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HYDRO

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Title:

GEOCHEMICAL CHARACTERIZATION OF OILS FROM WELL 30/9-10.

Summary/Conclusion/Recommendation:

The two RFTs from well 30/9-10 appears to be near identical based on the distribution of light hydrocarbons.
The oils from 30/9-10 have a lower content of saturated hydrocarbons compared to the other Oseberg oils in this study.
The oil from 30/6-21 have previously been shown to have a similar low content of saturated hydrocarbons. The 30/9-10 oils also have a higher content of asphaltenes than the other Oseberg oils.
The analysed RFT samples from 30/9-10 are somewhat different based on the distribution of biomarkers.
The oils from 30/9-10 have a higher content of C_{29} steranes than the other investigated oils. This might imply that these oils have a contribution from another more terrestrially influenced source rock like the Heather Fm. The analysed oils appear to be sourced from a mature, predominantly marine source rock.
Several of the oils are shown to be a composite of an early, heavily biodegraded oil, and a later migrating unaltered oil.

Keywords:
OIL-OIL CORRELATION, GEOCHEMISTRY
BIOMARKERS,

Pages-appendix	Amendment no.	Revision no.	Revision date

Quadrant/Block-well	Project no.	Licens no	Date
30/9-10	30425	PL 104	29.10.90

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INTRODUCTION

The oil samples from well 30/9-10 have been characterised by petroleum geochemical techniques, and are correlated with other oils from 30/9-7, 30/9-8 and 30/9-9.

The two samples from 30/9-10 are RFT samples, the other samples are DST samples.

RFT 1225 AD	2775 m
RFT 1236 AD	2822 m

The well locations are given in Fig. 1.

The analyses and compilation of this report has been carried out at Norsk Hydro Research Center in Bergen.

RESULTS AND DISCUSSION

The distribution of C_1-C_9 hydrocarbons in two samples from well 30/9-10 (RFT 1225 AD and 1236 AD) are given in Appendix 1.

The heptane ratios and iso-heptane ratios are near identical and well within the analytical errors. The two samples are near identical based on the distribution of light hydrocarbons.

The results of group type analysis are given in Table 1.

The oils from well 30/9-9 contain no asphaltenes, and in general the investigated suite of oils are low in asphaltenes. The samples from well 30/9-10 are richer in aromatics, NSOs and asphaltenes than the rest of the analysed samples.

WELL	DST#	% ASPH.	% SAT.	% ARO.	% NSO
30/9-10	1225AD	4.9	35	44	16
30/9-10	1236AD	4.0	36	45	15
30/9-9	1	0	66	24	10
30/9-9	2	0	65	24	11
30/9-8	2A	1.7	54	33	13
30/9-7	1	1.8	56	29	15

Table 1: Results from deasphalting and group type separation.

The saturated hydrocarbon fractions have been analysed by gas chromatography and gas chromatography-mass spectrometry.

The gas chromatograms of the saturated hydrocarbon fractions are given in Appendix 2. Molecular parameters from the gas chromatography of the saturated hydrocarbons are given in Table 3.

WELL	DST#	Prist/n-C_{17}	Prist/Phyt	CPI	n-C_{17}/n-C_{27}
30/9-10	1225	0.70	1.75	1.03	3.70
30/9-10	1236	0.74	1.76	1.04	3.61
30/9-9	1	0.96	3.28	1.04	3.28
30/9-9	2	0.98	3.20	1.03	3.08
30/9-8	2A	0.80	1.84	1.01	3.72
30/9-7	1	0.89	2.09	0.96	3.40

Table 3: Molecular parameters from GC of saturated fractions.

The ratio of Pristane/n-C_{17} range from 0.96 in the 30/9-9 oils to 0.70 in the oil from 30/9-10. and suggests that these oils are unaffected by biodegradation.
The Pristane/Phytane ratios range from 3.28 in the oils from 30/9-9 to 1.75 in the oil from 30/9-10. This parameter may reflect the oxygen level at the time of deposition of the source rock. but is also affected by maturity. Here it probably reflects a higher maturity of the 30/9-9 oils. The maturity of the RFT samples from 30/9-10 are similar to the samples from 30/9-8 and 30/9-7.
The CPI (Carbon Preference Index) values are all around 1.0 suggesting mature, marine oils. Higher values suggest a odd over even carbon number predominance which is typical of immature organic matter.

Oils 30/9-10

The ratio of n-C_{17} to n-C_{27} gives an estimate of how light the oil is. High values suggest condensate like samples. This value is very similar in this suite of oils and suggests a normal marine oil with a low wax content.

In this study the biological markers in the saturated hydrocarbon fraction have been analysed both by Single Ion Monitoring GC-MS and Metastable Ion Monitoring GC-MS. The m/z 191 and m/z 217 mass chromatograms of the saturated fractions from a HP 5970 MSD are given in Appendix 3, and the m/z 231 and m/z 253 mass chromatograms of the aromatic fraction of one of the RFT samples (1236 AD) from 30/9-10 is given in Appendix 4.

The normalised results of metastable ion monitoring of biological markers of the terpane and sterane type using a VG 7070E mass spectrometer interfaced to a HP5890 GC are given in Appendix 5.

The biological marker ratios from the monitoring of steranes are given in Table 4.

WELL	DST#	%20S	%αββ	%C29	%C28	%C27	C21/C29	Dia/Reg
30/9-10	1225	57	62	38	30	32	0.32	1.29
30/9-10	1236	54	55	38	29	33	0.37	2.22
30/9-9	1	49	63	23	38	39	0.22	1.14
30/9-9	2							
30/9-8	2A	55	60	22	44	34	0.39	1.61
30/9-7	1	52	59	23	43	36	0.28	1.07

Table 4: Sterane biological marker ratios from Oseberg oils.

The maturity parameters %20S and %αββ have both reached their equilibrium values showing that these oils have been generated at average maturities higher than 0.7% vitrinite reflectance.

The Sterane Carbon Number distribution (%C_{27}.%C_{28}.%C_{29}) is sensitive to the original organic input of the source rocks for these oils. The values are similar, but have a slightly higher contribution of C_{29} steranes in the oils from 30/9-10. This may imply a higher input from the more terrestrially influenced Heather Fm. or a poorer development of the Draupne Fm.

The ratio of C_{21} steranes to C_{29} steranes (C_{21}/C_{29}) is both source and maturity dependent. In these oils with a limited range of maturities, this ratio probably reflects source variations. The ratio range from 0.22 to 0.39. The oils from 30/9-9 have the lowest values, indicating a higher maturity.

Oils 30/9-10

The ratio of diasteranes to regular steranes (Dia/Reg) is a function of both the lithology of the source rock facies and maturity. Lower values indicate a lower maturity or a more carbonate dominated source lithology. The lowest value are represented by the oil from 30/9-7. One of the samples (1236 AD) from 30/9-10 have a higher value (2.22) than the rest of the samples.

The biological marker ratios calculated from the terpanes are listed in Table 5.

WELL	DST#	Ts/Tm	25-nor/nor	24/23	23/Hop	St/Hop
30/9-10	1225	2.21	0.30	0.56	0.07	1.39
30/9-10	1236	1.39	0.31	0.88	0.06	1.12
30/9-9	1	2.01	0.01	1.35	0.03	1.55
30/9-9	2					
30/9-8	2A	1.27	0.32	0.31	0.05	1.22
30/9-7	1	1.21	0.20	0.34	0.04	1.36

Table 5: Terpane biological marker ratios for Oseberg oils.

The ratio of Ts/Tm. which is maturity dependent within a confined type of depositional environment. range from 1.21 to 2.21.
The ratio of 25-norhopane to norhopane (25-nor/nor) is dependent on biodegradation. With intense biodegradation 25-norhopanes are generated. The values in Table 5 suggests that the oils from 30/9-8. 30/9-7 and the RFT samples from 30/9-10 contains two migration pulses. one early oil which has been very heavily biodegraded. and a fresh. unaltered oil which migrated in at a later stage.
The ratio of C_{24}-tetracyclic terpane to C_{23}-tricyclic terpane (C_{24}/C_{23}) show little variation except for the 30/9-9 oil which have a much higher value for this ratio. The ratio of C_{23}-tricyclic terpane to hopane (C_{23}/Hop) show little variation suggesting that these oils are derived from the same type of source rock.

The Sterane to Hopane ratio (St/Hop) is also relatively constant.

CONCLUSION

The two RFTs from well 30/9-10 appears to be near identical based on the distribution of light hydrocarbons.

The oils from 30/9-10 have a lower content of saturated hydrocarbons compared to the other Oseberg oils in this study. The oil from well 30/6-21 have previously been shown to have a similar low content of saturated hydrocarbons. The 30/9-10 oils also have a higher content of asphaltenes than the other Oseberg oils.

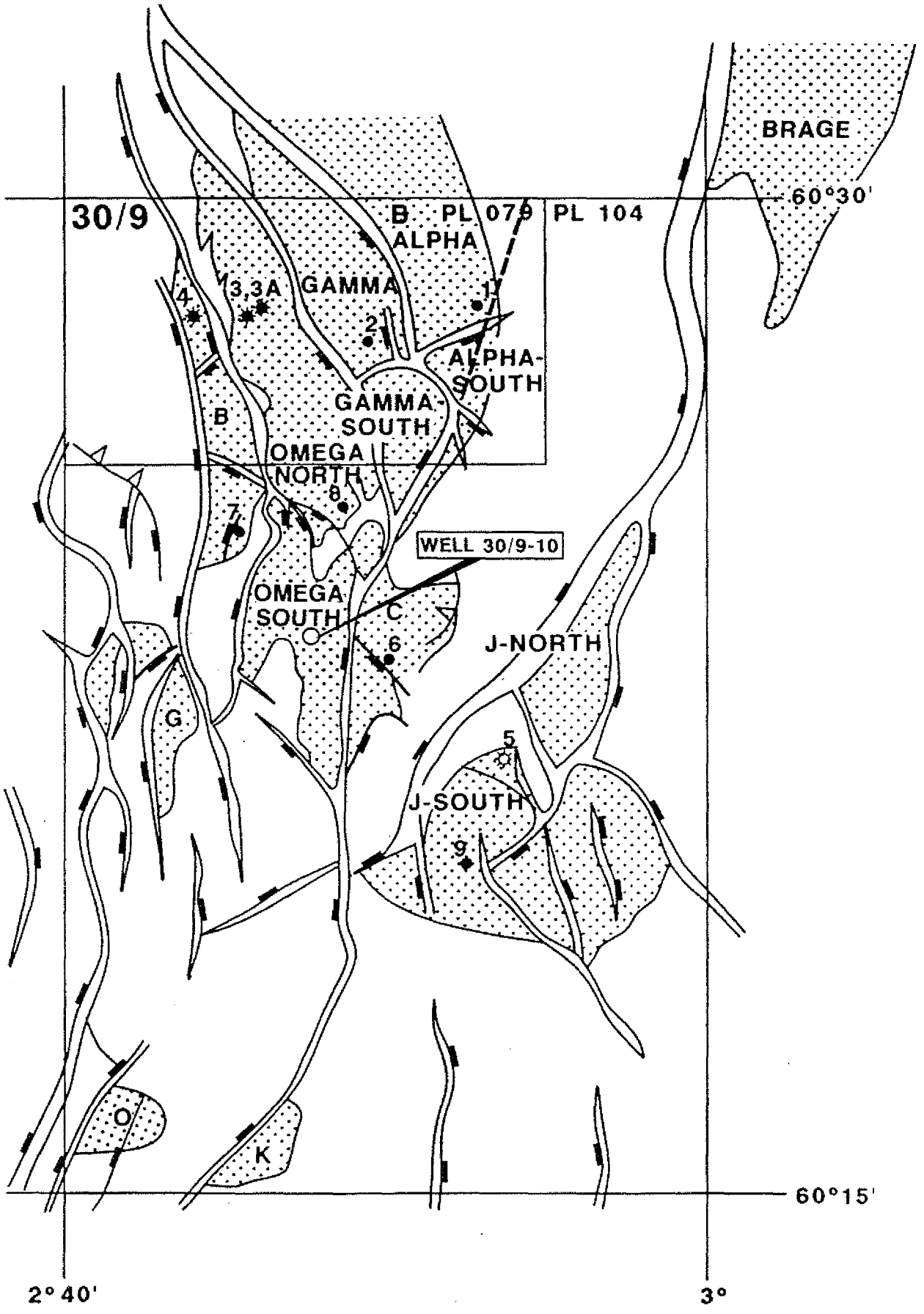
The analysed RFT samples from 30/9-10 are somewhat different based on the distribution of biomarkers.

