ZymaX FORENSICS

July 19, 2000

Mr. David Elias
Cambria Environmental Technology, Inc.
1144 65th Street, Suite C
Oakland, CA 94608

Project: 153-1247

Dear Mr. Elias,

Two aqueous samples were submitted to ZymaX forensics, Inc. on April 21, 2000. However, only sample, MW-16, was selected for chemical characterization. A small amount of black colored sheen was collected from the top layer of the water sample. The main objective of the investigations was to identify fuel type, especially the presence or absence of gasoline and/or heavy fuel hydrocarbons.

To achieve the above objective, the following analyses were performed on the sample submitted:

1. Simulated distillation of the product to determine the boiling point range distribution.

2. High resolution gas chromatography in the C_3-C_{44} hydrocarbon range using a gas chromatograph equipped with a 100m Petrocol fused silica capillary column and a flame ionization detector.

3. Gas chromatograph-mass spectrometer (GC/MS) analysis of the sheen sample in a full-scan mode with identification of the following fuel-specific homologous series: n-alkanes (m/z 85), isoprenoids (m/z 113), alkylcyclohexanes (m/z 83), C_4-alkylbenzenes (m/z 134), bicyclanes (m/z 123), terpanes (m/z 191), steranes (m/z 217), triaromatic steranes (m/z 231), pyrogenic compounds (m/z 252) and polynuclear aromatic hydrocarbons.

A brief discussion of the analytical results obtained and the conclusions reached are presented below. The Chain-of-Custody record is in the Appendix.

The initial boiling range for sample MW-16 beginning around 180°F, displays characteristics of a partially evaporated gasoline (Figure 1). However, the majority of the sample (90%) boils below 450°F and then rapidly rises to 900°F final boiling point. The inflection of the curve at around 370°F (40% recovery) suggests the presence of another fuel type.

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email: forensics@ZymaXusa.com

The C_3-C_{44} whole oil hydrocarbon range gas chromatogram depicted in Figure 2, and Tables 1 and 2 show a pattern corresponding to a degraded low octane gasoline, based in part on the presence of olefins and isooctane, with a relatively high peak strength for n-C_{10} (peak #76), and even higher for n-C_{11} to n-C_{18}. This suggests that the product is a mixture of gasoline with a possible mid-distillated fuel. Furthermore, the presence of pristane and phytane suggests that the sheen sample may also contain diesel No. 2 fuel or possibly another heavy fuel.

The distribution patterns of hydrocarbon families identified by GC-MS (Figures 3-7, 9, 12-17) indicate that the product is a mixture of gasoline with other fuels. The presence of 2,5-dimethylhexane (I-8), 2,3,4-trimethylpentane (I-8'), and 2,3-dimethylhexane (I-8") in mass chromatogram of m/z 85 (Figure 4) confirm that gasoline is present in the sheen sample analyzed. Further, the alkane distribution of n-C_8 to n-C_{26}, optimizing at n-C_{12}, is attributed to the contribution of a kerosene type fuel with possibly a small concentration of No. 6 fuel oil (Bunker C oil; Figures 3 and 4). The distribution patterns of isoprenoids (m/z 113, Figure 5, Table 3) and alkylcyclohexanes (m/z 83, Figure 6) also support the above conclusion that the sheen sample is a mixture of gasoline, kerosene (or Jet fuel) with a small amount of No. 6 fuel oil. The presence of methylcyclohexane (CH-1) and the relatively high concentration of CH-2 to CH-3 at m/z 83 for sample MW-16 is further indication for the presence of gasoline.

The C_4-alkylbenzenes (m/z 134, Figure 7, Table 4) distribution pattern showing peak 32 lower than peak 31 or 31a is characteristic of gasoline, more so than kerosene or No. 6 fuel oil. This may be attributed to the relatively higher concentration of gasoline than kerosene (Jet fuel) or No. 6 fuel oil. Furthermore, the ratio of 31/31a (Figure 8) provides a parameter for biodegradation. Peak 31 is more vulnerable to biodegradation than 31a. The ratio generally falls between 1.5-2.0 in newly dispensed gasoline. The measured value for the sheen sample is 0.61, indicating that moderate degradation has occurred in the sample analyzed.

The distribution pattern of bicyclanes (m/z 123, Figure 9, Table 5) indicates the presence of Jet fuel (probably Jet A). This pattern can be differentiated from that of either gasoline or diesel, and usually from kerosene.

Evidence for a moderate biodegradation is the relative low n-C_{17}/Pr, it is 0.66 for the sheen sample MW-16 (Figure 10). In Jet A, this ratio generally falls between 3.5-4.0 indicating that significant biodegradation has occurred, probably extending to environmental exposure in excess of 15 years.

A significant concentrations of polycyclic aliphatic biomarkers such as terpanes and steranes (Figure 11, Table 6) were detected in the sheen sample. The C_{29} and C_{30} hopanes are the most prominent peaks in the distribution pattern (m/z 191, Figure 12, Table 7), with C_{21} to C_{30} tricyclic terpanes and C_{31} to C_{35} homohopanes present in subordinate concentration. It is interesting to note that the presence of C_{28} bisnorhopane

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suggests that the original feedstock of heavy refined product (possibly Bunker C oil) probably originated from a California Monterey derived crude oil. The distribution patterns of steranes in Figure 13 (Table 8; relatively low in regular steranes, peaks 1 to 6) , mono-aromatic steranes (MAS) and tri-aromatic steranes (TAS) are also suggestive of a possible California crude as initial feedstock.

The presence of pyrogenic compounds (Figure 14, Table 9) such as benzo(A)pyrene, benzo(E)pyrene, benzo(J)fluorene confirms that the high boiling component is probably a residual fuel, possibly No. 6 fuel oil (Bunker C oil). Furthermore, the aromatic hydrocarbon distribution is dominated by alkylbenzenes and naphthalenes with other PAH such as MAS (Figure 15, Table 10) and TAS (Figure 16, Table 11) present in subordinate concentration. This distribution pattern (Figure 17, Table 12) also supports the conclusion reached above, that the sheen sample contains a mixture of gasoline with smaller components kerosene (Jet fuel) and No. 6 fuel oil (Bunker C oil).

In summary, the analytical results demonstrate that (1) the sheen sample MW-16 is a mixture of 40% gasoline, 50% jet fuel and about 10% of a residual fuel, probably No. 6 fuel oil (Bunker C oil). (2) Both gasoline and jet fuel appear to be moderately weathered. The gasoline fraction in sample MW-16 is more severely weathered than sample FDP-S4-L analyzed in December 9,1998 by Global Geochemistry Corporation, whereas the jet fuel sample is only slightly more weathered. (3) The Bunker C oil, however, appears to have been severely weathered. (TBW-5)

If you have any questions or comments regarding this report, please do not hesitate to contact us if you have any questions or comments regarding this report.

Sincerely,

Isaac R. Kaplan

Isaac R. Kaplan, Ph.D.
Senior Consultant

19835 (Cambria)-report.wpd

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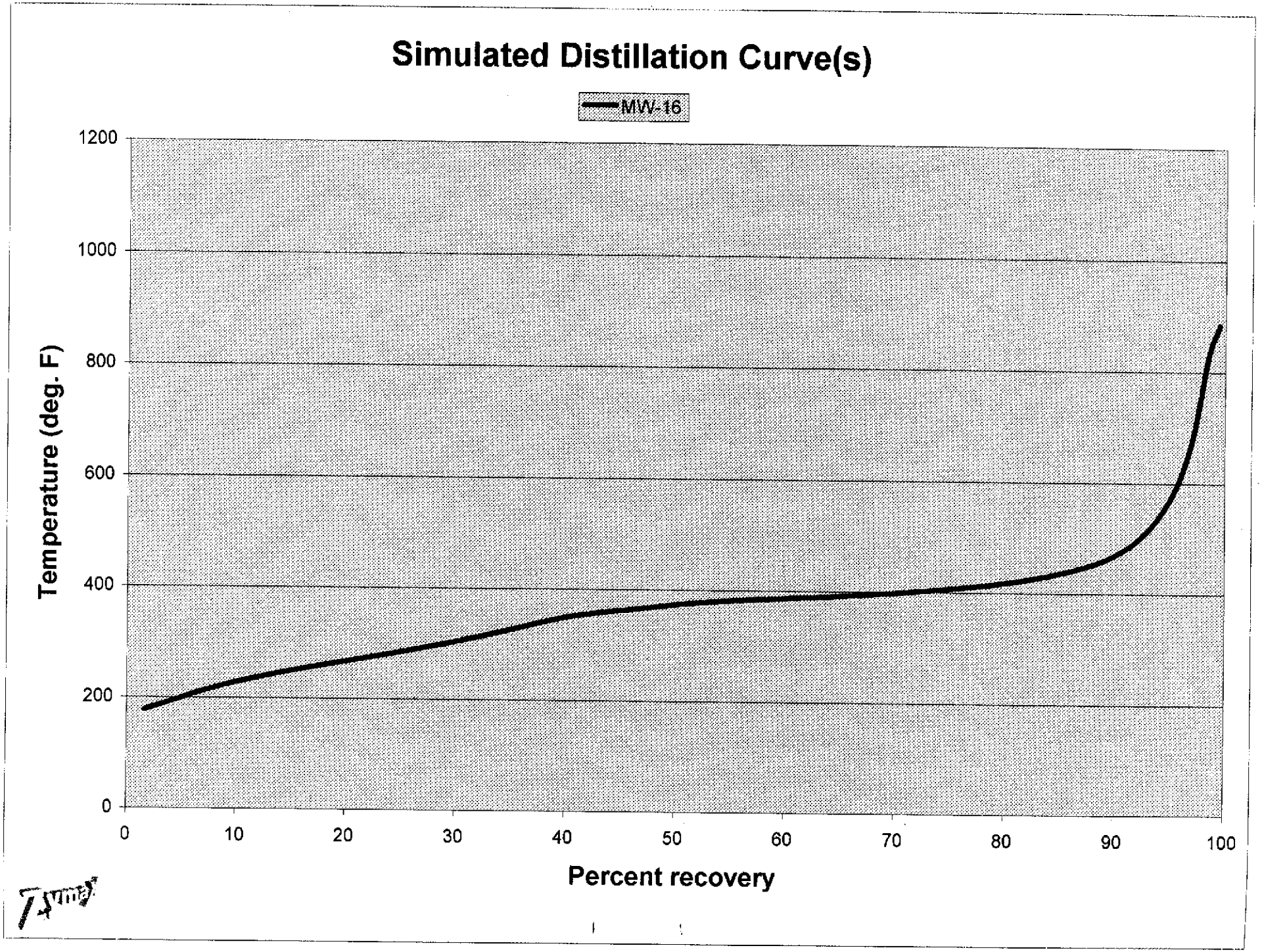
Figure 1


Simulated Distillation Curve(s)
MW-16
Temperature (deg. F)
1200
1000
800
600
400
200
0
0
10
20
30
40
50
60
70
80
90
100
Percent recovery

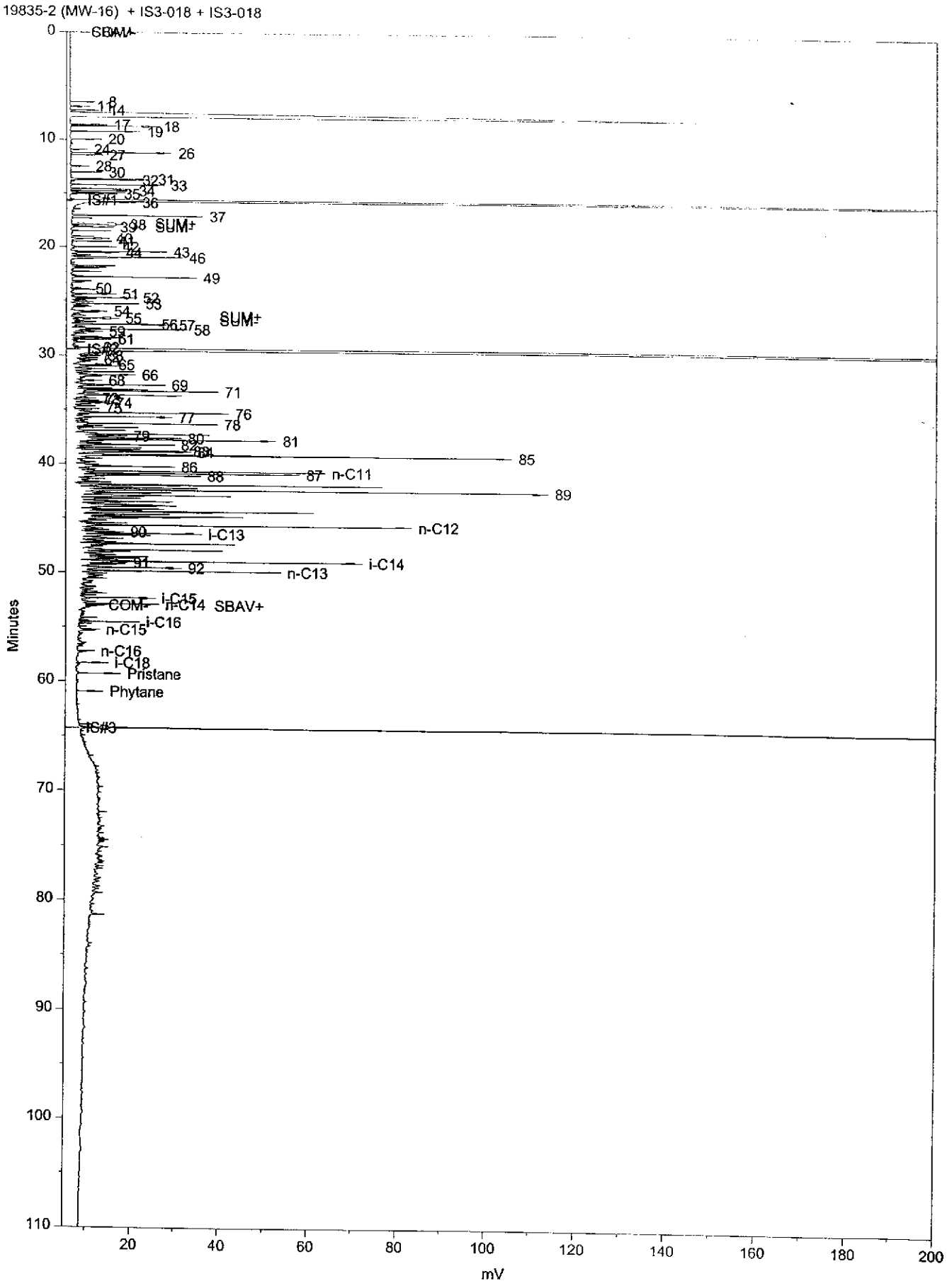

19835-2 (MW-16) + IS3-018 + IS3-018
SBAV+
SUM+
SUM+
IS#1
IS#3
n-C11
n-C12
i-C13
i-C14
n-C13
i-C15
COM-
n-C14
SBAV+
i-C16
n-C15
n-C16
i-C18
Pristane
Phytane
Minutes
mV

Figure 2

Figure 2 (continued)

C3 to C10 ANALYSIS by ZYMAX FORENSICS

TODAY'S DATE: 5/11/2000 TIME: 5:01:01 PM
RAW DATA FILE NAME: H:\DATA3\C310130.13R
SAMPLE NAME.....19835-2 (MW-16) + IS3-018 + IS3-018
DATE TAKEN: 05-9-2000 22:19:03
METHOD FILE: H:\DATA3\C310130M.MET
METHOD: C3-C44 Analysis
CALIBRATION FILE: H:\DATA3\C344130M.CAL
INSTRUMENT: HP6890--FID OPERATOR: Jinbo Su
RUN TIME: 110min
COM PORT: 3
HEADING 1: C3-C10 Analysis
HEADING 2:
FORMAT FILE: H:\DATA3\C3C10.FMT

