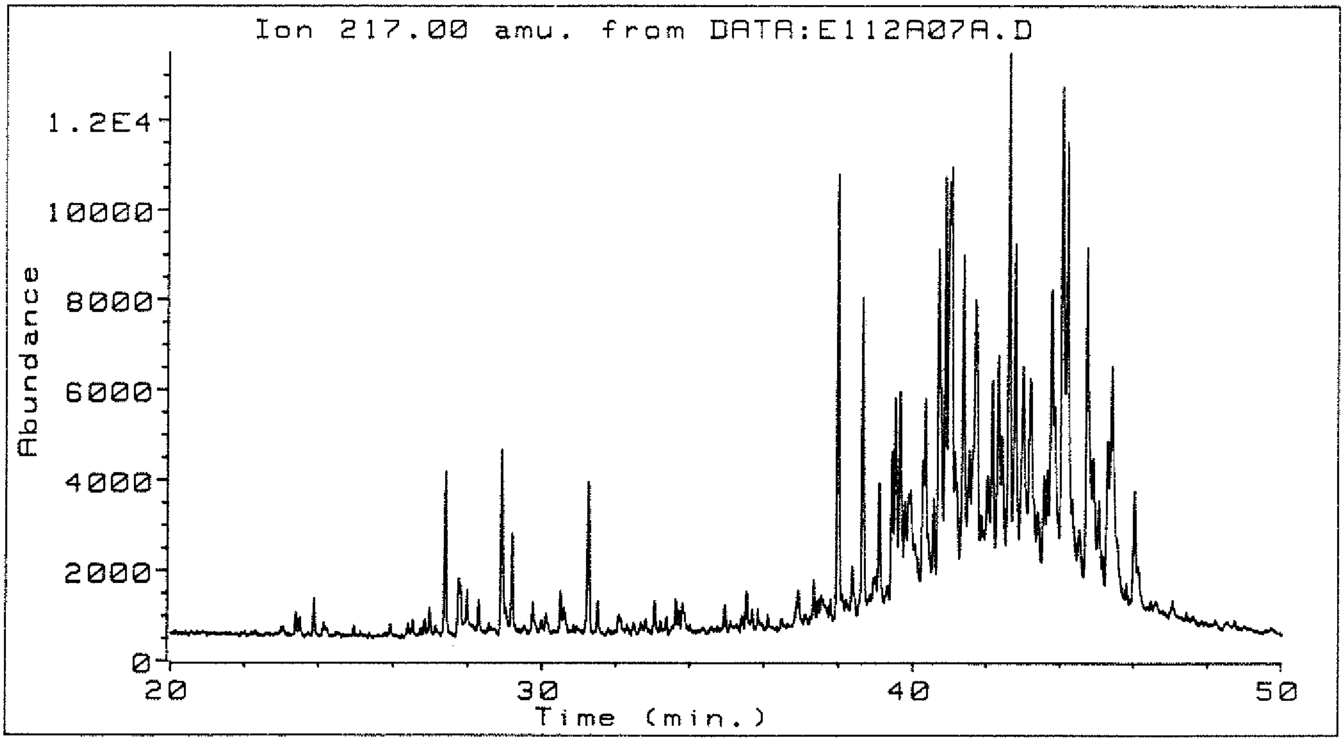
30/9-11A

2568.7 M



30/9-11A

2568.9 M

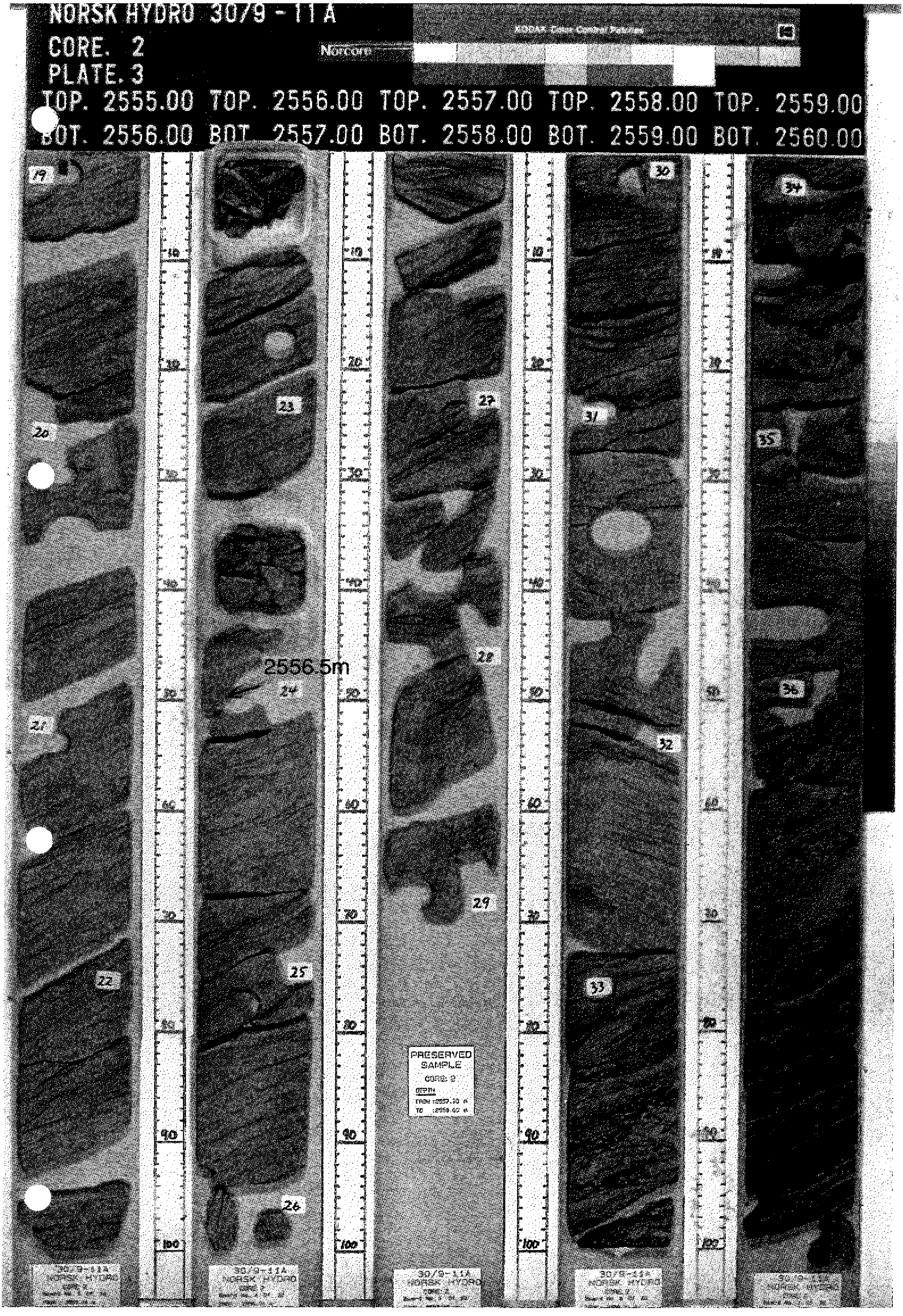


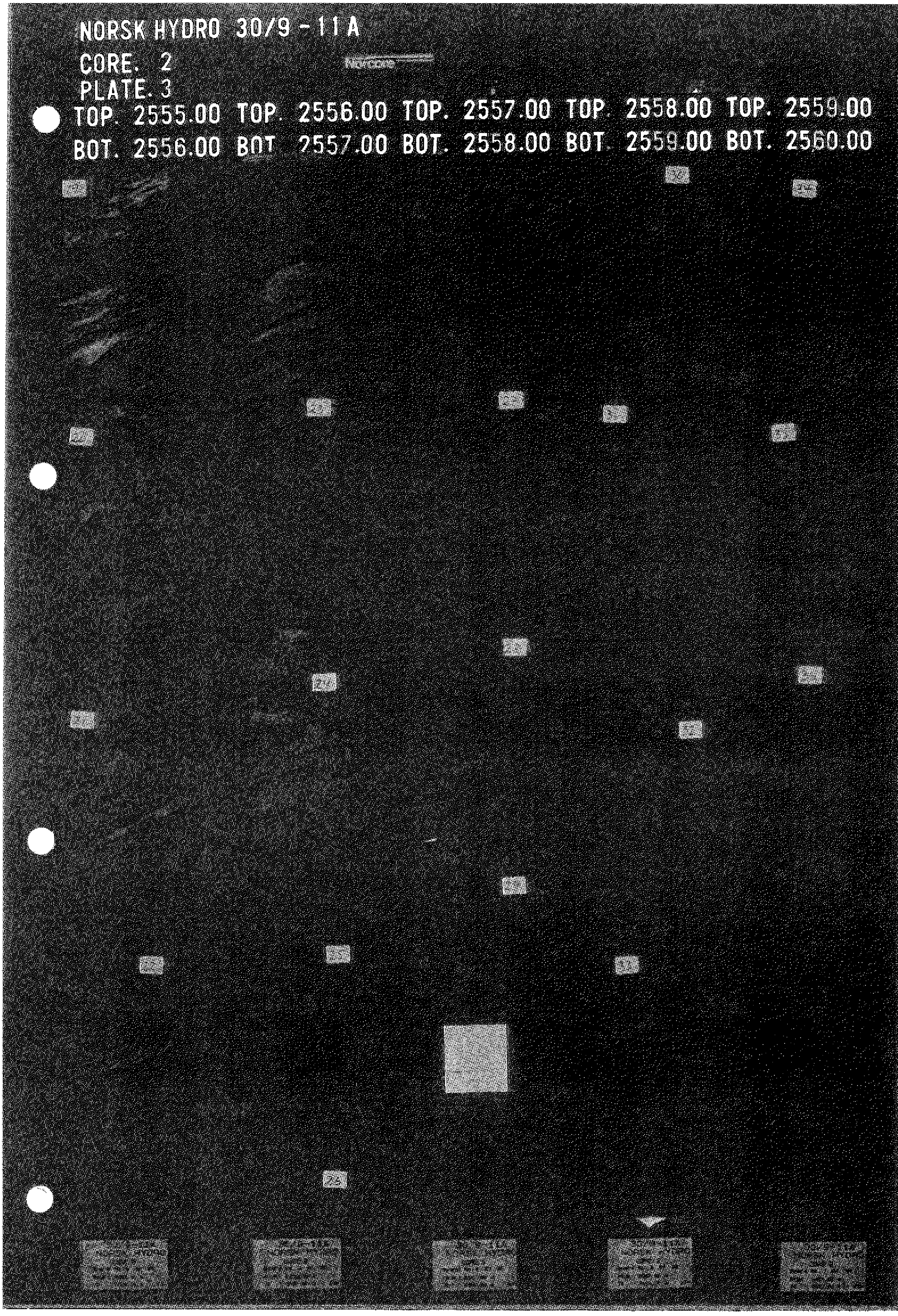
30/9-11A

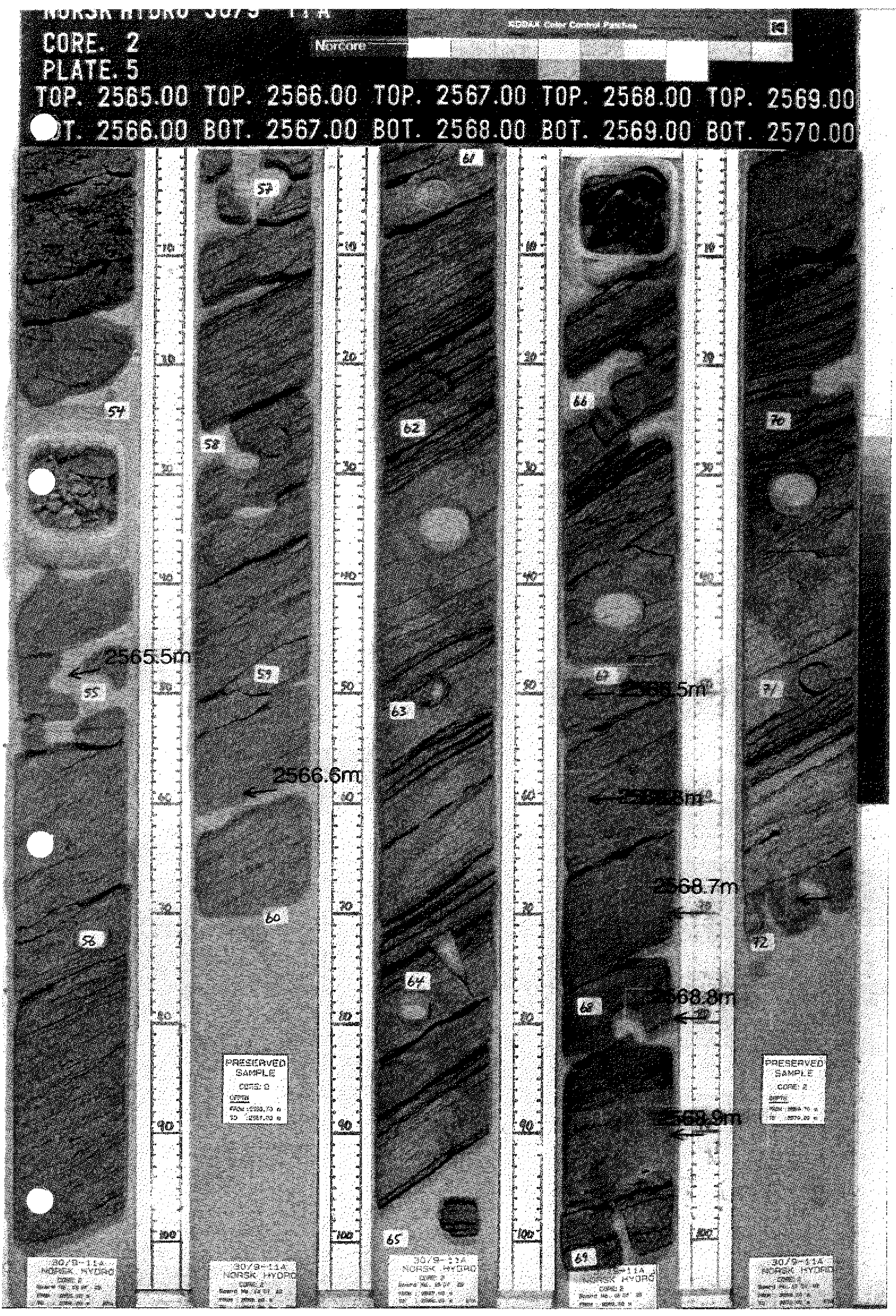
2568.9 M

APPENDIX IV

Core photos.