The oils from 30/9-10 have a higher content of C_{29} steranes that the other investigated oils. This might imply that these oils have a contribution from another more terrestrially influenced source rock like the Heather Fm. or a poorer developed Draupne Fm. The analysed oils appear to be sourced from a mature, predominantly marine source rock.

The 30/9-10 oils have a lower content of saturated hydrocarbons and consequently a higher content of non-hydrocarbons than the oil from 30/9-8. The molecular parameters from GC of the saturated fractions are very similar in the samples from 30/9-10 and 30/9-8. The sterane distribution in the samples from 30/9-10 is different from 30/9-8, suggesting a change in original organic input.

Several of the oils are shown to be a composite of an early, heavily biodegraded oil, and a later migrating unaltered oil.

FIGURE 1: Well location map.



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TNI001/KeK-OH/NA/10.89

Location Map, Well 30/9-10

HYDRO

APPENDIX 1

DISTRIBUTION OF C_1-C_9 HYDROCARBONS IN 30/9-10 TESTS

Injection Report

Acquired on 28-OCT-1990 at 19:15

NORSK HYDRO RESEARCH CENTRE

Analyst Name : NILS
Lims Id :
Comment : OILS WELL:30/9-10
Method Title : C1-C9 HYDROCARBONS
Sample Name : 30/9-10 RFT AD 1225
Sample Id :
Sample Type : Sample Amount=1.00000
Bottle No : 1

PEAK INFORMATION

Peak	RT mins	RT Corr	RT Val	Hght uV	Area uVs	Wt%	Peak name	Width	Type
1	4.173	4.205	559.659	1033	1399	0.008	ETHANE	1.6A	QF
2	4.184	4.215	559.744	774	1710	0.010		5.4A	QL
3	4.379	4.412	561.311	12646	22317	0.133	PROPANE	1.6A	QF
4	4.416	4.449	561.611	8525	18054	0.108		2.2A	QL
5	4.696	4.731	563.865	8183	14866	0.089	ISO-BUTANE	1.9A	QF
6	4.733	4.769	564.165	6286	14089	0.084		2.6A	QL
7	4.965	5.003	566.032	24667	46004	0.275	N-BUTANE	1.6A	QF
8	5.003	5.040	566.333	18429	43011	0.257		2.6A	PQL
9	5.147	5.185	567.492	41	55	3.267E-4	NEO-PENTANE	1.8	R
10	5.955	5.999	573.994	17892	39391	0.235	ISO-PENTANE	2.2A	QF
11	5.992	6.037	574.295	15346	38059	0.227		2.6A	QL
12	6.485	6.534	578.265	24666	43191	0.258	N-PENTANE	2.2A	QF
13	6.496	6.545	578.351	22065	64795	0.387		5.8A	QL
14	7.501	7.554	586.441	625	3205	0.019	CYCLOPENTANE	5.1	
15	8.573	8.630	595.069	3158	6169	0.037		3.8A	QF
16	8.635	8.692	595.562	2519	5746	0.034		5.8A	O
17	8.795	8.852	596.850	12403	64673	0.386	2M-PENTANE	5.1	QL
18	9.485	9.545	602.408	7353	38917	0.232	3M-PENTANE	5.3	
19	10.429	10.503	610.005	22775	119423	0.713	HEXANE	5.3	
20	12.075	12.173	623.247	495	2749	0.016	2,2DM-PENTANE	5.8	QF
21	12.256	12.357	624.706	12011	68958	0.412	M-CYCLO PENTANE	5.6	PQL
22	12.544	12.649	627.024	1084	6055	0.036	2,4-DM PENTANE	5.6	R
23	12.989	13.101	630.608	107	598	0.004	2,2,3-TM BUTANE	5.8	
24	14.221	14.351	640.523	4504	27308	0.163	BENZENE	5.9	
25	14.776	14.913	644.986	281	1800	0.011	3,3-DM PENTANE	6.2	
26	15.139	15.281	647.905	15676	102043	0.609	CYCLO HEXANE	6.4	
27	16.107	16.253	655.695	6735	41205	0.246	2M-HEXANE	6.1	QF
28	16.267	16.414	656.983	2390	15178	0.091	2,3-DM PENTANE	6.6	O
29	16.549	16.698	659.258	1542	9916	0.059	1,1 DM CY-PENTANE	6.2	QL
30	17.051	17.201	663.292	7344	46627	0.278	3-M HEXANE	6.2	
31	17.723	17.876	668.701	2736	17483	0.104	C1,3DM-CYPEN	6.1	QF
32	18.037	18.192	671.233	2509	16290	0.097	T1,3-DM CYCLOPENTANE	6.1	O
33	18.352	18.508	673.765	4496	30738	0.184	T1,2-DM CYCLOPENTANE	6.7	O
34	18.573	18.731	675.547	24048	155760		ISO-OCTANE	6.2	QL
35	19.931	20.094	686.470	21565	128396	0.767	N-HEPTANE	5.9	

Peak	RT mins	RT Corr	RT Val	Hght uV	Area uVs	Wt%	Peak name	Width	Type
36	22.283	22.449	705.398	29691	195708	1.169	M-CYCLO HEXANE	6.2	P
37	22.675	22.841	708.553	1769	10647	0.064	2,2-DM HEXANE	5.9	R
38	23.755	23.922	717.245	2410	14847	0.089	ETHYL CYCLOPENTANE	5.9	CF
39	24.000	24.168	719.219	954	6123	0.037	2,5-DM HEXANE	6.1	O
40	24.235	24.403	721.108	1357	8244	0.049	2,4-DM HEXANE	5.9	CL
41	24.915	25.084	726.580	1692	10615	0.063	1T,2C,4-TM CYCLOPENTANE	6.1	CF
42	25.109	25.279	728.147	363	2286	0.014	3,3-DM HEXANE	6.1	CL
43	25.872	26.042	734.285	1855	11708	0.070	1,T2,C3-TM CYCLOPENTANE	6.1	
44	26.256	26.427	737.375	397	2527	0.015	2,3,4-TM PENTANE	6.1	
45	26.715	26.886	741.066	12537	79617	0.475		6.1	
46	27.768	27.940	749.543	1779	11175	0.067	2,3-DM HEXANE	6.1	CF
47	27.917	28.090	750.745	458	2696	0.016	2M,3ET PENTANE	6.4A	CL
48	28.640	28.813	756.561	7795	46113	0.275	2-M HEPTANE	5.6	CF
49	28.824	28.998	758.042	2391	13289	0.079		5.4	CL
50	29.667	29.841	764.823	5826	32732	0.195	3-M HEPTANE	7.0A	CF
51	29.749	29.924	765.489	6689	42762	0.255	C1,3DM-CYHEXANE	6.7A	O
52	29.995	30.170	767.463	2875	16867	0.101	T1,4-DM-CYCLOHEXANE	5.6	CL
53	30.715	30.891	773.258	1231	7693	0.046	1,1-DM-CYHEXANE	6.1	
54	31.144	31.320	776.713	67	157	9.363E-4		4.8A	CF
55	31.256	31.433	777.614	922	5379	0.032	C1,2-M,ET PENTANE	5.9	CL
56	31.544	31.721	779.932	847	5162	0.031	1-ET,2-M CYPENTANE	5.8A	CF
57	31.715	31.892	781.305	2164	14625	0.087		6.4	O
58	31.984	32.161	783.473	316	2005	0.012	C-1,4-DM CYHEXANE	6.1	CL
59	32.360	32.538	786.499	3669	23310	0.139	T1,3DM-CYHEXANE	6.1	
60	33.357	33.536	794.525	21339	134085	0.801		5.9	
61	35.163	35.344	809.054	214	1293	0.008		5.9	
62	35.515	35.696	811.887	174	992	0.006	USPES. C-9	5.6	CF
63	35.715	35.897	813.497	274	1661	0.010	2,2-DM HEPTANE	5.8	CL
64	36.008	36.190	815.857	301	1730	0.010		5.6	
65	36.557	36.740	820.278	1397	12517	0.075	USPES. C-9	8.3	
66	37.248	37.432	825.837	8671	60586	0.362		6.7	CF
67	37.480	37.664	827.704	3165	19705	0.118	2,5-DM HEPTANE	5.9	FCL
68	37.707	37.891	829.528	117	633	0.004		5.6	R
69	37.979	38.163	831.717	3844	23273	0.139	3,3-DM HEPTANE	5.9	CF
70	38.347	38.532	834.678	1986	14115	0.084	3,5-DM HEPTANE	6.7	O
71	38.680	38.865	837.361	367	2244	0.013		6.1A	O
72	38.853	39.039	838.756	568	4304	0.026	1,2,4TM-CYHEX	7.4	O
73	39.061	39.247	840.430	306	1851	0.011		5.9	CL
74	39.643	39.829	845.108	3145	20320	0.121		6.2	CF
75	39.811	39.997	846.460	1110	8114	0.048	USPES.C-9	7.7A	O
76	40.037	40.224	848.285	1342	8361	0.050		5.9	CL
77	40.296	40.483	850.366	212	1308	0.008		5.9	
78	40.848	41.036	854.809	8370	53604	0.320		6.2	CF
79	40.981	41.170	855.882	2608	14812	0.088	P XYLENE	7.4A	O
80	41.123	41.311	857.019	2591	15654	0.093		6.2	O
81	41.376	41.565	859.058	240	1316	0.008		5.8A	O
82	41.483	41.671	859.916	351	960	0.006		6.7A	O
83	41.576	41.765	860.667	1013	5473	0.033	3,4-DM HEPTANE	6.1A	O
84	41.771	41.960	862.234	567	3482	0.021		5.9	O
85	41.936	42.125	863.565	130	716	0.004		6.1	CL
86	42.197	42.387	865.668	2904	16976	0.101	4-M OCTANE	5.9	CF
87	42.336	42.526	866.784	3836	22022	0.131	2M OCTANE	5.6	CL
88	42.581	42.771	868.758	52	60	3.566E-4		1.9A	CF
89	42.709	42.900	869.788	604	3365	0.020	3-ET HEPTANE	6.4A	CL

Peak	RT mins	RT Corr	RT Val	Hght uV	Area uVs	Wt%	Peak name	Width	Type
90	43.056	43.247	872.578	975	6674	0.040	USPES.C-9	7.4A	OF
91	43.227	43.418	873.952	3910	24771	0.148	3M OCTANE	6.1	O
92	43.536	43.727	876.441	141	1458	0.009		15.0A	O
93	43.675	43.866	877.557	154	437	0.003		6.7A	O
94	43.827	44.018	878.780	4682	30335	0.181	O-XYLENE	6.2	O
95	43.925	44.117	879.574	729	2382	0.014		7.7A	O
96	44.013	44.205	880.283	173	1054	0.006		20.5A	CL
97	44.683	44.875	885.669	1574	10237	0.061	USPES.C9	6.4A	OF
98	44.832	45.025	886.871	3037	19121	0.114	N-BUTYLCYPENE	6.1	CL
99	45.123	45.316	889.210	2188	13551	0.081	USPES. C-9	5.9	
100	45.477	45.671	892.065	254	1530	0.009	USP.C-9	5.8	
101	45.669	45.863	893.610	288	1648	0.010	PARAF. C-9	6.4	OF
102	45.733	45.927	894.125	134	279	0.002		5.4A	CL
103	46.387	46.581	899.383	415	2644	0.016	1,2,3TM-CYHEX	6.1	OF
104	46.723	46.918	902.067	207	1288	0.008		7.0A	O
105	46.901	47.097	903.525	20433	119815	0.715	N-NONANE	5.6	O
106	47.211	47.406	906.014	2020	14416	0.086		6.9	O
107	47.533	47.729	908.611	652	5230	0.031		7.8	O
108	47.760	47.956	910.435	81	433	0.003		5.4	CL
109	48.040	48.237	912.688	1149	6572	0.039		5.4	OF
110	48.445	48.642	915.950	2791	19100	0.114		6.1	O
111	48.683	48.880	917.860	1999	11449	0.068		5.4	O
112	48.859	49.056	919.277	417	2478	0.015		6.7A	O
113	49.096	49.294	921.187	1067	8292	0.050		7.0A	O
114	49.144	49.342	921.573	886	3952	0.024		9.3A	O
115	49.341	49.540	923.161	291	1671	0.010		8.3A	O
116	49.387	49.585	923.526	204	784	0.005		8.6A	CL
117	49.675	49.873	925.844	615	4352	0.026		7.2	OF
118	49.888	50.087	927.560	6155	36819	0.220		5.3	FCL
119	50.048	50.247	928.848	233	826	0.005		4.2	R
120	50.325	50.525	931.080	1734	8889	0.053		5.0	OF
121	50.491	50.690	932.411	519	3785	0.023		5.8A	O
122	50.824	51.024	935.093	4469	25225	0.151		5.3	O
123	50.891	51.091	935.630	1383	4444	0.027		7.4A	O
124	51.067	51.267	937.046	692	4222	0.025		5.4A	O
125	51.285	51.486	938.806	2465	16726	0.100		6.7	O
126	51.568	51.769	941.081	2316	11649	0.070		5.0	O
127	51.707	51.908	942.197	356	2010	0.012		7.0A	O
128	51.864	52.065	943.463	389	2748	0.016		7.4A	O
129	52.067	52.268	945.094	3374	18420	0.110		5.0	O
130	52.256	52.458	946.617	2062	11836	0.071		5.6	CL
131	52.704	52.906	950.223	2069	10892	0.065		5.3	OF
132	52.851	53.053	951.403	3176	17741	0.106		5.3	O
133	53.104	53.307	953.442	493	1984	0.012		8.6A	O
134	53.304	53.507	955.051	382	1018	0.006		4.8A	O
135	53.389	53.592	955.738	1511	6064	0.036		4.5A	O
136	53.555	53.758	957.069	3546	15666	0.094		4.3	O
137	53.749	53.953	958.635	2768	5492	0.033		3.2A	O
138	53.800	54.003	959.043	4528	21404	0.128		4.5A	FO
139	54.048	54.252	961.039	429	1147	0.007		4.8A	O
140	54.107	54.311	961.511	698	3109	0.019		5.4A	O
141	54.243	54.447	962.606	344	1509	0.009		5.0	O
142	54.403	54.607	963.893	3513	18427	0.110		5.0	CL
143	54.651	54.855	965.889	675	3397	0.020		4.6	

Injection Report

Acquired on 29-OCT-1990 at 11:31

NORSK HYDRO RESEARCH CENTRE

Analyst Name : NILS
Lims Id :
Comment : OILS WELL:30/9-10
Method Title : C1-C9 HYDROCARBONS
Sample Name : 30/9-10 RFT AD 1236
Sample Id :
Sample Type : Sample Amount=1.00000
Bottle No : 2

PEAK INFORMATION

Peak	RT mins	RT Corr	RT Val	Hght uV	Area uVs	WT%	Peak name	Width	Type
1	4.189	4.210	534.224	577	1284	0.010	ETHANE	2.4	
2	4.395	4.417	536.389	6642	15710	0.128	PROPANE	2.4	
3	4.712	4.736	539.736	4748	12152	0.099	ISO-BUTANE	2.6	
4	4.981	5.006	542.576	15717	40621	0.330	N-BUTANE	2.7	P
5	5.125	5.151	544.094	66	161	0.001	NEO-PENTANE	2.7	R
6	5.971	6.001	553.009	14127	41743	0.339	ISO-PENTANE	3.0	
7	6.501	6.534	558.605	20893	62624	0.509	N-PENTANE	3.0	
8	6.941	6.978	563.245	226	697	0.006		3.0	
9	7.512	7.554	569.263	556	1893	0.015	CYCLOPENTANE	3.4	
10	8.579	8.630	580.512	2784	7682	0.062	2,3DM-BUTANE	3.2A	CF
11	8.597	8.649	580.709	2462	7962	0.065		7.4A	O
12	8.797	8.851	582.818	11332	41640	0.339	2M-PENTANE	3.7	CL
13	9.485	9.545	590.073	6558	25567	0.208	3M-PENTANE	3.8	
14	10.427	10.503	600.000	19981	80580	0.655	HEXANE	4.0	
15	12.064	12.168	617.267	419	1947	0.016	2.2DM-PENTANE	4.5	CF
16	12.248	12.355	619.207	9979	47055	0.383	M-CYCLO PENTANE	4.6	FCL
17	12.533	12.645	622.216	926	4251	0.035	2,4-DM PENTANE	4.5	R
18	12.976	13.095	626.884	88	399	0.003	2,2,3-TM BUTANE	4.6	
19	14.216	14.356	639.961	3860	20166	0.164	BENZENE	5.0	
20	14.768	14.918	645.782	227	1207	0.010	3,3-DM PENTANE	5.3	
21	15.125	15.281	649.550	12945	72018	0.585	CYCLO HEXANE	5.3	
22	16.096	16.258	659.786	5415	29300	0.238	2M-HEXANE	5.3	CF
23	16.261	16.424	661.530	1919	10620	0.086	2,3-DM PENTANE	5.3	O
24	16.539	16.703	664.454	1229	7001	0.057	1,1 DM CY-PENTANE	5.4	CL
25	17.037	17.205	669.713	5952	33291	0.271	3-M HEXANE	5.4	
26	17.712	17.883	676.828	2202	12478	0.101	CI,3DM-CYPEN	5.4	CF
27	18.024	18.197	680.118	2008	11639	0.095	TI,3-DM CYCLOPENTANE	5.6	O
28	18.189	18.364	681.862	519	2753	0.022	3-ETYL PENTANE	6.4A	O
29	18.339	18.514	683.436	3639	21869	0.178	TI,2-DM CYCLOPENTANE	5.8	O
30	18.563	18.739	685.799	23546	136534		ISO-OCTANE	5.6	CL
31	19.909	20.094	700.000	16861	92947	0.756	N-HEPTANE	5.3	
32	22.264	22.443	724.831	22881	141385	1.149	M-CYCLO HEXANE	5.9	P
33	22.661	22.862	729.021	1375	7794	0.063	2,2-DM HEXANE	5.4	R
34	23.744	23.951	740.439	1856	10694	0.087	ETHYL CYCLOPENTANE	5.6	CF
35	23.987	24.195	742.998	740	4503	0.037	2,5-DM HEXANE	5.6	O

Peak	RT mins	RT Corr	RT Val	Hght uV	Area uVs	Wt%	Peak name	Width	Type
36	24.224	24.434	745.501	1053	6045	0.049	2,4-DM HEXANE	5.6	CL
37	24.901	25.115	752.643	1300	7729	0.063	1T,2C,4-TM CYCLOPENTANE	5.8	CF
38	25.101	25.317	754.753	272	1608	0.013	3,3-DM HEXANE	5.8	CL
39	25.861	26.081	762.767	1442	8608	0.070	1,T2,C3-TM CYCLOPENTANE	5.8	
40	26.245	26.467	766.817	305	1799	0.015	2,3,4-TM PENTANE	5.8	
41	26.704	26.929	771.654	9642	58518	0.476		5.8	
42	27.760	27.991	782.790	1359	8155	0.066	2,3-DM HEXANE	5.8	CF
43	27.909	28.141	784.364	343	1959	0.016	2M,3ET PENTANE	6.1A	CL
44	28.627	28.863	791.929	6022	34237	0.278	2-M HEPTANE	5.4	CF
45	28.813	29.051	793.898	1829	9831	0.080	4M-HEPTANE	5.3	CL
46	29.653	29.896	802.756	4261	22215	0.181	3-M HEPTANE	6.7A	CF
47	29.739	29.982	803.656	5046	33419	0.272	C1,3DM-CYHEXANE	6.4A	O
48	29.987	30.231	806.271	2137	12320	0.100	T1,4-DM-CYCLOHEXANE	5.6	CL
49	30.712	30.961	813.920	916	5648	0.046	1,1-DM-CYHEXANE	5.9	
50	31.248	31.500	819.573	675	3787	0.031	C1,2-M,ET PENTANE	5.4	
51	31.539	31.792	822.638	636	3769	0.031	1-ET,2-M CYPENTANE	5.4A	CF
52	31.707	31.961	824.409	1630	10678	0.087	T1,2-DM CYHEXANE	6.2	O
53	31.976	32.232	827.250	240	1436	0.012	C-1,4-DM CYHEXANE	5.9	CL
54	32.349	32.608	831.187	2808	17134	0.139	T1,3DM-CYHEXANE	5.9	
55	33.333	33.598	841.564	16637	99523	0.809		5.8	
56	35.160	35.435	860.827	159	924	0.008	2,4-DM HEPTANE	5.9	
57	35.515	35.792	864.567	131	713	0.006		5.4	CF
58	35.707	35.985	866.592	204	1175	0.010	2,2-DM HEPTANE	5.6	CL
59	36.005	36.286	869.741	223	1249	0.010	4,4-DM HEPTANE	5.6	
60	36.557	36.841	875.562	1037	8403	0.068		8.3	CF
61	36.645	36.929	876.490	330	794	0.006		6.1A	CL
62	37.240	37.528	882.762	6587	45010	0.366	USER'S C-9	6.6	CF
63	37.467	37.756	885.152	2410	14631	0.119	2,5-DM HEPTANE	5.9	FO
64	37.699	37.989	887.598	88	470	0.004		5.4	R
65	37.973	38.265	890.495	2883	17445	0.142		5.9	O
66	38.339	38.633	894.348	1526	10563	0.086		6.4	O
67	38.675	38.971	897.891	281	1669	0.014		6.1A	O
68	38.848	39.145	899.719	427	3196	0.026		7.2	O
69	39.056	39.354	901.912	237	1411	0.011		5.9	CL
70	39.643	39.945	908.099	2326	14850	0.121		6.1	CF
71	39.805	40.108	909.814	840	6118	0.050		8.0	O
72	40.035	40.339	912.233	1002	6242	0.051		5.9	CL
73	40.293	40.599	914.961	154	915	0.007	NAFTEN 9	5.6	
74	40.840	41.149	920.726	6415	40232	0.327		6.1	CF
75	40.979	41.289	922.188	1935	10896	0.089		6.7A	O
76	41.120	41.431	923.678	1983	11859	0.096		6.1	O
77	41.373	41.686	926.350	194	1135	0.009		6.4A	O
78	41.573	41.887	928.459	762	4198	0.034		6.1A	O
79	41.771	42.085	930.540	427	2587	0.021		5.9	O
80	41.933	42.249	932.255	94	515	0.004		5.8	CL
81	42.189	42.506	934.955	2241	12683	0.103		5.9	CF
82	42.331	42.649	936.445	2911	16557	0.135		5.6	CL
83	42.707	43.027	940.411	440	2815	0.023		6.1	
84	43.051	43.373	944.038	732	4794	0.039		6.7A	CF
85	43.221	43.545	945.838	3044	18181	0.148		5.6	CL
86	43.677	44.003	950.647	60	108	8.799E-4		3.2A	CF
87	43.821	44.148	952.165	3513	23259	0.189		5.9	RCL
88	44.683	45.015	961.249	1205	7860	0.064	N-BUTYLCYPENE	7.0A	CF
89	44.821	45.154	962.711	2313	14428	0.117		6.1	O

Peak	RT mins	RT Corr	RT Val	Hght uV	Area uVs	WT%	Peak name	Width	Type
90	45.120	45.455	965.861	1651	10234	0.083		5.9	CL
91	45.480	45.817	969.657	178	952	0.008		5.3	
92	45.672	46.010	971.682	222	1522	0.012		6.6	
93	46.387	46.729	979.218	297	1722	0.014		5.8	
94	46.725	47.069	982.790	118	353	0.003		5.8A	CF
95	46.891	47.236	984.533	15981	89569	0.728		5.4	CL
96	47.211	47.558	987.908	1524	10513	0.085		6.7	CF
97	47.525	47.874	991.226	481	3702	0.030		7.7	CL
98	48.037	48.389	996.625	838	4600	0.037		5.4	
99	48.443	48.797	1000.900	2035	12953	0.105		5.9	CF
100	48.683	49.038	1003.431	1455	8039	0.065		5.3	O
101	48.864	49.221	1005.343	280	1613	0.013		6.4A	O
102	49.099	49.457	1007.818	807	5714	0.046		6.7A	O
103	49.141	49.500	1008.268	649	2969	0.024		9.6A	O
104	49.336	49.696	1010.321	207	1077	0.009		6.4A	O
105	49.379	49.739	1010.771	154	622	0.005		10.6A	CL
106	49.675	50.036	1013.892	452	3175	0.026		7.2	CF
107	49.888	50.251	1016.142	4690	27425	0.223		5.1	FCL
108	50.040	50.404	1017.745	179	620	0.005		4.2	R
109	50.328	50.694	1020.782	1330	6659	0.054		4.8	CF
110	50.488	50.855	1022.469	388	2820	0.023		6.4A	O
111	50.824	51.193	1026.012	3364	18716	0.152		5.1	O
112	50.891	51.260	1026.715	1038	3255	0.026		7.4A	O
113	51.072	51.442	1028.628	500	2975	0.024		5.8A	O
114	51.285	51.657	1030.877	1827	12266	0.100		6.6	O
115	51.568	51.941	1033.858	1757	8599	0.070		4.6	O
116	51.709	52.083	1035.349	270	1480	0.012		6.1	O
117	51.859	52.233	1036.923	291	2037	0.017		6.7A	O
118	52.069	52.445	1039.145	2568	13774	0.112		5.0	O
119	52.259	52.636	1041.142	1503	8827	0.072		5.8	CL
120	52.704	53.084	1045.838	1563	8217	0.067		5.3	CF
121	52.851	53.231	1047.385	2438	13544	0.110		5.3	O
122	53.093	53.475	1049.944	430	2184	0.018		10.6A	O
123	53.312	53.695	1052.250	351	1176	0.010		6.1A	O
124	53.392	53.776	1053.093	1219	5187	0.042		4.5A	O
125	53.560	53.945	1054.865	2750	12722	0.103		4.3	O
126	53.797	54.184	1057.368	3646	22551	0.183		5.9	O
127	54.059	54.447	1060.124	470	1742	0.014		6.7A	O
128	54.112	54.500	1060.686	648	3236	0.026		6.1A	O
129	54.405	54.795	1063.780	2907	16875	0.137		5.3	O
130	54.659	55.050	1066.451	706	4178	0.034		5.1	CL
131	54.907	55.300	1069.066	130	590	0.005		4.6	

Totals

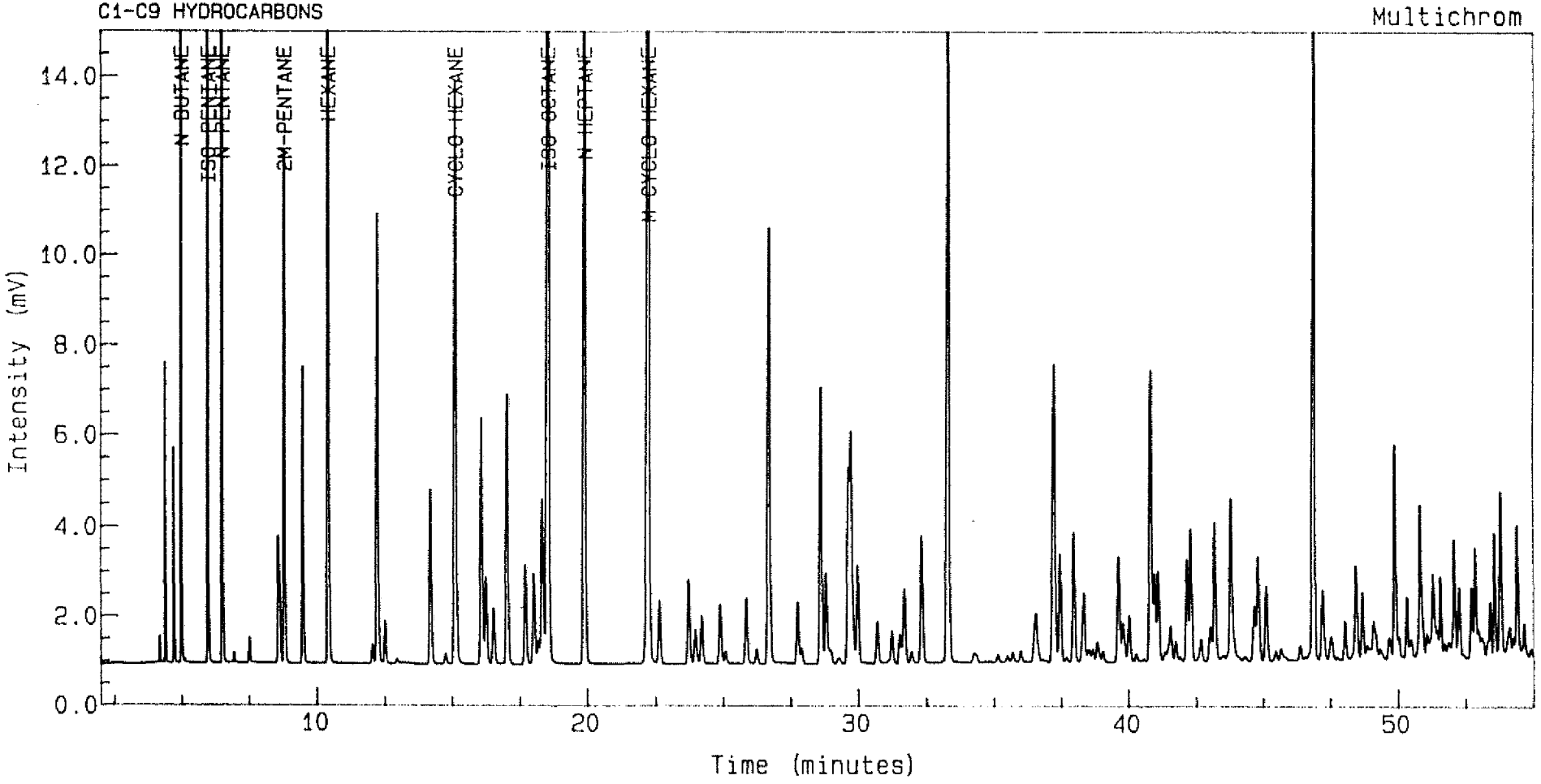
Unknowns	0	0	N/A
Quantified	397218	2027457	15.373
Grand Total	397218	2027457	15.373

NORSK HYDRO RESEARCH CENTRE

Analysis Name : [PETRO] 15 A3009100, 2, 1.

30/9-10 RFT AD 1236 Amount : 1.000

C1-C9 HYDROCARBONS



Instrument : HP5880
Channel Title : OIL GC
Lims ID :
Acquired on 29-OCT-1990 at 11:31
Reported on 29-OCT-1990 at 14:51

Method : PETRO
Calibration : PVT
Run Sequence : PETRO

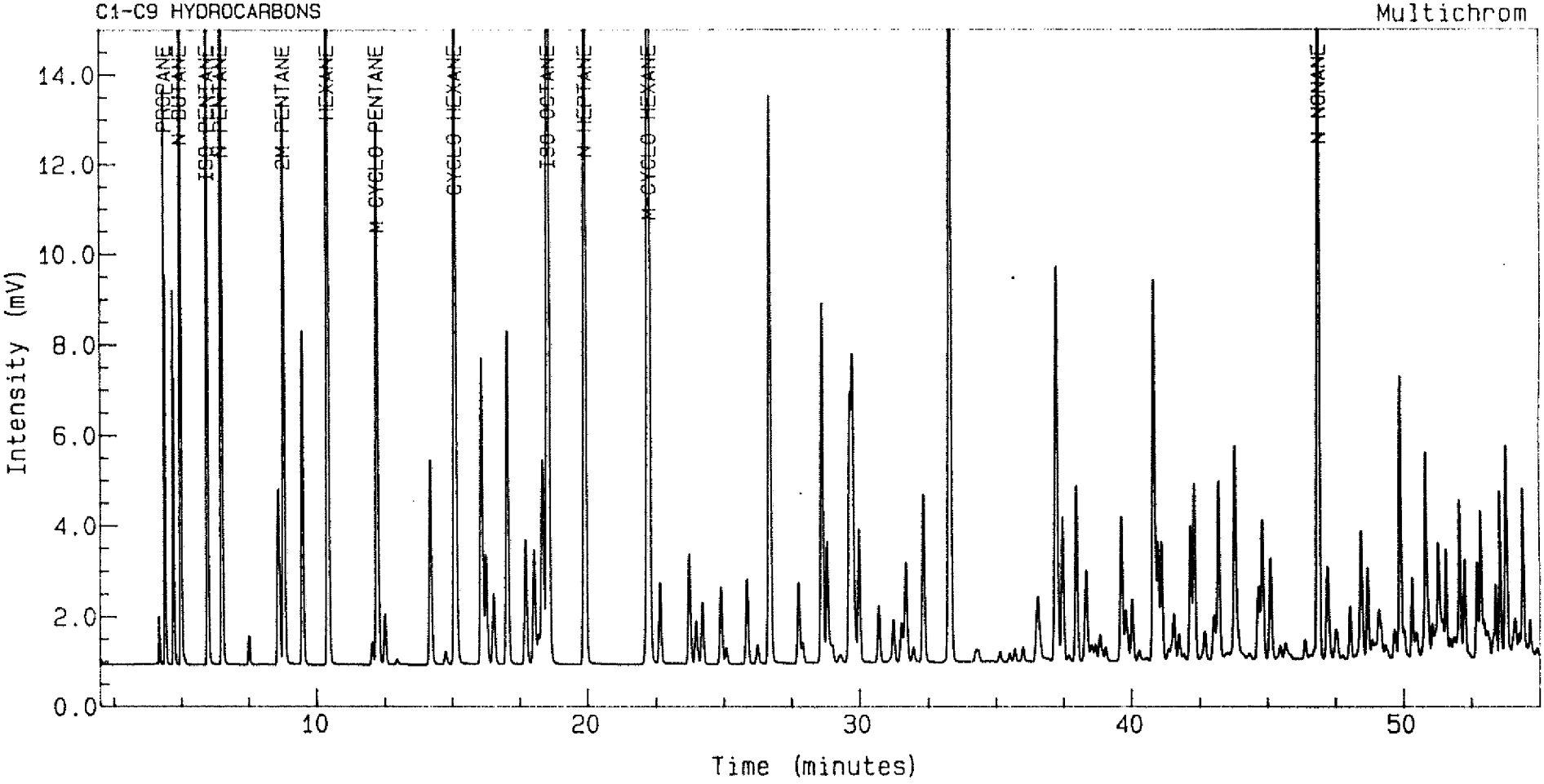
NORSK HYDRO RESEARCH CENTRE

Analysis Name : [PETRO] 15 A3009100, 1, 1.

30/9-10 RFT AD 1225 Amount : 1.000

C1-C9 HYDROCARBONS

Multichrom



Instrument : HP5880
Channel Title : OIL GC
Lims ID :
Acquired on 28-OCT-1990 at 19:15
Reported on 29-OCT-1990 at 14:50

Method : PETRO
Calibration : PVT
Run Sequence : PETRO

HYDRO

APPENDIX 2

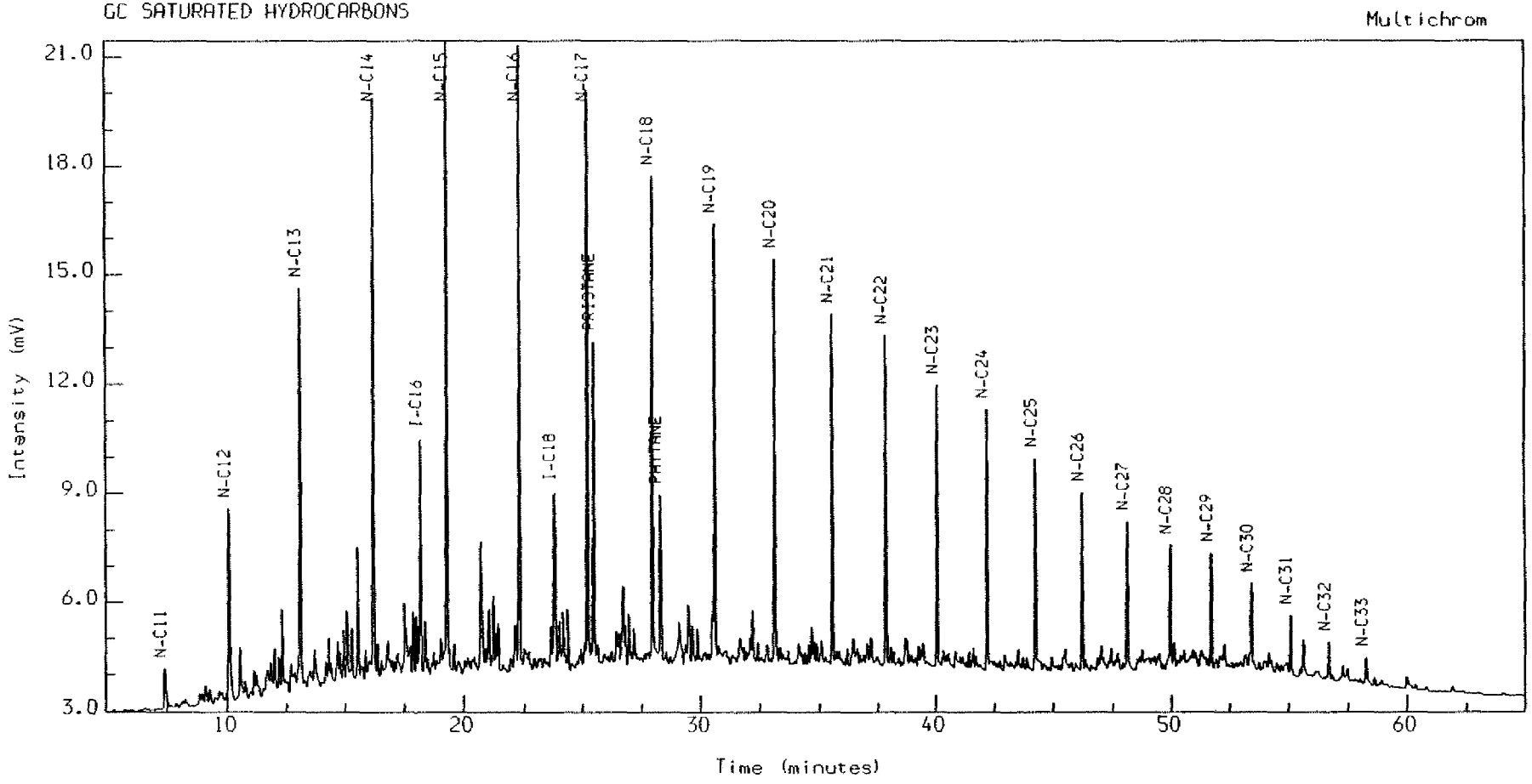
GAS CHROMATOGRAMS OF SATURATED HYDROCARBONS

NORSK HYDRO RESEARCH CENTRE

Analysis Name : [PETRO] 7 A30062305.5.1.

30/9-10 RFT 1225AD

GC SATURATED HYDROCARBONS



Instrument : HP5890

Channel Title : MSD

Lims ID :

Acquired on 5-SEP-1990 at 21:59

Reported on 5-SEP-1990 at 23:21

Method : MSDS

Calibration : MSDS

Run Sequence : MSDS

Reported on 5-SEP-1990 at 23:20

Injection Report

Acquired on 5-SEP-1990 at 21:59

NORSK HYDRO RESEARCH CENTRE

Analyst Name : NILS 104
Lims Id :
Comment : SATURATED FRACTIONS OSEBERG OILS
Method Title : GC-MSD SATURATED HYDROCARBONS 4 DEG/MIN.
Sample Name : 30/9-10 RFT 1225AD
Sample Id :
Sample Type : Sample Amount=0.00000
Bottle No : 5

PEAK INFORMATION

Peak	RT mins	RT Corr	Hght uV	Area uVs	Area %	Peak name	Width
1	7.413	7.720	1077	6128	0.53	N-C11	5.1
5	10.083	10.500	5276	25578	2.19	N-C12	4.0
18	13.091	13.633	10627	38088	3.26	N-C13	3.4
31	16.219	16.890	15707	50014	4.29	N-C14	3.2
43	18.213	18.891	6453	25499	2.19	I-C16	3.5
49	19.320	20.000	16944	54131	4.64	N-C15	3.2
63	22.331	23.020	16965	56006	4.80	N-C16	3.4
68	23.805	24.498	4704	27740	2.38	I-C18	5.8
74	25.221	25.917	15659	54002	4.63	N-C17	3.4
75	25.493	26.190	8610	37721	3.23	PRISTANE	4.5
86	27.984	28.686	13223	47120	4.04	N-C18	3.4
87	28.315	29.017	4450	21507	1.84	PHYTANE	4.8
96	30.624	31.332	11907	41900	3.59	N-C19	3.5
106	33.147	33.860	11070	37807	3.24	N-C20	3.4
118	35.557	36.279	9642	32504	2.79	N-C21	3.4
128	37.867	38.596	9060	31133	2.67	N-C22	3.4
138	40.083	40.820	7743	26953	2.31	N-C23	3.5
148	42.205	42.950	7115	23867	2.05	N-C24	3.4
154	44.253	45.005	5755	20374	1.75	N-C25	3.4
158	46.221	46.980	4890	16899	1.45	N-C26	3.4
166	48.125	48.891	4032	14606	1.25	N-C27	3.5
171	49.957	50.729	3227	11434	0.98	N-C28	3.7
177	51.728	52.506	3140	11198	0.96	N-C29	3.4
180	53.445	54.229	2059	6826	0.58	N-C30	3.4
183	55.099	55.888	1602	5941	0.51	N-C31	3.5
186	56.704	57.499	987	3418	0.29	N-C32	3.5
189	58.285	59.086	694	3332	0.29	N-C33	4.0
191	59.992	60.798	288	1448	0.12	N-C34	4.3

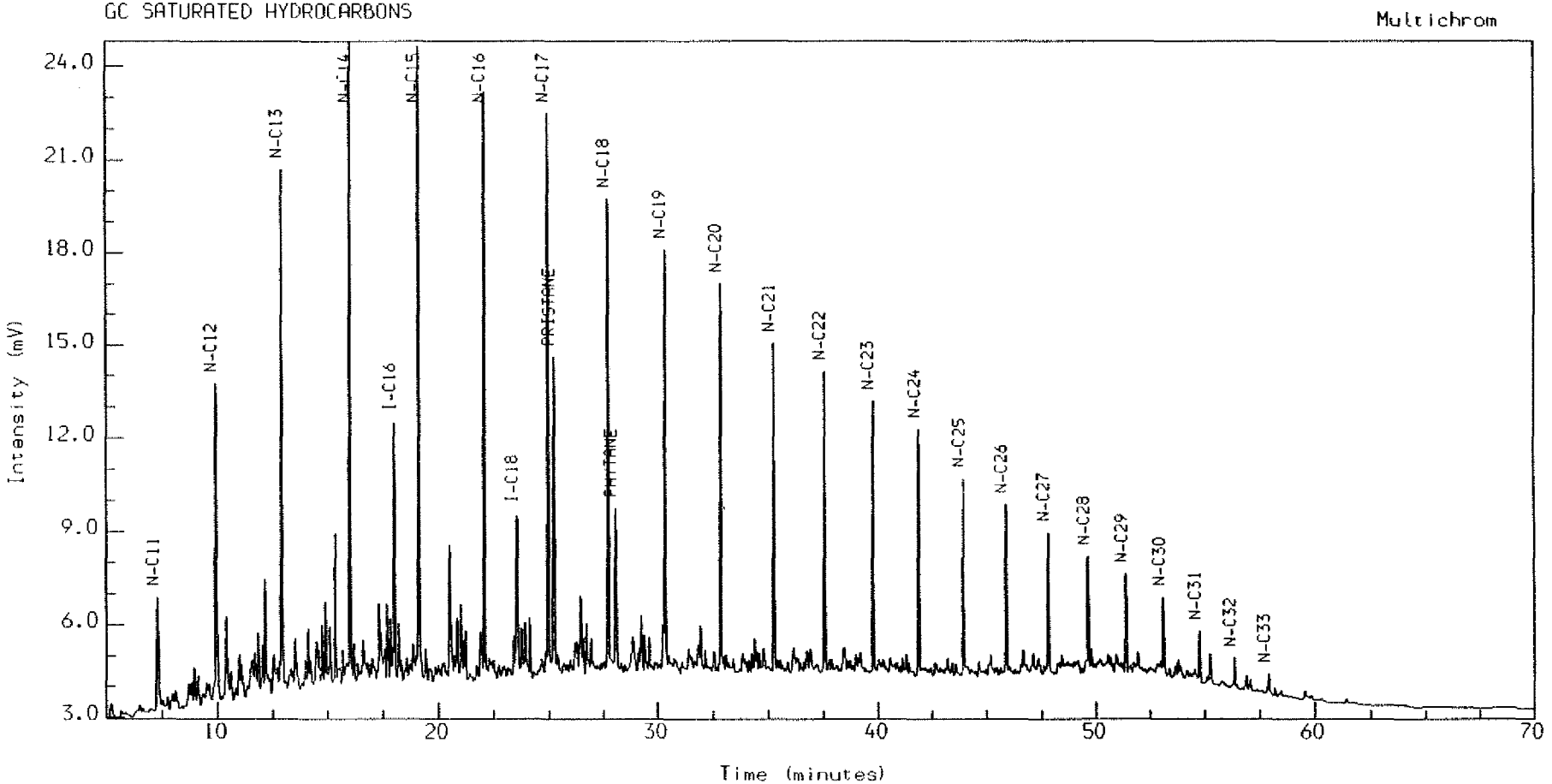
Totals			
Unknowns	103716	433806	37.17
Quantified	202908	733175	62.83
Grand Total	306623	1166981	100.00

NORSK HYDRO RESEARCH CENTRE

Analysis Name : [PETRO] 7 OIL300910.3.1.

30/9-10 RFT 1236 AD

GC SATURATED HYDROCARBONS



Instrument : HP5890

Channel Title : MSD

Lims ID :

Acquired on 30-AUG-1990 at 17:14

Reported on 28-OCT-1990 at 19:39

Method : MSDS

Calibration : MSDS

Run Sequence : MSDS

Injection Report

Acquired on 30-AUG-1990 at 17:14

NORSK HYDRO RESEARCH CENTRE

Analyst Name : NILS N101
Lims Id :
Comment : OLJER FRA GYDA OG OSEBERG
Method Title : GC-MSD SATURATED HYDROCARBONS 4 DEG/MIN.
Sample Name : 30/9-10 RFT 1236 AD
Sample Id :
Sample Type : Sample Amount=0.00000
Bottle No : 3

PEAK INFORMATION

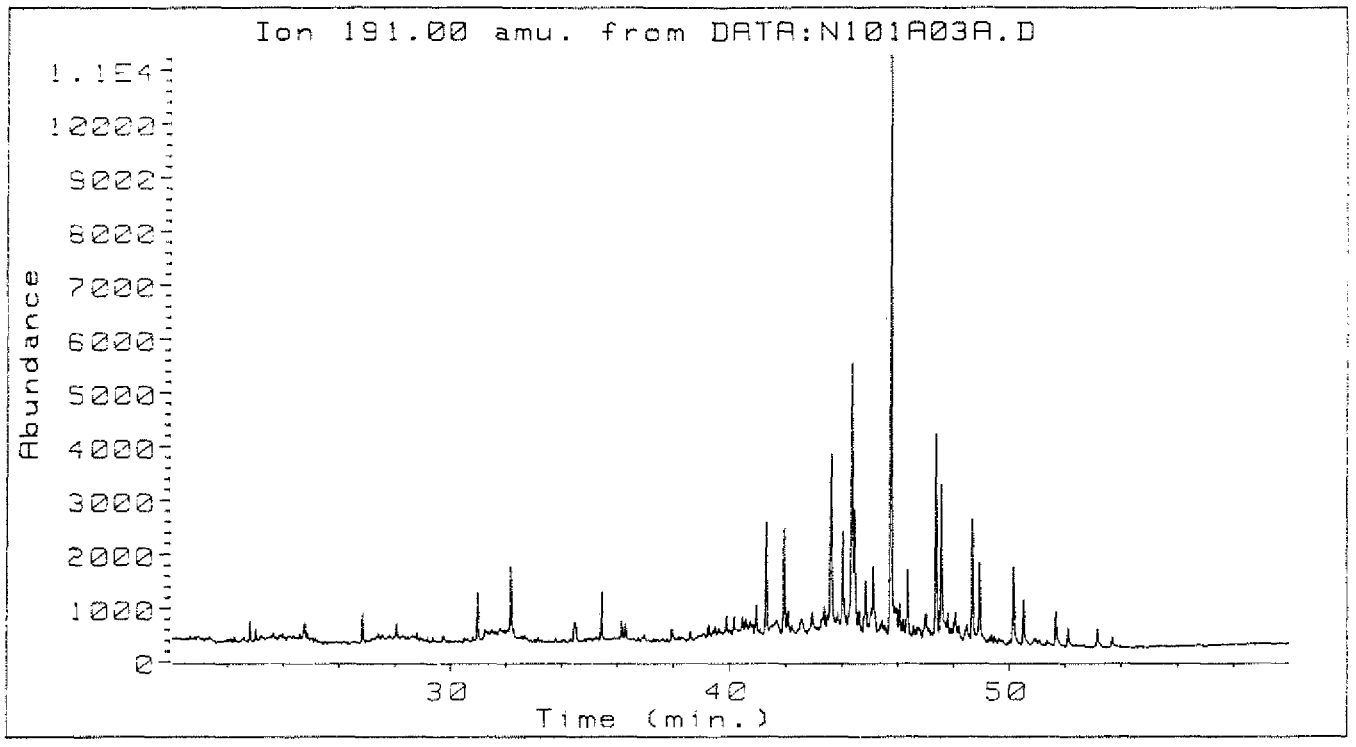
Peak	RT mins	RT Corr	Hght uV	Area uVs	Area %	Peak name	Width
1	5.189	5.469	480	3058	0.20	N-C10	5.9
2	7.275	7.667	3647	20165	1.34	N-C11	4.8
13	9.928	10.463	10217	48032	3.19	N-C12	4.0
30	12.920	13.616	16673	59906	3.98	N-C13	3.5
44	16.027	16.890	20299	64653	4.29	N-C14	3.2
58	18.005	18.887	8251	28655	1.90	I-C16	3.4
65	19.107	19.998	20379	72511	4.81	N-C15	3.5
82	22.101	23.020	18757	65815	4.37	N-C16	3.4
91	23.555	24.485	5181	34172	2.27	I-C18	6.1
97	24.973	25.914	18052	63204	4.20	N-C17	3.4
98	25.245	26.188	10125	46790	3.11	PRISTANE	4.5
110	27.720	28.682	15194	55801	3.70	N-C18	3.5
111	28.053	29.018	5240	26593	1.77	PHYTANE	4.6
120	30.347	31.329	13431	46387	3.08	N-C19	3.4
129	32.859	33.860	12498	42041	2.79	N-C20	3.2
142	35.256	36.274	10573	35665	2.37	N-C21	3.4
151	37.557	38.590	9645	33935	2.25	N-C22	3.4
162	39.768	40.816	8726	29045	1.93	N-C23	3.4
172	41.888	42.950	7834	25883	1.72	N-C24	3.4
177	43.928	45.004	6250	22288	1.48	N-C25	3.4
183	45.891	46.980	5393	18143	1.20	N-C26	3.4
189	47.787	48.889	4578	17526	1.16	N-C27	3.4
195	49.616	50.730	3480	11158	0.74	N-C28	3.2
202	51.376	52.502	3177	11855	0.79	N-C29	3.5
206	53.085	54.223	2451	9107	0.60	N-C30	3.4
211	54.741	55.890	1584	5359	0.36	N-C31	3.2
214	56.339	57.499	896	2850	0.19	N-C32	3.2
217	57.901	59.072	599	2630	0.17	N-C33	3.8
219	59.555	60.736	226	981	0.07	N-C34	3.8

Totals			
Unknowns	143239	602402	39.98
Quantified	243838	904210	60.02
Grand Total	387077	1506612	100.00

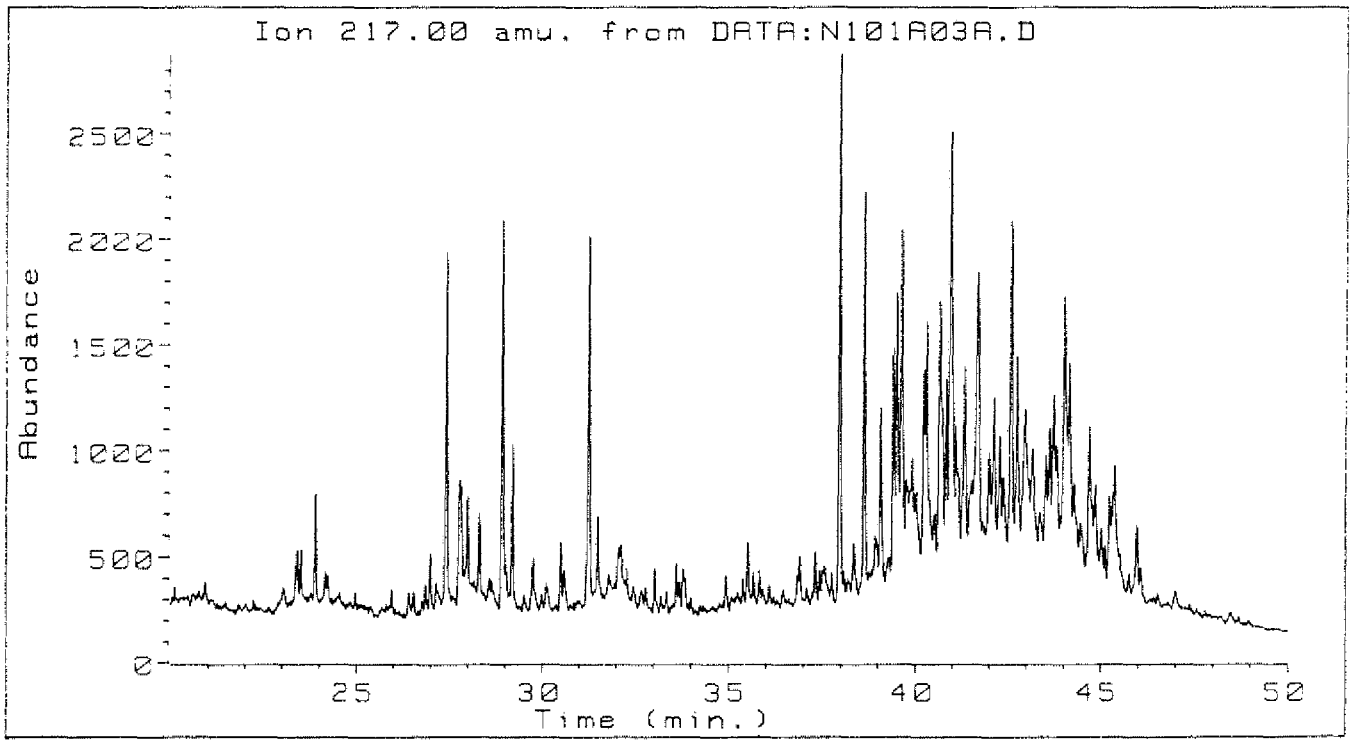
HYDRO

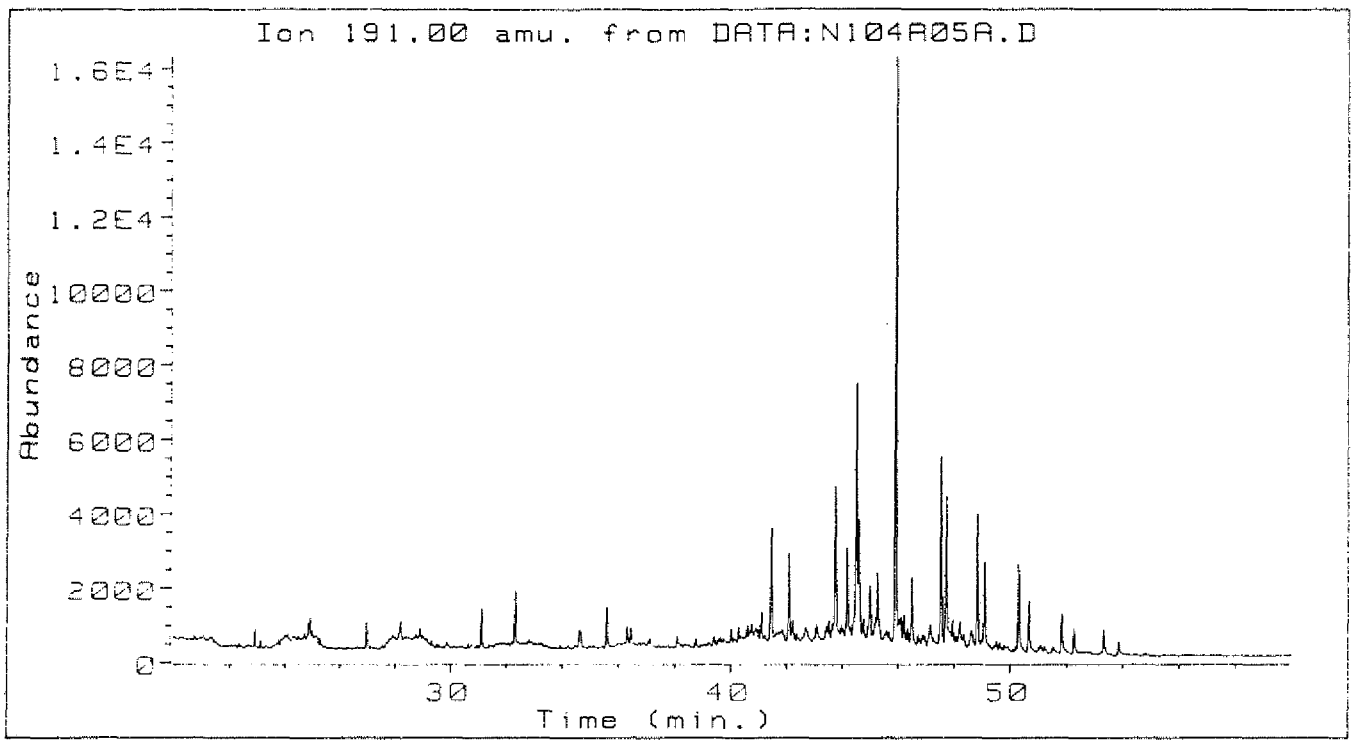
APPENDIX 3

DISTRIBUTION OF BIOLOGICAL MARKERS SATURATED HYDROCARBONS, MSD

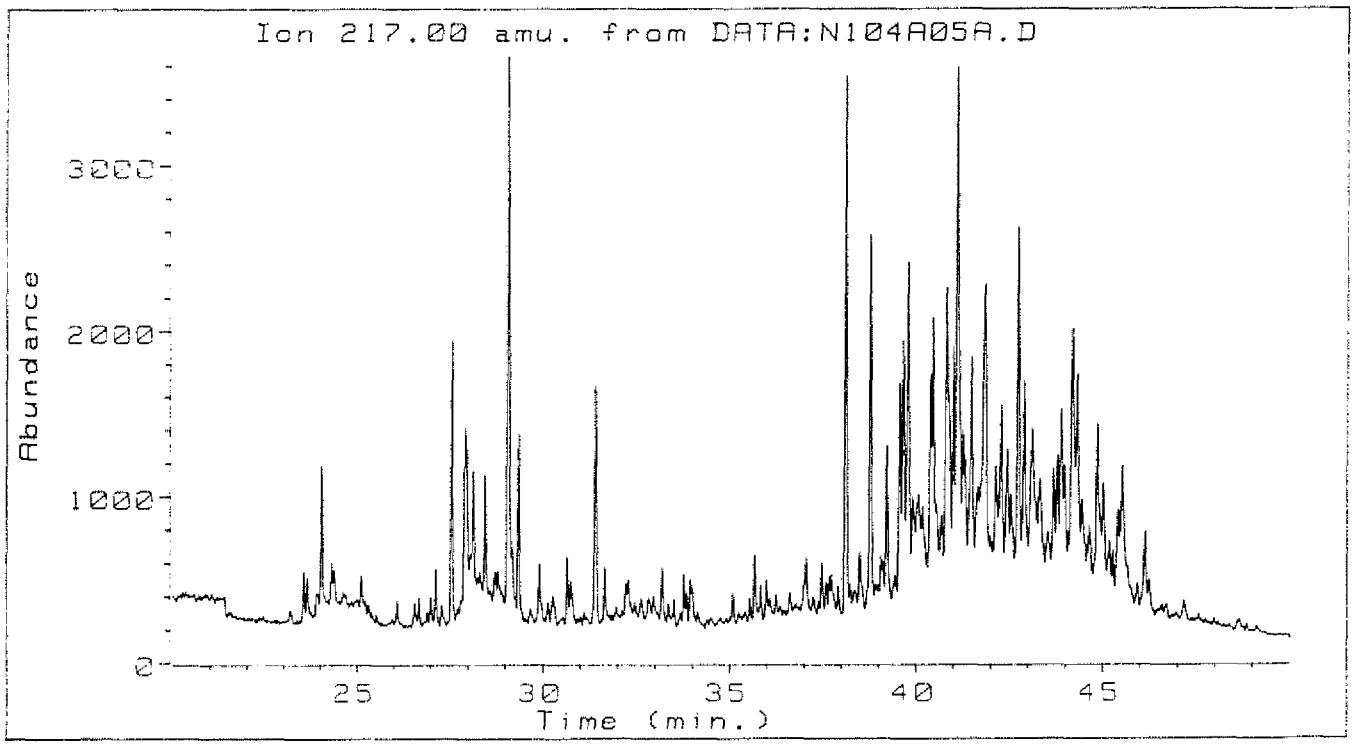


WELL: 30/9-10 RFT 1225 AD





WELL: 30/9-10 RFT 1236 AD



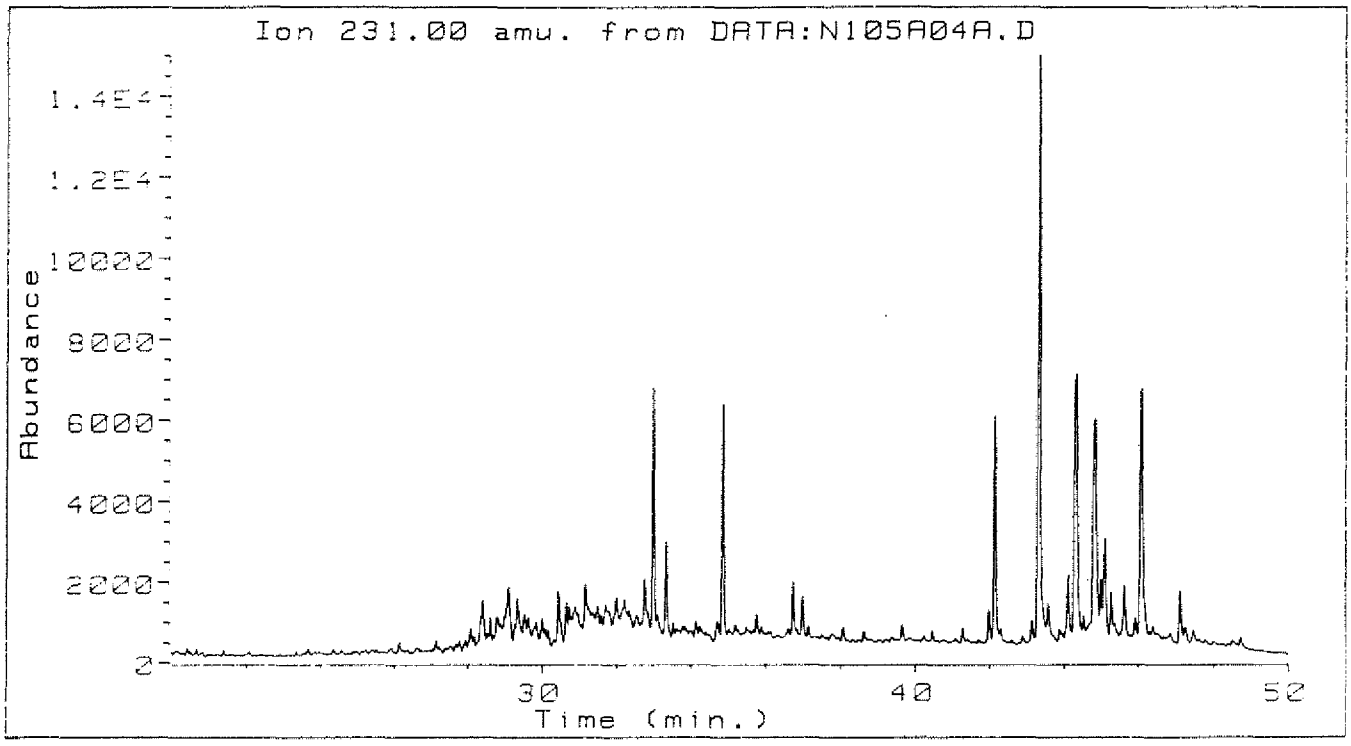
HYDRO

APPENDIX 4

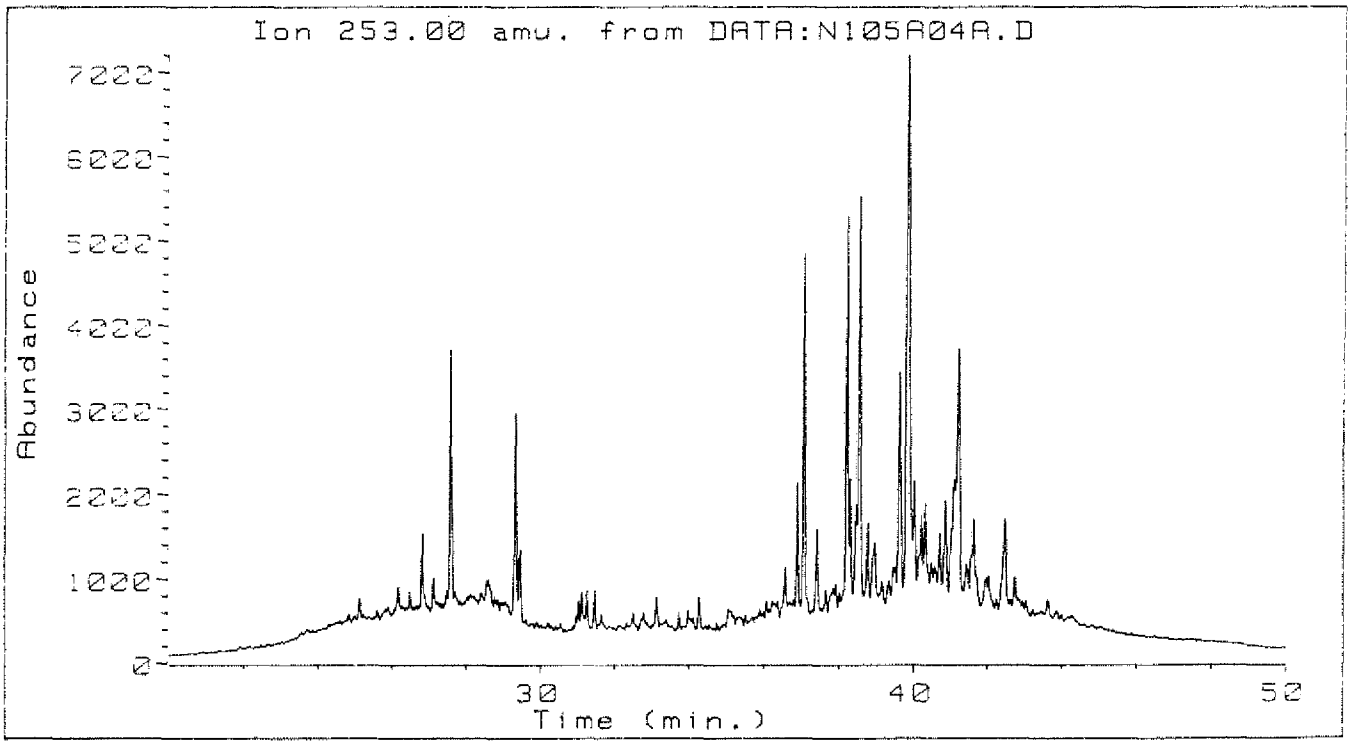
DISTRIBUTION OF AROMATIC STEROIDS

M/Z 231 Triaromatic steroids

M/Z 253 Monoaromatic steroids



WELL: 30/9-10 RFT 1236 AD



APPENDIX 5

RESULTS FROM METASTABLE ION MONITORING GC-MS OF SATURATED HYDROCARBONS

IDENTIFICATION OF BIOLOGICAL MARKERS

Triterpanes (m/z 191):

Numbers from **18** to **35** corresponds to the carbon number of the molecule. the following 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 $\Delta^{13,18}$-hopenes (**VI**)
I 25-norhopanes (**VII**)
L Lupane (**VIII**)
O 18α(H)-oleanane (**IX**)
X Tetracyclic terpanes (**X**)
Y Tricyclic terpanes (**XI**)

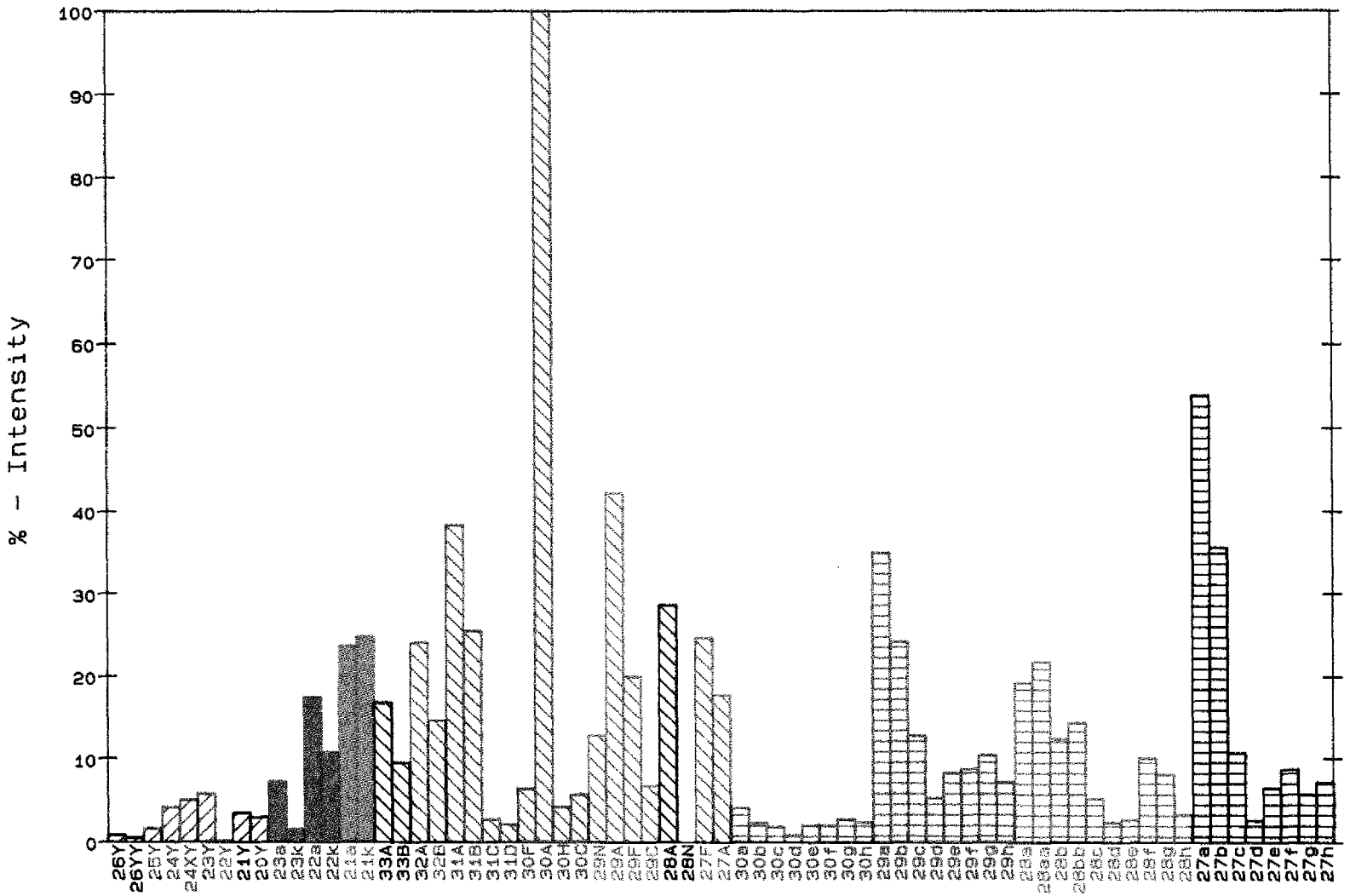
Steranes (m/z 217):

Numbers from **20** to **30** corresponds to the carbon number of the molecules. the following 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**)

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

Biomarker pattern, SAT-fraction
Well: B30/9-10, 1236m, RFT, NNS
ms-file: AS07090, norm. factor: 1803



Biomarker pattern, SAT-fraction
Well: B30/9-10, 1225m, RFT, NNS
ms-file: AS07090, norm. factor: 2158