PEAKS DETECTED IN THIS CHROMATOGRAM:

Peak #	Ret Time (min)	Peak Name	Peak Area	Peak Height
1	6.53	8	8779	3988
2	6.94	11	4158	1272
3	7.29	14	14054	4060
4	7.90		2117944	142669
5	8.63	17	8874	5171
6	8.76	18	29151	16477
7	9.26	19	23513	12678
8	9.97	20	11821	3922
9	10.93	24	2345	685
10	11.23	26	42526	19901
11	11.45	27	9781	4146
12	12.48	28	5397	1104
13	13.04	30	9486	4024
14	13.57		1902	723
15	13.66	31	35129	15246
16	13.74	32	27783	11586
17	13.88		2405	972
18	14.20	33	42485	18159
19	14.56		29534	12575
20	14.74	34	25379	10849
21	14.86		5032	2146
22	14.92		29674	12533
23	15.04	35	19525	7483
24	15.63	IS#1	7031372	1009240
25	15.83	36	45225	11609
26	16.43		16481	2359
27	17.02		28431	12972
28	17.06	37	71053	26806
29	17.30		16723	4985
30	17.88	38	40515	8822
31	18.15	39	20200	6575
32	18.50		24913	9440
33	19.00		17645	5448
34	19.20	40	15455	5678
35	19.47	41	16196	6170
36	19.99	42	22769	7162
37	20.20		5553	1073
38	20.43	43	48607	18761
39	20.53	44	29498	7874
40	20.78		20510	4641
41	20.95	46	115938	22298
42	21.12		15269	5189
43	21.48		3358	1164
44	21.76		32428	10113
45	21.90		21225	8158
46	21.99		18398	6532
47	22.31		19521	7152
48	22.60		3809	970

Figure 2 (continued)

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Peak #	Ret Time (min)	Peak Name	Peak Area	Peak Height
49	22.69		7495	2897
50	22.79	49	78886	25441
51	23.15		13312	4784
52	23.26		14373	3284
53	23.69		4103	627
54	23.87	50	2447	946
55	23.97		17441	6411
56	24.36	51	29237	7018
57	24.56		2349	910
58	24.71	52	40361	11650
59	24.82		14915	5726
60	24.94		9178	3473
61	25.07		13957	5263
62	25.25	53	33872	12243
63	25.42		10757	3965
64	25.50		14494	4688
65	25.60		9816	3378
66	25.96	54	29924	5038
67	26.07		18820	6129
68	26.19		7501	2054
69	26.59	55	39320	7604
70	26.82		7823	2957
71	26.90		15752	5795
72	26.99		6317	2115
73	27.10	56	39667	15861
74	27.17	57	52976	19837
75	27.35		10971	3161
76	27.51		24079	6623
77	27.59	58	62148	23165
78	27.63		22110	5432
79	27.82	59	10598	3885
80	27.86		6903	3132
81	28.00		12432	3655
82	28.11		3696	1124
83	28.29		22272	7066
84	28.37		32657	11324
85	28.51	61	18582	5886
86	28.68		5919	1491
87	28.77		14073	3147
88	29.16		6719	1673
89	29.29	62	8520	2499
90	29.44	IS#2	9918793	1008183
91	29.76		54734	7861
92	30.02	63	17328	3337
93	30.16		15310	4111
94	30.22		24902	6074
95	30.34		12277	3361
96	30.42	64	9295	2665
97	30.54		20548	4336
98	30.61		9666	3247
99	30.87	65	22058	5810
100	30.98		58690	11809
101	31.23		24955	8013
102	31.51		49970	13973
103	31.71		19272	3579
104	31.82	66	40332	11140
105	31.85		16555	6809
106	31.94		19850	6598
107	32.02		12086	3014
108	32.11		24255	2743
109	32.34	68	12327	3524
110	32.39		16197	2944
111	32.60		11398	3070
112	32.71	69	55538	17865
113	32.90		10300	2455

Figure 2 (continued)

ZymaX FORENSICS

Peak #	Ret Time (min)	Peak Name	Peak Area	Peak Height
114	33.04		32171	9006
115	33.14		53891	17134
116	33.28	71	119164	29697
117	33.48		23740	5900
118	33.67		85609	24852
119	33.97	72	8291	2006
120	34.15	73	14244	2527
121	34.24		28095	9204
122	34.39	74	35629	5043
123	34.51		14229	4275
124	34.67		18148	5134
125	34.90	75	9199	2681
126	35.04		19426	4277
127	35.19		16898	5786
128	35.29	76	93987	31853
129	35.44		17057	3557
130	35.57		8190	2138
131	35.68	77	55462	19248
132	35.78		17520	4146
133	35.96		14193	3303
134	36.15		9990	3452
135	36.29	78	91973	29320
136	36.38		14225	3110
137	36.49		32326	6750
138	36.65		43622	14600
139	36.93		62556	11904
140	37.16		14916	5280
141	37.27		108174	30784
142	37.42	79	39786	8815
143	37.52		30738	7890
144	37.62	80	63825	21191
145	37.68		53363	16190
146	37.78	81	120478	42404
147	37.90		24816	6870
148	38.00		11409	3559
149	38.08		22933	6306
150	38.24	82	77587	19592
151	38.28		13836	4717
152	38.50		52178	15283
153	38.66		44961	15003
154	38.79	83	61948	22341
155	38.86		48326	21385
156	38.89	84	65882	23241
157	39.16		130974	62161
158	39.20	85	301612	95590
159	39.52		42545	6391
160	39.67		7792	1721
161	39.76		9011	2527
162	39.84		18056	4803
163	40.05		19799	5632
164	40.17		37087	8372
165	40.25	86	74895	19544
166	40.50		28954	4907
167	40.62		13995	4594
168	40.70	n-C11	147319	53281
169	40.83		14005	3919
170	40.89	87	140065	47549
171	41.07	88	80083	25312
172	41.14		21997	7554
173	41.22		15254	4040
174	41.39		36468	6868
175	41.51		15142	3109
176	41.64		18748	6642
177	41.69		25031	8264
178	41.92		288343	69308

Figure 2 (continued)

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Peak #	Ret Time (min)	Peak Name	Peak Area	Peak Height
179	42.21		125199	27846
180	42.36		51788	21700
181	42.42	89	315717	103474
182	42.65		77589	21823
183	42.74		50746	17014
184	42.82		21037	5752
185	42.93		111722	35220
186	43.02		62882	15624
187	43.21		81389	14749
188	43.39		23659	7438
189	43.49		86764	22113
190	43.57		34536	11295
191	43.76		47543	12030
192	43.87		120698	22782
193	43.97		57158	18247
194	44.07		22779	4707
195	44.20		60130	19961
196	44.29		47497	14830
197	44.40		153221	53617
198	44.48		92311	30910
199	44.68		107084	21172
200	44.87		108146	37722
201	44.98		77998	23691
202	45.06		50595	13997
203	45.24		26959	6793
204	45.40		13385	3512
205	45.50		39136	11326
206	45.70	n-C12	233487	72383
207	45.96		39555	5879
208	46.10		32944	7253
209	46.29	90	30020	7284
210	46.37		28429	9557
211	46.45	i-C13	74112	25001
212	46.54		35147	12177
213	46.62		53195	16664
214	46.92		77793	10417
215	47.12		18586	5964
216	47.20		38716	8732
217	47.37		109574	35515
218	47.53		15718	5710
219	47.60		21891	5766
220	47.87		23880	5438
221	47.96		118213	32703
222	48.11		40573	11786
223	48.19		25539	7938
224	48.28		12819	4067
225	48.41		59071	8651
226	48.56		64943	15778
227	48.68		54303	13202
228	48.82		26796	9040
229	48.99	i-C14	183399	60840
230	49.09	91	31624	7664
231	49.21		35947	10577
232	49.30		36064	8553
233	49.52		28774	8494
234	49.57	92	59007	20098
235	49.64		30362	4408
236	49.87	n-C13	109610	42314
237	50.02		6881	2247
238	50.08		13423	5233
239	50.12		22308	6387
240	50.28		24365	5570
241	50.45		13655	3799
242	50.54		15990	6210
243	50.76		8090	3207

Figure 2 (continued)

ZymaX FORENSICS

Peak #	Ret Time (min)	Peak Name	Peak Area	Peak Height
244	50.99		8554	2774
245	51.28		12449	3711
246	51.54		11350	3140
247	51.62		7157	2449
248	51.77		13224	4133
249	51.92		20360	6136
250	52.12		8047	3721
251	52.35	i-C15	30662	13271
252	52.41		8385	3918
253	52.71		20020	3151
254	52.91	n-C14	25933	13390
255	53.03		16740	5063
256	53.14		5143	2275
257	53.37		1914	902
258	53.53		1821	776
259	53.94		2387	785
260	54.15		9301	3881
261	54.40		5205	2256
262	54.53	i-C16	24122	10395
263	54.69		6848	3033
264	54.97		3669	1916
265	55.24	n-C15	2423	941
266	55.32		10039	3367
267	55.56		2833	1195
268	55.67		3540	861
269	56.12		3544	919
270	56.37		2860	795
271	56.46		3392	1448
272	56.55		4309	1273
273	56.66		2289	1278
274	56.82		2575	1369
275	57.24	n-C16	1009	482
276	57.35		2876	1078
277	58.31	i-C18	8251	3816
278	58.42		2976	804
279	59.30	Pristane	14522	6529
280	60.94	Phytane	6091	2843
281	62.17		1950	690
282	63.56		1810	810
283	63.96		6597	3383
284	64.17		1680	761
285	64.29	IS#3	2369618	1006140
286	64.56		2385	865
287	64.95		3491	1157
288	65.30		2112	478
289	66.85		3186	1063
290	67.80		2285	1101
291	68.42		1436	838
292	68.84		1645	670
293	69.68		3352	1365
294	70.20		2694	878
295	70.72		2159	745
296	70.82		1670	616
297	71.97		5102	2082
298	72.25		2716	745
299	72.47		2342	1102
300	72.62		1389	481
301	72.77		2517	506
302	73.23		2082	964
303	73.50		3732	1005
304	73.86		11782	1510
305	74.31		7365	1698
306	74.45		7576	2429
307	74.56		4259	1486
308	74.67		6572	1421

Figure 2 (continued)

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Peak #	Ret Time (min)	Peak Name	Peak Area	Peak Height
309	75.15		9529	2280
310	75.55		2856	947
311	75.88		3066	884
312	75.98		2462	894
313	76.34		6596	1172
314	76.45		5294	1549
315	76.89		7807	1957
316	77.13		6263	1718
317	77.65		5964	825
318	77.96		3473	1025
319	78.29		12582	1592
320	78.76		11893	1518
321	78.96		9473	1374
322	79.31		10149	2285
323	80.38		5862	1085
324	81.31		14824	3343
325	82.27		3707	627
326	84.58		1926	387
327	86.25		5200	888
328	86.78		2906	534