NORSK HYDRO 30/9 - 11 A
CORE. 2
PLATE. 3
Norcore
TOP. 2555.00 TOP. 2556.00 TOP. 2557.00 TOP. 2558.00 TOP. 2559.00
BOT. 2556.00 BOT. 2557.00 BOT. 2558.00 BOT. 2559.00 BOT. 2560.00
2556.5m
PRESERVED
SAMPLE
CORE: 2


NORSK HYDRO 30/9 - 11 A
CORE. 2
PLATE. 3
TOP. 2555.00 TOP. 2556.00 TOP. 2557.00 TOP. 2558.00 TOP. 2559.00
BOT. 2556.00 BOT. 2557.00 BOT. 2558.00 BOT. 2559.00 BOT. 2560.00

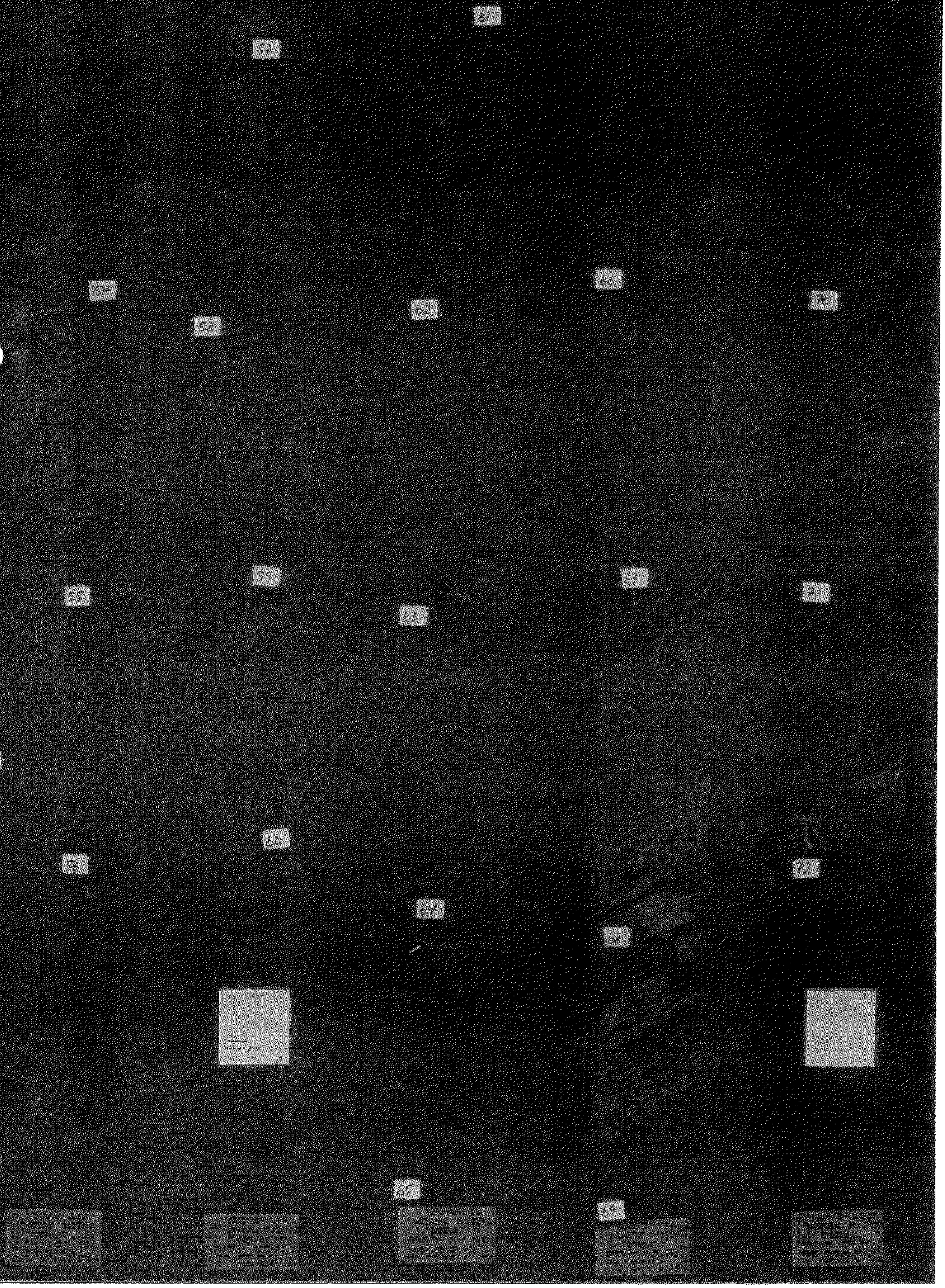

CORE. 2
PLATE. 5
Norcore
TOP. 2565.00 TOP. 2566.00 TOP. 2567.00 TOP. 2568.00 TOP. 2569.00
BOT. 2566.00 BOT. 2567.00 BOT. 2568.00 BOT. 2569.00 BOT. 2570.00
2565.5m
2566.6m
2568.7m
2568.8m
2568.9m
PRESERVED SAMPLE
PRESERVED SAMPLE
30/9-11A NORSK HYDRO
30/9-11A NORSK HYDRO
30/9-11A NORSK HYDRO
NORSK HYDRO
30/9-11A NORSK HYDRO

NORSK HYDRO 30/9 - 11 A

CORE. 2

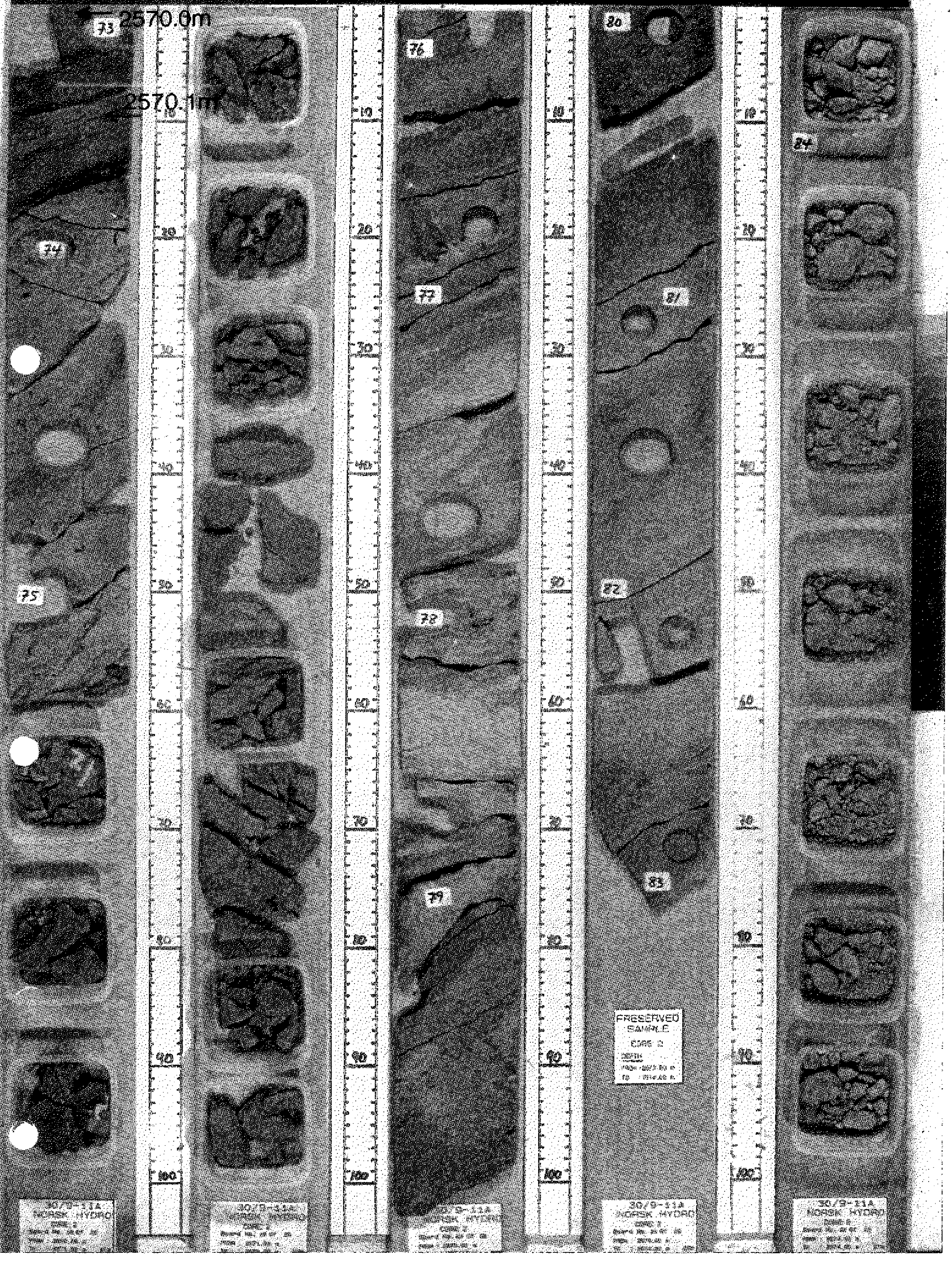
PLATE. 5

TOP. 2565.00	TOP. 2566.00	TOP. 2567.00	TOP. 2568.00	TOP. 2569.00
BOT. 2566.00	BOT. 2567.00	BOT. 2568.00	BOT. 2569.00	BOT. 2570.00



NORSK HYDRO 30/9 - 11 A
CORE. 2
PLATE. 6

TOP. 2570.00 TOP. 2571.00 TOP. 2572.00 TOP. 2573.00 TOP. 2574.00
BOT. 2571.00 BOT. 2572.00 BOT. 2573.00 BOT. 2574.00 BOT. 2574.95



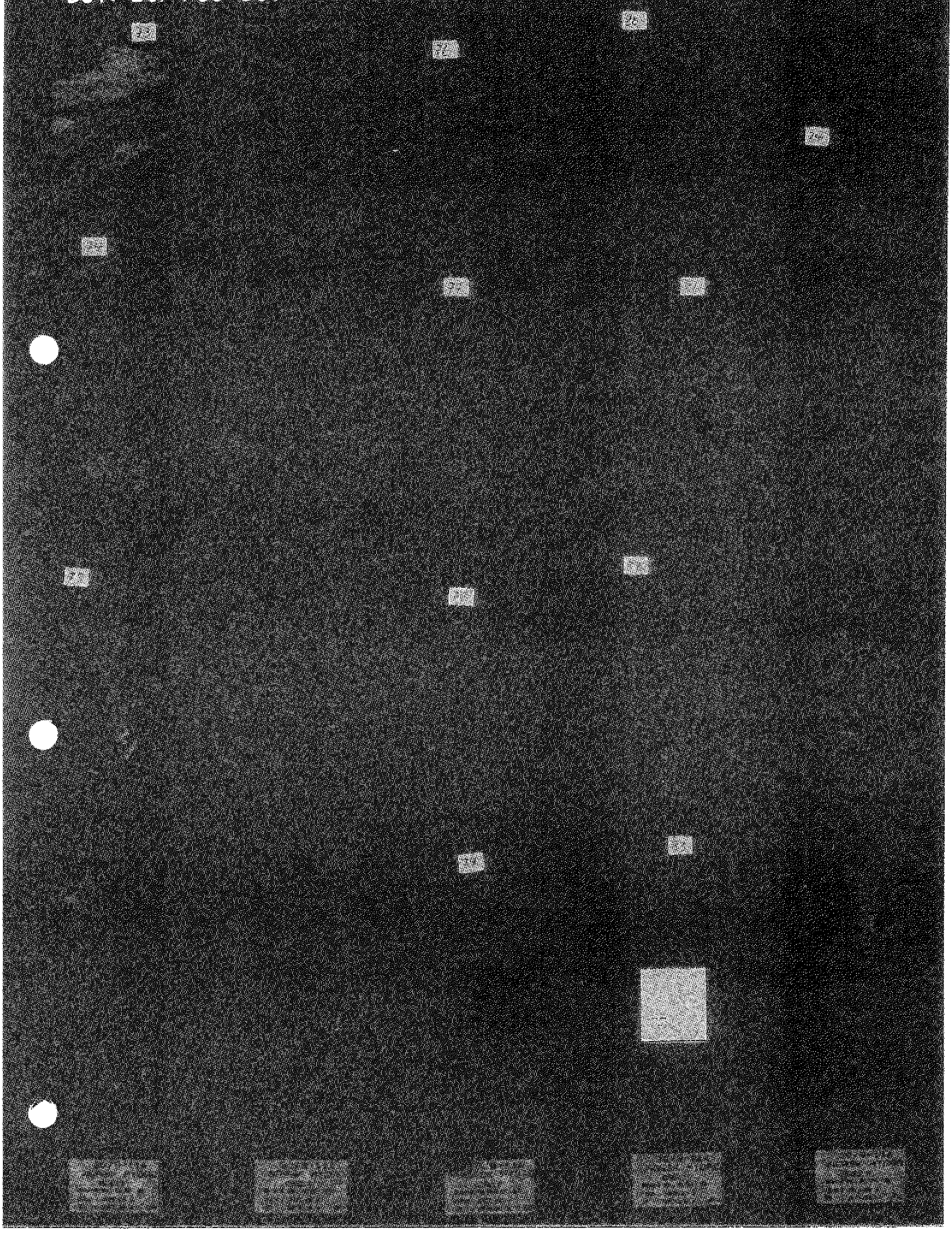
NORSK HYDRO 30/9 - 11 A

CORE. 2

PLATE. 6

TOP. 2570.00 TOP. 2571.00 TOP. 2572.00 TOP. 2573.00 TOP. 2574.00

BOT. 2571.00 BOT. 2572.00 BOT. 2573.00 BOT. 2574.00 BOT. 2574.95



APPENDIX V

Bargraphs from metastable ion monitoring.

Standardized identification of SAT-biomarkers:

Triterpanes:

Numbers from 18 to 35 correspond to the carbon number of the molecule, the subsequent capital letter identifies the stereochemistry and/or the number of rings.

A 17α(H)-hopanes (I) 22S
B 17α(H)-hopanes 22R
C 17β(H)-moretanes (II) 22S
D 17β(H)-moretanes 22R
E 17β(H)-hopanes (III)
F Neohopanes (IV)
G Gammacerane (V)
H Hopenes (VI)
I 25-norhopanes (VII)
L Lupane (VIII)
O 18α(H)-oleanane (IX)
X Tetracyclic terpanes (X)
Y Tricyclic terpanes (XI)
N Unidentified

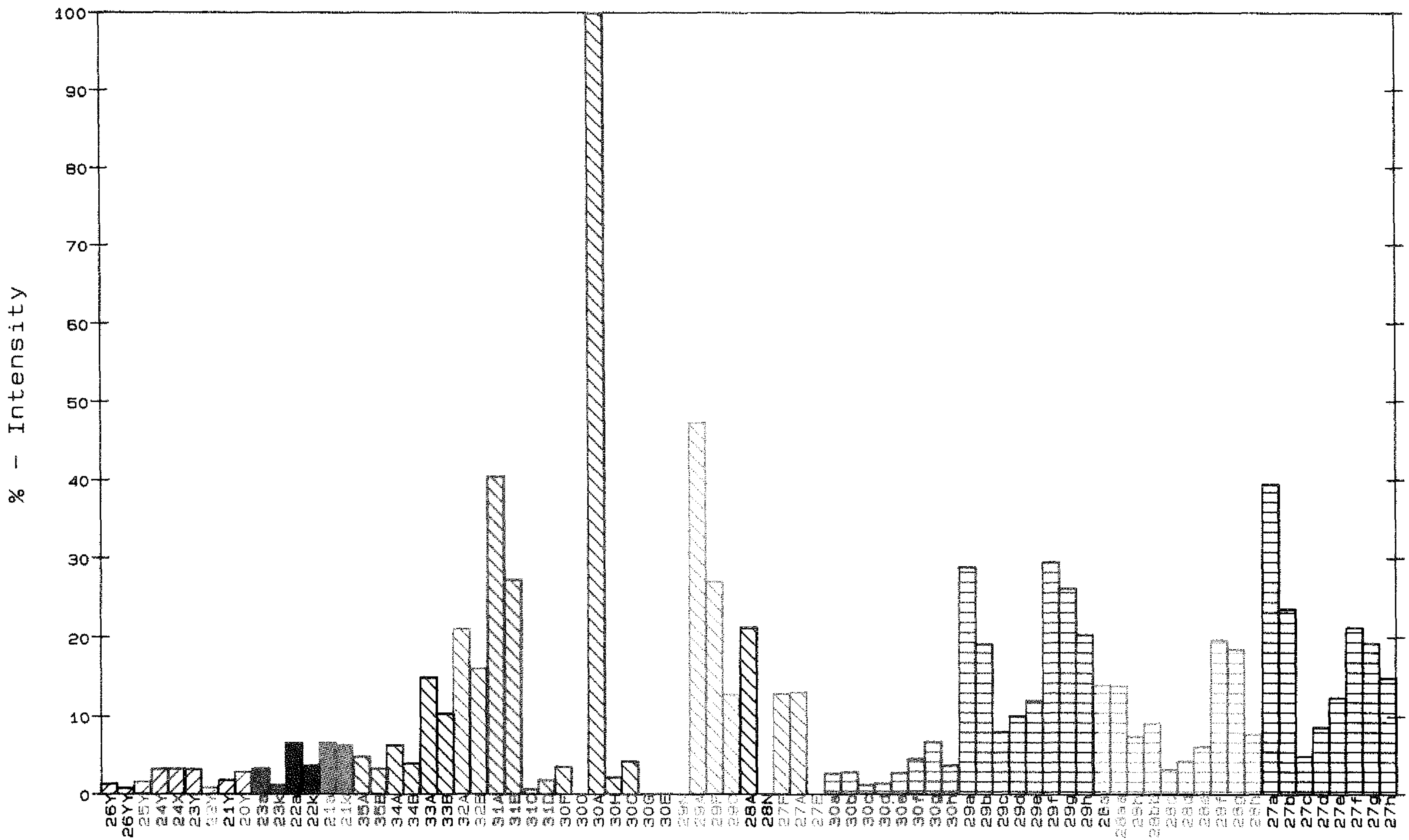
Steranes:

Numbers from 20 to 30 correspond to the carbon number of the molecules, the subsequent small letter identifies the stereochemistry.