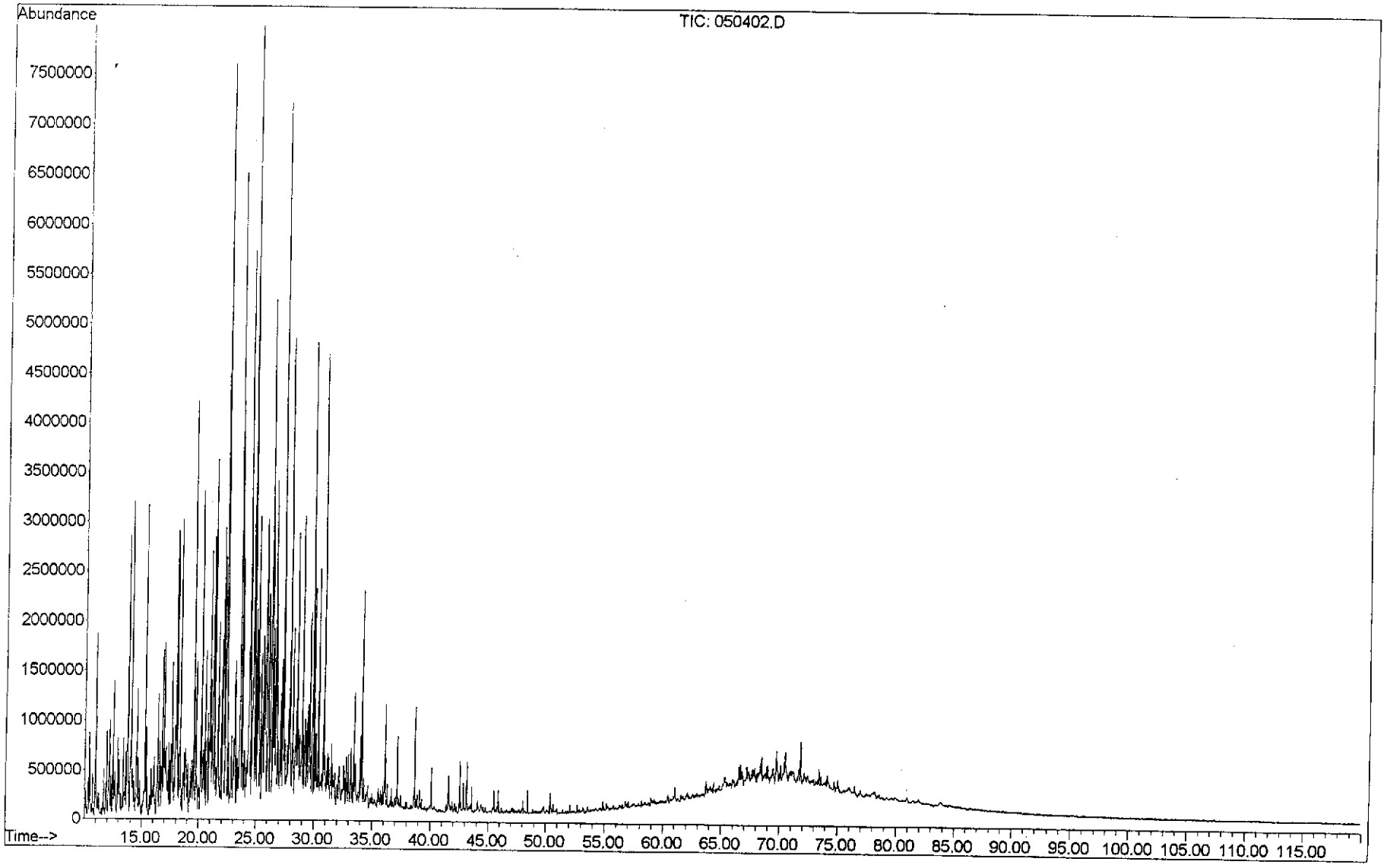
TOTAL AREA DETECTED = 3.159996E+07

Processed by: Jimbo Su

Date: 5-11-00

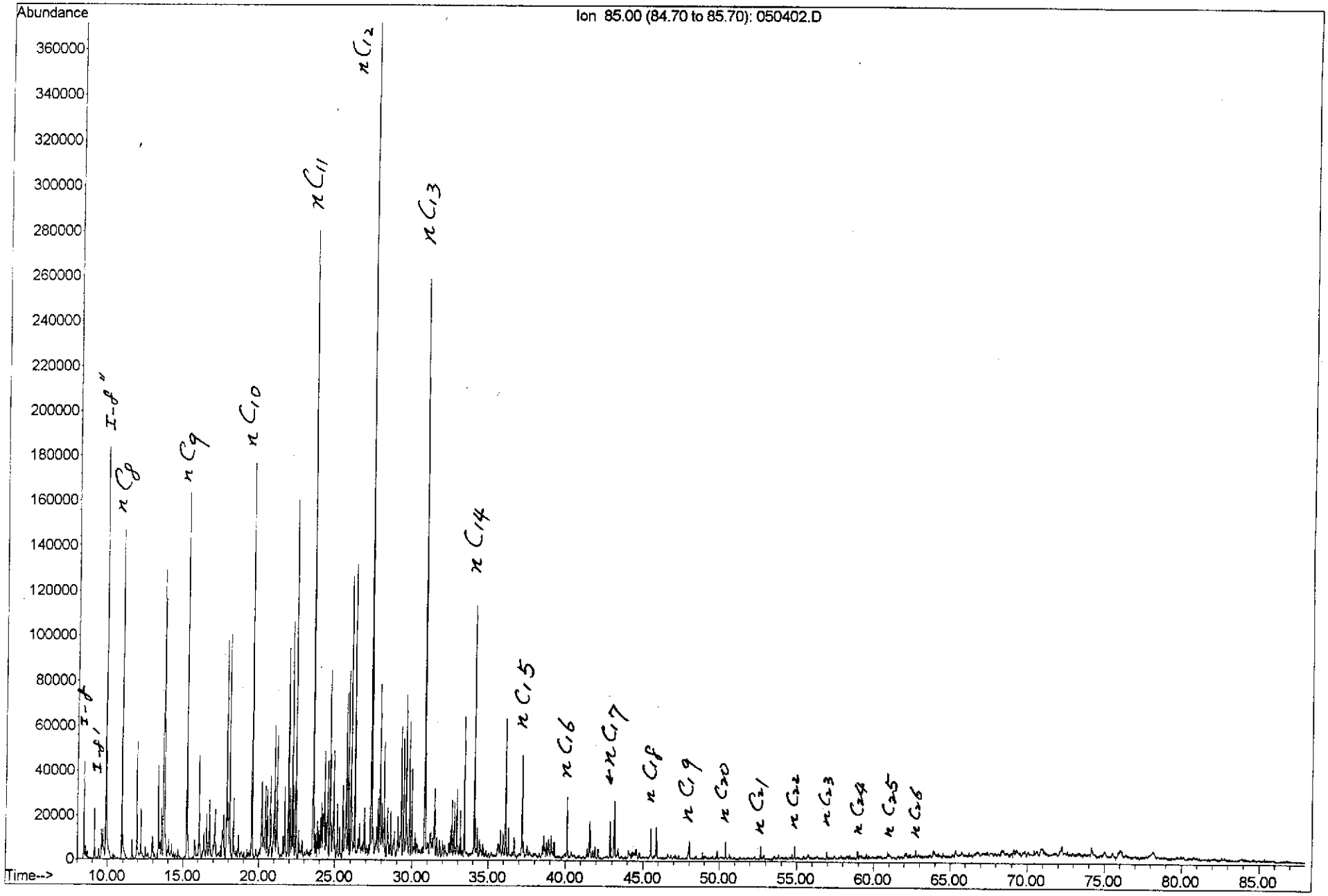
Figure 3

Sample Name: MW-16 (19835-2) Ali+Aro (Sheen)
Misc Info : 153-1247



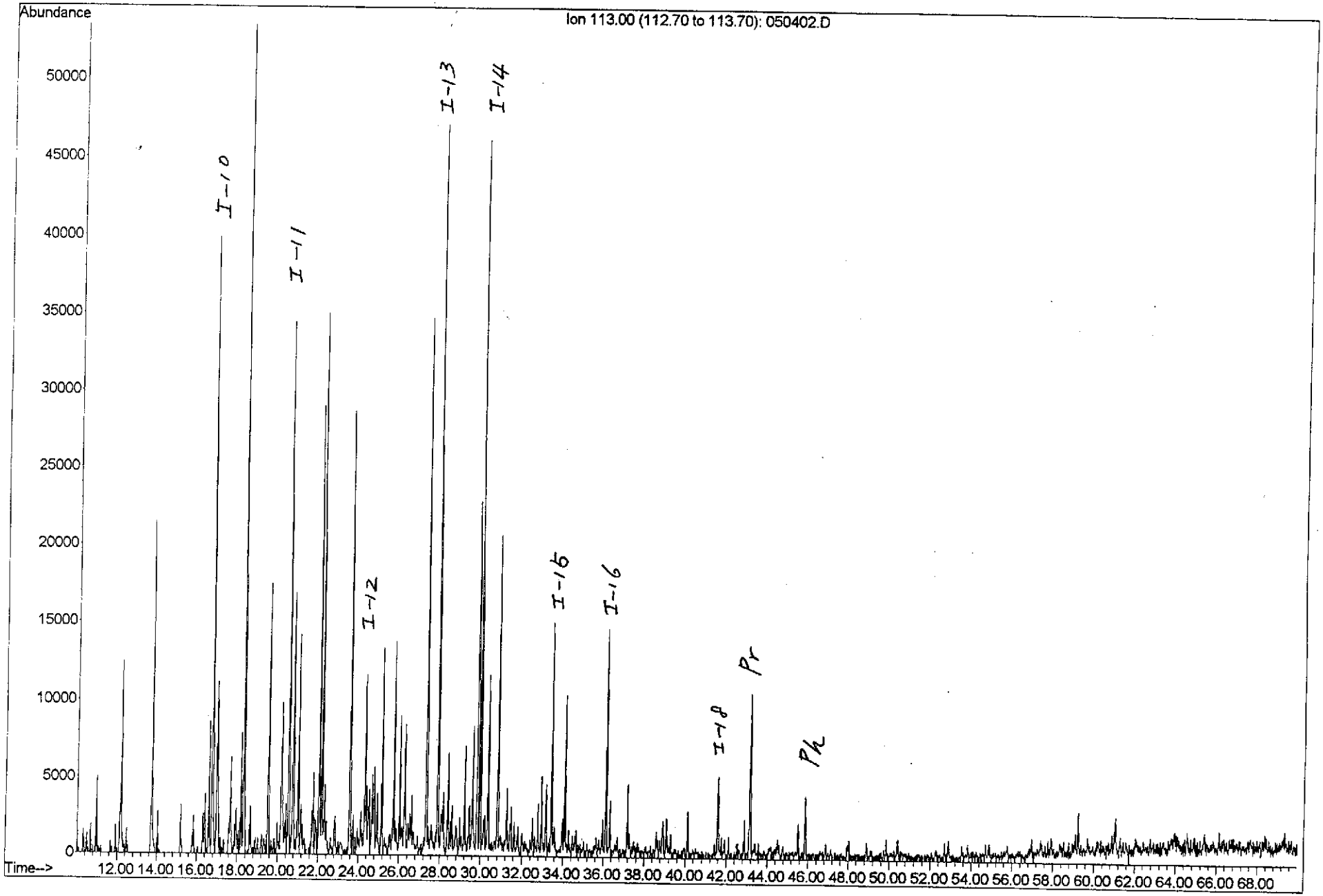
MW-16 (19835-2) Ali+Aro (Sheen)
153-1247

Figure 4



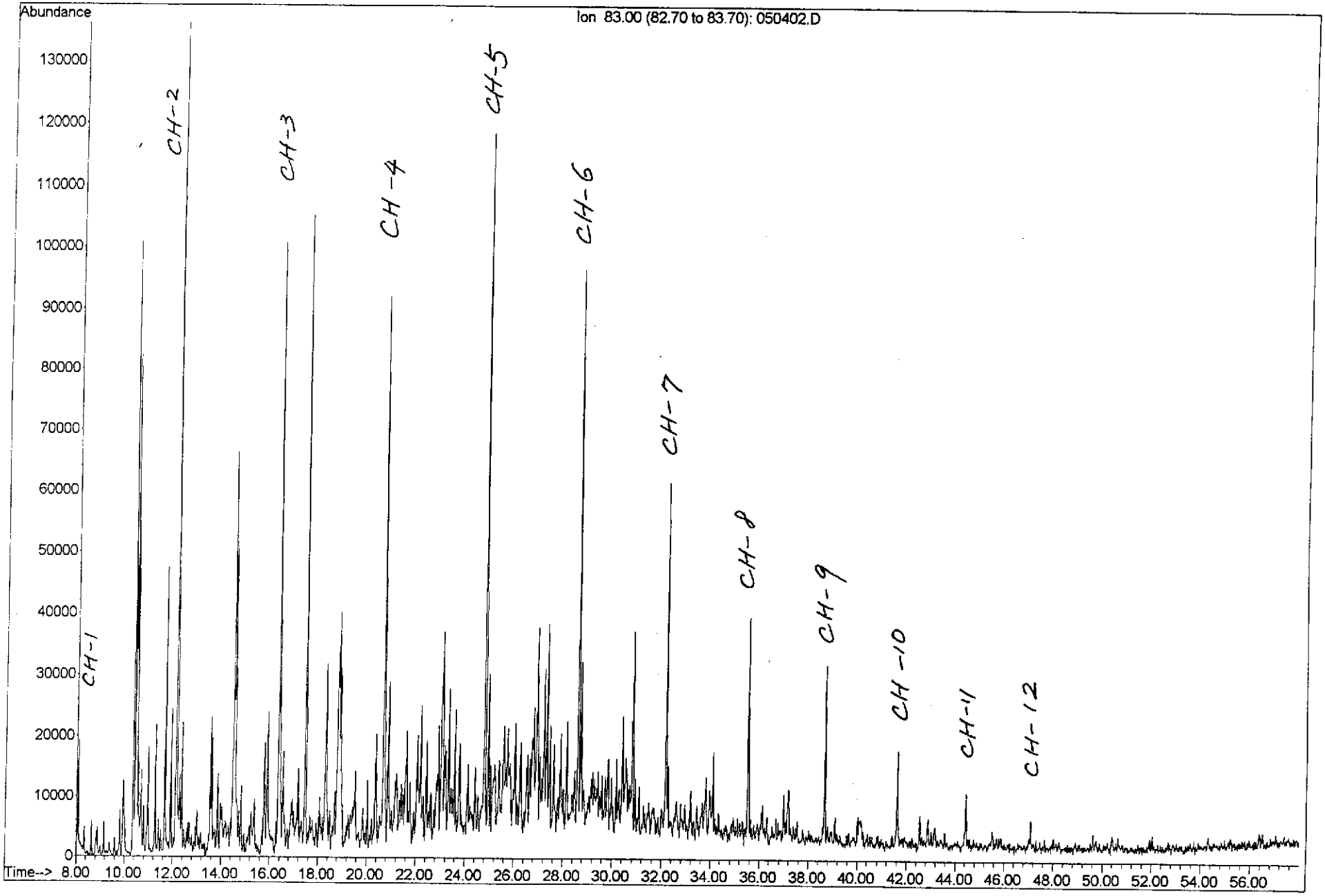
MW-16 (19835-2) Ali+Aro (Sheen)
153-1247

Figure 5



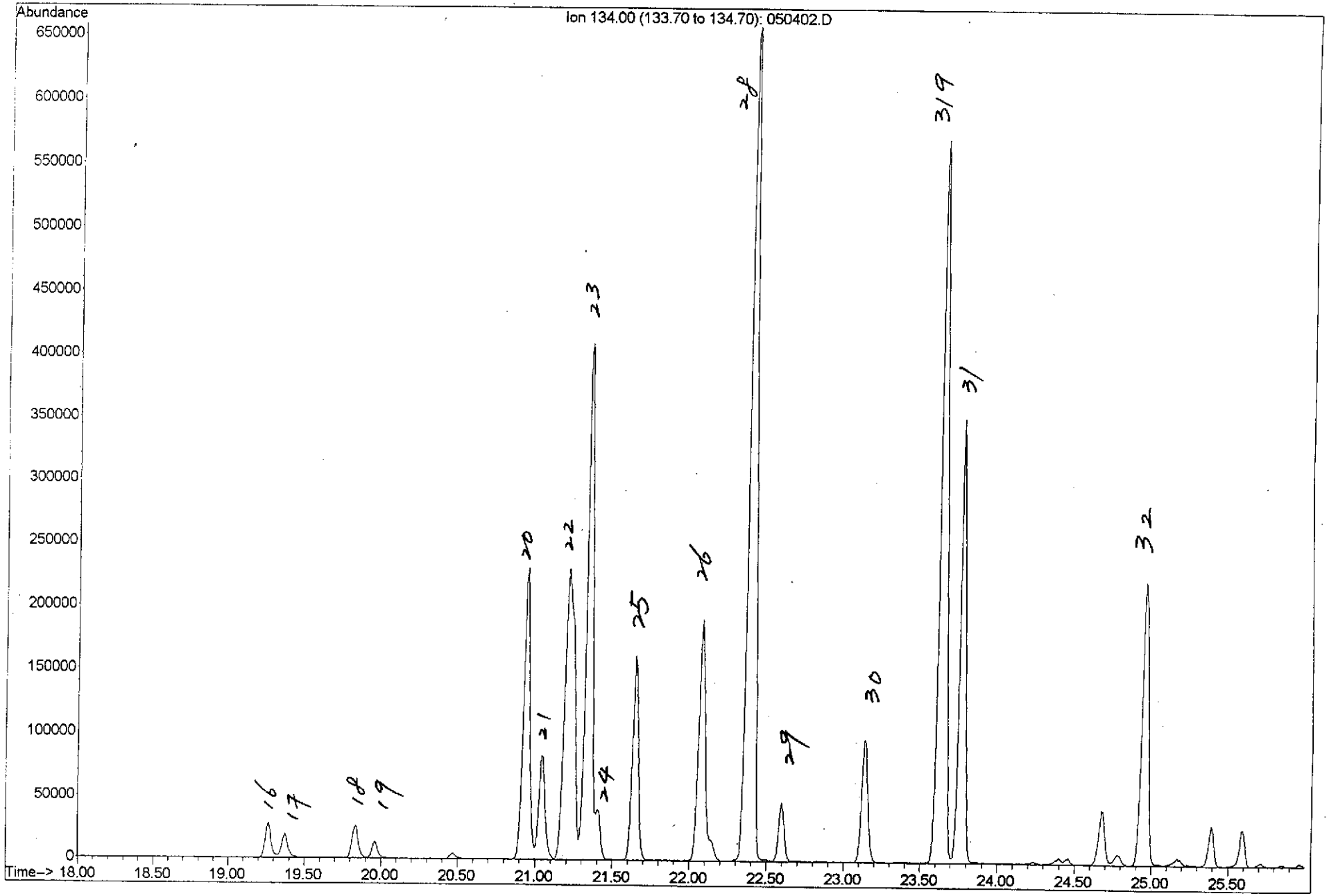
MW-16 (19835-2) Ali+Aro (Sheen)
153-1247

Figure 6



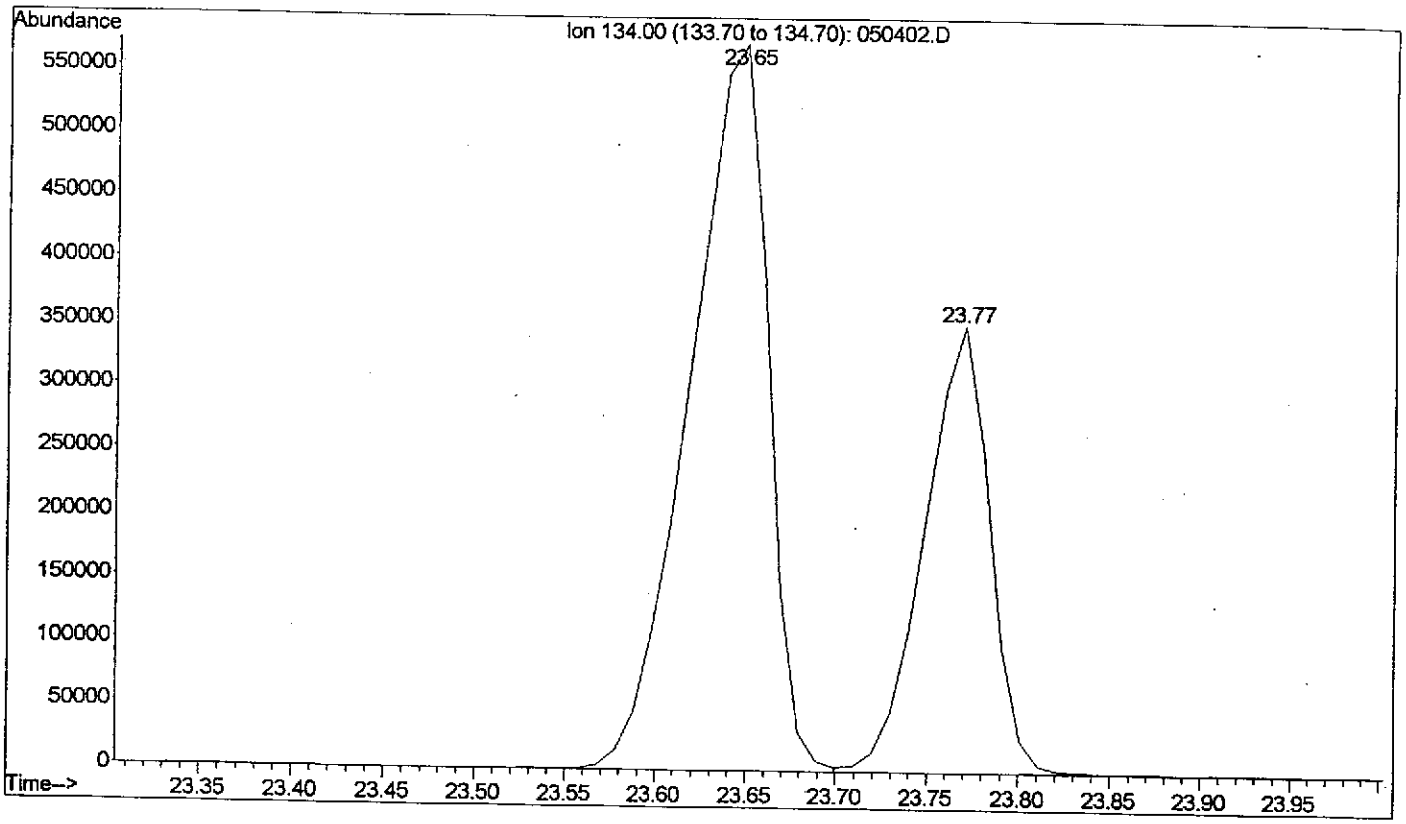
MW-16 (19835-2) Ali+Aro (Sheen)
153-1247

Figure 7



File : C:\HPCHEM\1\DATA\050400\050402.D
Operator : ST Lu
Acquired : 5 May 2000 12:17 am using AcqMethod FOREN3L
Instrument : GC/MS Ins
Sample Name: MW-16 (19835-2) Ali+Aro (Sheen)
Misc Info : 153-1247
Vial Number: 2

Figure 8



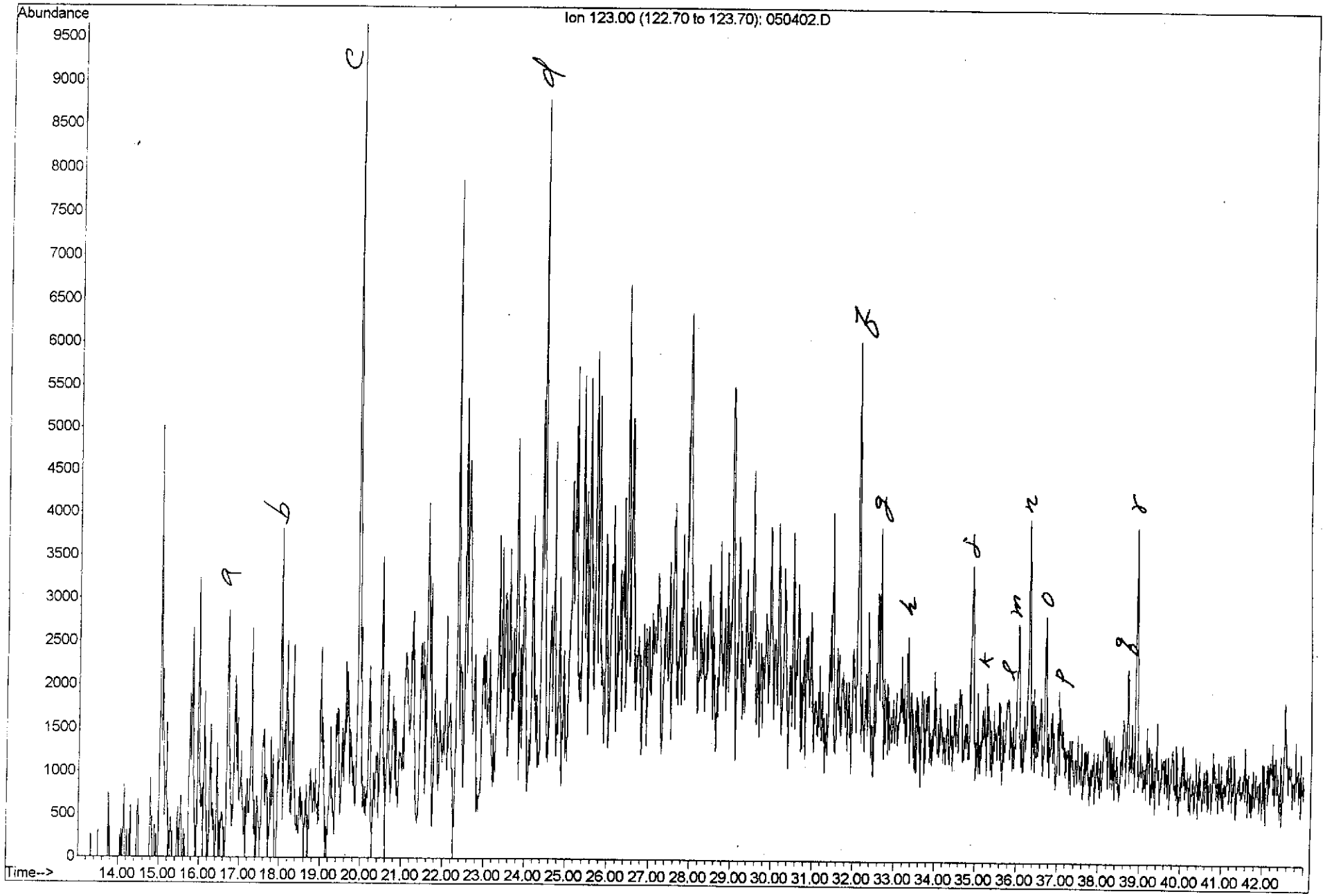
1,2,3,5-tetramethylbenzene(31) : 1,2,4,5-tetramethylbenzene(31a)

Peak No.		Ret Time	Peak Height
1	(31a)	23.6486	571213
2	(31)	23.7701	351265

(31)/(31a) Ratio 0.614946

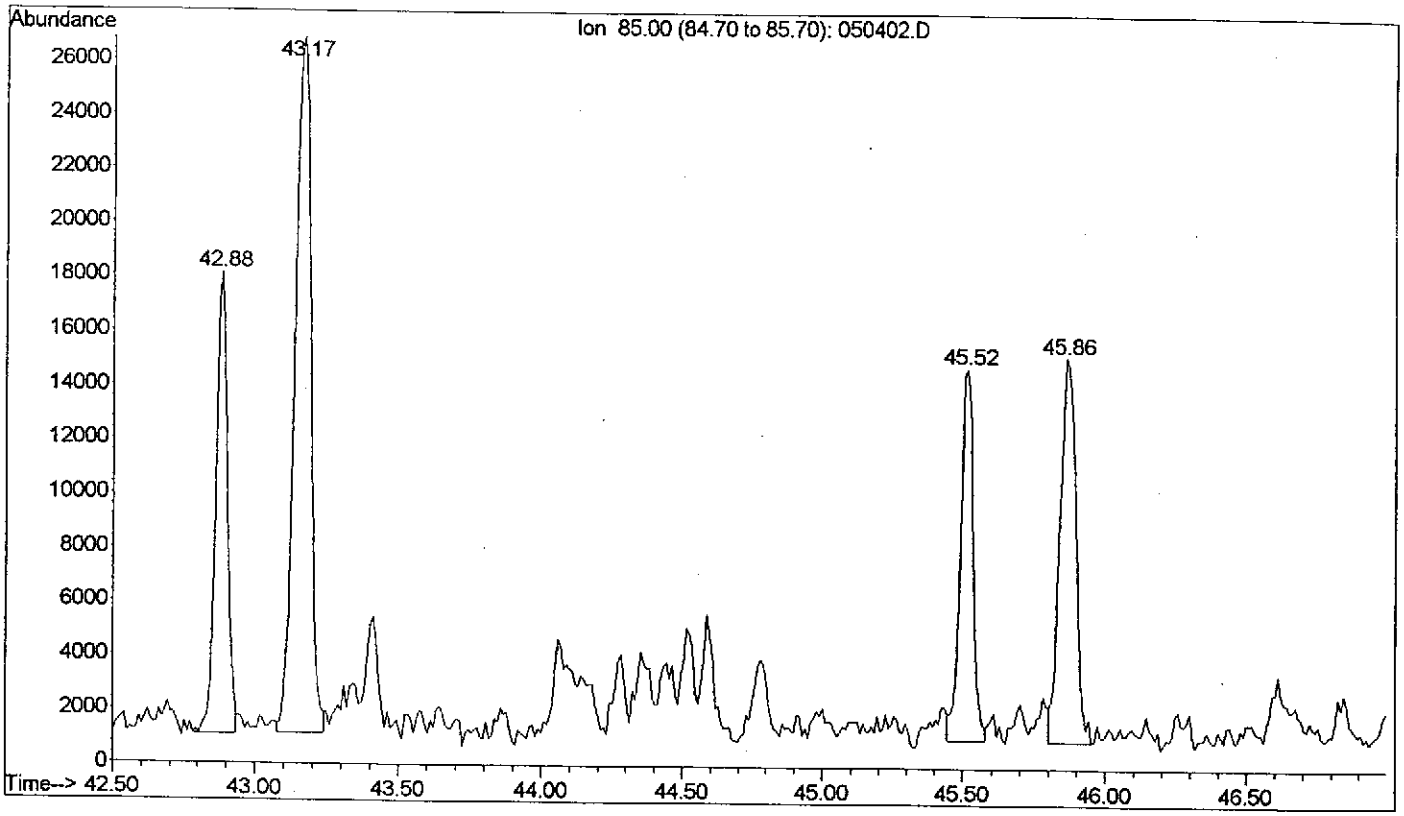
MW-16 (19835-2) Ali+Aro (Sheen)
153-1247

Figure 9



File : C:\HPCHEM\1\DATA\050400\050402.D
Operator : ST Lu
Acquired : 5 May 2000 12:17 am using AcqMethod FOREN3L
Instrument : GC/MS Ins
Sample Name: MW-16 (19835-2) Ali+Aro (Sheen)
Misc Info : 153-1247
Vial Number: 2

Figure 10



C17/Pristane and C18/Phytane Ratios

Peak No.	Ret Time	Peak Height
1	42.8834	17014
2	43.167	25708
3	45.5169	13755
4	45.8613	14252

C17/Pristane Ratio	0.661817
C18/Phytane Ratio	0.965128
Pristane/Phytane Ratio	1.80382

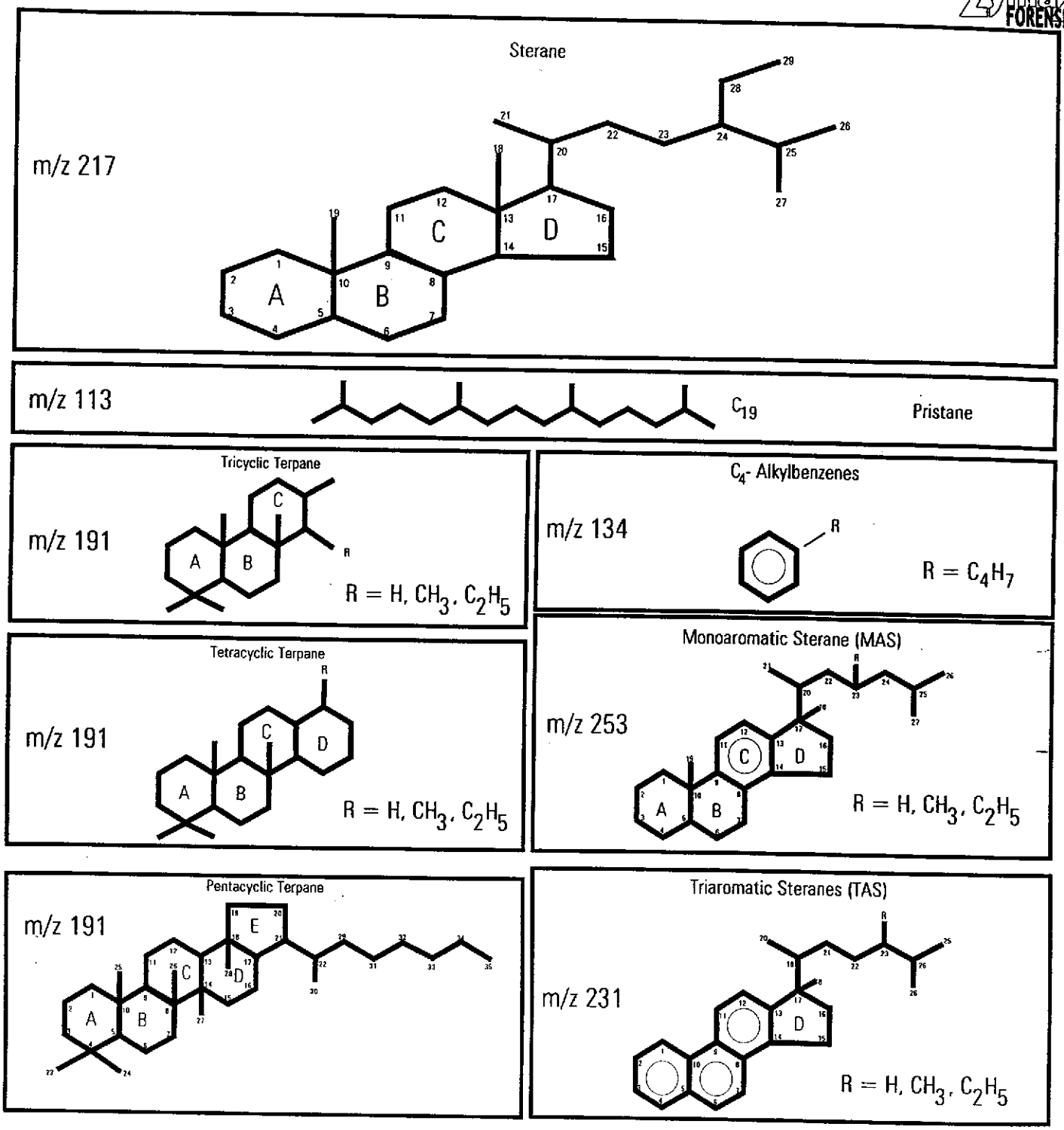
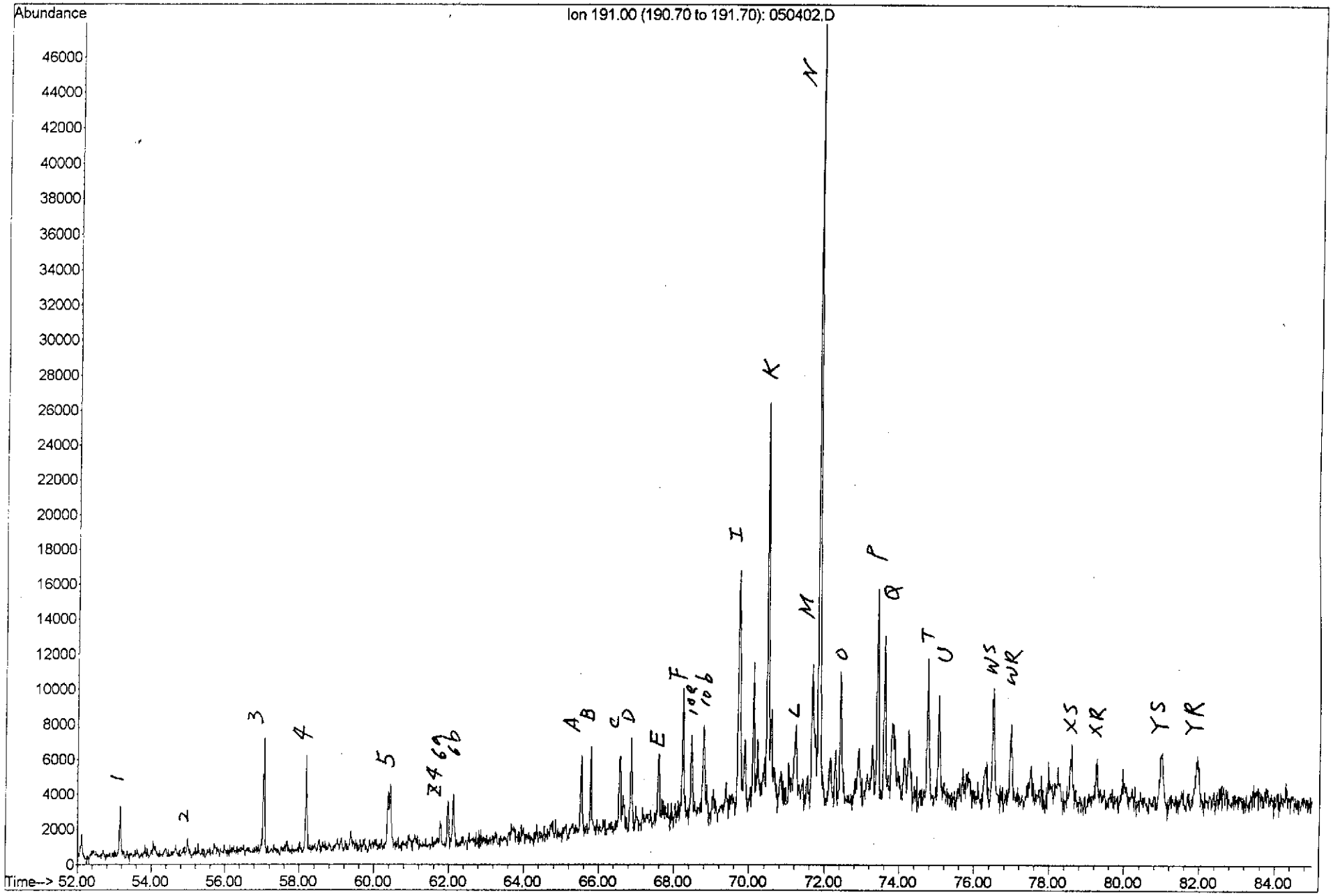