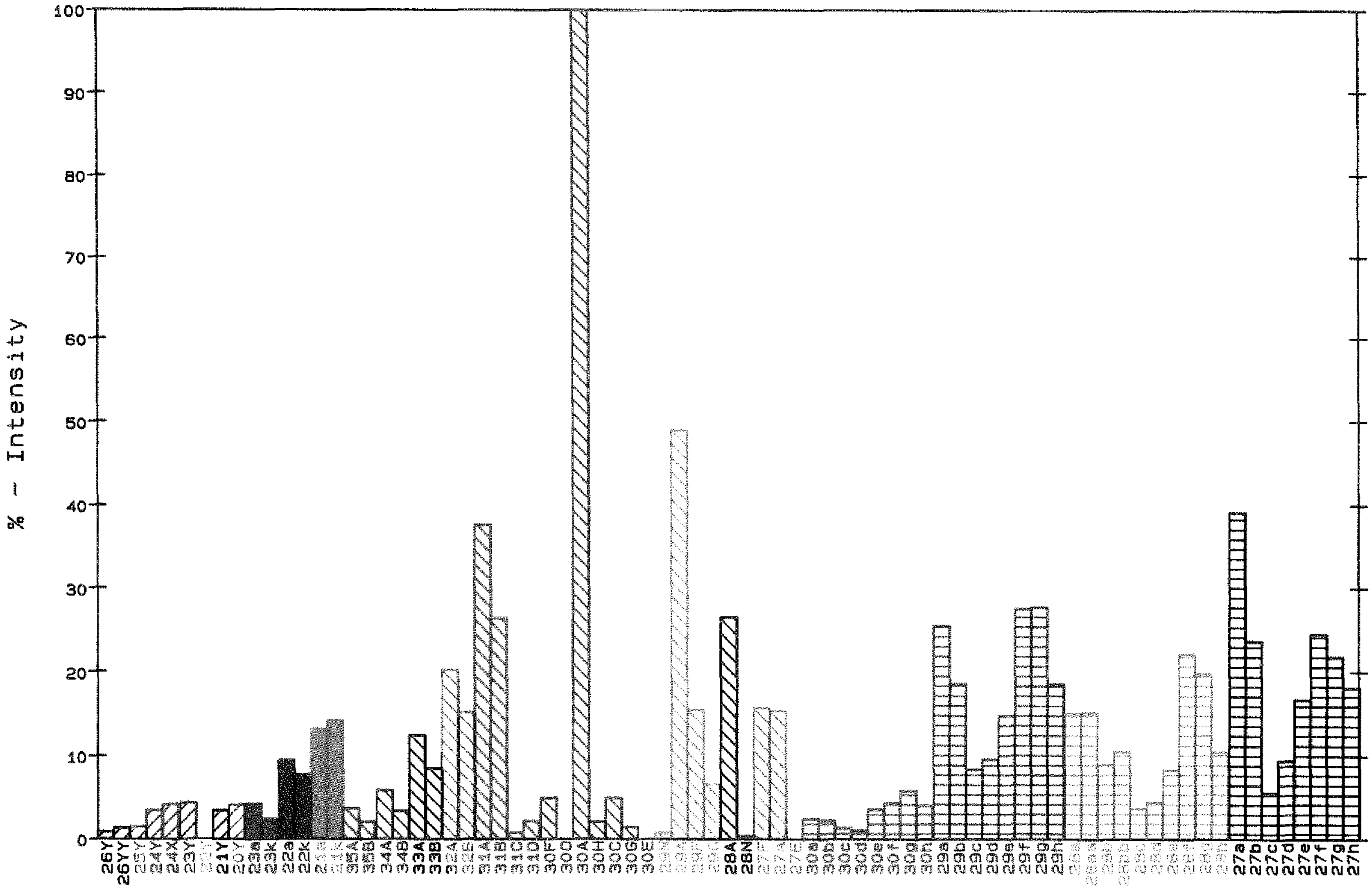
a 13β(H),17α(H)-diasteranes 20S (1)
b 13β(H),17α(H)-diasteranes 20R (2)
c 13α(H),17β(H)-diasteranes 20S (3)
d 13α(H),17β(H)-diasteranes 20R (4)
e 5α(H),14α(H),17α(H)-steranes 20S (5)
f 5α(H),14β(H),17β(H)-steranes 20R (6)
g 5α(H),14β(H),17β(H)-steranes 20S (7)
h 5α(H),14α(H),17α(H)-steranes 20R (8)
i 5β(H),14α(H),17α(H)-steranes (9)
k 4-methylsteranes (10)
n unidentified

Examples: 31B corresponds to 17α(H)-homohopane 22R
29e corresponds to ααα-ethylcholestane 20S

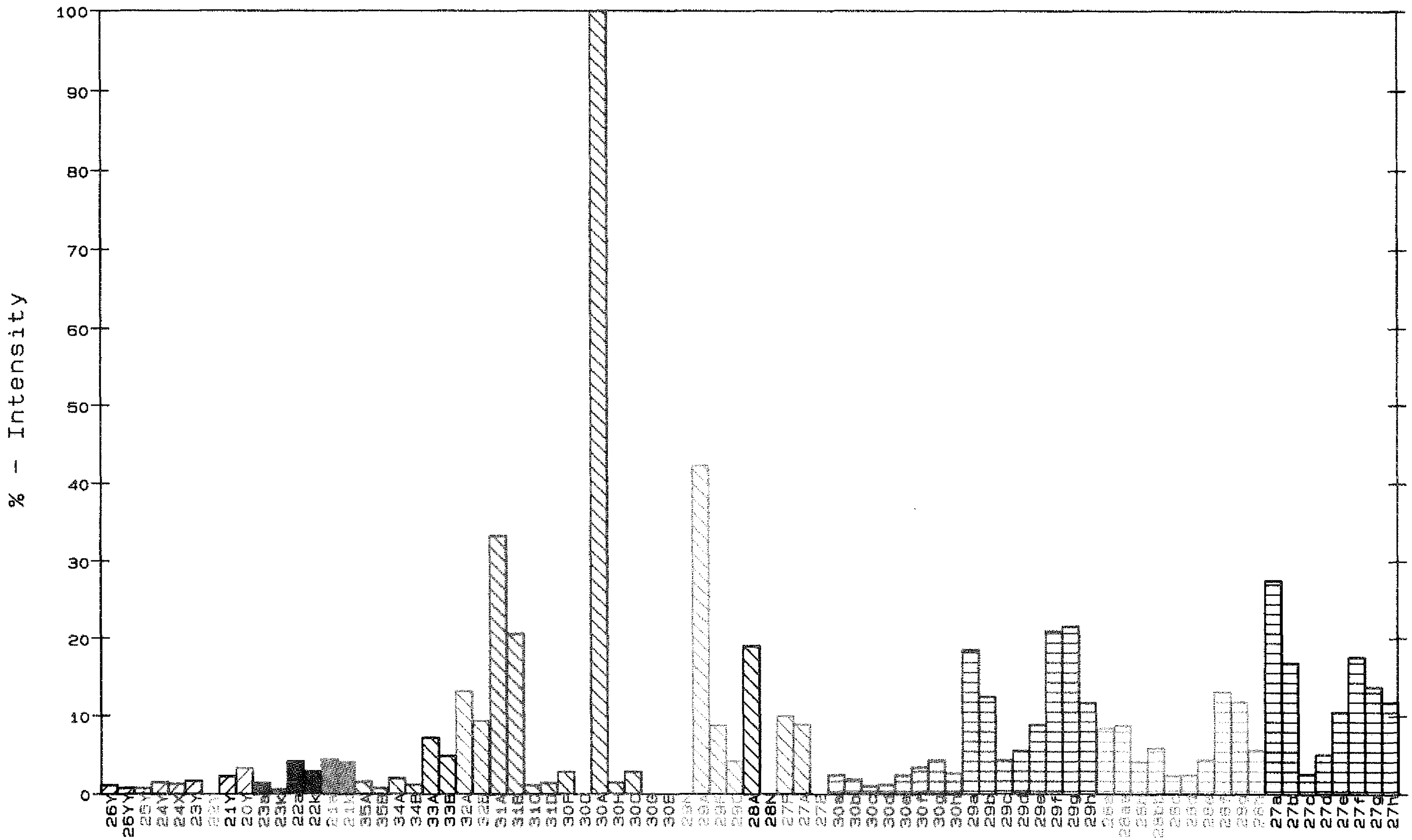
Biomarker pattern, SAT-fraction
Well: 30_9_11A, 2568.5m, COCH, SST
ms-file: AS22041, norm. factor: 868



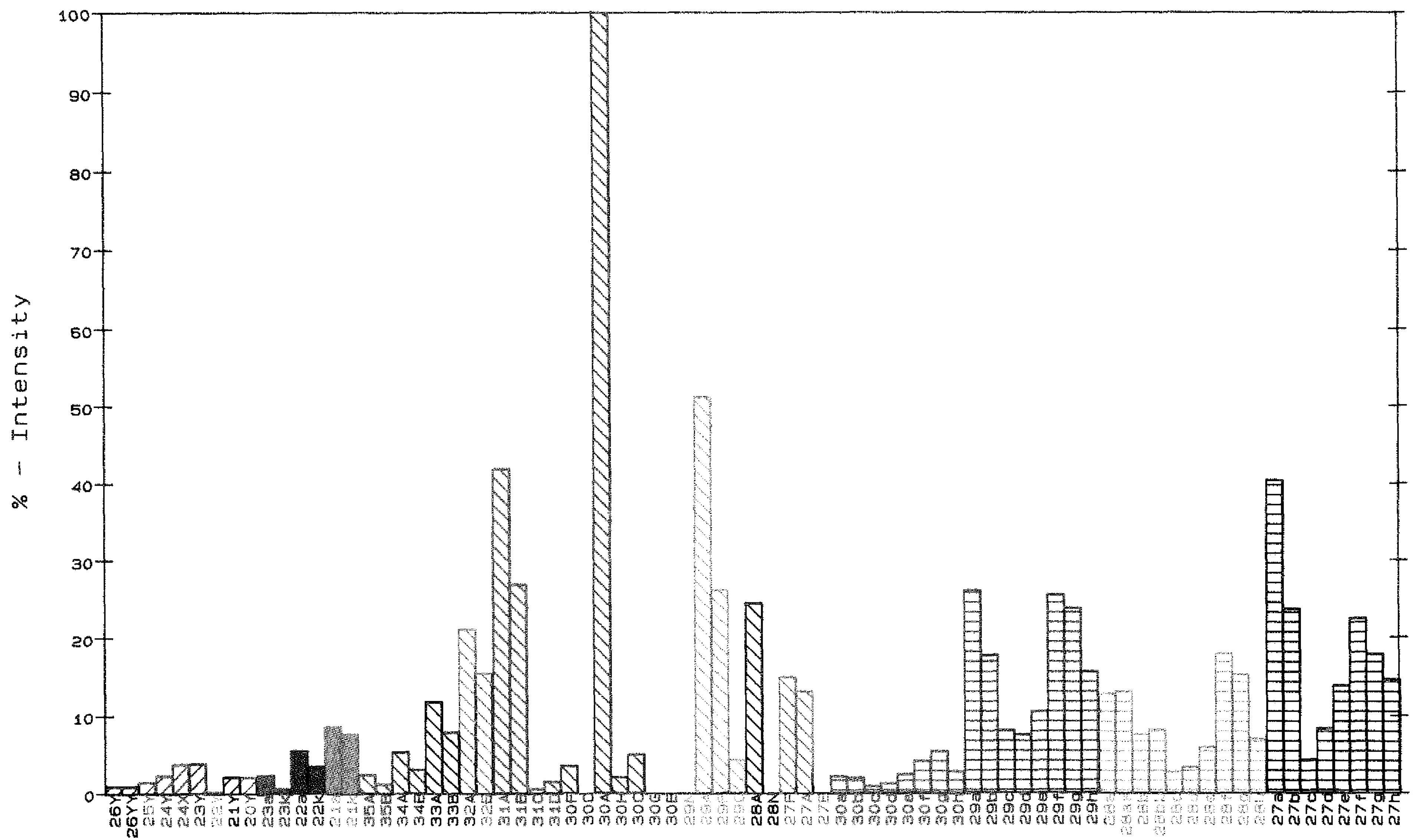
Biomarker pattern, SAT-fraction
Well: 30_9_11A, 2556.5m, COCH, SST
ms-file: ES03051, norm. factor: 2002.2



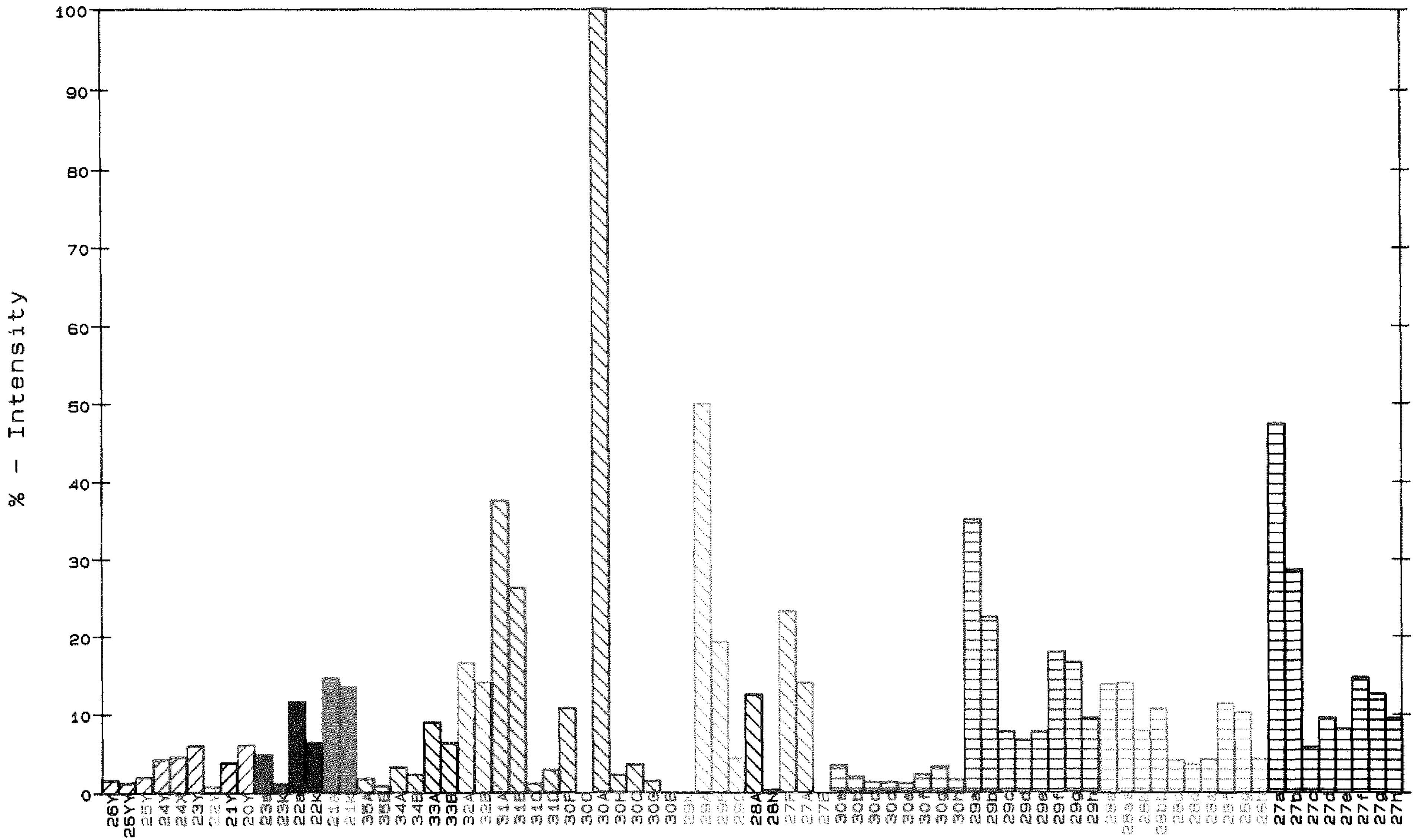
Biomarker pattern, SAT-fraction
Well: 30_9_11A, 2568.7m, COCH, SST
ms-file: AS22041, norm. factor: 493.5



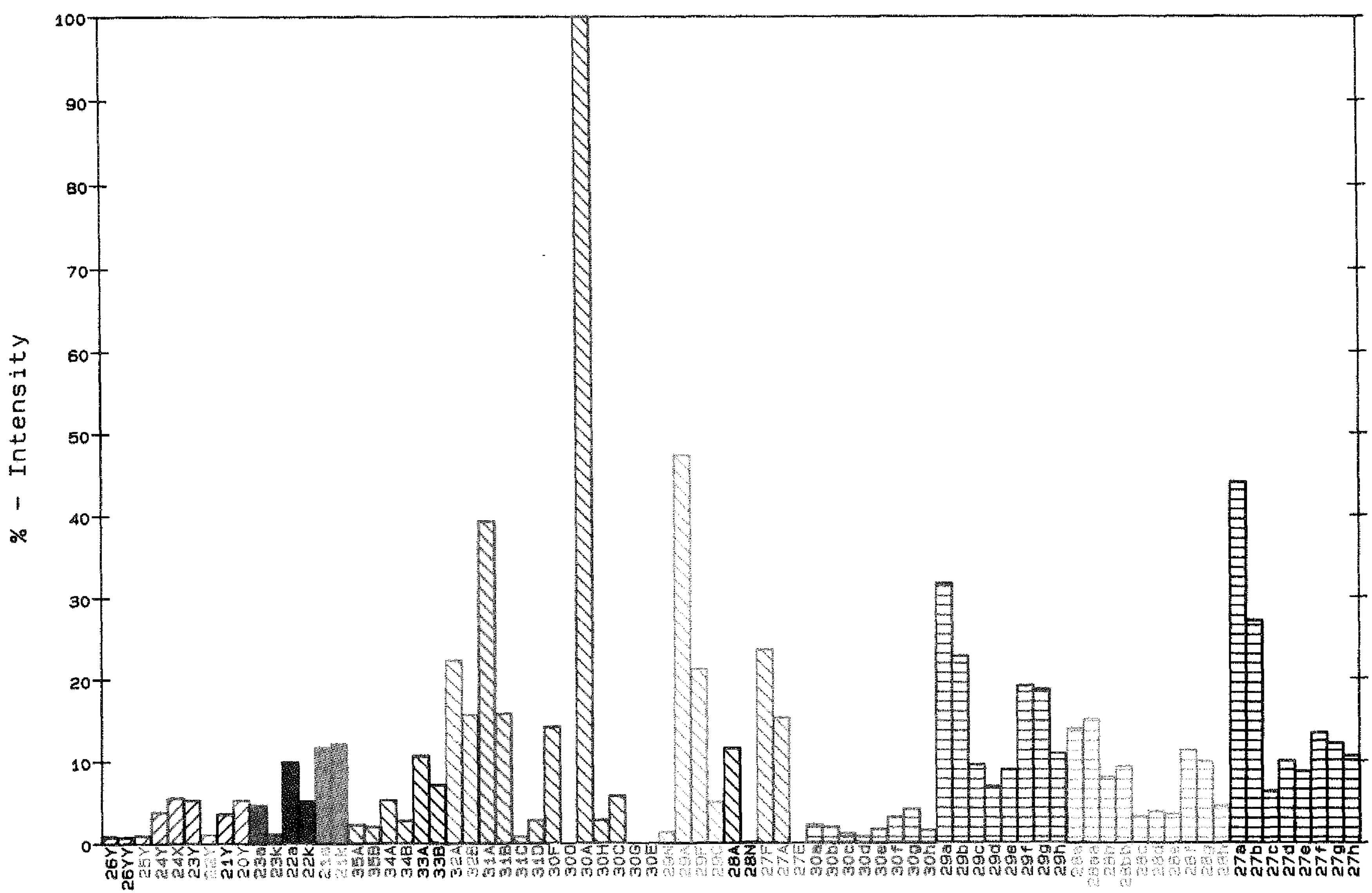
Biomarker pattern, SAT-fraction
Well: 30_9_11A, 2568.9m, COCH, SST
ms-file: AS22041, norm. factor: 902.4



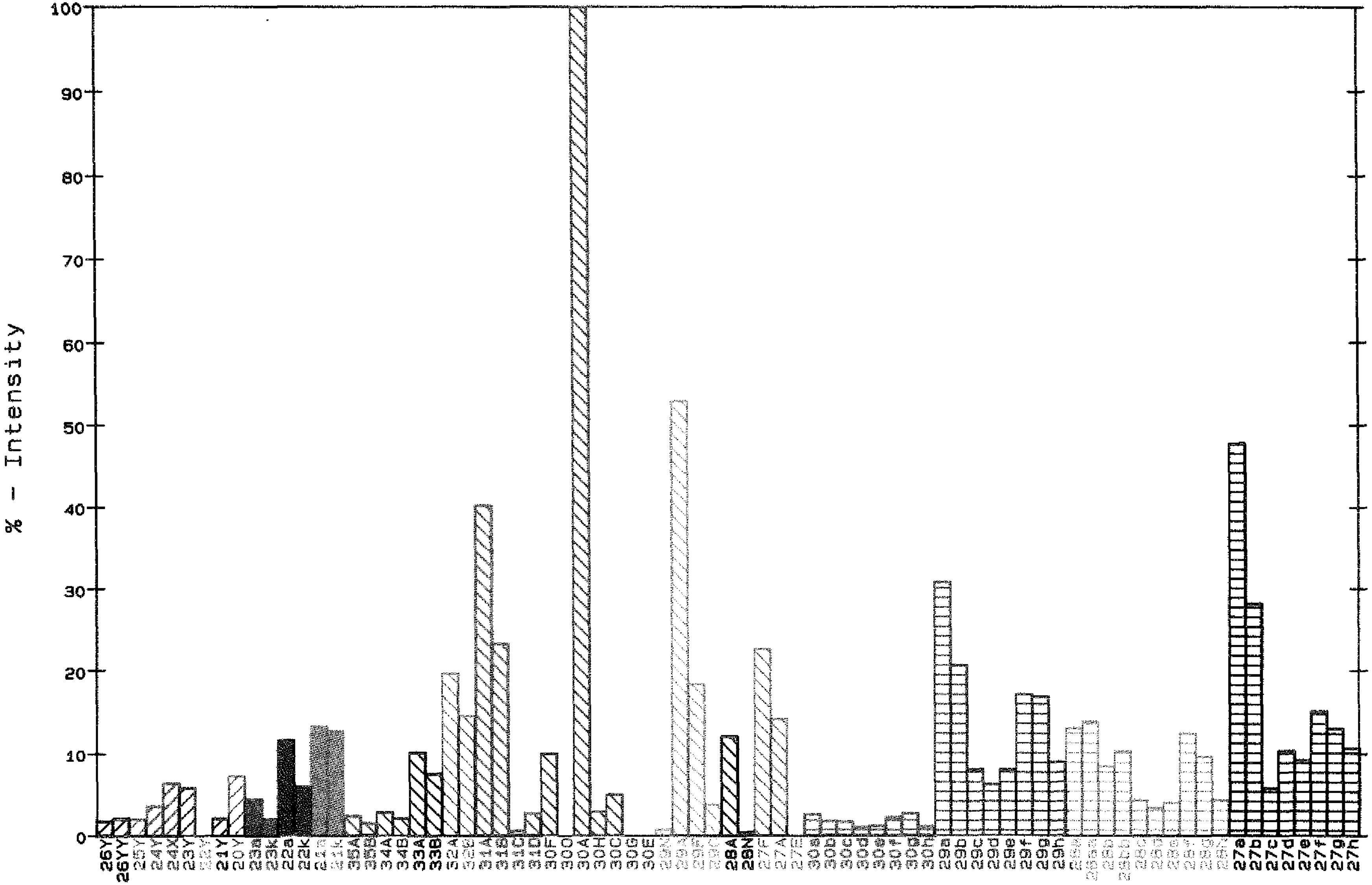
Biomarker pattern, SAT-fraction
Well: 30_9_9, 2291.1m, COCH, SST
ms-file: AS22041, norm. factor: 938



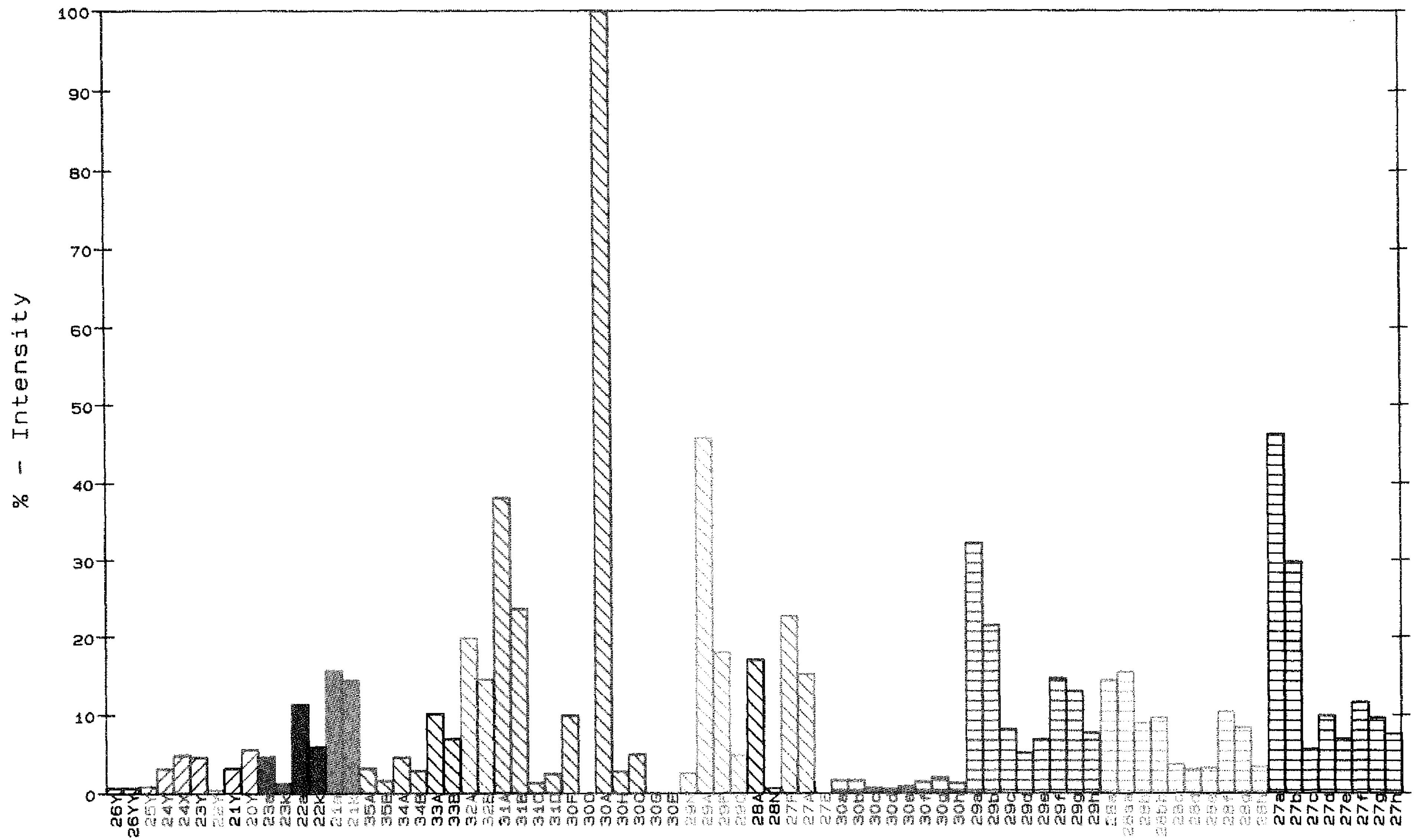
Biomarker pattern, SAT-fraction
Well: 30_9_9, 2293.02m, COCH, SST
ms-file: AS22041, norm. factor: 1889.4



Biomarker pattern, SAT-fraction
Well: 30_9_9, 2293.7m, COCH, SST
ms-file: AS22041, norm. factor: 756



Biomarker pattern, SAT-fraction
Well: 30_9_9, 2299.02m, COCH, SST
ms-file: AS22041, norm. factor: 1029.3



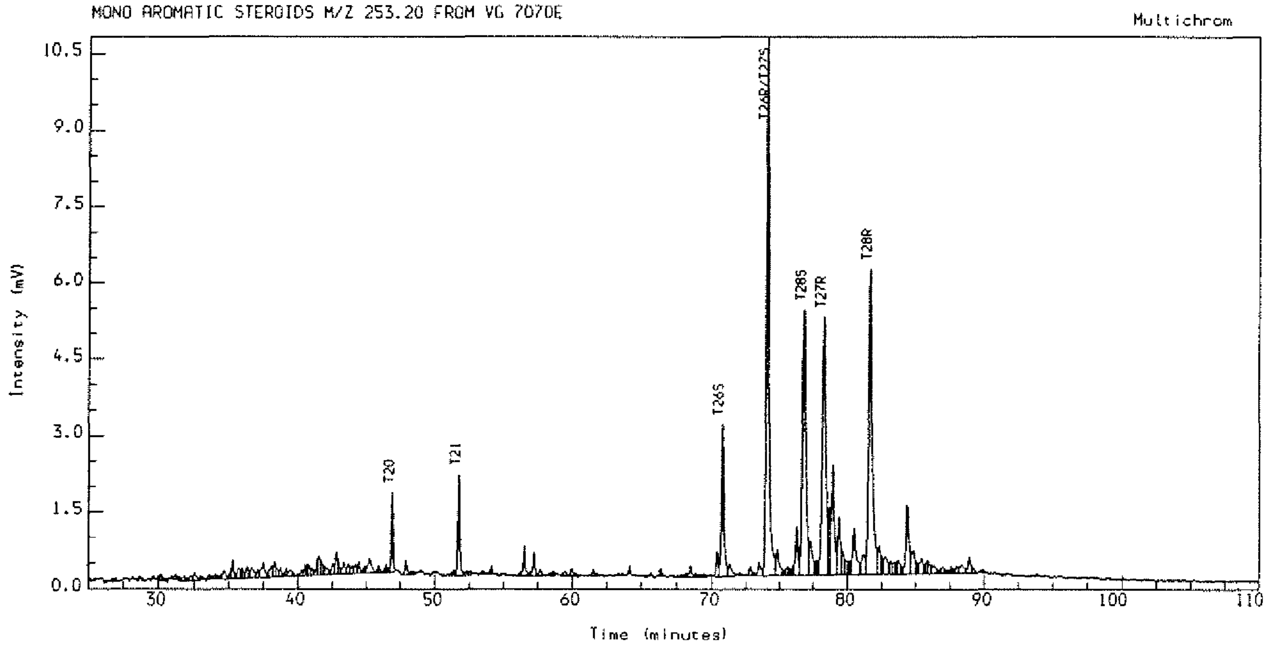
APPENDIX VI

Fragmentograms of Monoaromatic Steroids, (Ion 253 m/z).

Fragmentograms of Triaromatic Steroids, (Ion 231 m/z).

NORSK HYDRO RESEARCH CENTRE

Analysis Name : [PETRO] 1 TT123112.4.1.
30/9-11A 2556.5 Amount : 1.000
MONO AROMATIC STEROIDS M/Z 253.20 FROM VG 7070E

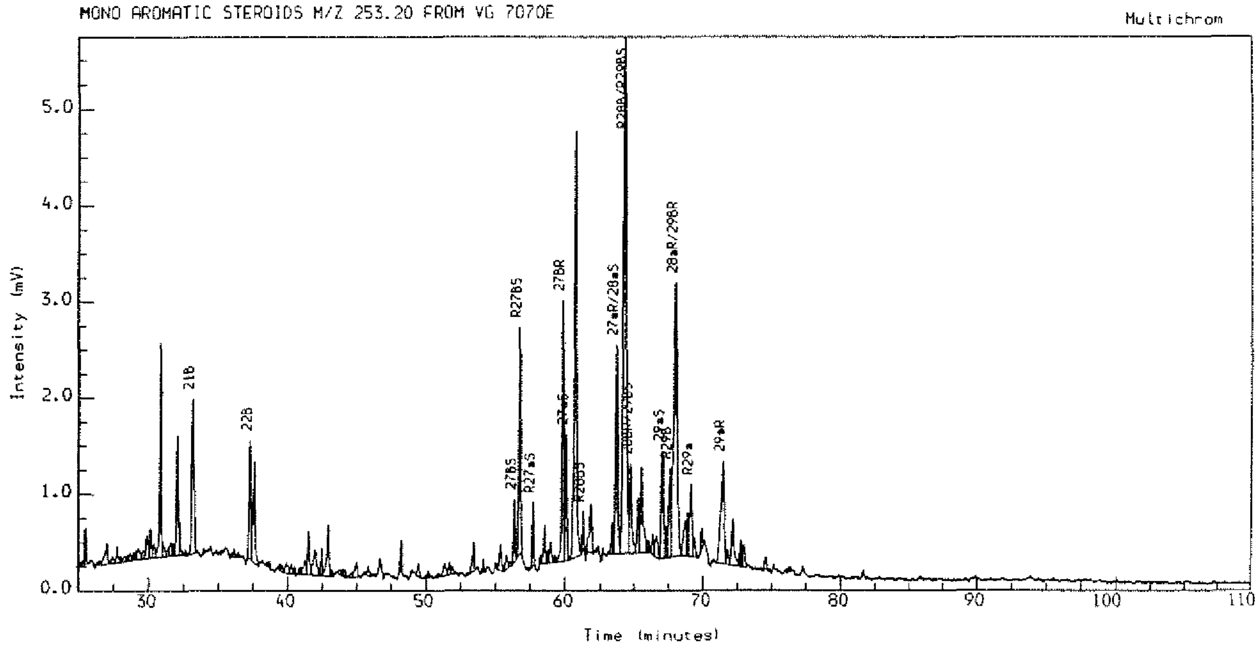


Instrument :
Channel Title :
Lims ID : 0
Acquired on at 00:00
Reported on 27-MAY-1991 at 10:47

Method : TT
Calibration : M23112
Run Sequence : TT

NORSK HYDRO RESEARCH CENTRE

Analysis Name : [PETRO] 1 TT125320.4.1.
30/9-11A 2556.5 Amount : 1.000
MONO AROMATIC STEROIDS M/Z 253.20 FROM VG 7070E

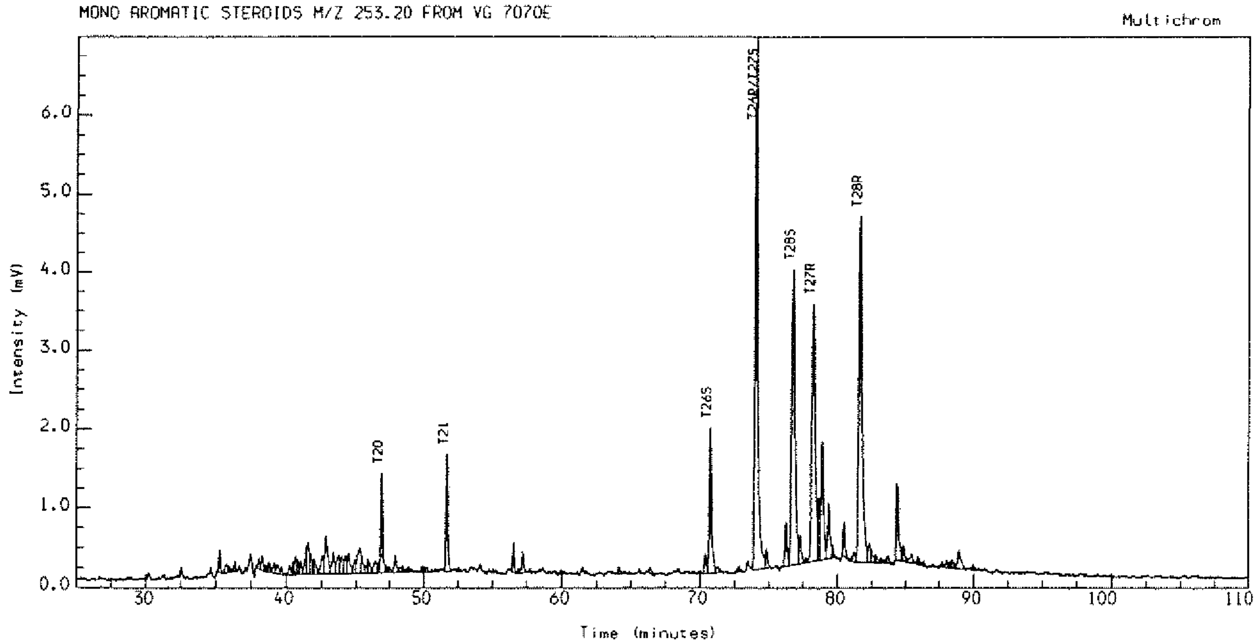


Instrument :
Channel Title :
Lims ID : 0
Acquired on at 00:00
Reported on 27-MAY-1991 at 11:11

Method : TT
Calibration : M25320
Run Sequence : TT

NORSK HYDRO RESEARCH CENTRE

Analysis Name : [PETRO] 1 TT123112.5.1.
30/9-11A 2568.5 Amount : 1.000
MONO AROMATIC STEROIDS M/Z 253.20 FROM VG 7070E

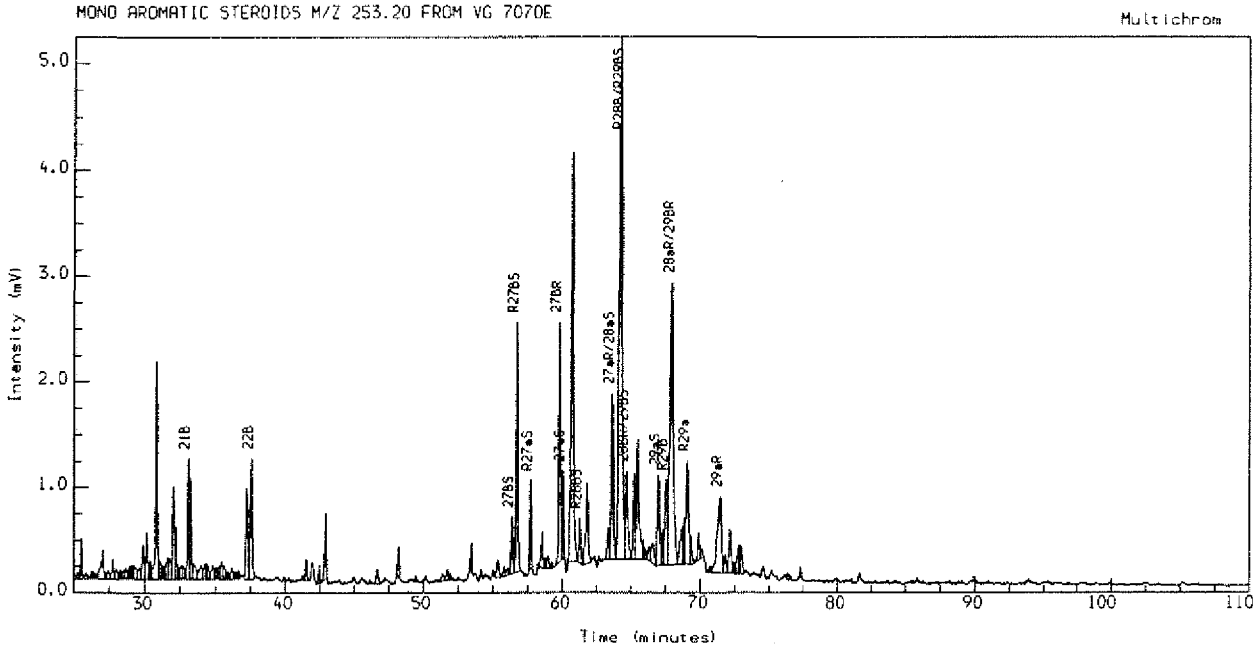


Instrument :
Channel Title :
Lims ID : 0
Acquired on at 00:00
Reported on 27-MAY-1991 at 10:49

Method : TT
Calibration : M23112
Run Sequence : TT

NORSK HYDRO RESEARCH CENTRE

Analysis Name : [PETRO] 1 TT125320.5.1.
30/9-11A 2568.5 Amount : 1.000
MONO AROMATIC STEROIDS M/Z 253.20 FROM VG 7070E

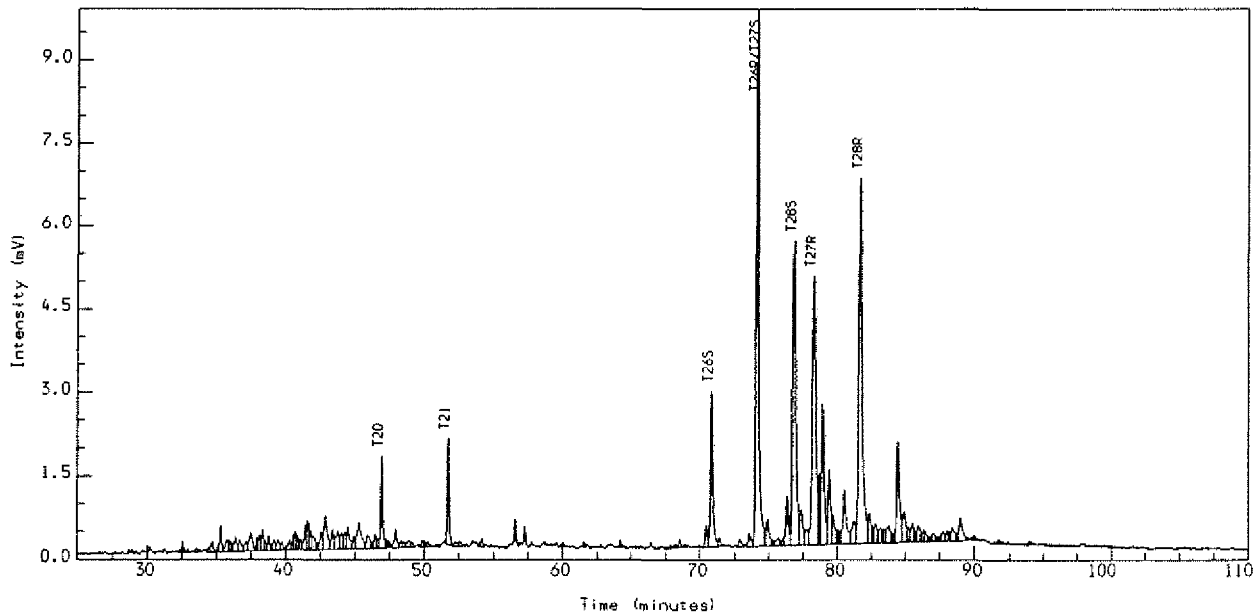


Instrument :
Channel Title :
Lims ID : 0
Acquired on at 00:00
Reported on 27-MAY-1991 at 11:13

Method : TT
Calibration : M25320
Run Sequence : TT

NORSK HYDRO RESEARCH CENTRE

Analysis Name : [PETRO] 1 TT123112,6,1.
30/9-11A 2568.7 Amount : 1.000
MONO AROMATIC STEROIDS M/Z 253.20 FROM VG 7070E

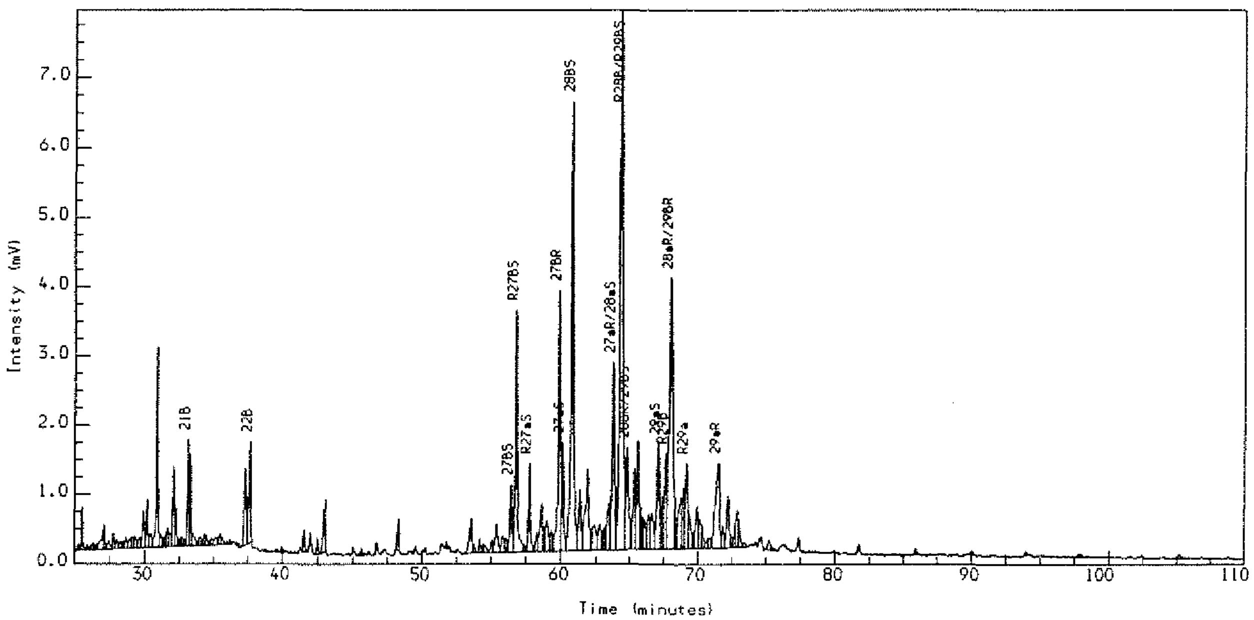


Instrument :
Channel Title :
Lims ID : 0
Acquired on at 00:00
Reported on 27-MAY-1991 at 10:50

Method : TT
Calibration : M23112
Run Sequence : TT

NORSK HYDRO RESEARCH CENTRE

Analysis Name : [PETRO] 1 TT125320,6,1.
30/9-11A 2568.7 Amount : 1.000
MONO AROMATIC STEROIDS M/Z 253.20 FROM VG 7070E

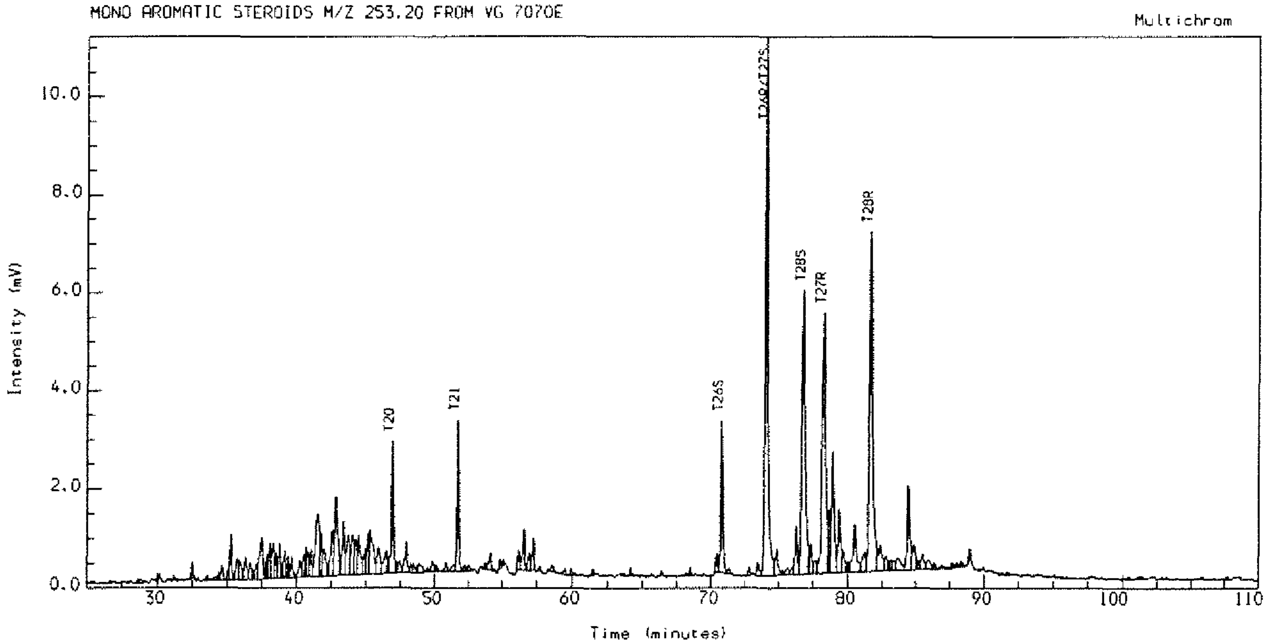


Instrument :
Channel Title :
Lims ID : 0
Acquired on at 00:00
Reported on 27-MAY-1991 at 11:14

Method : TT
Calibration : M25320
Run Sequence : TT

NORSK HYDRO RESEARCH CENTRE

Analysis Name : [PETRO] 1 TT123112.7.1.
30/9-11A 2568.9 Amount : 1.000
MONO AROMATIC STEROIDS M/Z 253.20 FROM VG 7070E

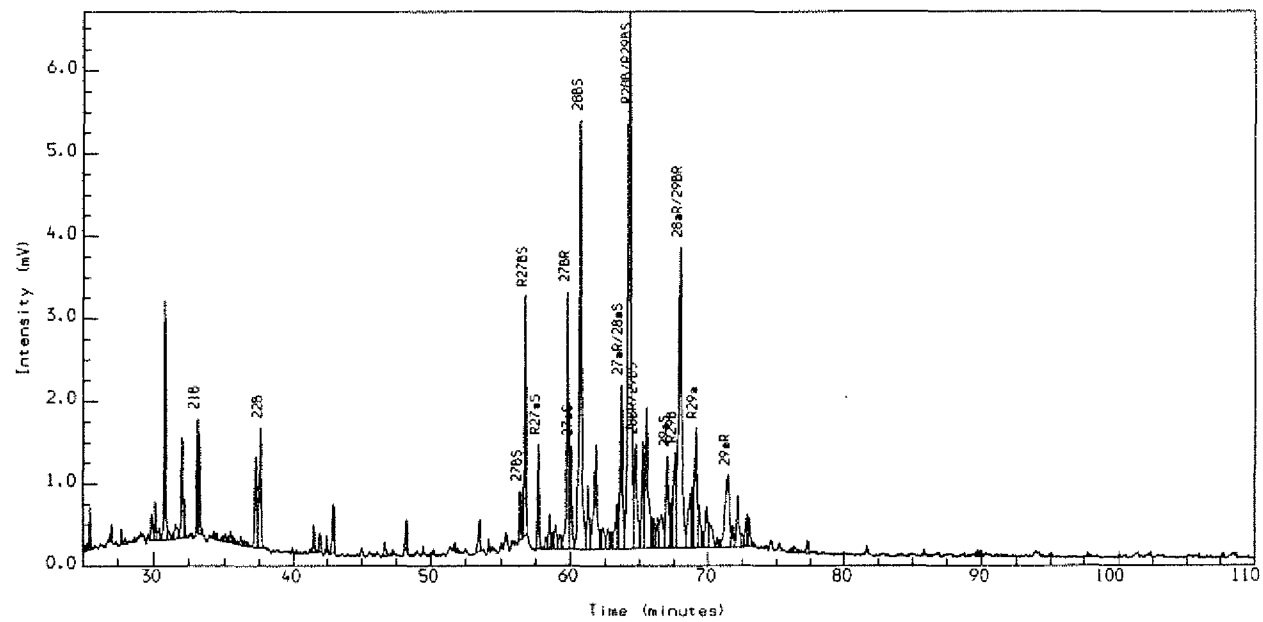


Instrument :
Channel Title :
Lims ID : 0
Acquired on at 00:00
Reported on 27-MAY-1991 at 10:52

Method : TT
Calibration : M23112
Run Sequence : TT

NORSK HYDRO RESEARCH CENTRE

Analysis Name : [PETRO] 1 TT125320.7.1.
30/9-11A 2568.9 Amount : 1.000
MONO AROMATIC STEROIDS M/Z 253.20 FROM VG 7070E



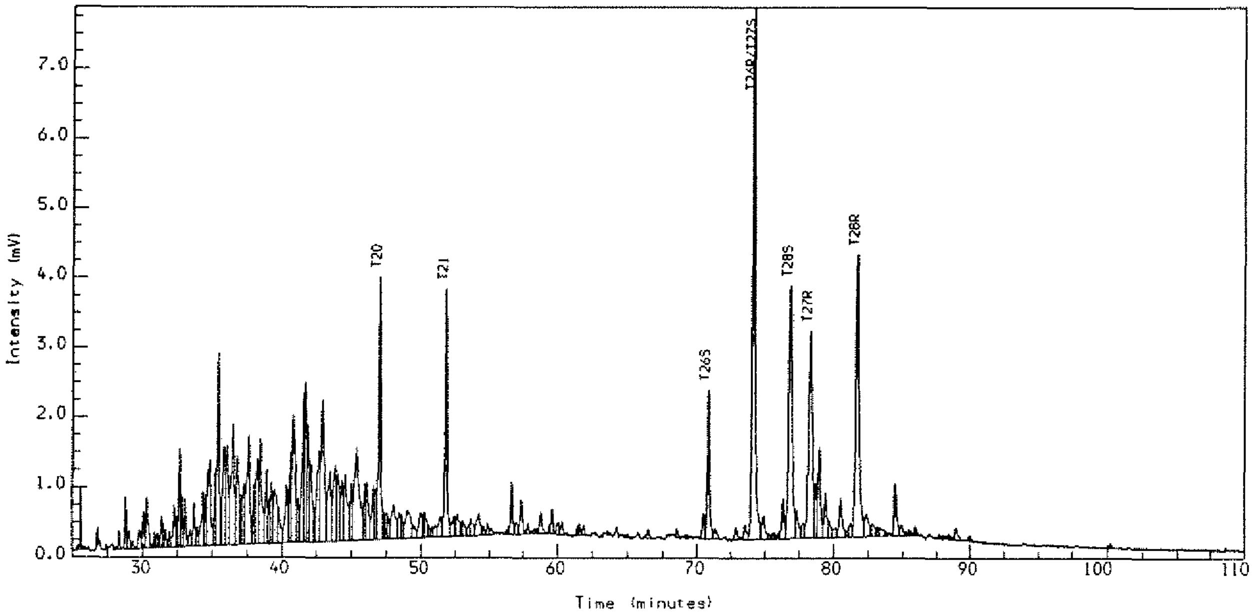
Instrument :
Channel Title :
Lims ID : 0
Acquired on at 00:00
Reported on 27-MAY-1991 at 11:16

Method : TT
Calibration : M25320
Run Sequence : TT

NORSK HYDRO RESEARCH CENTRE

Analysis Name : [PETRO] 1 TT123112.11.1.
30/9-9 2291.1 Amount : 1.000
MONO AROMATIC STEROIDS M/Z 253.20 FROM VG 7070E

Multichrom

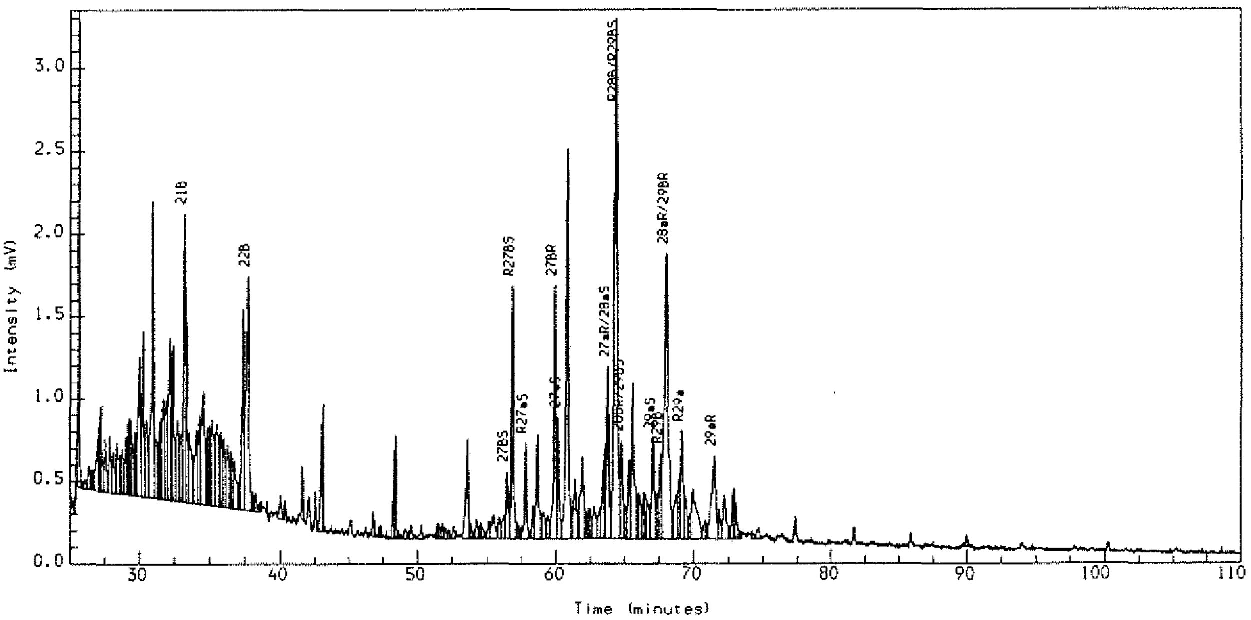


Instrument :	Method : TT
Channel Title :	Calibration : M23112
Lims ID : 0	Run Sequence : TT
Acquired on at 00:00	
Reported on 27-MAY-1991 at 10:58	

NORSK HYDRO RESEARCH CENTRE

Analysis Name : [PETRO] 1 TT125320.11.1.
30/9-9 2291.1 Amount : 1.000
MONO AROMATIC STEROIDS M/Z 253.20 FROM VG 7070E

Multichrom



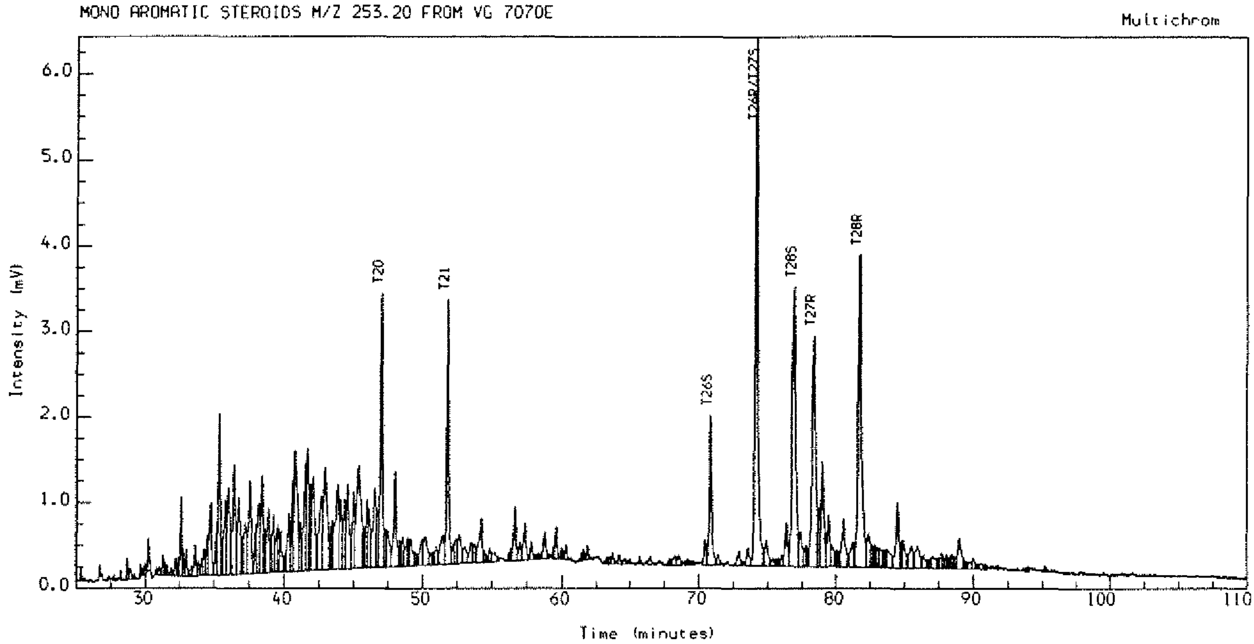
Instrument :	Method : TT
Channel Title :	Calibration : M25320
Lims ID : 0	Run Sequence : TT
Acquired on at 00:00	
Reported on 27-MAY-1991 at 11:22	

NORSK HYDRO RESEARCH CENTRE

Analysis Name : [PETRO] 1 TT123112.12.1.

30/9-9 2293.02 Amount : 1.000

MONO AROMATIC STEROIDS M/Z 253.20 FROM VG 7070E



Instrument :
Channel Title :
Lims ID : 0
Acquired on at 00:00
Reported on 27-MAY-1991 at 11:00

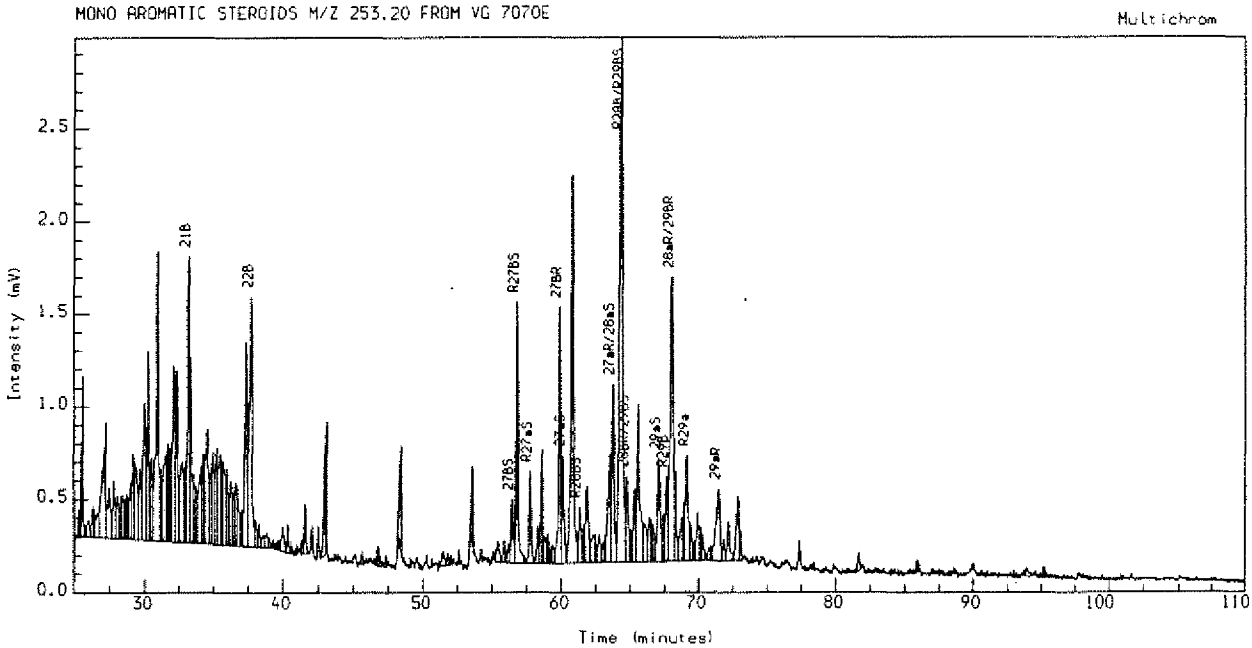
Method : TT
Calibration : M23112
Run Sequence : TT

NORSK HYDRO RESEARCH CENTRE

Analysis Name : [PETRO] 1 TT125320.12.1.

30/9-9 2293.02 Amount : 1.000

MONO AROMATIC STEROIDS M/Z 253.20 FROM VG 7070E



Instrument :
Channel Title :
Lims ID : 0
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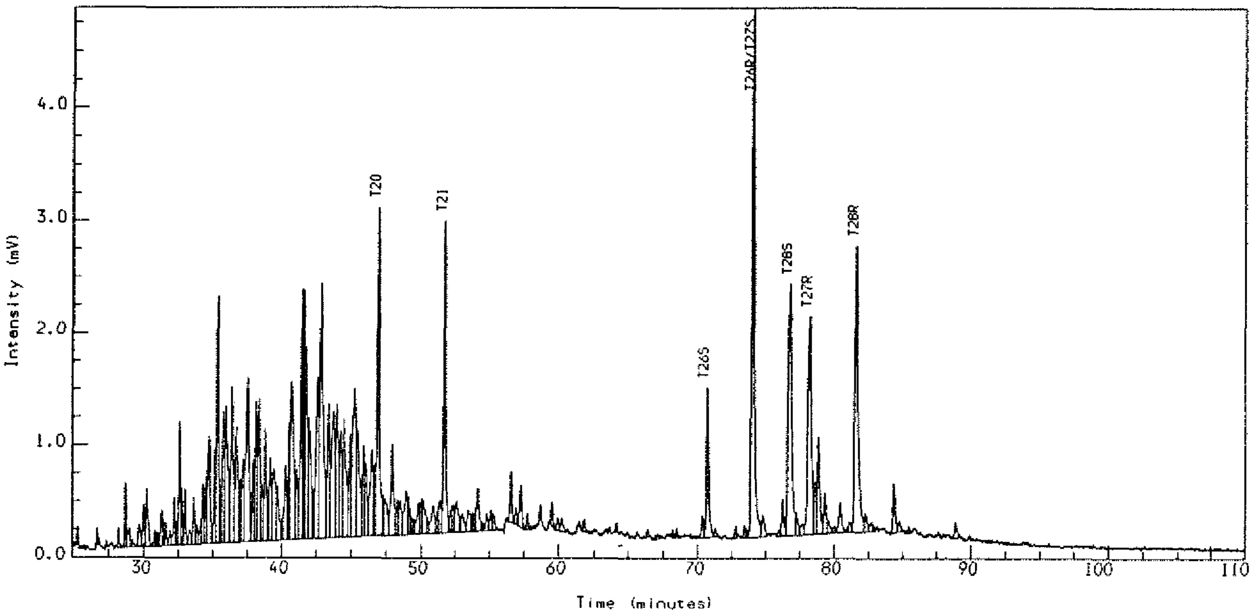
Reported on 27-MAY-1991 at 11:25

Method : TT
Calibration : M25320
Run Sequence : TT

NORSK HYDRO RESEARCH CENTRE

Analysis Name : [PETRO] 1 TT123112.13.1.
30/9-9 2293.7   Amount : 1.000
MONO AROMATIC STEROIDS M/Z 253.20 FROM VG 7070E

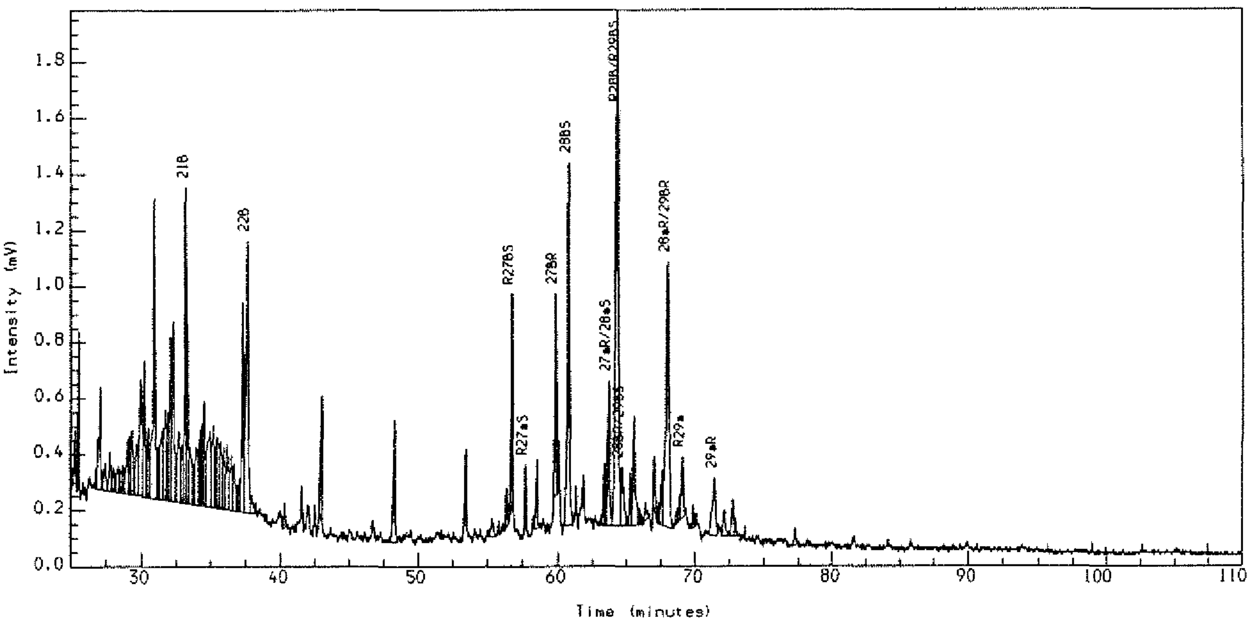


Instrument :
Channel Title :
Lims ID : 0
Acquired on at 00:00
Reported on 27-MAY-1991 at 11:02

Method : TT
Calibration : M23112
Run Sequence : TT

NORSK HYDRO RESEARCH CENTRE

Analysis Name : [PETRO] 1 TT125320.13.1.
30/9-9 2293.7   Amount : 1.000
MONO AROMATIC STEROIDS M/Z 253.20 FROM VG 7070E



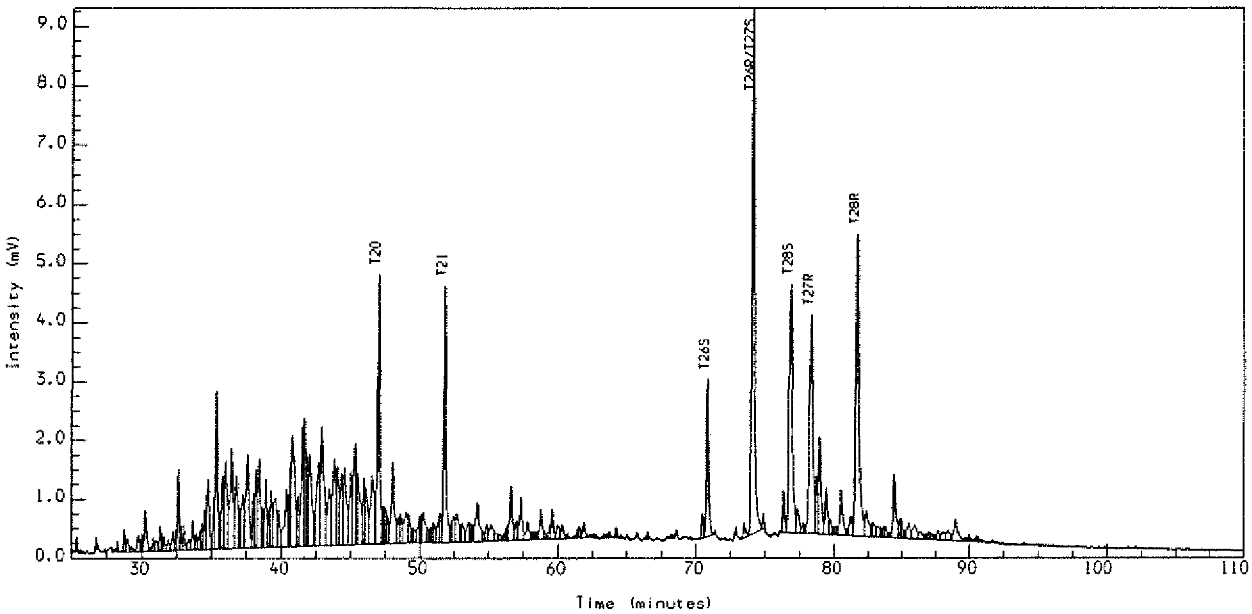
Instrument :
Channel Title :
Lims ID : 0
Acquired on at 00:00
Reported on 27-MAY-1991 at 11:27

Method : TT
Calibration : M25320
Run Sequence : TT

NORSK HYDRO RESEARCH CENTRE

Analysis Name : [PETRO] 1 TT123112.14.1.
30/9-9 2299.2 Amount : 1.000
MONO AROMATIC STEROIDS M/Z 253.20 FROM VG 7070E

Multichrom



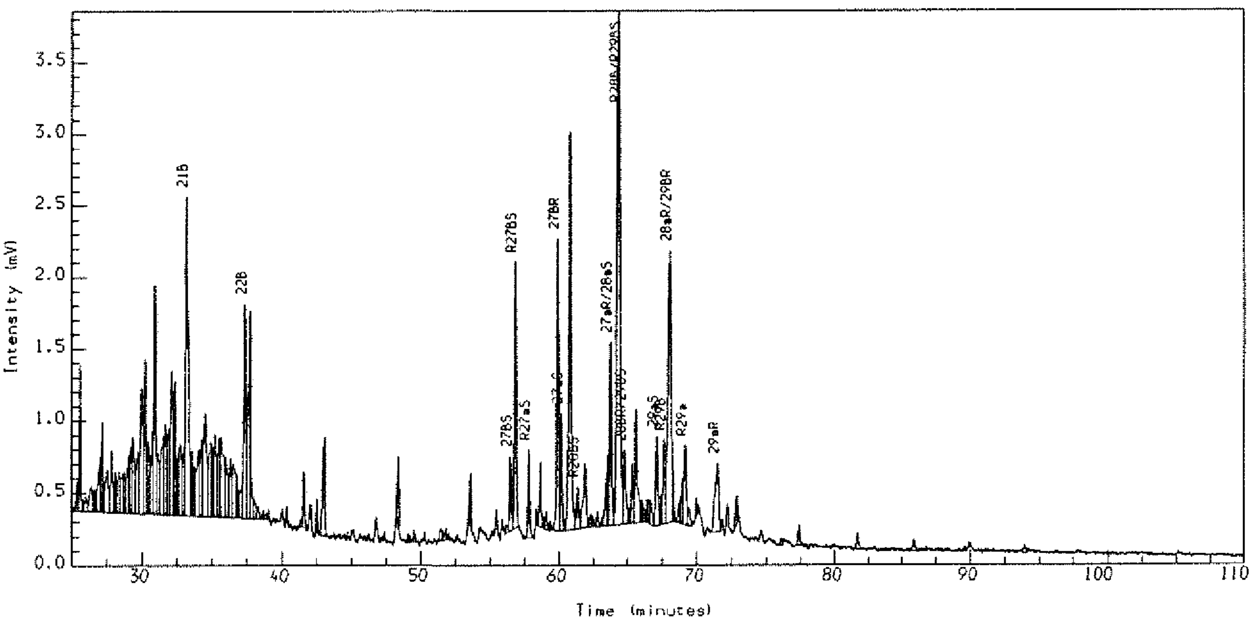
Instrument :
Channel Title :
Lims ID : 0
Acquired on at 00:00
Reported on 27-MAY-1991 at 11:04

Method : TT
Calibration : M23112
Run Sequence : TT

NORSK HYDRO RESEARCH CENTRE

Analysis Name : [PETRO] 1 TT125320.14.1.
30/9-9 2299.2 Amount : 1.000
MONO AROMATIC STEROIDS M/Z 253.20 FROM VG 7070E

Multichrom



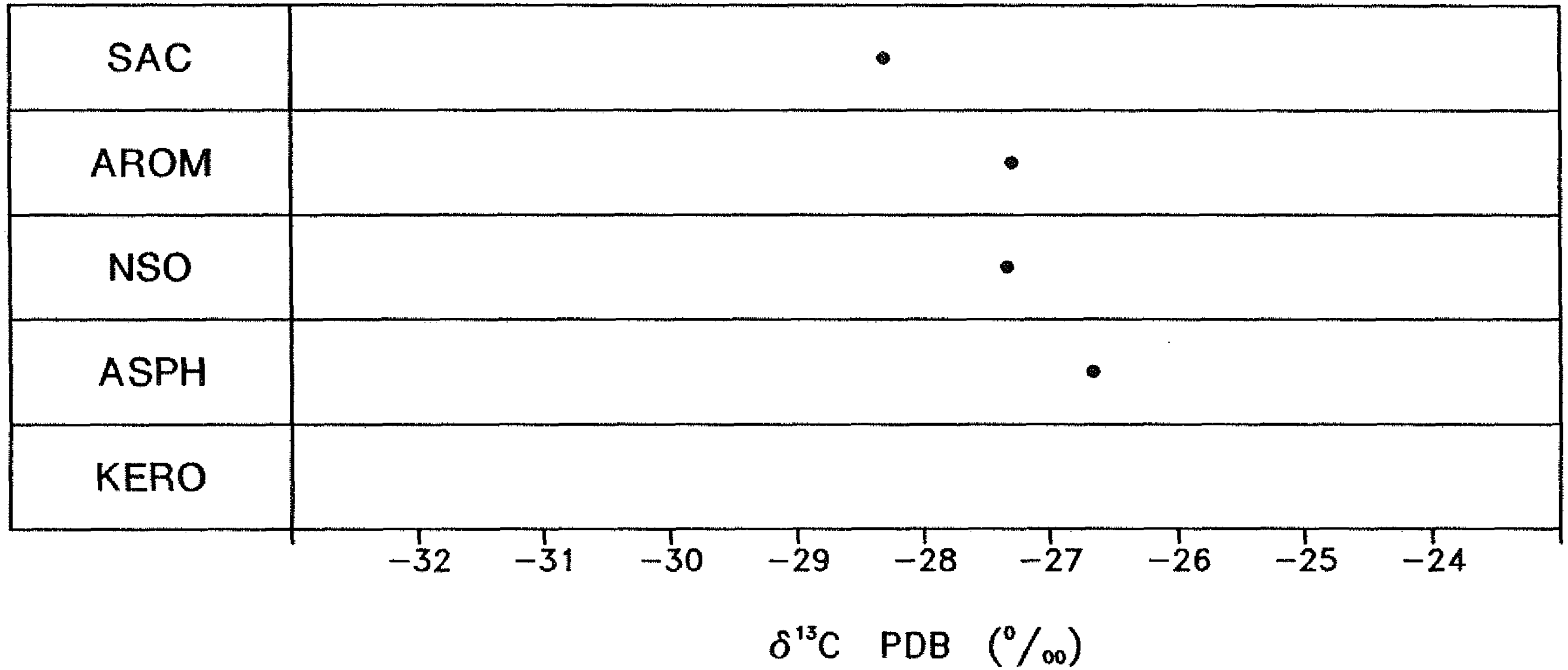
Instrument :
Channel Title :
Lims ID : 0
Acquired on at 00:00
Reported on 27-MAY-1991 at 11:29

Method : TT
Calibration : M25320
Run Sequence : TT

APPENDIX VII

Galimov Plots.

WELL 30/9-9   Depth: 2291.10 m

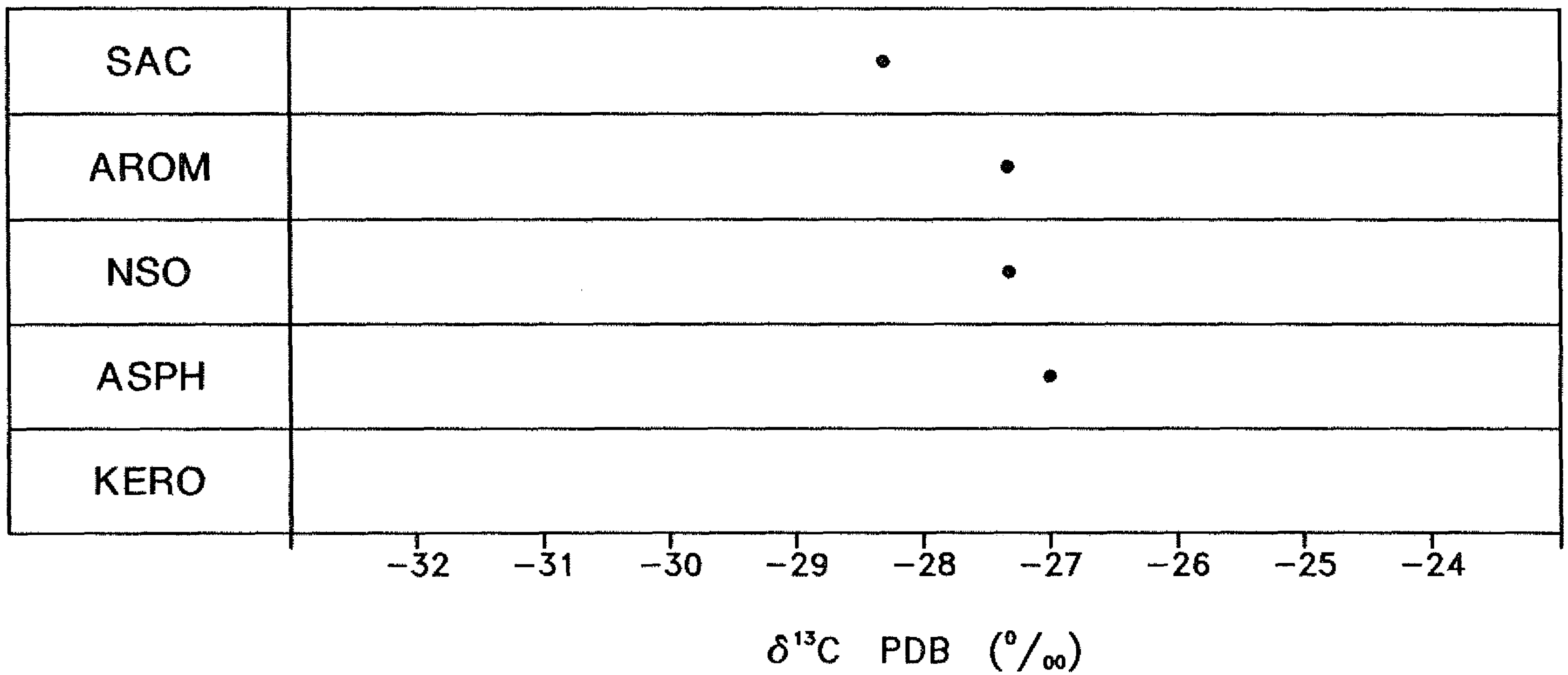


WHOLE OIL $\delta^{13}C$ =

WHOLE EXTRACT $\delta^{13}C$ =

PYROLYSATE $\delta^{13}C$ =

WELL 30/9-9 Depth: 2293.02 m

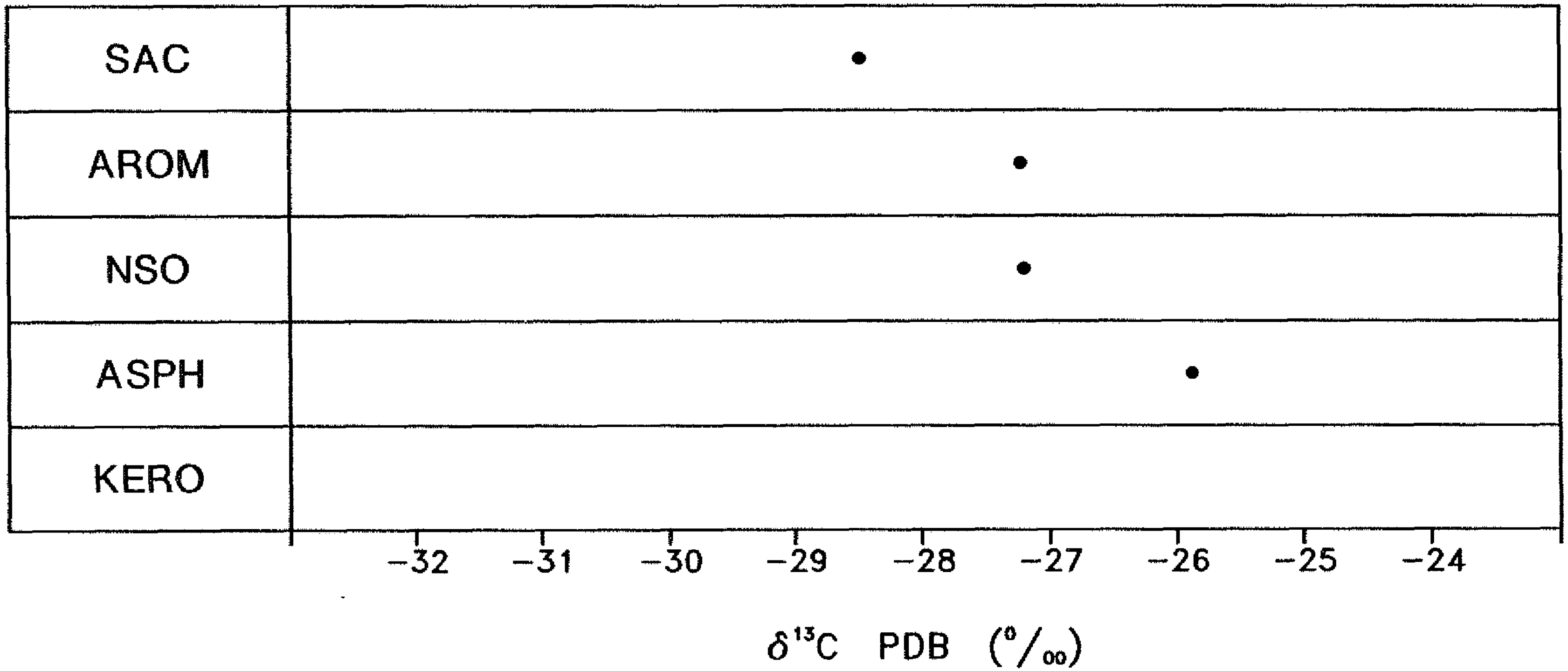


WHOLE OIL $\delta^{13}C$ =

WHOLE EXTRACT $\delta^{13}C$ =

PYROLYSATE $\delta^{13}C$ =

WELL 30/9-9 Depth: 2299.02 m

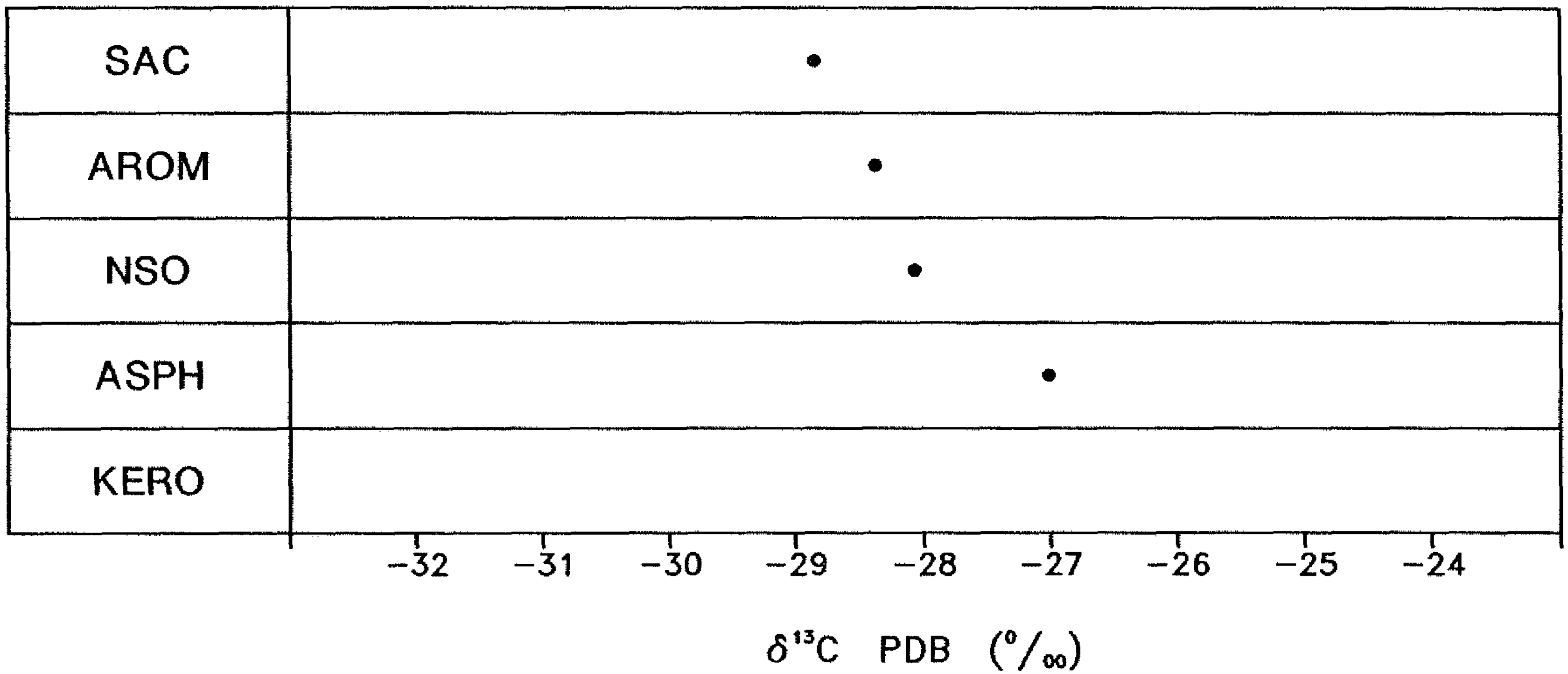


WHOLE OIL $\delta^{13}C$ =

WHOLE EXTRACT $\delta^{13}C$ =

PYROLYSATE $\delta^{13}C$ =

WELL 30/9-11A   Depth: 2556.50 m

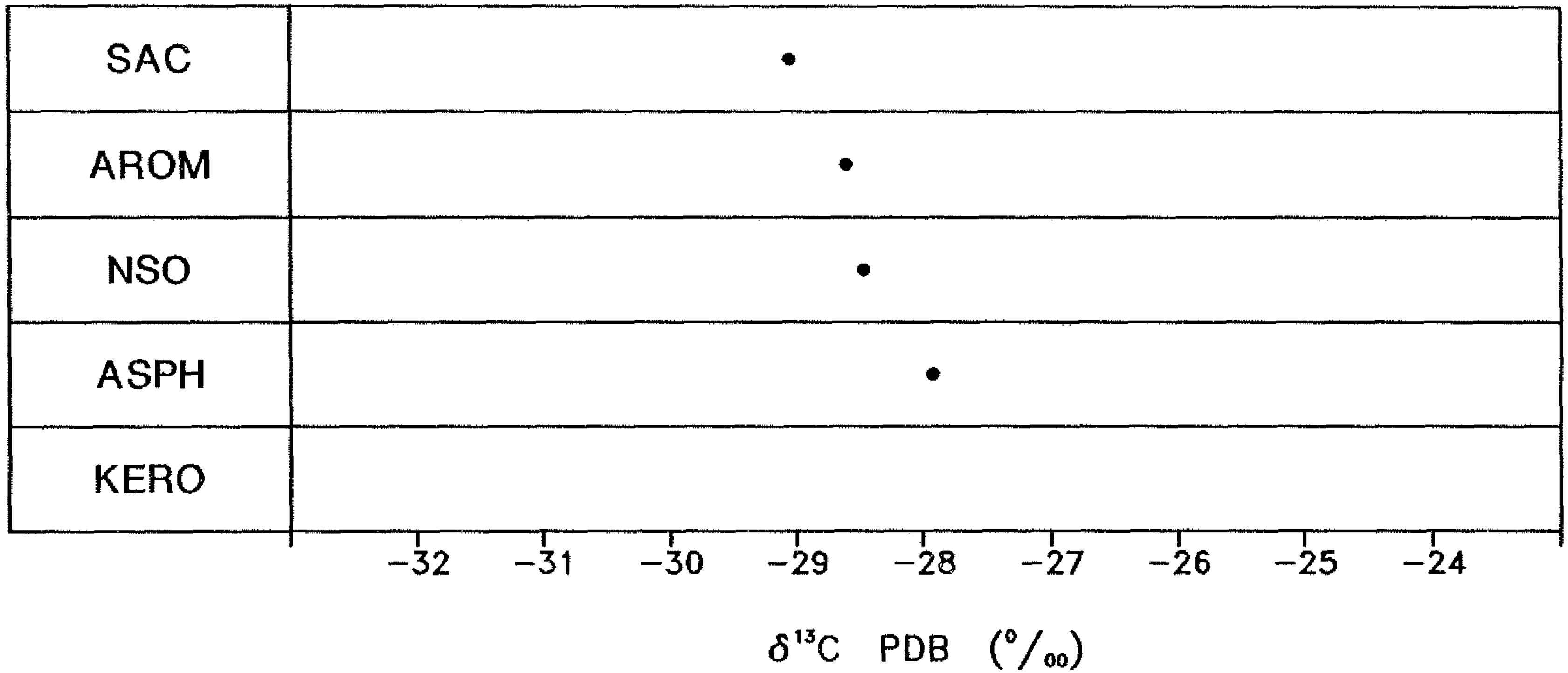


WHOLE OIL $\delta^{13}C$ =

WHOLE EXTRACT $\delta^{13}C$ =

PYROLYSATE $\delta^{13}C$ =

WELL 30/9-11A Depth: 2568.70 m

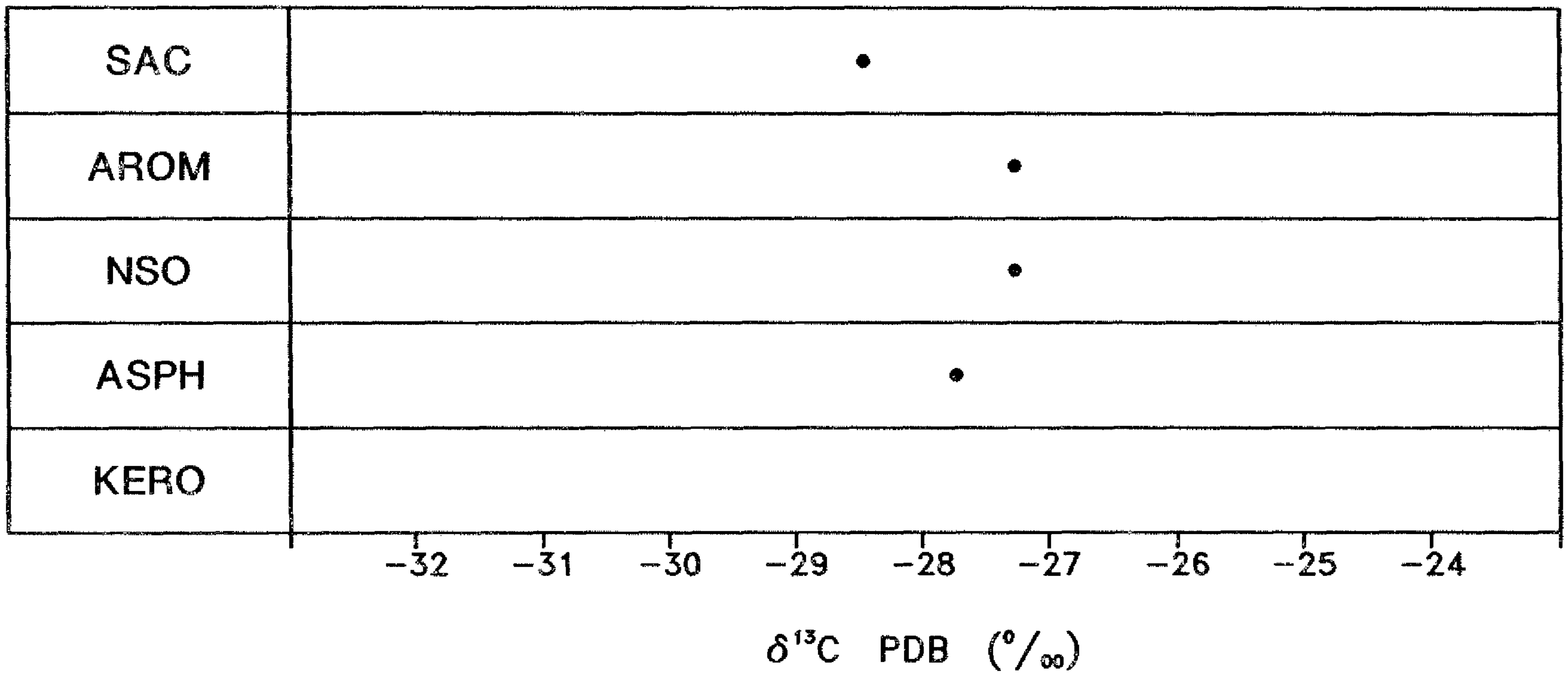


WHOLE OIL $\delta^{13}C$ =

WHOLE EXTRACT $\delta^{13}C$ =

PYROLYSATE $\delta^{13}C$ =

WELL 30/11-4



WHOLE OIL $\delta^{13}C$ =

WHOLE EXTRACT $\delta^{13}C$ =

PYROLYSATE $\delta^{13}C$ =