Figure 11: The compound structures of pristane, C_4-alkylbenzene, sterane; terpanes; monoaromatic and triaromatic steranes

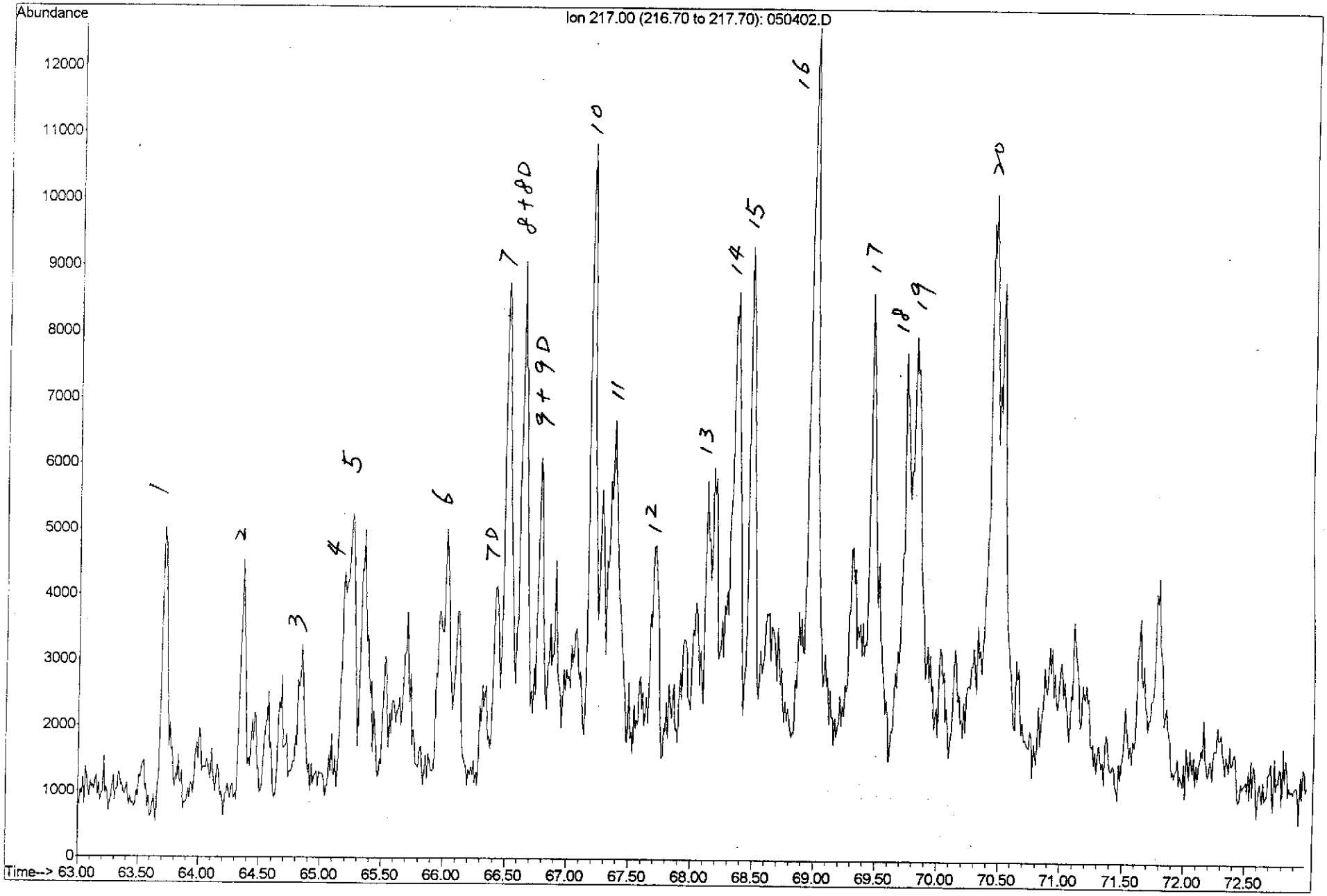
MW-16 (19835-2) Ali+Aro (Sheen)
153-1247

Figure 12



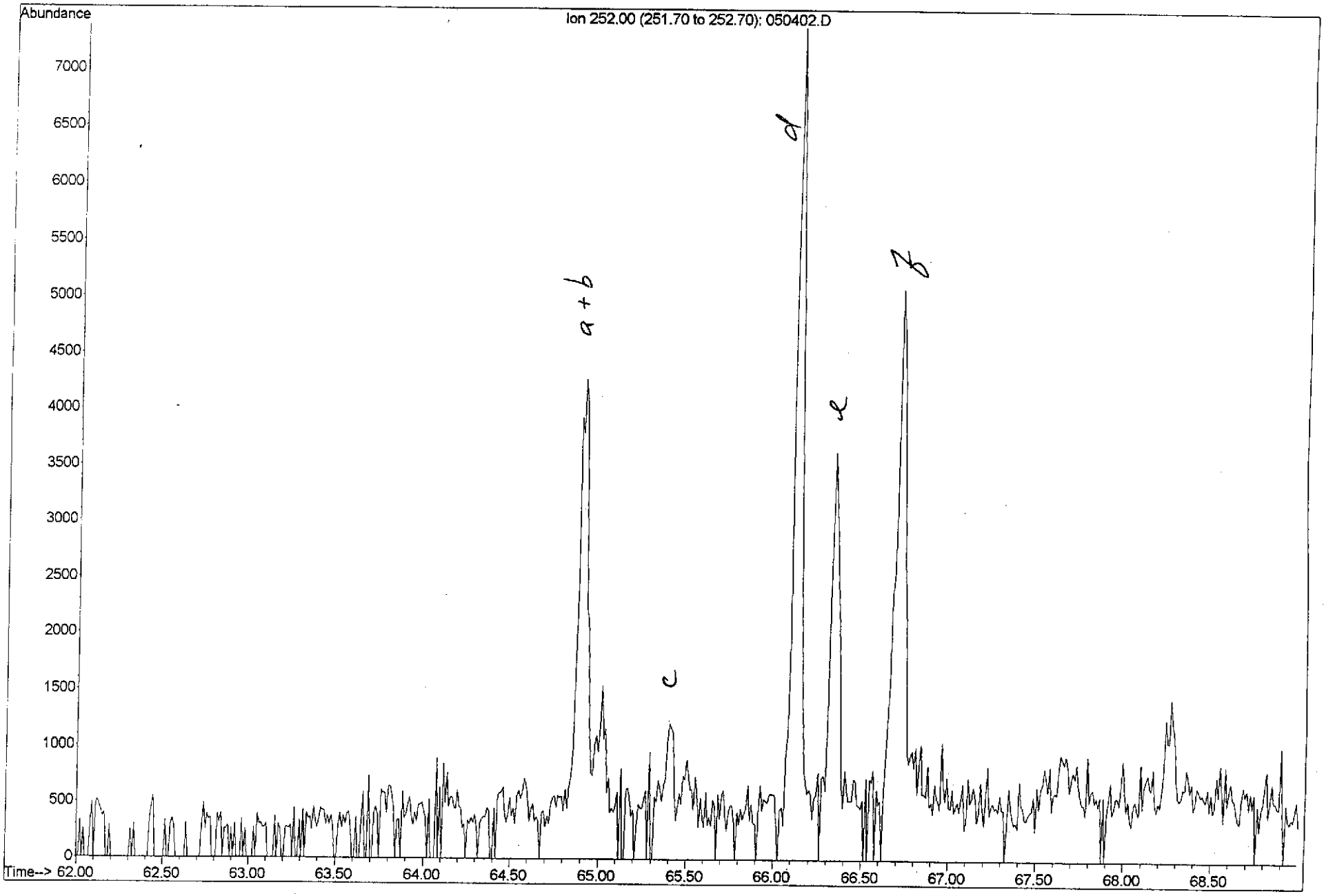
MW-16 (19835-2) Ali+Aro (Sheen)
153-1247

Figure 13



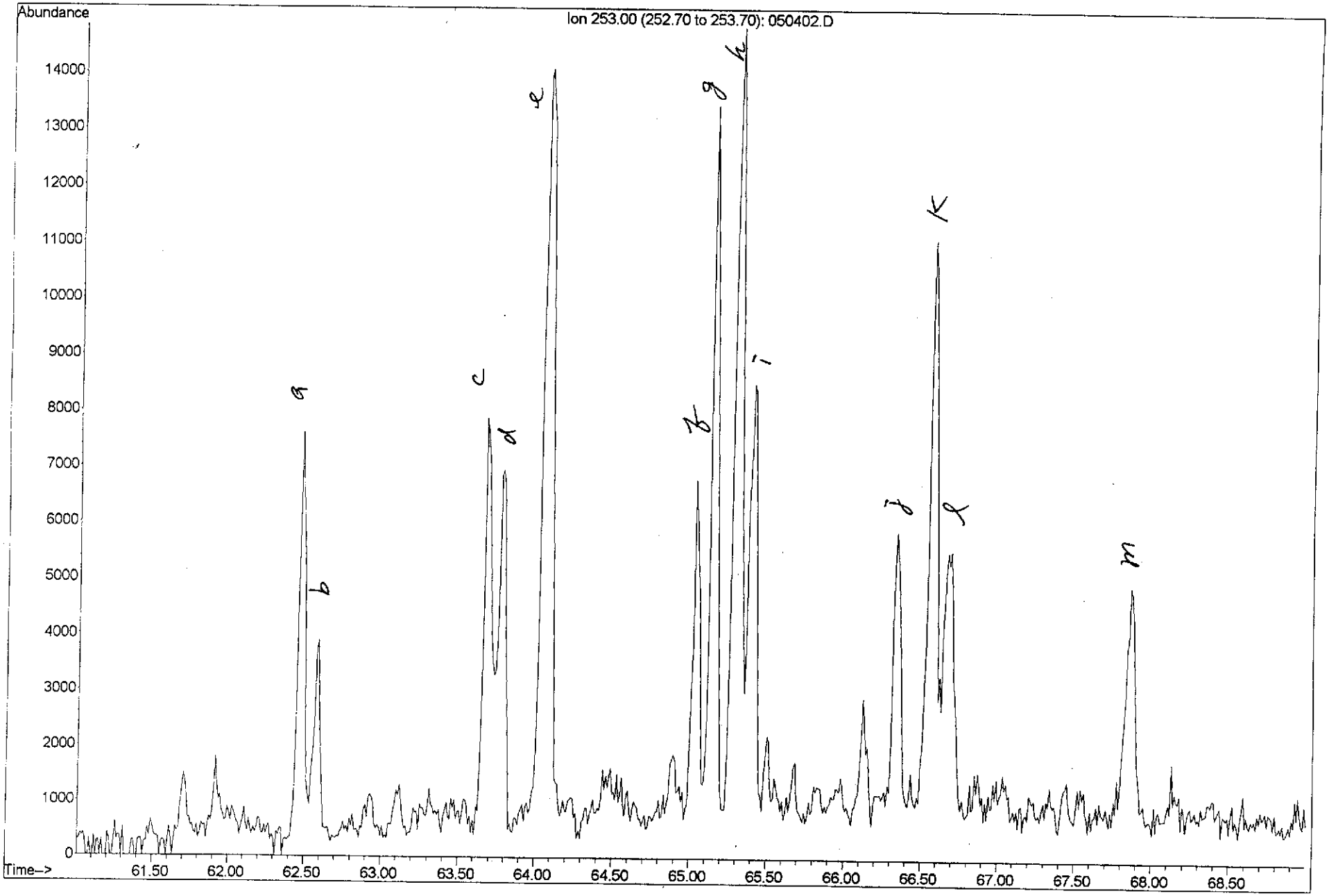
MW-16 (19835-2) Ali+Aro (Sheen)
153-1247

Figure 14



MW-16 (19835-2) Ali+Aro (Sheen)
153-1247

Figure 15



MW-16 (19835-2) Ali+Aro (Sheen)
153-1247

Figure 16

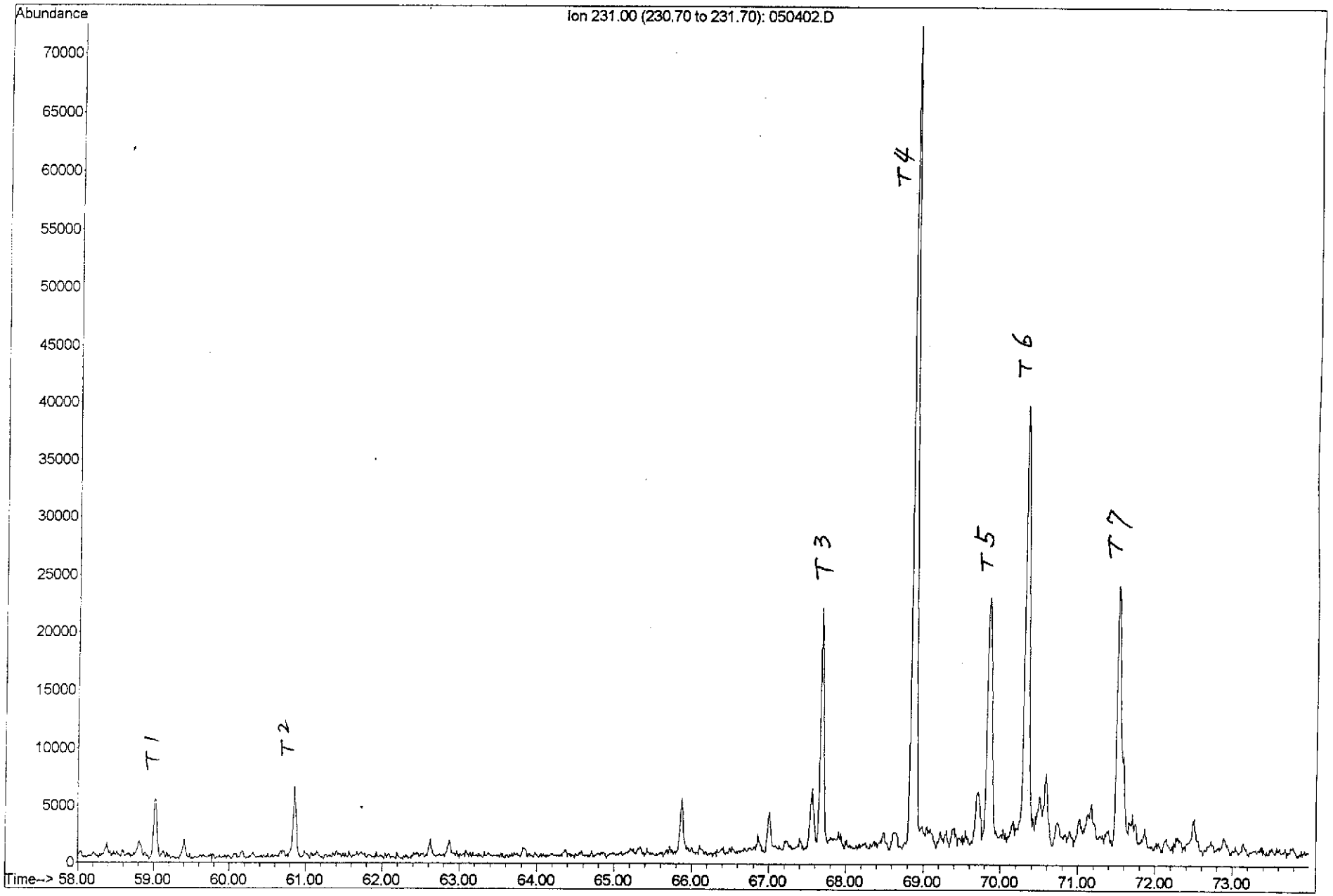


Figure 17

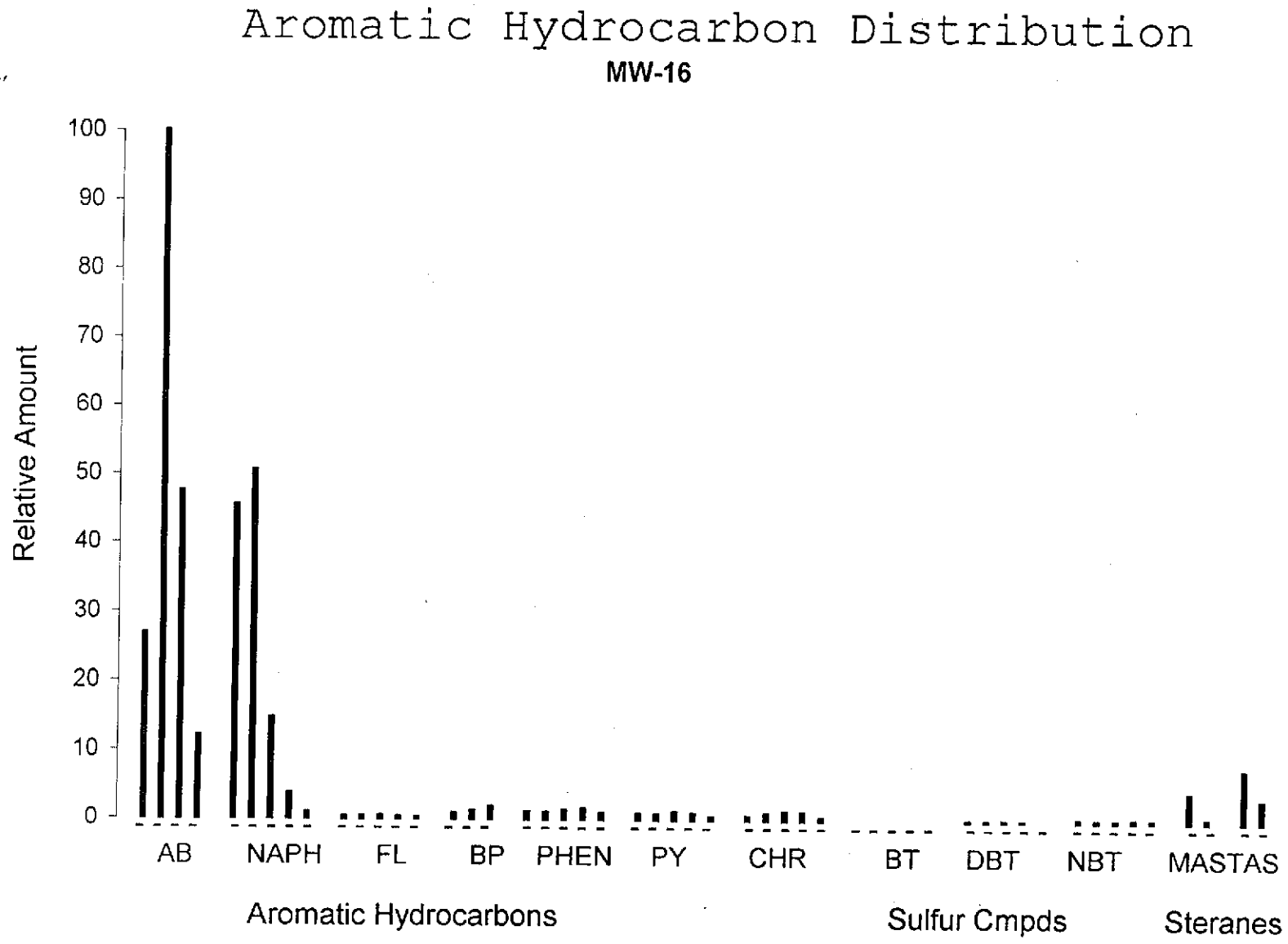

Aromatic Hydrocarbon Distribution
MW-16
Relative Amount
100
90
80
70
60
50
40
30
20
10
0
AB
NAPH
FL
BP
PHEN
PY
CHR
BT
DBT
NBT
MASTAS
Aromatic Hydrocarbons
Sulfur Cmpds
Steranes

Figure 18

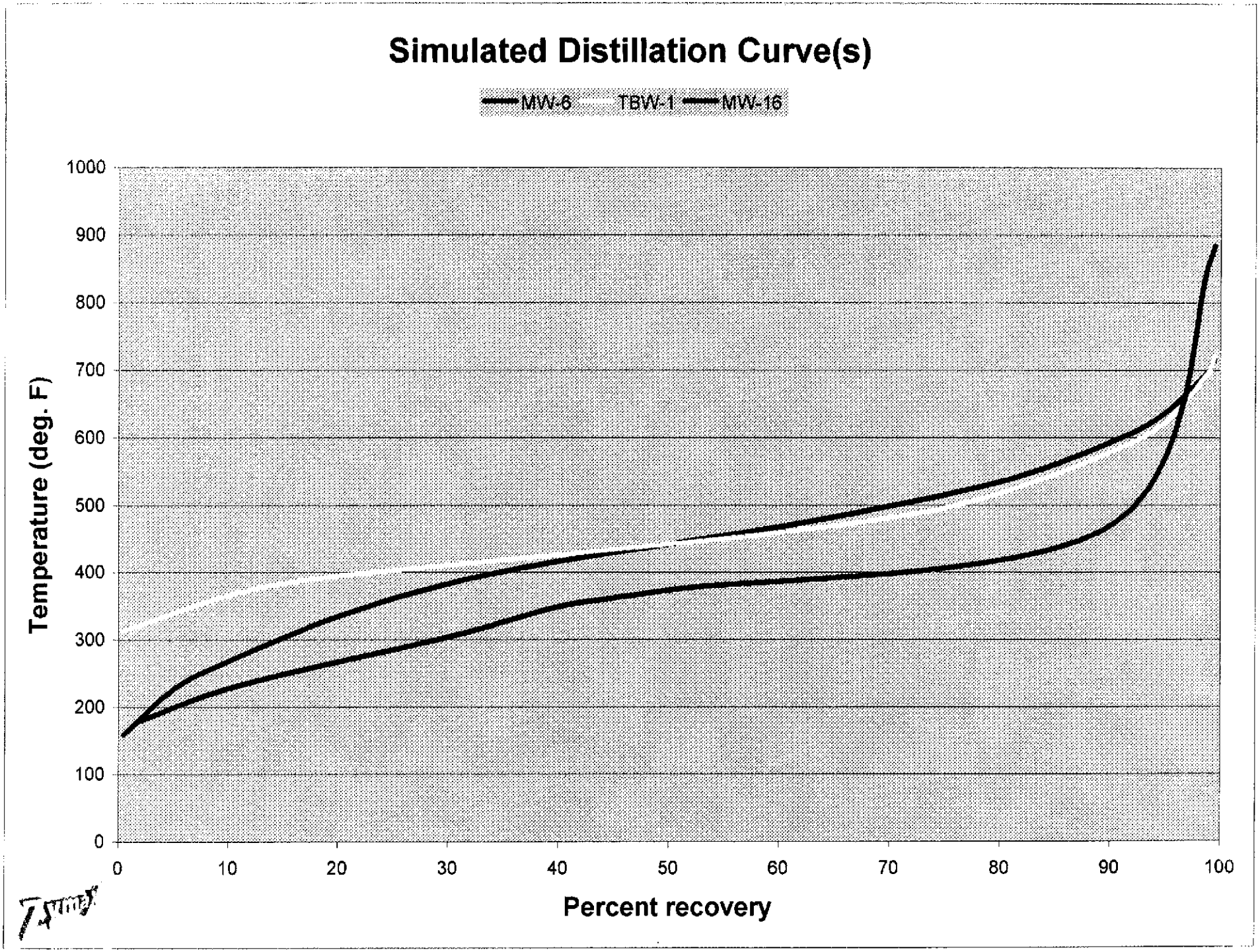

Simulated Distillation Curve(s)
MW-6
TBW-1
MW-16
Temperature (deg. F)
1000
900
800
700
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
Percent recovery

Table 1

N19835

05-11-2000

Detailed Gasoline Range Hydrocarbon Analysis for
One product sample submitted by Cambria Environmental Technology
(relative %)

	Sample	MW-16
	Zymax ID	19835-2
1	Propane	
2	Isobutane	
3	Isobutene	
4	Butane/Methanol	
5	trans-2-Butene	
6	cis-2-Butene	
7	3-Methyl-1-butene	
8	Isopentane	0.28
9	1-Pentene	
10	2-Methyl-1-butene	
11	Pentane	0.13
12	trans-2-Pentene	
13	cis-2-Pentene/t-Butanol	
14	2-Methyl-2-butene	0.45
15	2,2-Dimethylbutane	
16	Cyclopentane	
17	2,3-Dimethylbutane/MTBE	0.28
18	2-Methylpentane	0.93
19	3-Methylpentane	0.75
20	Hexane	0.38
21	trans-2-Hexene	
22	3-Methylcyclopentene	
23	3-Methyl-2-pentene	
24	cis-2-Hexene	0.07
25	3-Methyl-trans-2-pentene	
26	Methylcyclopentane	1.35
27	2,4-Dimethylpentane	0.31
28	Benzene	0.17
29	5-Methyl-1-hexene	
30	Cyclohexane	0.30
31	2-Methylhexane/TAME	1.12
32	2,3-Dimethylpentane	0.88
33	3-Methylhexane	1.35
34	2-Methyl-1-hexene	0.81
35	2,2,4-Trimethylpentane	0.62
IS1	α,α,α-Trifluorotoluene	
36	n-Heptane	1.44
37	Methylcyclohexane	2.26
38	2,5-Dimethylhexane	1.29
39	2,4-Dimethylhexane	0.64
40	2,3,4-Trimethylpentane	0.49
41	Toluene	0.51
42	2,3-Dimethylhexane	0.72

Table 1 (continued)

N19835

05-11-2000

Detailed Gasoline Range Hydrocarbon Analysis for
One product sample submitted by Cambria Environmental Technology
(relative %)

Sample		MW-16
Zymax ID		19835-2
43	2-Methylheptane	1.55
44	4-Methylheptane	0.94
45	3,4-Dimethylhexane	
46	3-Ethyl-3-methylpentane	3.69
47	3-Methylheptane	
48	2-Methyl-1-heptene	
49	n-Octane	2.51
50	2,2-Dimethylheptane	0.08
51	2,4-Dimethylheptane	0.93
52	Ethylcyclohexane	1.28
53	2,6-Dimethylheptane	1.08
54	Ethylbenzene	0.95
55	m + p Xylenes	1.25
56	4-Methyloctane	1.26
57	2-Methyloctane	1.68
58	3-Ethylheptane	1.98
59	3-Methyloctane	0.34
60	o-Xylene	
61	1-Nonene	
62	n-Nonane	0.27
IS2	p-Bromofluorobenzene	
63	Isopropylbenzene	0.55
64	3,3,5-Trimethylheptane	0.30
65	2,4,5-Trimethylheptane	0.70
66	n-Propylbenzene	1.28
67	1-Methyl-3-ethylbenzene	
68	1-Methyl-4-ethylbenzene	0.39
69	1,3,5-Trimethylbenzene	1.77
70	3,3,4-Trimethylheptane	
71	1-Methyl-2-ethylbenzene	3.79
72	3-Methylnonane	0.26
73	1,2,4-Trimethylbenzene	0.45
74	Isobutylbenzene	1.13
75	sec-Butylbenzene	0.29
76	n-Decane	2.99
77	1,2,3-Trimethylbenzene	1.76
78	Indan	2.92
79	1,3-Diethylbenzene	1.26
80	1,4-Diethylbenzene	2.03

Table 1 (continued)

N19835

05-11-2000

Detailed Gasoline Range Hydrocarbon Analysis for
One product sample submitted by Cambria Environmental Technology
(relative %)

Sample		MW-16
Zymax ID		19835-2
81	n-Butylbenzene	3.83
82	1,3-Dimethyl-5-ethylbenzene	2.47
83	1,4-Dimethyl-2-ethylbenzene	1.97
84	1,3-Dimethyl-4-ethylbenzene	2.09
85	1,2-Dimethyl-4-ethylbenzene	9.59
86	Undecene	
87	1,2,4,5-Tetramethylbenzene	4.45
88	1,2,3,5-Tetramethylbenzene	2.55
89	1,2,3,4-Tetramethylbenzene	10.04
90	Naphthalene	0.95
91	2-Methyl-naphthalene	1.01
92	1-Methyl-naphthalene	1.88

Table 2

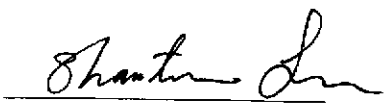
ZymaX FORENSICS

19835H

05-11-2000

Degradation ratios and bulk composition calculated from the gasoline range analysis for
One product sample submitted by Cambria Environmental Technology

Sample	MW-16
Zymax ID	19835-2
Evaporation	
n-Pentane/n-Heptane	0.09
2-Methylpentane/2-Methylheptane	0.60
Waterwashing	
Benzene/Cyclohexane	0.57
Toluene/Methylcyclohexane	0.23
Aromatics/Total Paraffins(n+iso+cyc)	1.52
Aromatics/Naphthenes	10.91
Biodegradation	
(C4-C8 Para+Isopara)/C4-C8 Olefins	15.27
3-Methylhexane/n-Heptane	0.94
Methylcyclohexane/n-Heptane	1.57
Isoparaffins+Naphthenes/Paraffins	3.84
Octane rating	
2,2,4-Trimethylpentane/Methylcyclohexane	0.27
Relative percentages - Bulk hydrocarbon composition as PIANO	
% Paraffinic	8.08
% Isoparaffinic	25.61
% Aromatic	59.47
% Naphthenic	5.45
% Olefinic	1.39



Supervisor

ZymaX FORENSICS

Table 3

Key to Chromatogram Symbol Identification

Symbol	Detail
i-10	Iso-alkane with 10 carbon atoms
i-15	Farnesane (isoprenoid with 15 carbon atoms)
i-16	Isoprenoid with 16 carbon atoms
Pr	Pristane (isoprenoid with 19 carbon atoms)
Ph	Phytane (isoprenoid with 20 carbon atoms)
nC_8	n-C_8 normal alkane
nC_{15}	n-C_{15} normal alkane
i-8	2,5-(2,4)-Dimethylhexane
i-8'	2,3,4-Trimethylpentane
i-8"	2,3-Dimethylhexane
CH-*n*	Alkylcyclohexane (where *n* indicates number of carbon atoms in the side chain)

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ZymaX FORENSICS

Table 4

Key for C_4-Alkylbenzenes (m/z 134 mass chromatograms)

#	Compound
16	Sec-Butylbenzene
17	1-Methyl-3-Isopropylbenzene
18	1-Methyl-4-Isopropylbenzene
19	1-Methyl-2-Isopropylbenzene
20	1,3-Diethylbenzene
21	1-Methyl-3-Propylbenzene
22	Butylbenzene
23	1,3-Diemethyl-5-Ethylbenzene
24	1,2-Diethylbenzene
25	1-Methyl-2-Propylbenzene
26	1,4-Dimethyl-2-Ethylbenzene
27	1,3-Dimethyl-4-Ethylbenzene
28	1,2-Dimethyl-4-Ethylbenzene
29	1,3-Dimethyl-2-Ethylbenzene
30	1,2-Dimethyl-3-Ethylbenzene
31a	1,2,4,5-Tetramethylbenzene
31	1,2,3,5-Tetramethylbenzene
32	1,2,3,4-Tetramethylbenzene

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Table 5

Key for identification of the bicyclanes (m/z 123 mass chromatograms)

Peak No.	Identity	Formula	M.W.
a	2,2,3-Trimethylbicyloheptane	$C_{10}H_{18}$	138
b	C_{10} bicyclic	$C_{10}H_{18}$	138
c	3,3,7-Trimethylbicycloheptane	$C_{10}H_{18}$	138
d	C_{11} decalin	$C_{11}H_{20}$	152
f	Nordrimane	$C_{14}H_{26}$	194
g	Nordrimane	$C_{14}H_{26}$	194
h	Rearranged drimane	$C_{15}H_{28}$	208
j	Rearranged drimane	$C_{15}H_{28}$	208
k	Isomer of eudesmane	$C_{15}H_{28}$	208
l	4β(H) Eudesmane	$C_{15}H_{28}$	208
m	C_{15} bicyclic sesquiterpane	$C_{15}H_{28}$	208
n	8β(H) Drimane	$C_{15}H_{28}$	208
o	C_{15} bicyclic sesquiterpane	$C_{15}H_{28}$	208
p	C_{16} bicyclic sesquiterpane	$C_{16}H_{30}$	222
q	C_{16} bicyclic sesquiterpane	$C_{16}H_{30}$	222
r	8β(H) Homodrimane	$C_{16}H_{30}$	222

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Table 6

Key for Identifying Aromatic Hydrocarbons

No.	m/z	Compound
1	120	C_3-alkylbenzenes
2	134	C_4-alkylbenzenes
3	148	C_5-alkylbenzenes
4	162	C_6-alkylbenzenes
5	128	C_0-naphthalene
6	142	C_1-naphthalenes
7	156	C_2-naphthalenes
8	170	C_3-naphthalenes
9	184	C_4-naphthalenes
10	166	C_0-fluorene
11	180	C_1-fluorenes
12	194	C_2-fluorenes
13	208	C_3-fluorenes
14	222	C_4-fluorenes
15	154	C_0-biphenyl
16	168	C_1-biphenyls + dibenzofuran
17	182	C_2-biphenyls + C_1-dibenzofuran
18	178	C_0-phenanthrene
19	192	C_1-phenanthrenes
20	206	C_2-phenanthrenes
21	220	C_3-phenanthrenes
22	234	C_4-phenanthrenes
23	202	C_0-pyrene/fluoranthene
24	216	C_1-pyrenes/fluoranthenes
25	230	C_2-pyrenes/fluoranthenes
26	244	C_3-pyrenes/fluoranthenes
27	258	C_4-pyrenes/fluoranthenes
28	228	C_0-chrysene
29	242	C_1-chrysenes
30	256	C_2-chrysenes
31	270	C_3-chrysenes
32	284	C_4-chrysenes
33	148	C_1-benzothiophenes
34	162	C_2-benzothiophenes
35	176	C_3-benzothiophenes
36	190	C_4-benzothiophenes
37	204	C_5-benzothiophenes
28	184	C_0-dibenzothiophene
39	198	C_1-dibenzothiophenes
40	212	C_2-dibenzothiophenes
41	226	C_3-dibenzothiophenes
42	240	C_4-dibenzothiophenes
43	234	C_0-naphthobenzothiophene
44	248	C_1-naphthobenzothiophenes
45	262	C_2-naphthobenzothiophenes
46	276	C_3-naphthobenzothiophenes
47	290	C_4-naphthobenzothiophenes
48	253	Monoaromatic steranes
49	267	Monoaromatic steranes
50	239	Monoaromatic steranes
51	231	Triaromatic steranes
52	245	Triaromatic steranes

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Table 7

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Key for Tricyclic, Tetracyclic, and Pentacyclic Terpanes Identification (m/z 191 mass chromatograms)

Code	Identity	Carbon #
0	C_{20}-Tricyclic Terpane	20
1	C_{21}-Tricyclic Terpane	21
2	C_{22}-Tricyclic Terpane	22
3	C_{23}-Tricyclic Terpane	23
4	C_{24}-Tricyclic Terpane	24
5	C_{25}-Tricyclic Terpane	25
Z4	C_{24}-Tetracyclic Terpane	24
6a	C_{26}-Tricyclic Terpane	26
6b	C_{26}-Tricyclic Terpane	26
7	C_{27}-Tricyclic Terpane	27
A	C_{28}-Tricyclic Terpane #1	28
B	C_{28}-Tricyclic Terpane #2	28
C	C_{29}-Tricyclic Terpane #1	29
D	C_{29}-Tricyclic Terpane #2	29
E	18α-22,29,30-Trisnorneohopane (Ts)	27
F	17α-22,29,30-Trisnorhopane (Tm)	27
G	17ß-22,29-30-Trisnorhopane	27
H	17α-23,28-Bisnorlupane	28
10a	C_{30}-Tricyclic Terpane #1	30
10b	C_{30}-Tricyclic Terpane #2	30
I	17α-28,30-Bisnorhopane	28
11a	C_{31}-Tricyclic Terpane #1	31
J	17α-25-Norhopane	29
11b	C_{31}-Tricyclic Terpane #2	31
K	17α,21ß-30-Norhopane	29
C_{29}Ts	18α-30-Norneohopane	29
C_{30}*	17α-Diahopane	30
L	17ß-21α-30-Normoretane	29
Ma	18α-Oleanane	30
Mb	18ß-Oleanane	30
N	17α,21ß-Hopane	30
O	17ß,21α-Moretane	30
13a	C_{33}-Tricyclic Terpane #1	33
13b	C_{33}-Tricyclic Terpane #2	33
P	22S-17α,21ß-30-Homohopane	31
Q	22R-17α,21ß-30-Homohopane	31
R	Gammacerane	30
14a	C_{34}-Tricyclic Terpane #1	34
S	17ß,21α-Homomoretane	31
14b	C_{34}-Tricyclic Terpane #2	34
T	22S-17α,21ß-30-Bishomohopane	32
U	22R-17α,21ß-30-Bishomohopane	32
15a	C_{35}-Tricyclic Terpane #1	35
15b	C_{35}-Tricyclic Terpane #2	35
V	17ß,21α-C_{32}-Bishomomoretane	32
WS	22S-17α,21ß-30,31,32-Trishomohopane	33
WR	22R-17α,21ß-30,31,32-Trishomohopane	33
16a	C_{36}-Tricyclic Terpane #1	36
16b	C_{36}-Tricyclic Terpane #2	36
XS	22S-17α,21ß-30,31,32,33-Tetrahomohopane	34
XR	22R-17α,21ß-30,31,32,33-Tetrahomohopane	34
YS	22S-17α,21ß-30,31,32,33,34-Pentahomohopane	35
YR	22R-17α,21ß-30,31,32,33,34-Pentahomohopane	35

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Table 8

Key for Steranes Identification (m/z 217 Mass Chromatogram)

Code	Identity	Carbon #
1	13ß,17α-diacholestane (20S)	27
2	13ß,17α-diacholestane (20R)	27
3	13α,17ß-diacholestane (20S)	27
4	13α,17ß-diacholestane (20R)	27
5	24-methyl-13ß,17α-diacholestane (20S)	28
6	24-methyl-13ß,17α-diacholestane (20R)	28
7D	24-methyl-13α,17ß-diacholestane (20S)	28
7	14α,17α-cholestane (20S)	27
8D	24-ethyl-13ß,17α-diacholestane (20S)	29
8	14ß,17ß-cholestane (20R)	27
9	14ß,17ß-cholestane (20S)	27
9D	24-methyl-13α,17ß-diacholestane (20R)	28
10	14α,17α-cholestane (20R)	27
11	24-ethyl-13ß,17α-diacholestane (20R)	29
12	24-ethyl-13α,17ß-diacholestane (20S)	29
13	24-methyl-14α,17α-cholestane (20S)	28
14D	24-ethyl-13α,17ß-diacholestane (20R)	29
14	24-methyl-14ß,17ß-cholestane (20R)	28
15	24-methyl-14ß,17ß-cholestane (20S)	28
16	24-methyl-14α,17α-cholestane (20R)	28
17	24-ethyl-14α-cholestane (20S)	29
18	24-ethyl-14ß,17ß-cholestane (20R)	29
19	24-ethyl-14ß,17ß-cholestane (20S)	29
20	24-ethyl-14α,17α-cholestane (20R)	29
21A	24-n-Propylcholestane (20S)	30
21B	4-methyl-24-ethylcholestane (20S)	30
22A	4α-methyl-24-ethyl-14β,17β-cholestane(20S)	30
22B	24-n-propyl-14β,17β-cholestane (20S)	30
23A	4α-methyl-24-ethyl-14β,17β-cholestane(20R)	30
23B	24-n-propyl-14β,17β-cholestane (20R)	30
24A	4α-methyl-24-ethylcholestane(20R)	30
24B	24-n-propylcholestane (20R)	30

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Table 9

Key for Identification for Six Pyrogenic PAH (m/z 252)

Peak No.	Identity
a	Benzo(J)fluoranthene
b	Benzo(B+K)fluoranthene
c	Benzo(A)fluoranthene
d	Benzo(E)pyrene
e	Benzo(A)pyrene
f	Perylene

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Table 10

Key for Monoaromatic Steranes Identification (m/z 253 mass chromatogram)

Code	Identity	Elemental Composition
a	20S, 5ß C_{27}-Monoaromatic sterane	$C_{27}H_{42}$
b	20S, dia C_{27}-Monoaromatic sterane	$C_{27}H_{42}$
c	20R, 5ß C_{27}-Monoaromatic sterane + 20R C_{27} dia MAS	$C_{27}H_{42}$
d	20S, 5α C_{27}-Monoaromatic sterane	$C_{27}H_{42}$
e	20S, 5ß C_{28}-Monoaromatic sterane + 20S C_{28} dia MAS	$C_{28}H_{44}$
f	20R, 5α C_{27}-Monoaromatic sterane	$C_{27}H_{42}$
g	20S, 5α C_{28}-Monoaromatic sterane	$C_{28}H4_4$
h	20R, 5ß C_{28}-Monoaromatic sterane + 20R C_{28} dia MAS	$C_{28}H_{44}$
i	20S, 5ß C_{29}-Monoaromatic sterane + 20S C_{29} dia MAS	$C_{29}H_{46}$
j	20S, 5α C_{29}-Monoaromatic sterane	$C_{29}H_{46}$
k	20R, 5α C_{28}-Monoaromatic sterane	$C_{28}H_{44}$
l	20R, 5ß C_{29}-Monoaromatic sterane + 20R C_{29} dia MAS	$C_{29}H_{46}$
m	20R, 5α C_{29}-Monoaromatic sterane	$C_{29}H_{46}$

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Table 11

Key for Triaromatic Steranes Identification (m/z 231 chromatogram)

Code	Identity	Elemental Composition
T1	C_{20} Triaromatic sterane	$C_{20}H_{20}$
T2	C_{21} Triaromatic sterane	$C_{21}H_{22}$
T3	20S C_{26} Triaromatic sterane	$C_{26}H_{32}$
T4	20R C_{26} + 20S C_{27}-Triaromatic steranes	$C_{26}H_{32}$ + $C_{27}H_{34}$
T5	20S C_{28}-Triaromatic sterane	$C_{28}H_{36}$
T6	20R C_{27}-Triaromatic sterane	$C_{27}H_{34}$
T7	20R C_{28}-Triaromatic sterane	$C_{28}H_{36}$

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Table 12

Key for Aromatic Compounds Identification in Bar Diagram

AB:	C_3-C_6 Alkylbenzenes
NAPH:	C_0-C_4 Naphthalenes
FL:	C_0-C_4 Fluorenes
BP:	C_0-C_2 BP Biphenyl/Dibenzofuran
PHEN:	C_0-C_4 Phenanthrenes
PY:	C_0-C_4 Pyrenes/Fluoranthenes
CHR:	C_0-C_4 Chrysenes
BT:	C_1-C_5 Benzothiophenes
DBT:	C_0-C_4 Dibenzothiophenes
NBT:	C_0-C_4 Naphthobenzothiophenes
MAS:	Monoaromatic Steranes
TAS:	Triaromatic Steranes

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APPENDIX

Chain of Custody

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CHAIN OF CUSTODY

Page 1 of 1

Cambria Manager: DAVID ELIAS
Cambria Sampler: MARK ERICKSON
Client: CITY OF OAKLAND
Site Address: 7101 EDGEWATER DR.
Project Number: 153-1247.

SAMPLE ID	DATE	TIME	MATRIX	# OF SAMPLES	#	C3-C44	Full scan	Column chromatography	extraction (Sep)						LAB: # CALL FOR ANALYTES. DAVID ELIAS (510) 420-3307
MW-6	4/18/00	12:45	WATER	2											Lab #
MW-16	4/18/00	1:30	WATER	2		X	X	X	X						19835-1
									X						-2

Relinquished by: [signature]
Received by:
Time/Date: 4/20/00 6:10

Relinquished by:
Received by: [signature]
Time/Date: 4-21-00 1100

Relinquished by:
Received by:
Time/Date:

Relinquished by:
Received by:
Time/Date:

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Table 3

Key to Chromatogram Symbol Identification

Symbol	Detail
i-10	Iso-alkane with 10 carbon atoms
i-15	Farnesane (isoprenoid with 15 carbon atoms)
i-16	Isoprenoid with 16 carbon atoms
Pr	Pristane (isoprenoid with 19 carbon atoms)
Ph	Phytane (isoprenoid with 20 carbon atoms)
nC_8	n-C_8 normal alkane
nC_{15}	n-C_{15} normal alkane
i-8	2,5-(2,4)-Dimethylhexane
i-8'	2,3,4-Trimethylpentane
i-8"	2,3-Dimethylhexane
CH-*n*	Alkylcyclohexane (where *n* indicates number of carbon atoms in the side chain)

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Table 4

Key for C_4-Alkylbenzenes (m/z 134 mass chromatograms)

#	Compound
16	Sec-Butylbenzene
17	1-Methyl-3-Isopropylbenzene
18	1-Methyl-4-Isopropylbenzene
19	1-Methyl-2-Isopropylbenzene
20	1,3-Diethylbenzene
21	1-Methyl-3-Propylbenzene
22	Butylbenzene
23	1,3-Diemethyl-5-Ethylbenzene
24	1,2-Diethylbenzene
25	1-Methyl-2-Propylbenzene
26	1,4-Dimethyl-2-Ethylbenzene
27	1,3-Dimethyl-4-Ethylbenzene
28	1,2-Dimethyl-4-Ethylbenzene
29	1,3-Dimethyl-2-Ethylbenzene
30	1,2-Dimethyl-3-Ethylbenzene
31a	1,2,4,5-Tetramethylbenzene
31	1,2,3,5-Tetramethylbenzene
32	1,2,3,4-Tetramethylbenzene

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Table 5

Key for identification of the bicyclanes (m/z 123 mass chromatograms)

Peak No.	Identity	Formula	M.W.
a	2,2,3-Trimethylbicyloheptane	$C_{10}H_{18}$	138
b	C_{10} bicyclic	$C_{10}H_{18}$	138
c	3,3,7-Trimethylbicycloheptane	$C_{10}H_{18}$	138
d	C_{11} decalin	$C_{11}H_{20}$	152
f	Nordrimane	$C_{14}H_{26}$	194
g	Nordrimane	$C_{14}H_{26}$	194
h	Rearranged drimane	$C_{15}H_{28}$	208
j	Rearranged drimane	$C_{15}H_{28}$	208
k	Isomer of eudesmane	$C_{15}H_{28}$	208
l	4β(H) Eudesmane	$C_{15}H_{28}$	208
m	C_{15} bicyclic sesquiterpane	$C_{15}H_{28}$	208
n	8β(H) Drimane	$C_{15}H_{28}$	208
o	C_{15} bicyclic sesquiterpane	$C_{15}H_{28}$	208
p	C_{16} bicyclic sesquiterpane	$C_{16}H_{30}$	222
q	C_{16} bicyclic sesquiterpane	$C_{16}H_{30}$	222
r	8β(H) Homodrimane	$C_{16}H_{30}$	222

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Table 6

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Key for Identifying Aromatic Hydrocarbons

No.	m/z	Compound
1	120	C_3-alkylbenzenes
2	134	C_4-alkylbenzenes
3	148	C_5-alkylbenzenes
4	162	C_6-alkylbenzenes
5	128	C_0-naphthalene
6	142	C_1-naphthalenes
7	156	C_2-naphthalenes
8	170	C_3-naphthalenes
9	184	C_4-naphthalenes
10	166	C_0-fluorene
11	180	C_1-fluorenes
12	194	C_2-fluorenes
13	208	C_3-fluorenes
14	222	C_4-fluorenes
15	154	C_0-biphenyl
16	168	C_1-biphenyls + dibenzofuran
17	182	C_2-biphenyls + C_1-dibenzofuran
18	178	C_0-phenanthrene
19	192	C_1-phenanthrenes
20	206	C_2-phenanthrenes
21	220	C_3-phenanthrenes
22	234	C_4-phenanthrenes
23	202	C_0-pyrene/fluoranthene
24	216	C_1-pyrenes/fluoranthenes
25	230	C_2-pyrenes/fluoranthenes
26	244	C_3-pyrenes/fluoranthenes
27	258	C_4-pyrenes/fluoranthenes
28	228	C_0-chrysene
29	242	C_1-chrysenes
30	256	C_2-chrysenes
31	270	C_3-chrysenes
32	284	C_4-chrysenes
33	148	C_1-benzothiophenes
34	162	C_2-benzothiophenes
35	176	C_3-benzothiophenes
36	190	C_4-benzothiophenes
37	204	C_5-benzothiophenes
28	184	C_0-dibenzothiophene
39	198	C_1-dibenzothiophenes
40	212	C_2-dibenzothiophenes
41	226	C_3-dibenzothiophenes
42	240	C_4-dibenzothiophenes
43	234	C_0-naphthobenzothiophene
44	248	C_1-naphthobenzothiophenes
45	262	C_2-naphthobenzothiophenes
46	276	C_3-naphthobenzothiophenes
47	290	C_4-naphthobenzothiophenes
48	253	Monoaromatic steranes
49	267	Monoaromatic steranes
50	239	Monoaromatic steranes
51	231	Triaromatic steranes
52	245	Triaromatic steranes

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Table 7

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Key for Tricyclic, Tetracyclic, and Pentacyclic Terpanes Identification (m/z 191 mass chromatograms)

Code	Identity	Carbon #
0	C_{20}-Tricyclic Terpane	20
1	C_{21}-Tricyclic Terpane	21
2	C_{22}-Tricyclic Terpane	22
3	C_{23}-Tricyclic Terpane	23
4	C_{24}-Tricyclic Terpane	24
5	C_{25}-Tricyclic Terpane	25
Z4	C_{24}-Tetracyclic Terpane	24
6a	C_{26}-Tricyclic Terpane	26
6b	C_{26}-Tricyclic Terpane	26
7	C_{27}-Tricyclic Terpane	27
A	C_{28}-Tricyclic Terpane #1	28
B	C_{28}-Tricyclic Terpane #2	28
C	C_{29}-Tricyclic Terpane #1	29
D	C_{29}-Tricyclic Terpane #2	29
E	18α-22,29,30-Trisnorneohopane (Ts)	27
F	17α-22,29,30-Trisnorhopane (Tm)	27
G	17ß-22,29-30-Trisnorhopane	27
H	17α-23,28-Bisnorlupane	28
10a	C_{30}-Tricyclic Terpane #1	30
10b	C_{30}-Tricyclic Terpane #2	30
I	17α-28,30-Bisnorhopane	28
11a	C_{31}-Tricyclic Terpane #1	31
J	17α-25-Norhopane	29
11b	C_{31}-Tricyclic Terpane #2	31
K	17α,21ß-30-Norhopane	29
C_{29}Ts	18α-30-Norneohopane	29
C_{30}*	17α-Diahopane	30
L	17ß-21α-30-Normoretane	29
Ma	18α-Oleanane	30
Mb	18ß-Oleanane	30
N	17α,21ß-Hopane	30
O	17ß,21α-Moretane	30
13a	C_{33}-Tricyclic Terpane #1	33
13b	C_{33}-Tricyclic Terpane #2	33
P	22S-17α,21ß-30-Homohopane	31
Q	22R-17α,21ß-30-Homohopane	31
R	Gammacerane	30
14a	C_{34}-Tricyclic Terpane #1	34
S	17ß,21α-Homomoretane	31
14b	C_{34}-Tricyclic Terpane #2	34
T	22S-17α,21ß-30-Bishomohopane	32
U	22R-17α,21ß-30-Bishomohopane	32
15a	C_{35}-Tricyclic Terpane #1	35
15b	C_{35}-Tricyclic Terpane #2	35
V	17ß,21α-C_{32}-Bishomomoretane	32
WS	22S-17α,21ß-30,31,32-Trishomohopane	33
WR	22R-17α,21ß-30,31,32-Trishomohopane	33
16a	C_{36}-Tricyclic Terpane #1	36
16b	C_{36}-Tricyclic Terpane #2	36
XS	22S-17α,21ß-30,31,32,33-Tetrahomohopane	34
XR	22R-17α,21ß-30,31,32,33-Tetrahomohopane	34
YS	22S-17α,21ß-30,31,32,33,34-Pentahomohopane	35
YR	22R-17α,21ß-30,31,32,33,34-Pentahomohopane	35

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Table 8

Key for Steranes Identification (m/z 217 Mass Chromatogram)

Code	Identity	Carbon #
1	13ß,17α-diacholestane (20S)	27
2	13ß,17α-diacholestane (20R)	27
3	13α,17ß-diacholestane (20S)	27
4	13α,17ß-diacholestane (20R)	27
5	24-methyl-13ß,17α-diacholestane (20S)	28
6	24-methyl-13ß,17α-diacholestane (20R)	28
7D	24-methyl-13α,17ß-diacholestane (20S)	28
7	14α,17α-cholestane (20S)	27
8D	24-ethyl-13ß,17α-diacholestane (20S)	29
8	14ß,17ß-cholestane (20R)	27
9	14ß,17ß-cholestane (20S)	27
9D	24-methyl-13α,17ß-diacholestane (20R)	28
10	14α,17α-cholestane (20R)	27
11	24-ethyl-13ß,17α-diacholestane (20R)	29
12	24-ethyl-13α,17ß-diacholestane (20S)	29
13	24-methyl-14α,17α-cholestane (20S)	28
14D	24-ethyl-13α,17ß-diacholestane (20R)	29
14	24-methyl-14ß,17ß-cholestane (20R)	28
15	24-methyl-14ß,17ß-cholestane (20S)	28
16	24-methyl-14α,17α-cholestane (20R)	28
17	24-ethyl-14α-cholestane (20S)	29
18	24-ethyl-14ß,17ß-cholestane (20R)	29
19	24-ethyl-14ß,17ß-cholestane (20S)	29
20	24-ethyl-14α,17α-cholestane (20R)	29
21A	24-n-Propylcholestane (20S)	30
21B	4-methyl-24-ethylcholestane (20S)	30
22A	4α-methyl-24-ethyl-14β,17β-cholestane(20S)	30
22B	24-n-propyl-14β,17β-cholestane (20S)	30
23A	4α-methyl-24-ethyl-14β,17β-cholestane(20R)	30
23B	24-n-propyl-14β,17β-cholestane (20R)	30
24A	4α-methyl-24-ethylcholestane(20R)	30
24B	24-n-propylcholestane (20R)	30

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Table 9

Key for Identification for Six Pyrogenic PAH (m/z 252)

Peak No.	Identity
a	Benzo(J)fluoranthene
b	Benzo(B+K)fluoranthene
c	Benzo(A)fluoranthene
d	Benzo(E)pyrene
e	Benzo(A)pyrene
f	Perylene

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Table 10

Key for Monoaromatic Steranes Identification (m/z 253 mass chromatogram)

Code	Identity	Elemental Composition
a	20S, 5ß C_{27}-Monoaromatic sterane	$C_{27}H_{42}$
b	20S, dia C_{27}-Monoaromatic sterane	$C_{27}H_{42}$
c	20R, 5ß C_{27}-Monoaromatic sterane + 20R C_{27} dia MAS	$C_{27}H_{42}$
d	20S, 5α C_{27}-Monoaromatic sterane	$C_{27}H_{42}$
e	20S, 5ß C_{28}-Monoaromatic sterane + 20S C_{28} dia MAS	$C_{28}H_{44}$
f	20R, 5α C_{27}-Monoaromatic sterane	$C_{27}H_{42}$
g	20S, 5α C_{28}-Monoaromatic sterane	$C_{28}H4_4$
h	20R, 5ß C_{28}-Monoaromatic sterane + 20R C_{28} dia MAS	$C_{28}H_{44}$
i	20S, 5ß C_{29}-Monoaromatic sterane + 20S C_{29} dia MAS	$C_{29}H_{46}$
j	20S, 5α C_{29}-Monoaromatic sterane	$C_{29}H_{46}$
k	20R, 5α C_{28}-Monoaromatic sterane	$C_{28}H_{44}$
l	20R, 5ß C_{29}-Monoaromatic sterane + 20R C_{29} dia MAS	$C_{29}H_{46}$
m	20R, 5α C_{29}-Monoaromatic sterane	$C_{29}H_{46}$

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Table 11

Key for Triaromatic Steranes Identification (m/z 231 chromatogram)

Code	Identity	Elemental Composition
T1	C_{20} Triaromatic sterane	$C_{20}H_{20}$
T2	C_{21} Triaromatic sterane	$C_{21}H_{22}$
T3	20S C_{26} Triaromatic sterane	$C_{26}H_{32}$
T4	20R C_{26} + 20S C_{27}-Triaromatic steranes	$C_{26}H_{32}$ + $C_{27}H_{34}$
T5	20S C_{28}-Triaromatic sterane	$C_{28}H_{36}$
T6	20R C_{27}-Triaromatic sterane	$C_{27}H_{34}$
T7	20R C_{28}-Triaromatic sterane	$C_{28}H_{36}$

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Table 12

Key for Aromatic Compounds Identification in Bar Diagram

AB:	C_3-C_6 Alkylbenzenes
NAPH:	C_0-C_4 Naphthalenes
FL:	C_0-C_4 Fluorenes
BP:	C_0-C_2 BP Biphenyl/Dibenzofuran
PHEN:	C_0-C_4 Phenanthrenes
PY:	C_0-C_4 Pyrenes/Fluoranthenes
CHR:	C_0-C_4 Chrysenes
BT:	C_1-C_5 Benzothiophenes
DBT:	C_0-C_4 Dibenzothiophenes
NBT:	C_0-C_4 Naphthobenzothiophenes
MAS:	Monoaromatic Steranes
TAS:	Triaromatic Steranes

6919 Eton Avenue
Canoga Park CA
91303-2194
fax 818.992.8940
818.992.4103

71 Zaca Lane
San Luis Obispo
California 93401
fax 805.544.8226
805.544.4696
email: forensics@ZymaXusa.com

ZymaX FORENSICS

APPENDIX

Chain of Custody

6919 Eton Avenue
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CAMBRIA ENVIRONMENTAL TECHNOLOGY, INC.

1144 65th Street, Suite C, Oakland, CA 94608
(510) 420-0700 Fax: (510) 420-9170

CHAIN OF CUSTODY

Page 1 of 1

Cambria Manager: DAVID ELIAS
Cambria Sampler: MARK ERICKSON
Client: CITY OF OAKLAND
Site Address: 7101 EDGEWATER DR.
Project Number: 153-1247.

SAMPLE ID	DATE	TIME	MATRIX	# OF SAMPLES	#	C3-C44	Full scan	Column chromatogr	extraction (draw)						LAB: # CALL FOR ANALYTES. DAVID ELIAS. (510) 420-3307
MW-6	4/18/00	12:45	WATER	2					X						Lab #
MW-16	4/18/00	1:30	WATER	2		X	X	X	X						19835-1
															-2

Relinquished by: [signature]
Received by:
Time/Date: 4/20/00 6:10

Relinquished by:
Received by: [signature]
Time/Date: 4-21-00 1100

Relinquished by:
Received by:
Time/Date:

Relinquished by:
Received by:
Time/Date: