June 30, 2000

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

Re: City of Oakland
P.O. 153-1247

Dear Mr . Elias,

1.0 INTRODUCTION

Two products ID MW-6 and TBW-1 were submitted to ZymaX forensics, Inc. on May 17, 2000 and were assigned Lab. No. 20097. One additional product ID MW-16 (previously assigned No. 19835 and reported on May 18, 2000) was also submitted to ZymaX forensics, Inc. on June 13, 2000 for simulated distillation analysis. Per your request, NAPL samples MW-6 and TBW-1 were analyzed and compared with the results previously obtained from MW-16.

To achieve the above objective, the following analyses were performed on the NAPL samples MW-6 and TBW-1:

1. Simulated distillation by ASTM 2887D method
2. C_3-C_{44} high resolution gas chromatography
3. Gas chromatograph-mass spectrometer (GC/MS) analyses of the NAPL samples in a full scan mode with identification of the following fuel-specific homologous series: n-alkanes (m/z 85), isoprenoid (m/z 113), alkylcyclohexane (m/z 83), alkylbenzenes (m/z 134) bicyclanes (m/z 123), terpanes (m/z 191), steranes (m/z 217), MAS & TAS (m/z 253& 231), and polynuclear aromatic hydrocarbons.

Only simulated distillation was performed on sample MW-16.

2.0 RESULTS

2.1 Gas Chromatography

The simulated distillation curve shown in Figure 1 displays the boiling points of the

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two products (MW-6 and TBW-1) to span the range from 160°-720°F for MW-6, and 310°-720°F for TBW-1. The boiling point range for sample MW-16 (Figure 2) is from 180°F to 900°F for NAPL sample MW-16. The simulated distillation curves for MW-6 and TBW-1 can be differentiated for the most volatile fuel components. Whereas MW-6 could represent a partially (mildly) evaporated gasoline (initial boiling point about 120°-130°F), the initial boiling point for sample TBW-1 is nearer the final boiling point of gasoline (370°-400°F) and may either represent a severely evaporated gasoline or another fuel type, such as a mid-distillate with a starting boiling range above 300°F. The remainder of the curve is characteristic of a mid-distillate fuel.

The initial boiling range for sample MW-16 beginning around 180°F, displays characteristics of a partially evaporated gasoline. 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.

The C_3-C_{44} whole oil range hydrocarbons gas chromatograms for samples MW-6 and TBW-1 are shown in Figures 3 and 4. The data show a distribution pattern of a mixture of a gasoline-range hydrocarbons together with a mid-range distillate, extending out to slightly beyond n-C_{20}. The gasoline range hydrocarbons in these figures have been itemized in Table 1. This table shows that both samples have lost their most volatile hydrocarbons. Both samples do not contain butenes or pentenes and only traces of hexenes. Benzene and toluene have been depleted from both samples, but more so from sample TBW-1. However, both samples display the presence of 2,2,4-trimethylpentane (compound No. 35, Table 1) which is also known as isooctane, a refinery manufactured gasoline octane booster. Surprisingly, xylenes and the alkyl (substituted) benzenes are also relatively low, especially in sample MW-6. This is reflected in the bulk composition shown in Table 2. The octane ratings calculated in Table 2 suggest that the gasoline fraction are low octane.

The chromatogram in Figure 3 further demonstrates that the mid-range distillate in sample MW-6 contains no detectable n-alkane or paraffin fraction. Hence, the data displayed in Figure 3 provide evidence for a mildly weathered gasoline-range fuel and a moderately weathered mid-range petroleum fuel. Whereas for sample TBW-1 (Figure 4), the chromatogram shows a moderately weathered gasoline-range fuel and a mildly weathered mid-range fuel. Based on these data, the two fuel mixtures in samples MW-6 and TBW-1 may not be related.

2.2 Gas Chromatography-Mass Spectrometry

2.2.1 Extraction and Cleaning of Samples

To remove polar and asphaltenic oxidation products compounds which can interfere with the mass spectrometer analysis of the hydrocarbons, the samples were passed down a vertical column packed with activated silica. The samples were separated into saturated

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(aliphatic) and aromatic hydrocarbons (fraction 1), and polar and asphaltenic hydrocarbons (fraction 2). The greater weight of fraction 2 in sample MW-6 signifies that the semi-volatile component in this sample is more highly weathered than the equivalent component in sample TBW-1.

The distribution patterns of hydrocarbon families identified by GC-MS are shown in Figures 5-29 and Tables 4-3.

2.2.2. The Total Ion Current (TIC)

The TIC chromatograms (Figures 5 and 6) are characteristic of mid-range distillates, with a heavier component appearing in Figure 6. Both show small humps at elution times 65-75 minutes, which could represent a high boiling residual component.

2.2.3 Specific Mass Fragments

Identification of hydrocarbon families at specific mass fragments starting in Figures 7 and 8 for the n-alkanes display similarities and differences between the two samples.

The presence of 2,5-dimethylhexane(I-8), 2,3 ,4-trimethylpentane (I-8') and2,3-dimethylhexane(I-8") in mass chromatogram of m/z 85) confirm that gasoline is present in NAPL samples MW-6 and TBW-1. Further, the C_{11+} n-alkanes are absent for MW-6, indicating the mid-distillate portion of MW-6 is biodegraded and may represent diesel No. 2, whereas n-alkane distribution ranging from n-C_8 to n-C_{24}, optimizing at n-C_{14} in sample TBW-1 can be attributed to the contribution of a kerosene type fuel, such as Jet-A, with a smaller concentration of diesel No. 2 fuel.

The distribution patterns of isoprenoids (m/z 113, Figures 9 and 10) and alkylcyclohexanes (m/z 83, Figures 11 and 12) support the above conclusions tnat product sample MW-6 is primarily diesel No. 2 fuel, whereas sample TBW-1 is a mixture of a kerosene type fuel and diesel No. 2. Both samples also contain gasoline as a minor component. The presence of methylcyclohexane (CH-1) in the m/z 83 mass chromatograms is further evidence for the presence of gasoline.

The C_4-alkylbenzenes (m/z 134) distribution patterns (Figures 13 and 14) showing peak 32 lower than 31 or 31a (Table 5) is characteristic of gasoline or a mixture containing gasoline. Furthermore, the ratio of 31/31a provides a parameter of biodegradation. Peaks 23 and 31 are more vulnerable to biodegradation than peak 31a. The ratio for 31/31a generally fall between 1.5 to 2.0 in newly dispensed gasoline and >2.0 in diesel. The measured value for both NAPLs, MW-6 and TBW-1, are 0.28 and 1.78 respectively, indicating that the fuel (diesel) in product sample MW-6 is moderately to severely biodegraded, whereas in TBW-1 the fuel mixture is only mildly degraded. The absence of peak 23 in Figure 13 and its prominent presence in Figure 14 further supports this conclusion. The n-C_{17}/pristane ratio in sample MW-6 is 0.0 (Figure 3), whereas for sample

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TBW-1, it is 0.21 (Figure 4) signifying moderate biodegradation for this sample and severe biodegradation for MW-6. We interpret this difference in degradation indicators for sample TBW-1 as being due to the fact that the peak 31/31a ratio reflects a young release of kerosene (jet fuel), whereas the n-C_{17}/pristane ratio reflects the weathering of the diesel components in the sample.

The distribution pattern of bicyclanes (m/z 123, Figures 15 and 16, Table 6) are slightly different for NAPL samples MW-6 and TBW-1, again reflecting different fuel mixtures.

2.2.4 Evidence for a Heavy Residual Component

A significant concentration of polycyclic aliphatic biomarkers such as terpanes and steranes (Figures 17) were detected in both product samples MW-6 and TBW-1. The C_{29} and C_{30} hopanes (Table 7) are the most prominent peaks in the distribution pattern of the mass chromatogram at m/z 191 (Figures 18 and 19), followed by C_{21} and C_{23} tricyclic terpanes, 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 (peak I, Figure 18) suggests that the original feedstock of heavy refined product probably originated from a California Monterey Formation derived crude oil. However, C_{21} and C_{23} content of tricyclic terpanes is greater in sample MW-6 than in both samples TBW-1 and MW-16, which reflects a more highly degraded fuel, in sample MW-6.

The relatively low abundance of diasteranes in the distribution patterns of steranes at m/z 217 (Figures 20 and 21), and the relative abundance of C_{29} steranes, especially peak 19 (Table 8), greater than C_{27} steranes, indicate that, in addition to crude oil from the California Monterey Formation, the residual refined oil in both MW-6 and TBW-1 may have contained another crude oil source. In general, the steranes distribution pattern are different for samples MW-6 and TBW-1 from that of sample MW-16.

The distribution pattern of pyrogenic compounds measured at m/z 252 (Figures 22 and 23) are significantly different between samples MW-6 and TBW-1, which are similar to each other but different from that in MW-16, which is similar to that of a typical heating fuel No. 6. Because of the enrichment of benzofluoranthene compounds (Table 9) in samples MW-6 and TBW-1 they may represent a mixture of heating fuel No. 6 plus a coal tar derivative.

The distribution patterns of mono- and tri-aromatic steranes (Figures 24-27, Tables 10 and 11) suggest a possible California crude as initial feedstock. The patterns for samples MW-6 and MW-16 MAS (Figures 24) are more similar to each other than to that of sample TBW-1 (Figure 25). However, the patterns for triaromatic steranes (Figures 26 and 27) all appear similar.

The aromatic hydrocarbon distribution for NAPL sample MW-6 is slightly dominated

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by alkylbenzenes and naphthalenes, with phenanthrenes, pyrenes, fluorenes, biphenyls, dibenzothiophenes, and mono- and tri-aromatic steranes (MAS and TAS) present in subordinate concentration (Figures 28 and 29, Tables 12 and 13), whereas the distribution of NAPL sample TBW-1 is strongly dominated by alkylbenzenes, followed by naphthalenes, and the other PAH present in relatively low abundance. This suggests that product sample MW-6 contains a mixture of No. 2 diesel together with small amounts of gasoline in addition to No. 6 heating oil and possibly traces of coal tar oil. NAPL sample TBW-1 is dominated by a Jet fuel with a more significant amount of weathered gasoline than in sample MW-6 in addition to a minor amount of a highly degraded diesel No. 2 fuel as well as trace amounts of No. 6 fuel and possibly coal tar oil.

3.0 CONCLUSIONS

1. NAPL sample MW-6 is dominated (about 95%) by a moderate to severely degraded No. 2 diesel with small amounts of mildly weathered gasoline, severely weathered heating fuel No. 6 and possibly a trace of coal tar oil.

2. NAPL samples TBW-1 is mainly composed of a mixture of mildly weathered Jet fuel (or kerosene), together with moderately weathered diesel No. 2, (about 70% combined), as well as minor amounts (about 30%) of moderately weathered gasoline, as well as trace amounts of moderately weathered heating fuel No. 6 and possibly traces of coal tar oil.

3. NAPL sample MW-16 is significantly different from sample MW-6, but it can also be differentiated from sample TBW-1. From the simulated distillation curves plotted in Figure 18, the differences in boiling characteristics become apparent. MW-16 contains 40% gasoline and 50% jet fuel, both moderately weathered and 10% moderately weathered No. 6 heating oil (see Table 14 for comparison of chemical characteristics), but no identifiable diesel No. 2.

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

Sincerely,

Isaac Kaplan

Isaac R. Kaplan, Ph.D.
Senior Consultant

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Figure 1

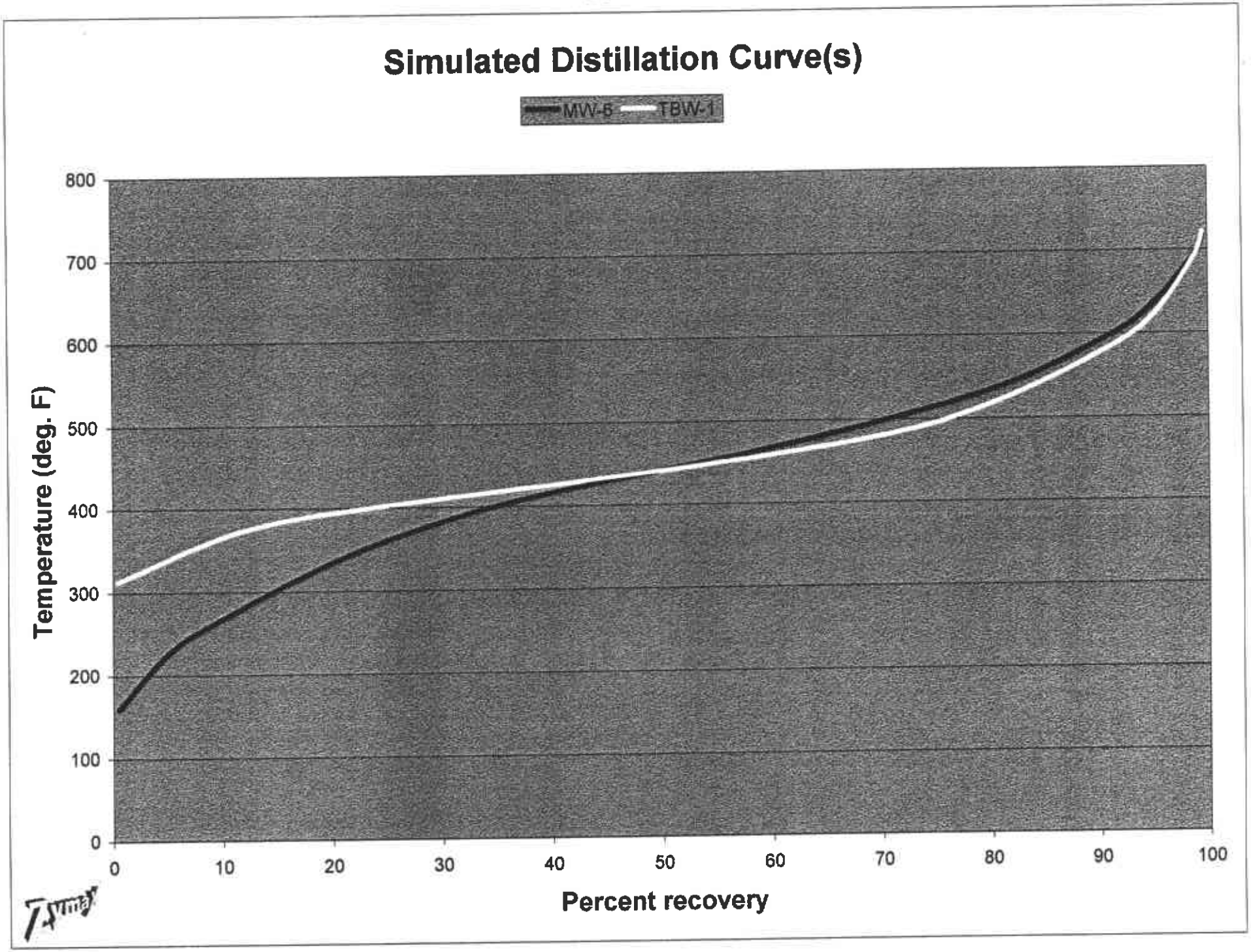
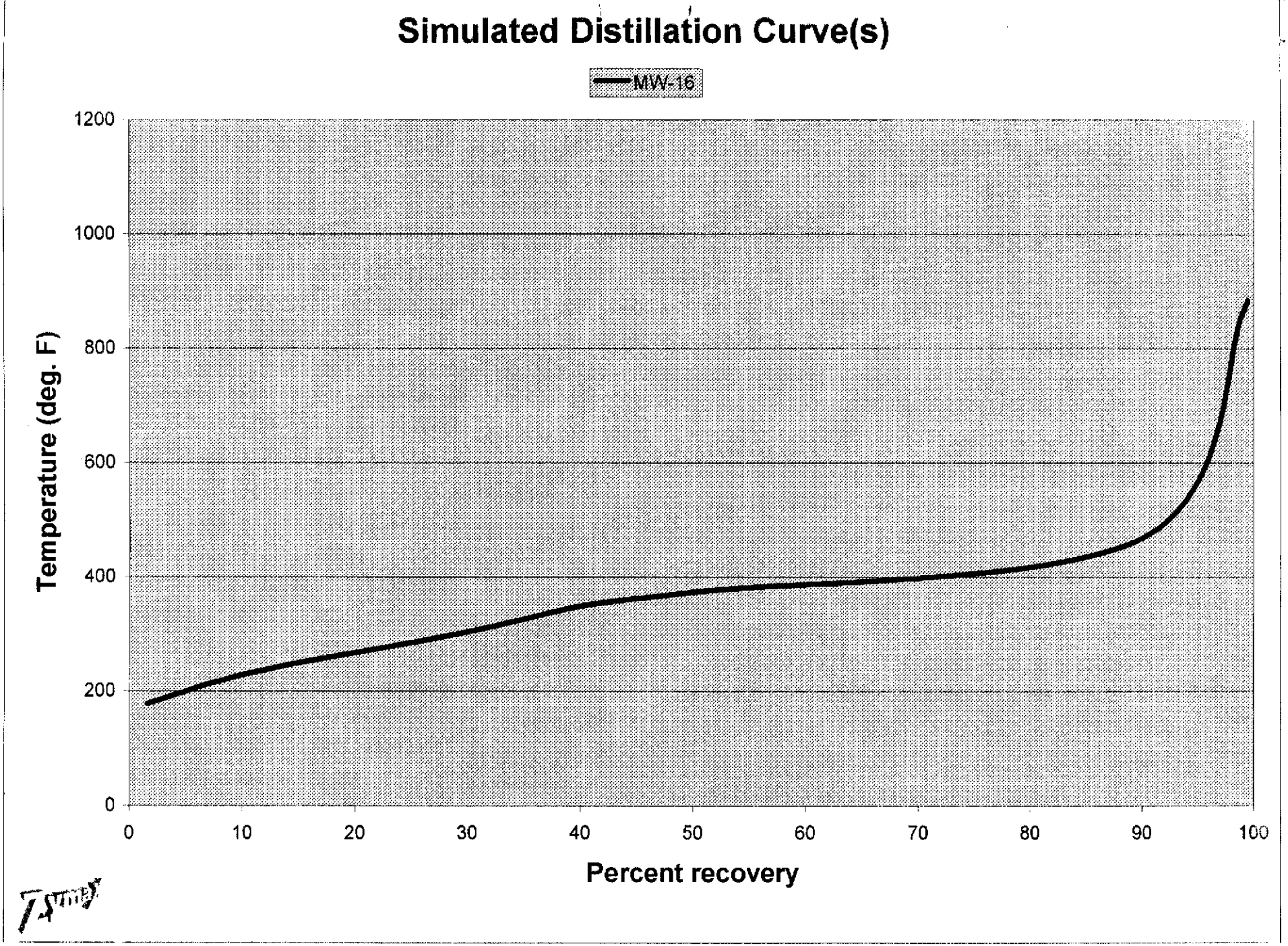
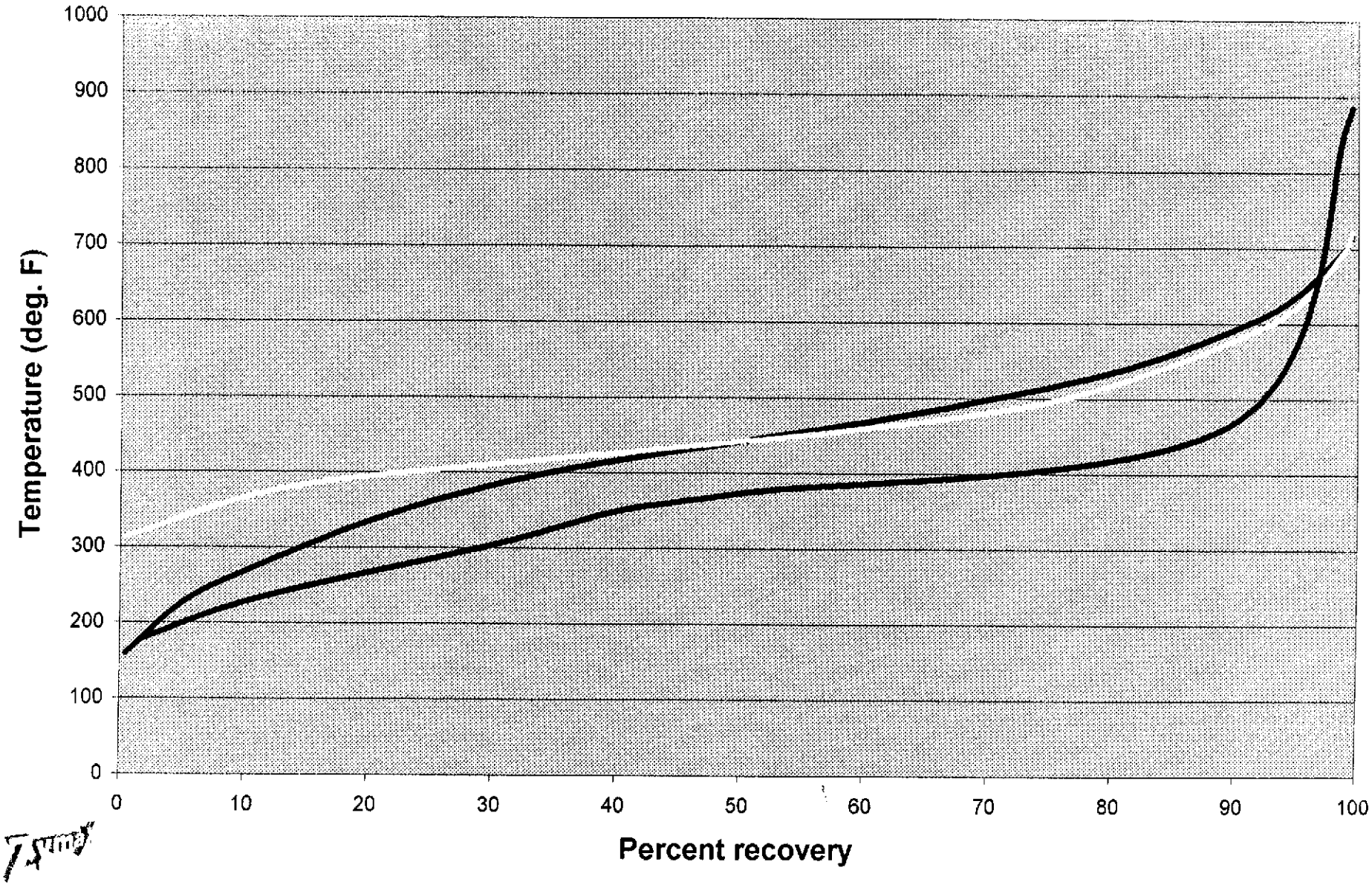

Simulated Distillation Curve(s)
MW-5
TBW-1
800
700
600
500
400
300
200
100
0
Temperature (deg. F)
0
10
20
30
40
50
60
70
80
90
100
Percent recovery

Figure 2


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

Note: Original figure included in Zymax 7/19/2000 letter/report to David Elias

Simulated Distillation Curve(s)



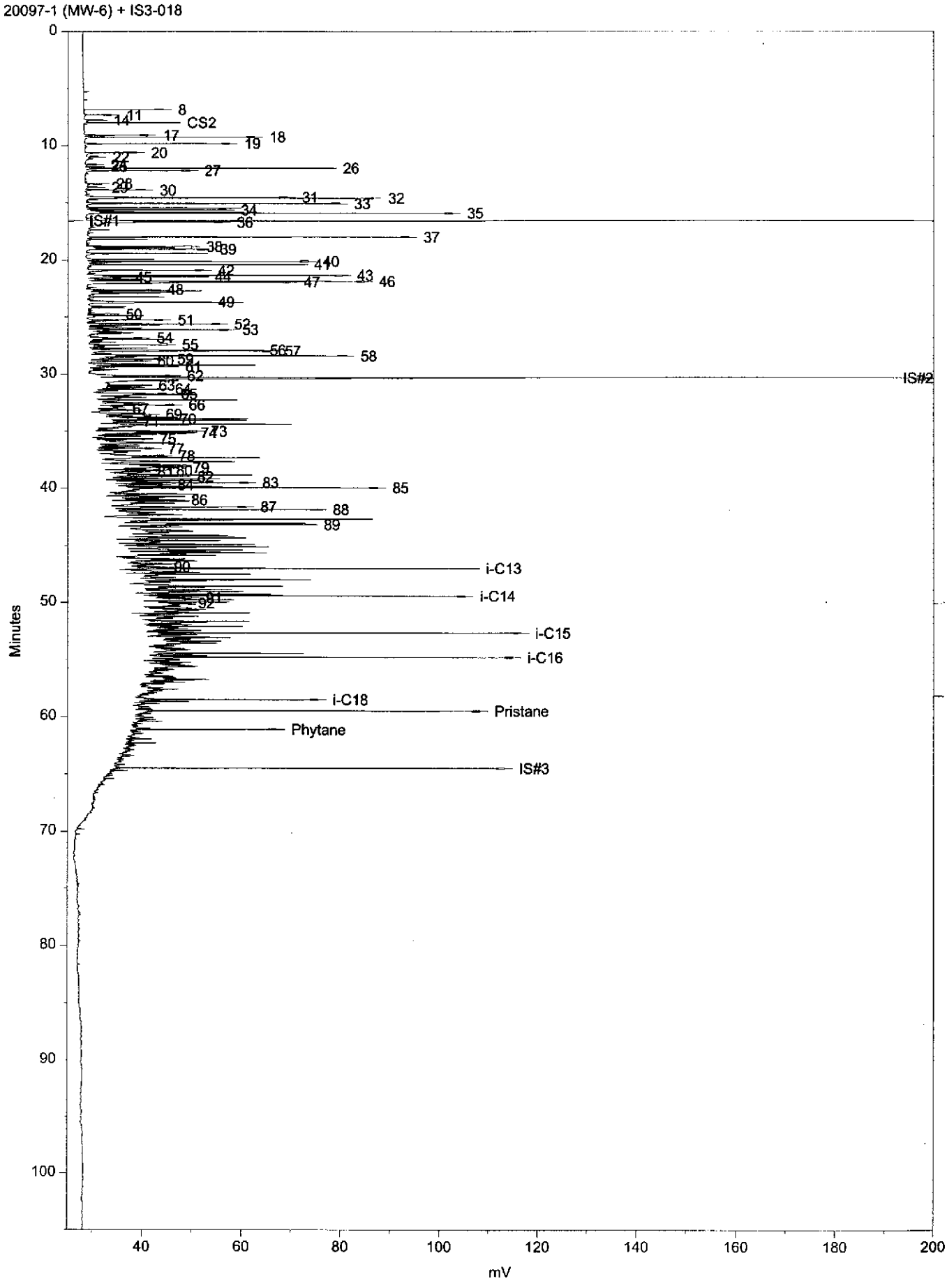


Figure 3

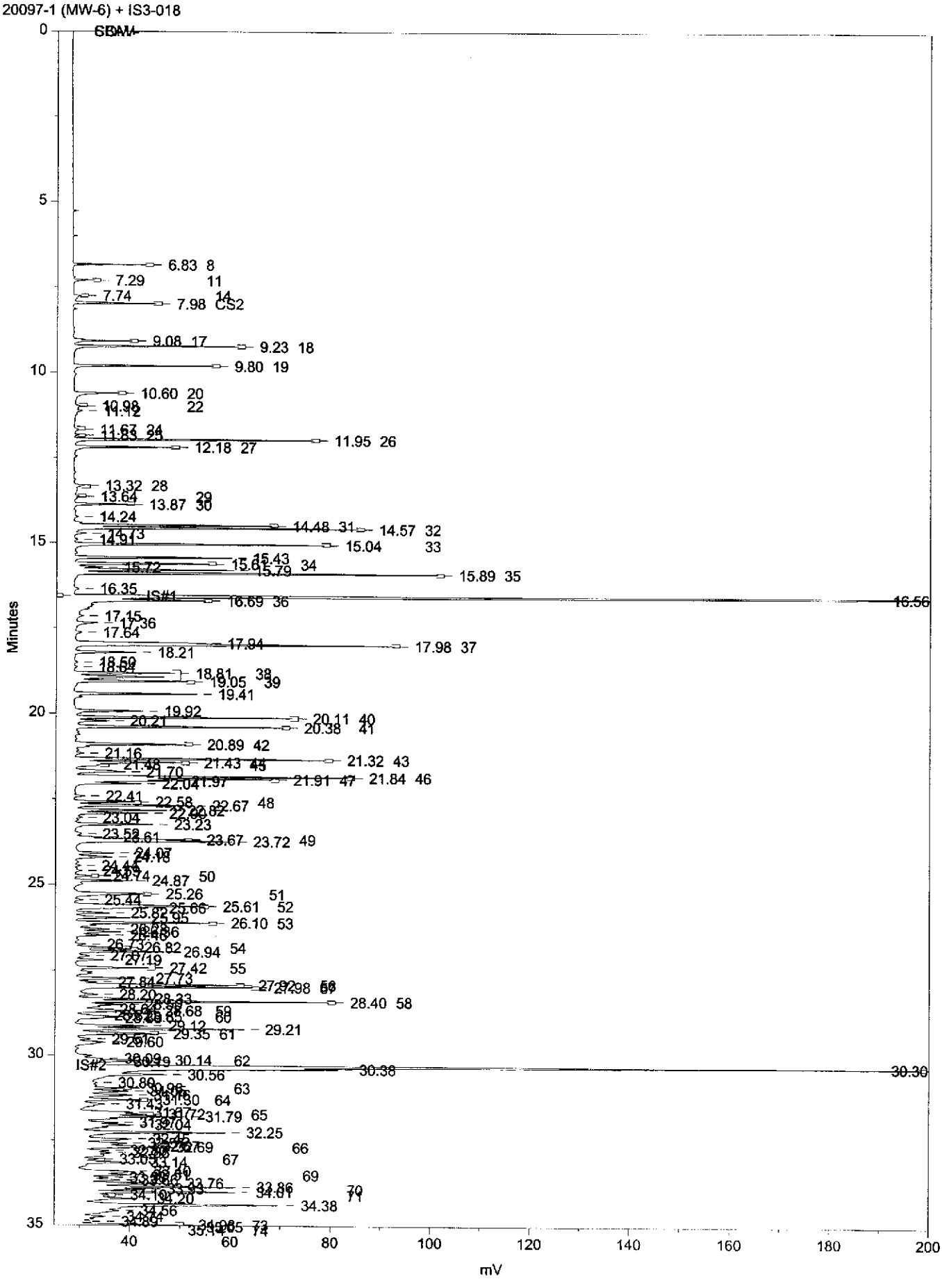


Figure 3 (continued)

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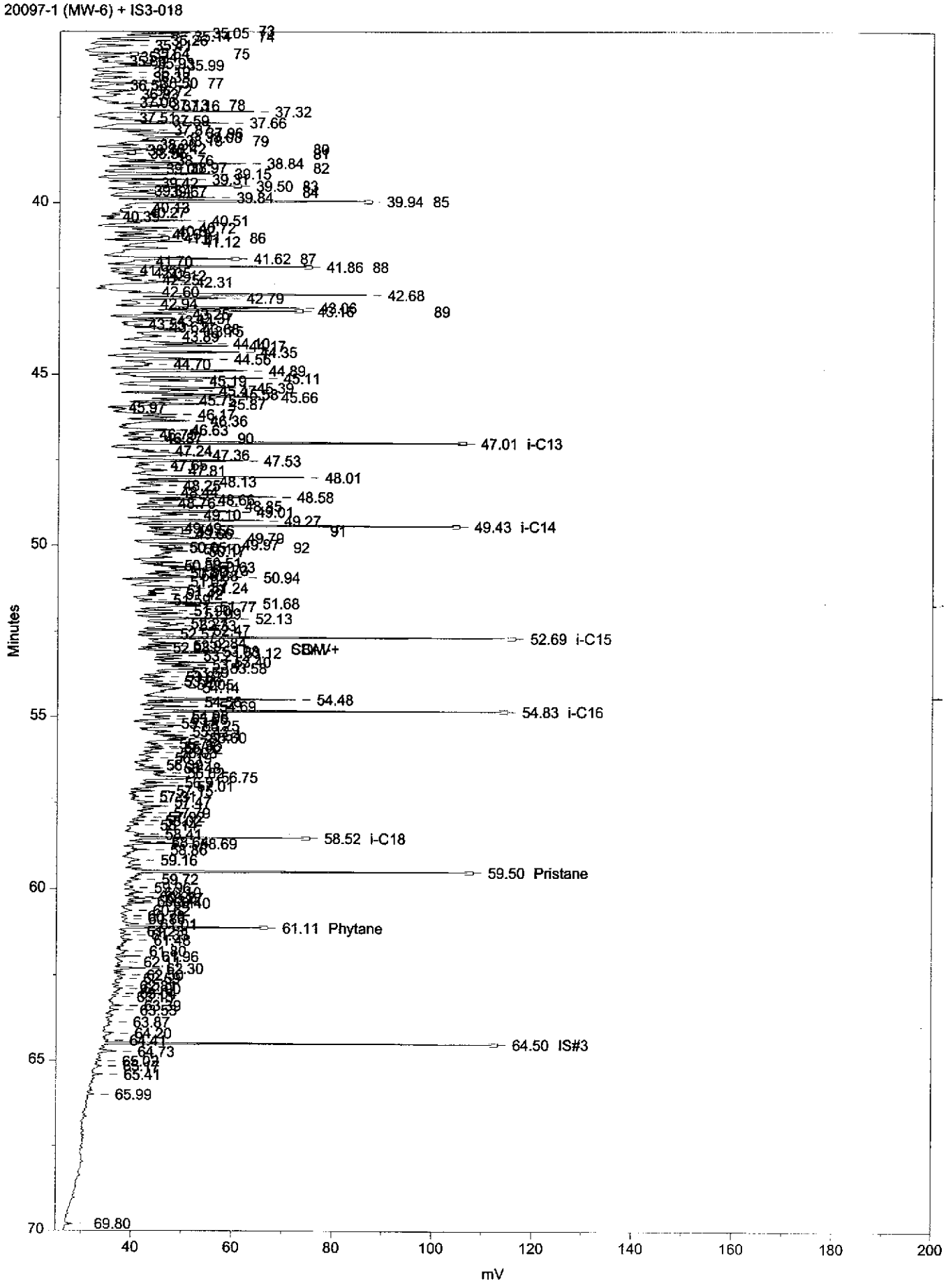

Figure 3 (continued)

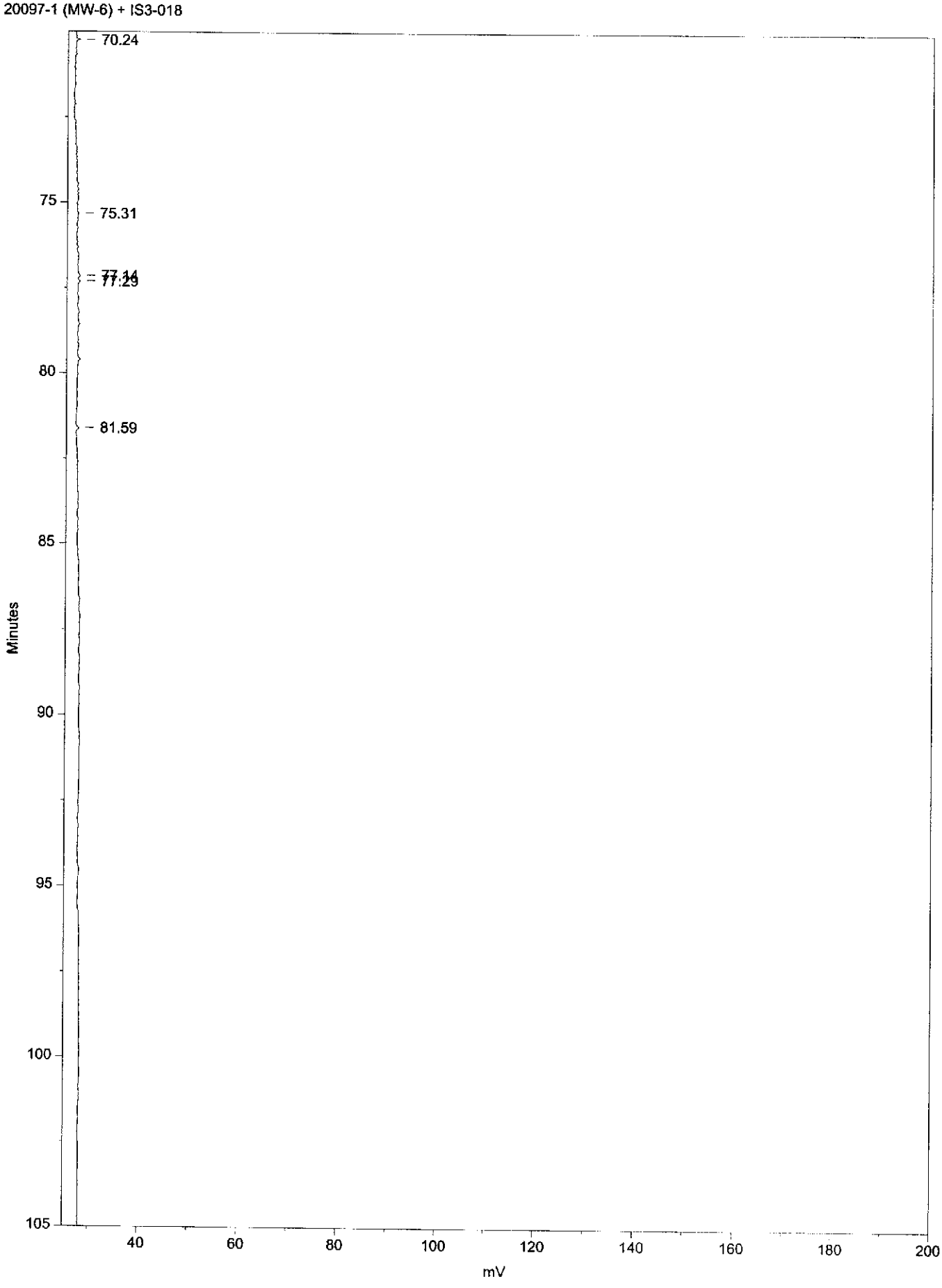

Figure 3 (continued)

ZYMAX FORENSICS

Figure 3 (continued)

C3 to C10 ANALYSIS by ZYMAX FORENSICS

TODAY'S DATE: 6/7/2000 TIME: 5:47:18 PM
RAW DATA FILE NAME: H:\DATA3\C344151.11R
SAMPLE NAME.....20097-1 (MW-6) + IS3-018
DATE TAKEN: 06-1-2000 10:47:12
METHOD FILE: !H:\DATA3\C344151K.MET
METHOD: C3-C44 Analysis
CALIBRATION FILE: !H:\DATA3\C344151K.CAL
INSTRUMENT: HP6890--FID OPERATOR: Jinbo Su
RUN TIME: 110min
COM PORT: 3
HEADING 1: C3-C44 Analysis
HEADING 2: split ratio 150:1
FORMAT FILE: H:\DATA3\C3C10.FMT

PEAKS DETECTED IN THIS CHROMATOGRAM:

Peak #	Ret Time (min)	Peak Name	Peak Area	Peak Height
1	6.83	8	19871	14752
2	7.29	11	8480	4206
3	7.74	14	8686	1690
4	7.98	CS2	37034	16421
5	9.08	17	28238	11624
6	9.23	18	70730	33008
7	9.80	19	60462	27946
8	10.60	20	35036	9163
9	10.98	22	5669	1448
10	11.12		6515	1792
11	11.67	24	5390	1035
12	11.83	25	3131	1064
13	11.95	26	113836	47828
14	12.18	27	53622	19822
15	13.32	28	8412	2048
16	13.64	29	4371	1153
17	13.87	30	28518	10832
18	14.24		3351	917
19	14.48	31	102438	39452
20	14.57	32	149099	56819
21	14.73		8168	2497
22	14.91		2919	816
23	15.04	33	131810	49963
24	15.43		81782	31445
25	15.61	34	69444	27055
26	15.72		14921	5758
27	15.79		81454	31852
28	15.89	35	194790	72839
29	16.35		4641	1032
30	16.56	IS#1	686680	260687
31	16.69	36	94817	26223
32	17.15		11266	1899
33	17.36		22723	4782
34	17.64		7290	1551
35	17.94		55169	26288
36	17.98	37	179659	63955
37	18.21		36403	12479
38	18.50		2857	819
39	18.64		2402	697
40	18.81	38	115517	19959
41	19.05	39	66876	22717
42	19.41		65556	24470
43	19.92		42953	13764
44	20.11	40	115881	43506
45	20.21		22383	7015
46	20.38	41	116183	41736
47	20.89	42	68121	22313
48	21.16		6954	1918

Figure 3 (continued)

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Peak #	Ret Time (min)	Peak Name	Peak Area	Peak Height
49	21.32	43	134138	50376
50	21.43	44	62061	21643
51	21.48	45	24933	5675
52	21.70		44275	10199
53	21.84	46	142235	54786
54	21.91	47	109888	39583
55	21.97		48670	19112
56	22.04		40566	13305
57	22.41		5894	2160
58	22.58	48	32333	12065
59	22.67		67237	23261
60	22.82		50253	18453
61	22.90		44096	14764
62	23.04		5098	1585
63	23.23		47964	15706
64	23.52		6959	1464
65	23.61		13598	5592
66	23.67	49	53406	22201
67	23.72		101101	31503
68	24.07		26519	7951
69	24.18		28233	7598
70	24.44		3859	1312
71	24.59		5171	1546
72	24.74	50	9933	3572
73	24.87		31130	11338
74	25.26	51	64302	14013
75	25.44		4901	1813
76	25.61	52	93241	25383
77	25.66		38660	14650
78	25.82		19838	7028
79	25.95		35283	11130
80	26.10	53	78145	26980
81	26.28		20723	6989
82	26.36		31198	9246
83	26.46		21237	6898
84	26.73		6324	2266
85	26.82	54	33415	9685
86	26.94		51693	17430
87	27.07		12822	2986
88	27.19		16818	5769
89	27.42	55	56452	14715
90	27.73		50905	11943
91	27.84		12104	4452
92	27.92	56	83833	32416
93	27.98	57	109530	35444
94	28.20		18422	4653
95	28.33		32332	11732
96	28.40	58	140373	50737
97	28.50		45568	9806
98	28.64		9723	4751
99	28.68	59	50393	13686
100	28.82		6229	3615
101	28.85	60	27564	9778
102	28.89		16080	5756
103	29.12		46479	14430
104	29.21		96117	33686
105	29.35	61	63006	15252
106	29.51		11632	3142
107	29.60		30198	6009
108	30.09		28995	5538
109	30.14	62	48679	15586
110	30.19		21701	7361
111	30.30	IS#2	459384	169235
112	30.38		231323	52428
113	30.56		112401	18076

Figure 3 (continued)

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Peak #	Ret Time (min)	Peak Name	Peak Area	Peak Height
114	30.80		18718	4218
115	30.96	63	35369	9747
116	31.05		43003	10519
117	31.16		50098	11223
118	31.30	64	47717	12998
119	31.43		39418	5679
120	31.67		40450	11257
121	31.72	65	38536	14084
122	31.79		67676	21408
123	31.97		26669	8280
124	32.04		40284	11278
125	32.25		111230	29535
126	32.45		50844	10901
127	32.57		40521	9960
128	32.67		29186	12793
129	32.69	66	46078	15528
130	32.80		21535	6372
131	32.86		23127	6842
132	33.05	67	13164	4198
133	33.14		44853	10380
134	33.40		57410	11017
135	33.51	69	33317	10795
136	33.58		17691	6183
137	33.66		34369	8429
138	33.76		66900	17460
139	33.86		89609	31427
140	33.93	70	38037	13563
141	34.01		96389	31273
142	34.10	71	25449	6173
143	34.20		53605	11470
144	34.38		187970	40212
145	34.56		51335	8144
146	34.74		19469	5413
147	34.89		11816	4305
148	34.98	73	54372	19632
149	35.05		75657	21146
150	35.14	74	69213	17540
151	35.26		45475	12942
152	35.41		41846	9680
153	35.64	75	28486	9139
154	35.74		25696	6588
155	35.86		16110	4231
156	35.93		26773	9727
157	35.99		62717	15535
158	36.19		34629	8571
159	36.33		28482	8322
160	36.50	77	30230	9696
161	36.56		8547	3516
162	36.72		32155	8162
163	36.83		25310	5400
164	37.06		19169	4716
165	37.13	78	22134	10983
166	37.16		57586	13133
167	37.32		115202	31289
168	37.51		10471	4041
169	37.59		29868	10518
170	37.66		82134	25818
171	37.87		31742	10510
172	37.96		64673	16816
173	38.08		85888	16398
174	38.18	79	36941	12445
175	38.30		28738	7140
176	38.42	80	31021	8781
177	38.46		10005	4508
178	38.55	81	19151	4882

Figure 3 (continued)

ZymaX FORENSICS

Peak #	Ret Time (min)	Peak Name	Peak Area	Peak Height
179	38.76		39590	9862
180	38.84		96645	27776
181	38.97	82	33542	12278
182	39.00		11689	7521
183	39.15		57921	20852
184	39.31		35768	16237
185	39.42		19335	5968
186	39.50	83	78176	24752
187	39.64		7032	4307
188	39.67	84	23278	7394
189	39.84		51537	20414
190	39.94	85	180282	50420
191	40.13		17743	3388
192	40.27		4441	2508
194	40.39		6875	-2971
195	40.51		32747	14635
196	40.72		22531	11757
197	40.82		25434	7532
198	40.91		13427	6314
199	41.01	86	19036	8393
200	41.12		43349	12148
201	41.62	87	92626	25745
202	41.70		28372	6292
203	41.86	88	123411	40569
204	41.95		14675	3398
205	42.05		19371	6287
206	42.12		49580	9393
207	42.25		24337	8201
208	42.31		67064	14924
209	42.60		32056	8735
210	42.68		200893	53646
211	42.79		99147	25159
212	42.94		51888	7586
213	43.06		142978	39112
214	43.16	89	119454	38329
215	43.25		40688	13160
216	43.37		41375	13544
217	43.44		34114	9534
218	43.55		13521	3686
219	43.62		24194	7740
220	43.68		43077	14091
221	43.75		50036	14683
222	43.89		69515	9477
223	44.10		82244	19101
224	44.17		77584	22136
225	44.35		84349	23881
226	44.56		63596	18138
227	44.70		25998	5746
228	44.89		83170	24241
230	45.11		77997	26600
231	45.19		28096	11628
232	45.39		69820	20573
233	45.47		31263	12895
234	45.58		39513	16995
235	45.66		86125	24746
236	45.75		22698	8225
237	45.87		27686	13829
238	45.97		31834	-6379
239	46.17		1824	6967
240	46.36		42087	12360
241	46.63		34365	8426
242	46.75		3802	2097
243	46.87	90	8697	3246
244	47.01	i-C13	202794	66318
246	47.24		13567	5088

Figure 3 (continued)

ZymaX FORENSICS

Peak #	Ret Time (min)	Peak Name	Peak Area	Peak Height
247	47.36		69710	12463
248	47.53		77840	22664
249	47.65		14399	4000
250	47.81		39117	7554
251	48.01		130055	34693
252	48.13		37775	13565
253	48.25		27135	6362
254	48.44		13093	5850
255	48.58		123120	28900
256	48.66		39918	13063
257	48.76		19350	5195
258	48.85		51668	18423
259	49.01		82375	20672
260	49.10		47907	10137
261	49.27		83784	26122
262	49.43	i-C14	145319	64209
263	49.49		15301	6200
264	49.56	91	23543	8681
265	49.66		35871	8351
266	49.79		96496	18547
267	49.97		61439	17467
268	50.05	92	16989	6971
269	50.10		24822	9777
270	50.17		100894	10730
271	50.51		31598	10236
272	50.58		15018	6545
273	50.63		36645	13528
274	50.73		44793	12558
275	50.80		24413	8666
276	50.88		31352	11125
277	50.94		58124	23732
278	51.05		45897	9292
279	51.24		50968	13132
280	51.30		21922	8084
281	51.42		21406	7650
282	51.59		20847	4911
283	51.68		52673	22478
284	51.77		76848	13742
285	51.90		22531	8372
286	51.99		36672	10286
287	52.13		72213	20224
288	52.27		23701	7105
289	52.33		42479	8691
290	52.47		28189	11192
291	52.57		10548	4382
292	52.69	i-C15	157080	74198
293	52.84		28408	9710
294	52.92		14369	6284
295	52.98		4612	2432
296	53.08		6953	4664
297	53.12		15678	8983
298	53.21		13658	5204
299	53.40		23842	10612
300	53.47		10775	5630
301	53.58		34680	8840
302	53.69		11900	3661
303	53.82		12455	4482
304	53.96		12910	3884
305	54.05		13047	5291
306	54.14		4828	2855
307	54.48		86474	29777
308	54.56		16700	7646
309	54.69		30246	11266
310	54.83	i-C16	162046	71407
311	54.98		6710	4236

Figure 3 (continued)

ZymaX FORENSICS

Peak #	Ret Time (min)	Peak Name	Peak Area	Peak Height
312	55.06		15944	4967
313	55.18		8400	3773
314	55.25		26350	7501
315	55.42		16853	5045
316	55.54		7890	4812
317	55.60		8557	4403
318	55.77		3284	1981
319	55.86		8422	3230
320	55.92		13044	4096
321	56.03		8977	3510
322	56.19		13379	2738
323	56.39		3573	1494
324	56.48		15435	5181
325	56.62		17679	3802
326	56.75		42961	9702
327	56.91		8812	4310
328	57.01		20949	7079
329	57.15		10330	4886
330	57.31		5217	1557
331	57.47		11116	3683
332	57.79		4495	2360
333	57.92		5285	2208
334	58.02		5768	2688
335	58.14		8283	2287
336	58.41		9447	2600
337	58.52	i-C18	79609	34005
338	58.64		5172	3496
339	58.69		17020	9318
340	58.86		20484	4814
341	59.16		14510	2803
342	59.50	Pristane	145024	66518
343	59.72		6119	2393
344	59.96		7625	1731
345	60.10		5898	2622
346	60.23		2512	1696
347	60.27		3682	2750
348	60.34		2914	1652
349	60.40		7856	5064
350	60.62		7436	1935
351	60.78		3276	1114
352	60.86		3727	1090
353	61.01		6739	2962
354	61.11	Phytane	59134	27475
355	61.23		4852	1318
356	61.33		4645	2054
357	61.48		3937	2115
358	61.80		3777	1754
359	61.96		9216	5026
360	62.11		4013	1196
361	62.30		17936	6227
362	62.50		5286	2089
363	62.59		4306	1261
364	62.81		2640	1299
365	62.90		2323	1328
366	63.04		4098	1256
367	63.13		4175	1005
368	63.39		4937	2539
369	63.53		6973	2150
370	63.87		1923	883
371	64.20		9366	2211
372	64.41		2125	876
373	64.50	IS#3	130170	77412
374	64.73		11644	3588
375	65.02		2250	1085
376	65.17		6385	1579

Figure 3 (continued)

ZymaX FORENSICS

Peak #	Ret Time (min)	Peak Name	Peak Area	Peak Height
377	65.41		4695	2127
378	65.99		4220	1465
379	69.80		3372	1676
380	70.24		2112	855
381	75.31		1717	367
382	77.14		2209	454
383	77.29		2692	473
384	81.59		2769	561

TOTAL AREA DETECTED = 1.652828E+07

Processed by: Jinbo Su

Date: 6-7-00

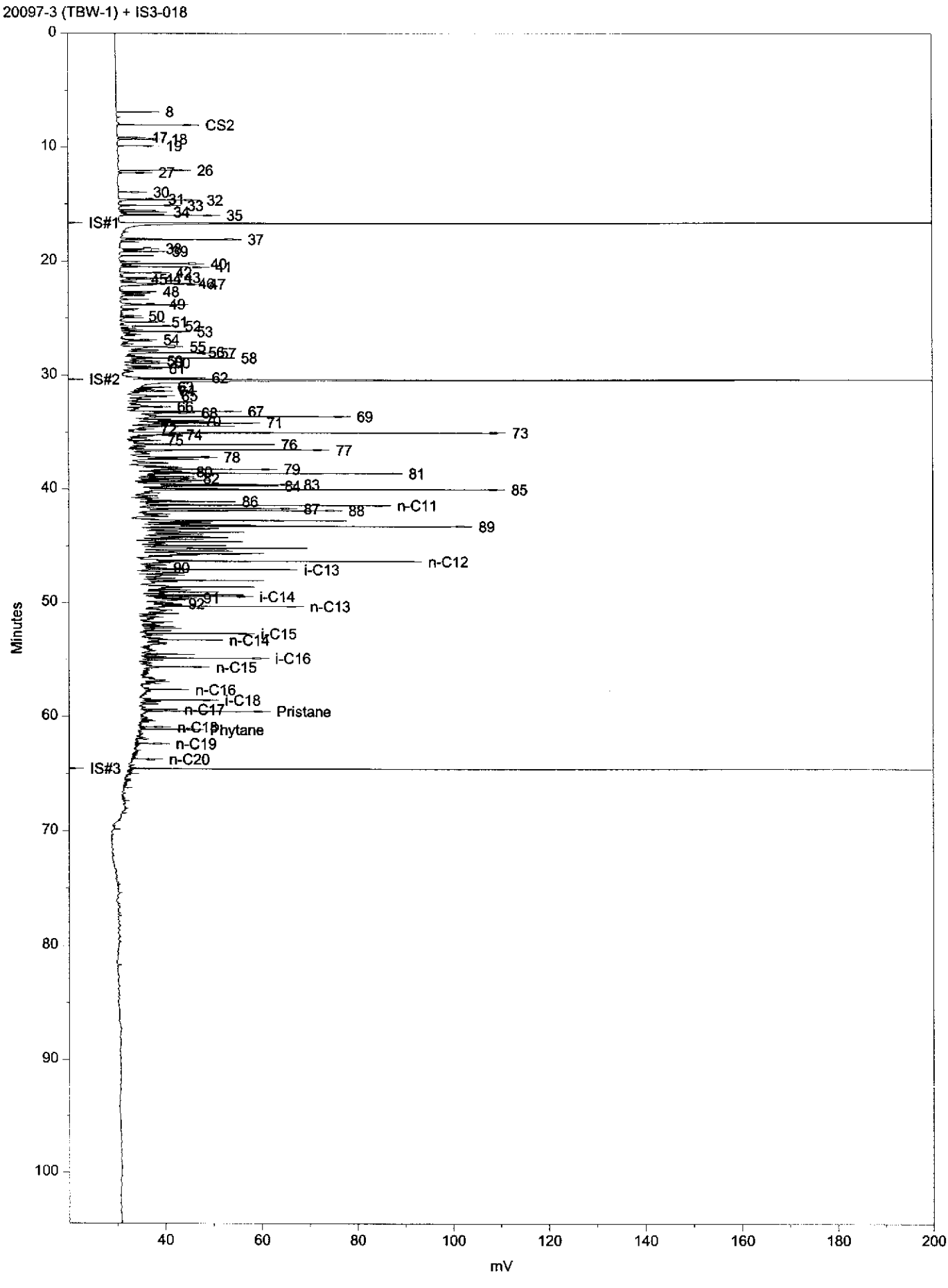


Figure 4

ZYMAX FORENSIC

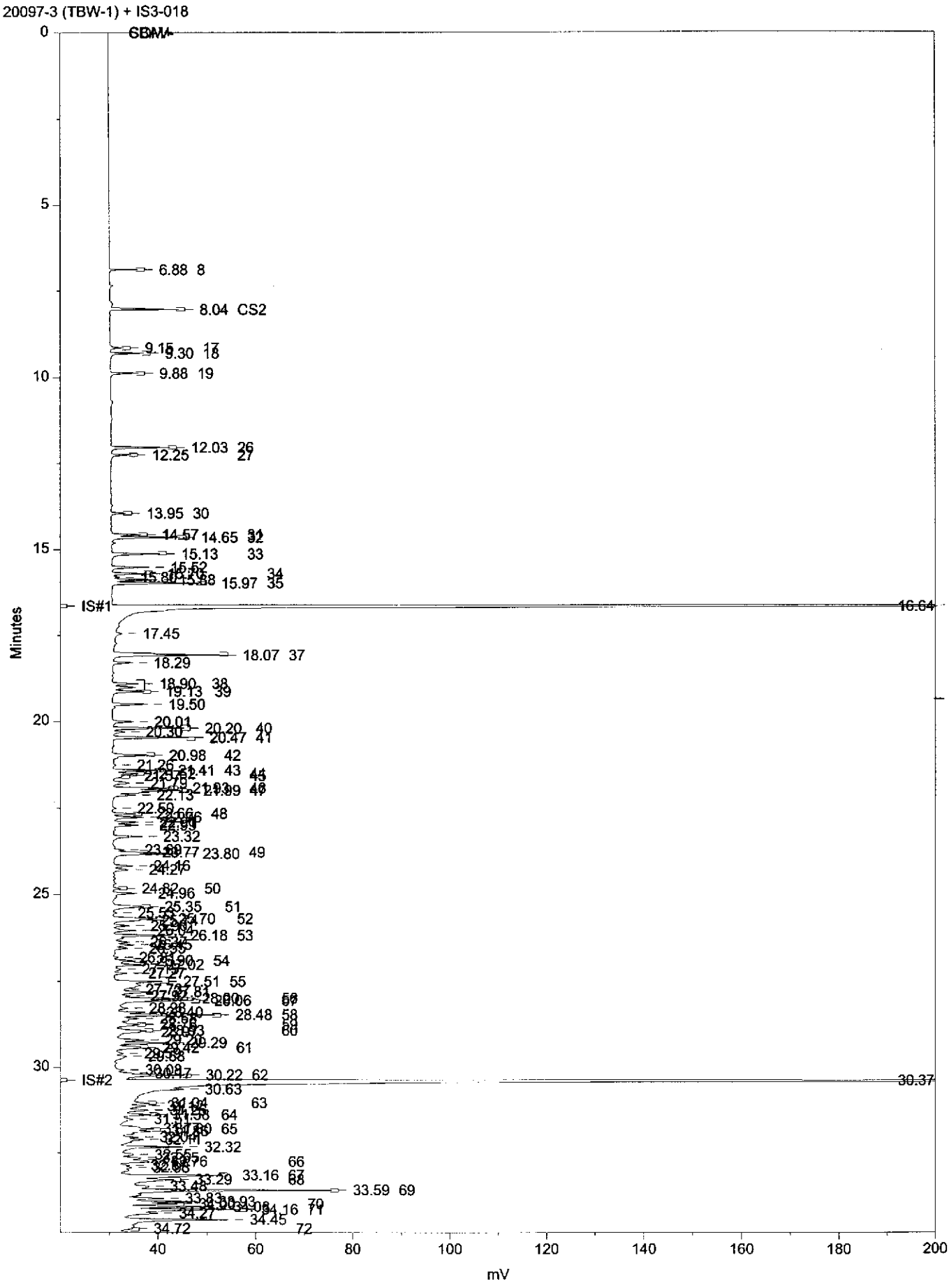


Figure 4 (continued)

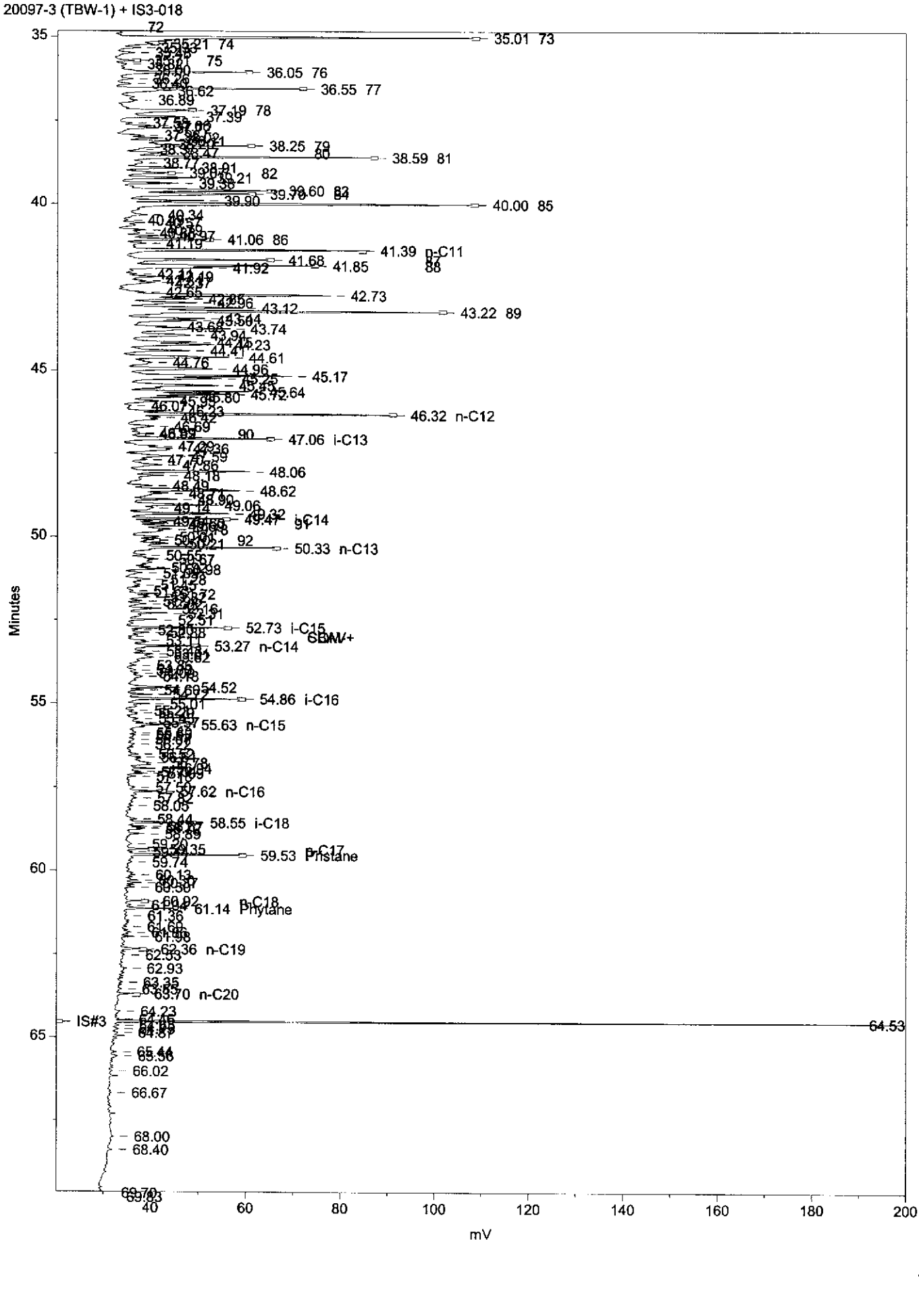


Figure 4 (continued)

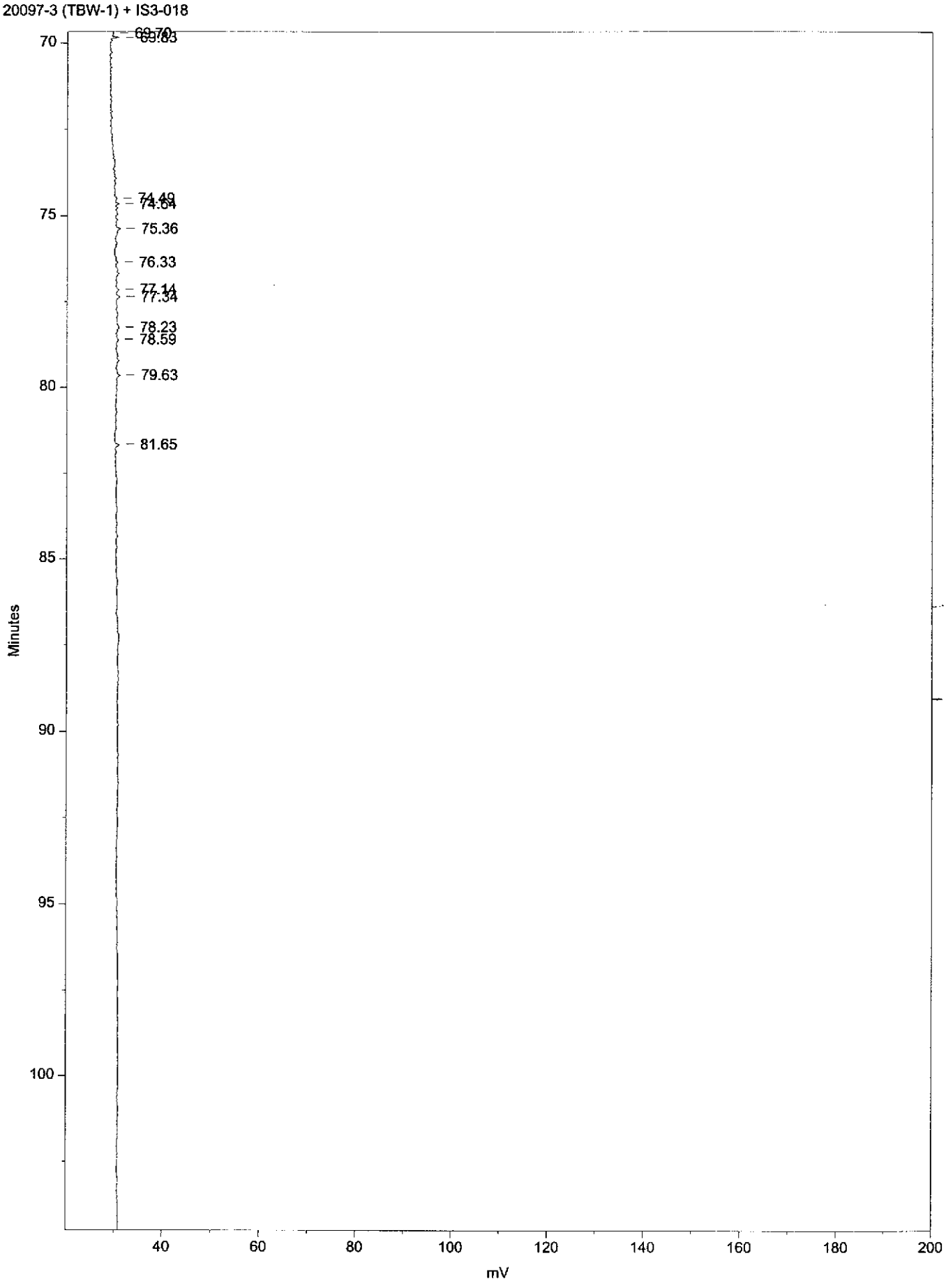


Figure 4 (continued)

ZymaX FORENSICS

Figure 4 (continued)

C3 to C10 ANALYSIS by ZYMAX FORENSICS

TODAY'S DATE: 6/7/2000 TIME: 5:49:14 PM
RAW DATA FILE NAME: H:\DATA3\C344151.12R
SAMPLE NAME.....20097-3 (TBW-1) + IS3-018
DATE TAKEN: 06-1-2000 12:52:32
METHOD FILE: !H:\DATA3\C344151L.MET
METHOD: C3-C44 Analysis
CALIBRATION FILE: !H:\DATA3\C344151L.CAL
INSTRUMENT: HP6890--FID OPERATOR: Jinbo Su
RUN TIME: 110min
COM PORT: 3
HEADING 1: C3-C44 Analysis
HEADING 2: split ratio 150:1
FORMAT FILE: H:\DATA3\C3C10.FMT

PEAKS DETECTED IN THIS CHROMATOGRAM:

Peak #	Ret Time (min)	Peak Name	Peak Area	Peak Height
1	6.88	8	8576	5910
2	8.04	CS2	30144	13975
3	9.15	17	4956	2627
4	9.30	18	16906	6915
5	9.88	19	14040	5770
6	12.03	26	31614	12149
7	12.25	27	12147	4141
8	13.95	30	8332	3014
9	14.57	31	16624	6126
10	14.65	32	40212	14140
11	15.13	33	31378	10067
12	15.52		22485	7819
13	15.70	34	19983	7186
14	15.80		4626	1643
15	15.88		25289	9541
16	15.97	35	51441	18169
17	16.64	IS#1	1578953	577841
18	17.45		18522	2140
19	18.07	37	87743	22537
20	18.29		14443	4287
21	18.90	38	35461	5432
22	19.13	39	23156	6742
23	19.50		20986	7330
24	20.01		14940	4463
25	20.20	40	40298	14771
26	20.30		9967	2651
27	20.47	41	45996	15768
28	20.98	42	24305	7465
29	21.26		3617	809
30	21.41	43	27450	9233
31	21.52	44	17372	5288
32	21.57	45	9974	2290
33	21.79		16318	3582
34	21.93	46	32736	12158
35	21.99	47	41747	14444
36	22.13		16373	4846
37	22.50		2373	837
38	22.66	48	12901	4777
39	22.76		20714	6459
40	22.91		15523	5354
41	22.99		17005	5384
42	23.32		21209	6142
43	23.69		8724	2345
44	23.77	49	9915	5992
45	23.80		48273	14241
46	24.16		14110	4103
47	24.27		12509	3206
48	24.82	50	4983	1637

Figure 4 (continued)

ZymaX FORENSICS

Peak #	Ret Time (min)	Peak Name	Peak Area	Peak Height
49	24.96		14254	5010
50	25.35	51	30491	6385
51	25.53		2491	858
52	25.70	52	32868	9172
53	25.74		14333	5617
54	25.90		9811	3427
55	26.04		16027	4758
56	26.18	53	34968	11601
57	26.37		10248	3327
58	26.45		14839	4298
59	26.55		9374	3003
60	26.81		2664	1001
61	26.90	54	16981	4541
62	27.02		20423	6671
63	27.15		6163	1502
64	27.27		8063	2779
65	27.51	55	80095	9957
66	27.73		2537	2186
67	27.81		33440	7836
68	27.92		10708	3283
69	28.00	56	38085	13748
70	28.06	57	59651	16248
71	28.28		13300	2846
72	28.40		19313	6354
73	28.48	58	60068	20516
74	28.58		31430	5073
75	28.76	59	22553	5092
76	28.93	60	23774	6580
77	28.97		18790	5243
78	29.20		22145	6066
79	29.29		34882	11160
80	29.42	61	29143	5452
81	29.59		6803	1706
82	29.68		13077	2485
83	30.08		5799	1749
84	30.17		8726	3700
85	30.22	62	56035	14136
86	30.37	IS#2	1702345	580663
87	30.63		149386	13917
88	31.04	63	29006	6926
89	31.12		27889	6027
90	31.25		31828	6560
91	31.38	64	29932	7200
92	31.51		25128	3305
93	31.77		19527	5201
94	31.80	65	20821	7599
95	31.86		24473	6922
96	32.04		14823	4443
97	32.11		20395	5498
98	32.32		52922	13552
99	32.55		16671	3292
100	32.65		20992	4855
101	32.76	66	31580	6562
102	32.87		7743	2473
103	32.93		9575	2880
104	33.16	67	94498	21178
105	33.29	68	68300	11504
106	33.48		36513	6350
107	33.59	69	152042	43877
108	33.83		35508	9379
109	33.93		48297	16273
110	34.00	70	34024	12085
111	34.08		56668	19172
112	34.16	71	88237	24965
113	34.27		34658	8031

Figure 4 (continued)

ZymaX FORENSICS

Peak #	Ret Time (min)	Peak Name	Peak Area	Peak Height
114	34.45		116466	22540
115	34.72	72	12532	2796
116	35.01	73	242824	76155
117	35.21	74	35933	8055
118	35.33		22128	5532
119	35.48		19514	4230
120	35.71	75	12823	4007
121	35.82		11365	2478
122	36.00		16913	3986
123	36.05	76	91743	27661
124	36.26		14750	3798
125	36.40		12276	3297
126	36.55	77	117735	39039
127	36.62		54706	8756
128	36.89		39012	4596
129	37.19	78	42147	15555
130	37.39		105567	14623
131	37.58		11328	3374
132	37.66		24854	7955
133	37.72		34836	8211
134	37.95		19386	5769
135	38.02		32484	9755
136	38.11		47263	11106
137	38.20		21054	8656
138	38.25	79	109947	27874
139	38.37		15286	4716
140	38.47	80	48855	9571
141	38.59	81	177893	53914
142	38.77		32004	5395
143	38.91		65732	13444
144	39.07	82	43296	10909
145	39.21		60335	16588
146	39.38		40209	12802
147	39.60	83	148296	31759
148	39.70	84	140014	27784
149	39.90		54623	18087
150	40.00	85	280084	75137
151	40.34		42270	6191
152	40.49		7104	1957
153	40.57		16591	5604
154	40.79		16853	5846
155	40.88		20957	4393
156	40.97		29089	8420
157	41.06	86	70946	18639
158	41.19		25731	5726
159	41.39	n-C11	179047	51052
160	41.68	87	126939	31425
161	41.85	88	119366	40766
162	41.92		57444	19636
163	42.11		11431	3666
164	42.19		35229	7909
165	42.31		16776	5581
166	42.37		30892	7439
167	42.65		20445	5656
168	42.73		178621	44757
169	42.85		59249	14606
170	42.96		76868	16448
171	43.12		107967	25801
172	43.22	89	236864	68016
173	43.44		54354	18046
174	43.50		75747	16245
175	43.68		28976	9964
176	43.74		113801	23274
177	43.94		91521	14788
178	44.15		62390	16090

Figure 4 (continued)

ZymaX FORENSICS

Peak #	Ret Time (min)	Peak Name	Peak Area	Peak Height
179	44.23		81292	19825
180	44.41		65411	14638
181	44.61		96896	22815
182	44.76		56342	6687
183	44.96		95446	19218
184	45.17		131925	36116
185	45.25		80533	21225
186	45.45		91669	20528
187	45.64		79688	26968
188	45.72		79894	22991
189	45.80		49698	13152
190	45.93		40603	7962
191	46.07		10850	1946
192	46.23		33067	9672
193	46.32	n-C12	172335	56868
194	46.42		27478	8074
195	46.69		36864	6624
196	46.89		21487	3605
197	46.92	90	11794	3579
198	47.06	i-C13	119299	30727
199	47.29		30264	7383
200	47.36		32964	10499
201	47.59		54751	10140
202	47.70		21652	5119
203	47.86		53122	8206
204	48.06		100640	26616
205	48.18		32458	8477
206	48.49		22525	.6072
207	48.62		105291	24464
208	48.71		57564	9414
209	48.90		40805	11232
210	49.06		65766	16902
211	49.14		39316	6218
212	49.32		78829	22073
213	49.47	i-C14	51180	21002
214	49.54		15995	5965
215	49.60	91	25957	9268
216	49.69		39718	9072
217	49.78		74885	9942
218	50.01		29169	7116
219	50.10	92	17150	6065
220	50.21		42498	9126
221	50.33	n-C13	84691	31417
222	50.55		13840	4268
223	50.67		42321	6958
224	50.92		15768	5315
225	50.98		21258	8228
226	51.09		14404	3526
227	51.28		17459	5044
228	51.45		12742	2914
229	51.63		4696	1360
230	51.72		15810	6791
231	51.82		16967	4801
232	51.94		7931	3190
233	52.02		13569	3980
234	52.16		22848	7081
235	52.31		32612	8286
236	52.51		13489	6103
237	52.73	i-C15	43478	20564
238	52.80		3755	1594
239	52.88		7850	3687
240	53.11		2566	1631
241	53.27	n-C14	35332	12562
242	53.43		6269	2483
243	53.51		6284	3131

Figure 4 (continued)

ZymaX FORENSICS

Peak #	Ret Time (min)	Peak Name	Peak Area	Peak Height
244	53.62		6039	2349
245	53.86		3927	1621
246	54.00		4279	1352
247	54.09		2797	1340
248	54.18		7419	1937
249	54.52		30729	10635
250	54.60		6290	2945
251	54.72		9811	4895
252	54.86	i-C16	57501	23128
253	55.01		7352	3997
254	55.21		2712	1304
255	55.29		7864	2043
256	55.45		5559	1725
257	55.57		3246	1868
258	55.63	n-C15	16669	8947
259	55.89		6471	1396
260	55.95		4729	1304
261	56.07		3911	1218
262	56.22		4227	1250
263	56.52		4793	1910
264	56.61		7490	2163
265	56.78		3118	1713
266	56.94		10520	5133
267	57.04		2497	1667
268	57.09		5766	3344
269	57.18		4208	1918
270	57.50		4177	1287
271	57.62	n-C16	14406	6017
272	57.82		3048	1107
273	58.05		2132	997
274	58.44		5028	1730
275	58.55	i-C18	29246	12586
276	58.67		5614	3551
277	58.72		9867	3156
278	58.89		7406	3529
279	59.20		6070	1129
280	59.35	n-C17	10431	4747
281	59.44		1369	958
282	59.53	Pristane	50244	23182
283	59.74		2410	823
284	60.13		6378	1566
285	60.30		3039	2063
286	60.37		5716	3126
287	60.50		3757	1961
288	60.92	n-C18	7328	3642
289	61.04		2927	1146
290	61.14	Phytane	22031	10236
291	61.36		1637	642
292	61.69		1454	897
293	61.86		2941	1368
294	61.98		5065	2754
295	62.36	n-C19	11922	4191
296	62.53		2130	833
297	62.93		5039	1275
298	63.35		2071	897
299	63.55		3219	903
300	63.70	n-C20	7616	3621
301	64.23		5498	1186
302	64.46		1441	648
303	64.53	IS#3	309719	180428
304	64.65		2547	1014
305	64.75		3857	1177
306	64.87		3066	919
307	65.44		2986	1234
308	65.56		5599	1426

Figure 4 (continued)

ZymaX FORENSICS

Peak #	Ret Time (min)	Peak Name	Peak Area	Peak Height
309	66.02		2216	702
310	66.67		5543	749
311	68.00		1676	669
312	68.40		3255	1069
313	69.70		4028	432
314	69.83		3249	1565
315	74.49		2351	434
316	74.64		2224	688
317	75.36		6400	874
318	76.33		1856	563
319	77.14		2576	529
320	77.34		3699	775
321	78.23		4820	512
322	78.59		2242	418
323	79.63		2194	589
324	81.65		3856	861

TOTAL AREA DETECTED = 1.434872E+07

Processed by: Jinbo Su

Date: 6-7-00

Figure 5

Sample Name: MW-6 (20097-1) ALI+AROM
Misc Info : CITY OF OAKLAND

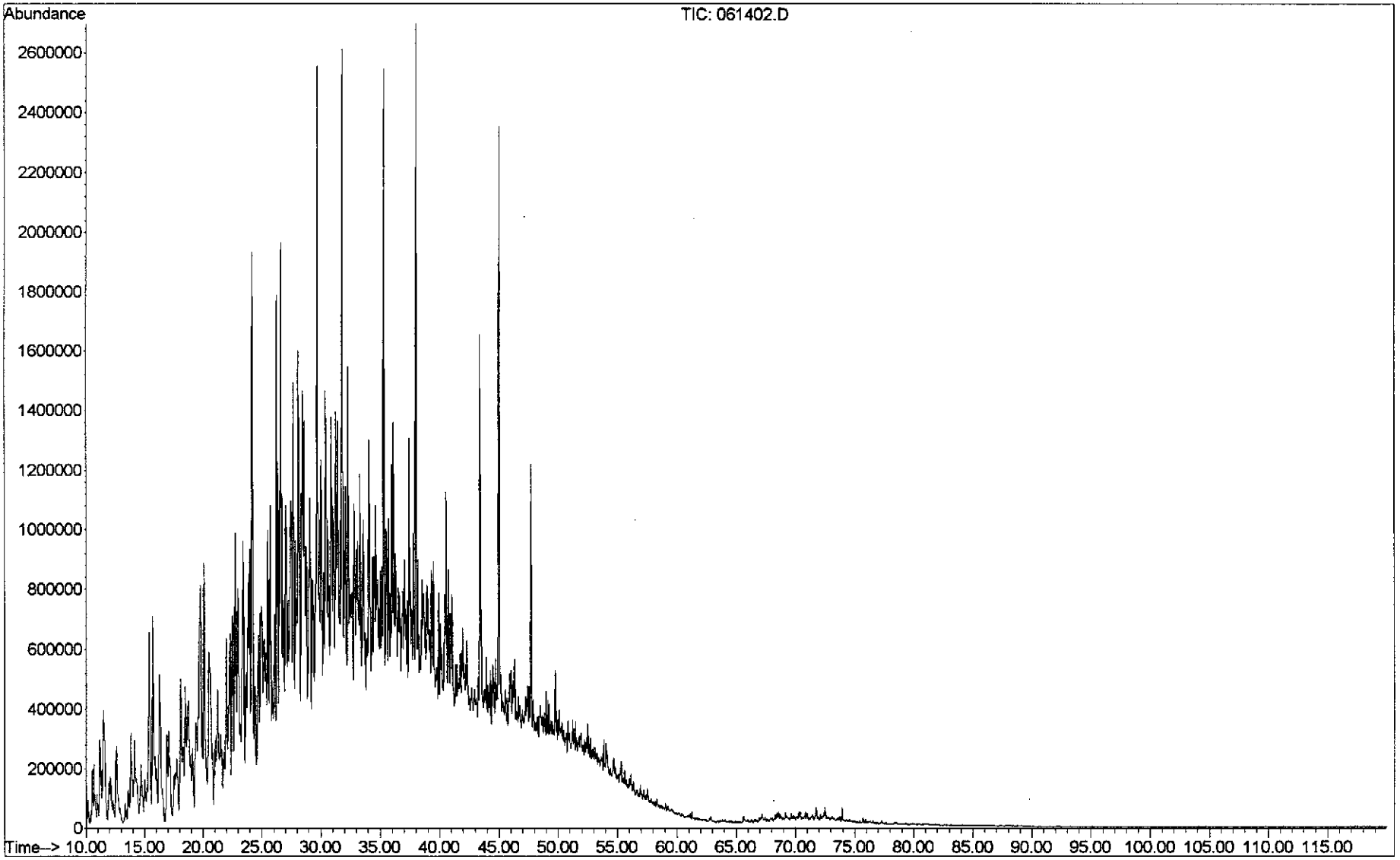
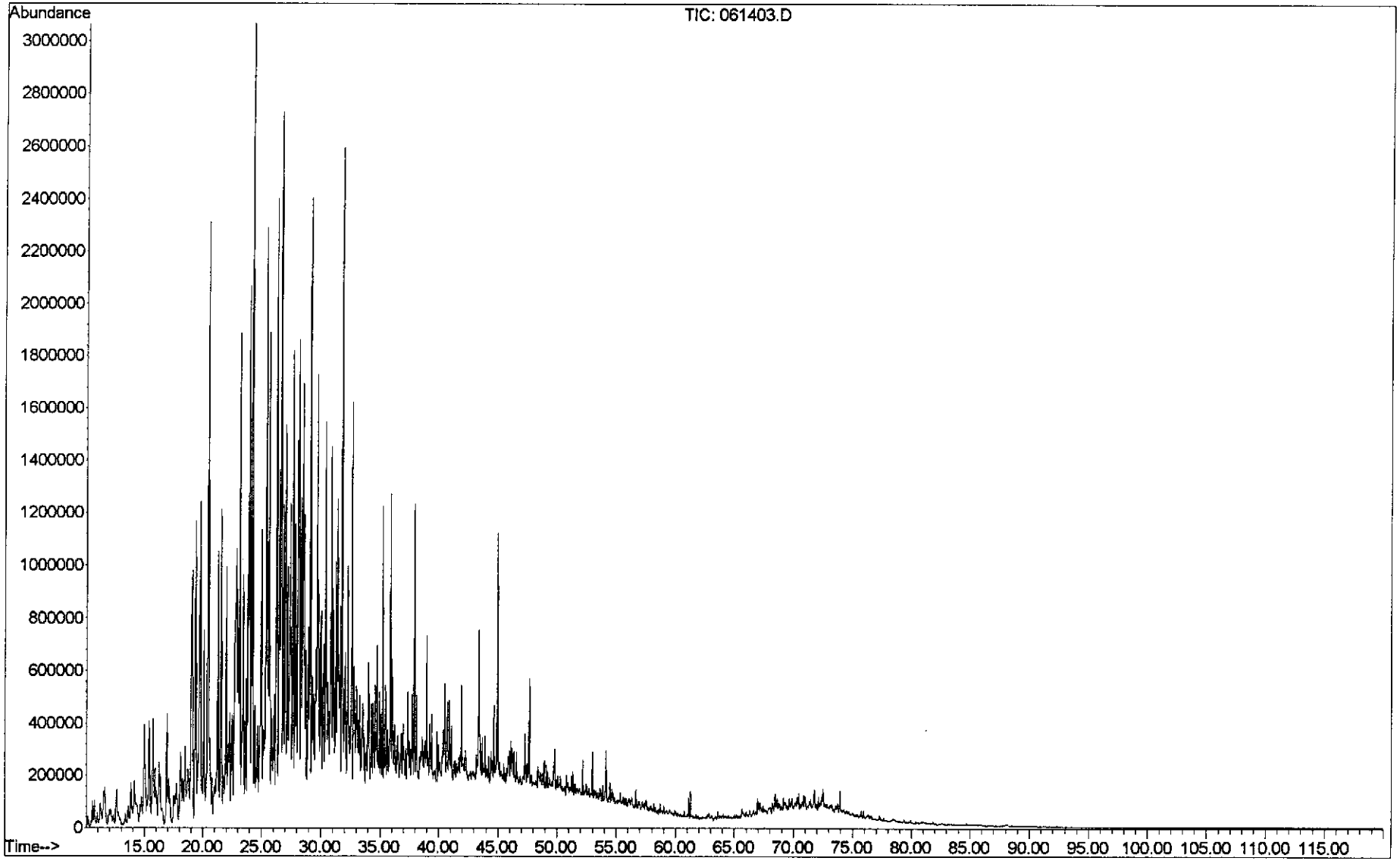


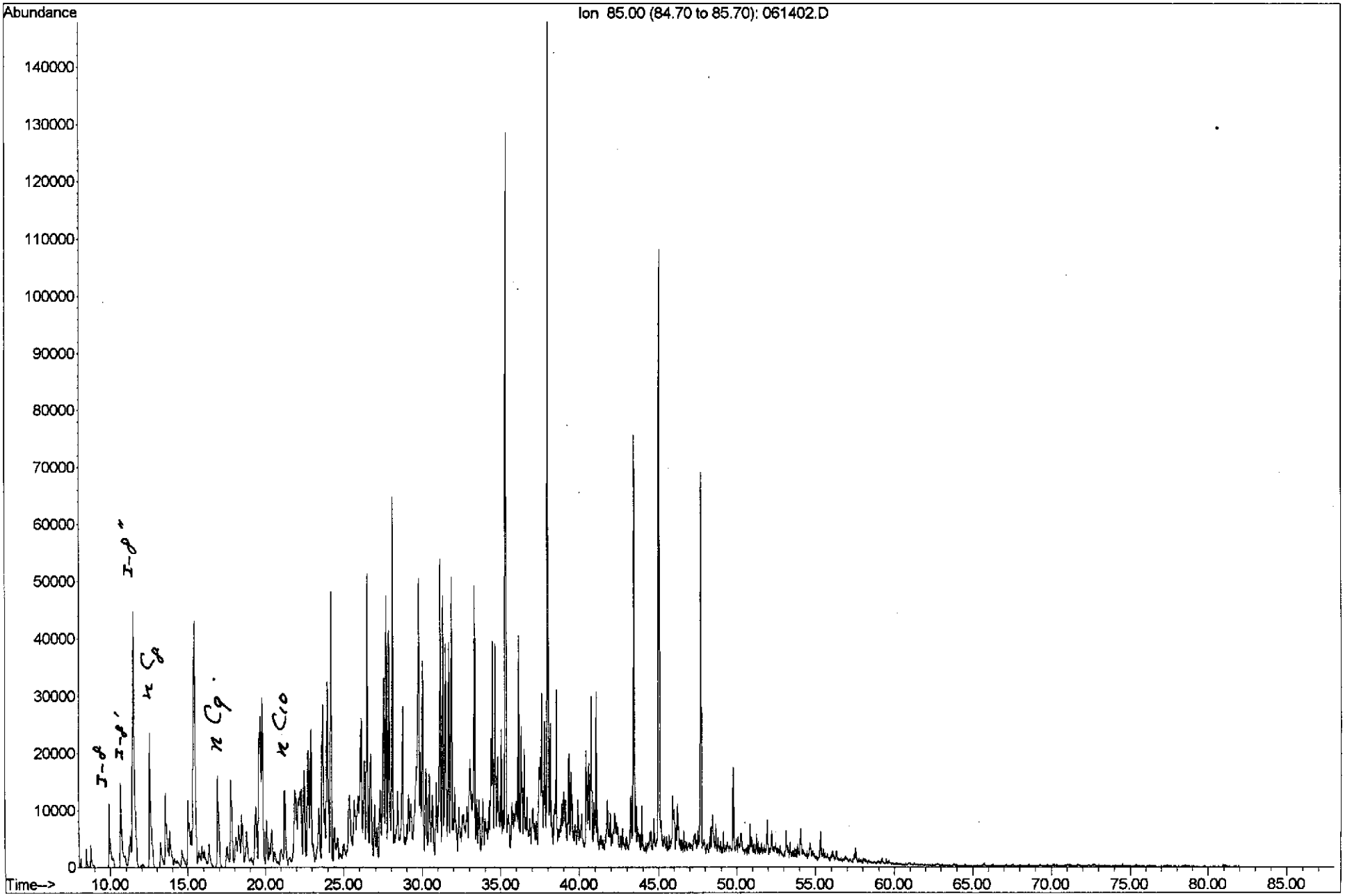
Figure 6

Sample Name: TBW-1 (20097-3) ALI+AROM
Misc Info : CITY OF OAKLAND



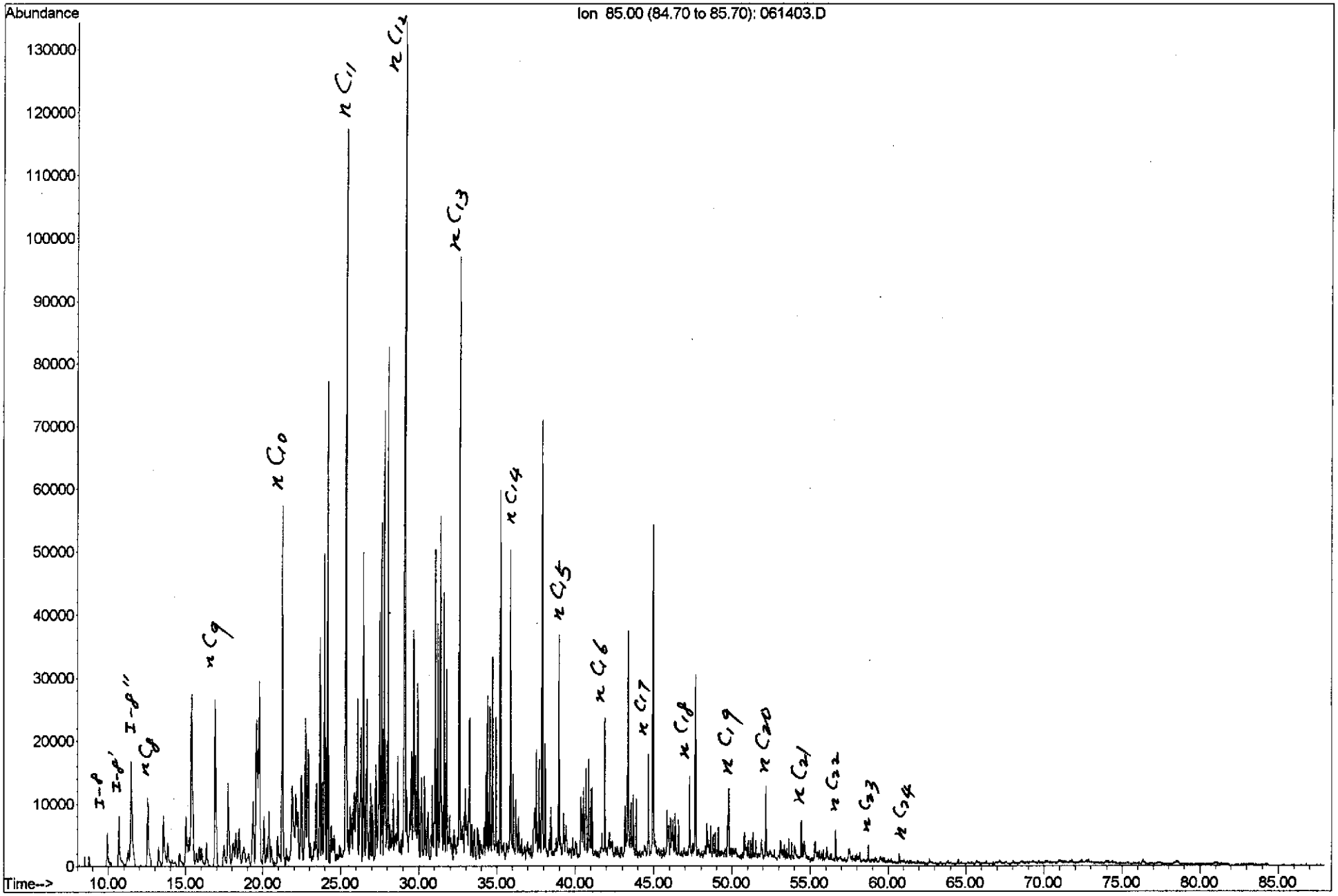
MW-6 (20097-1) ALI+AROM
CITY OF OAKLAND

Figure 7



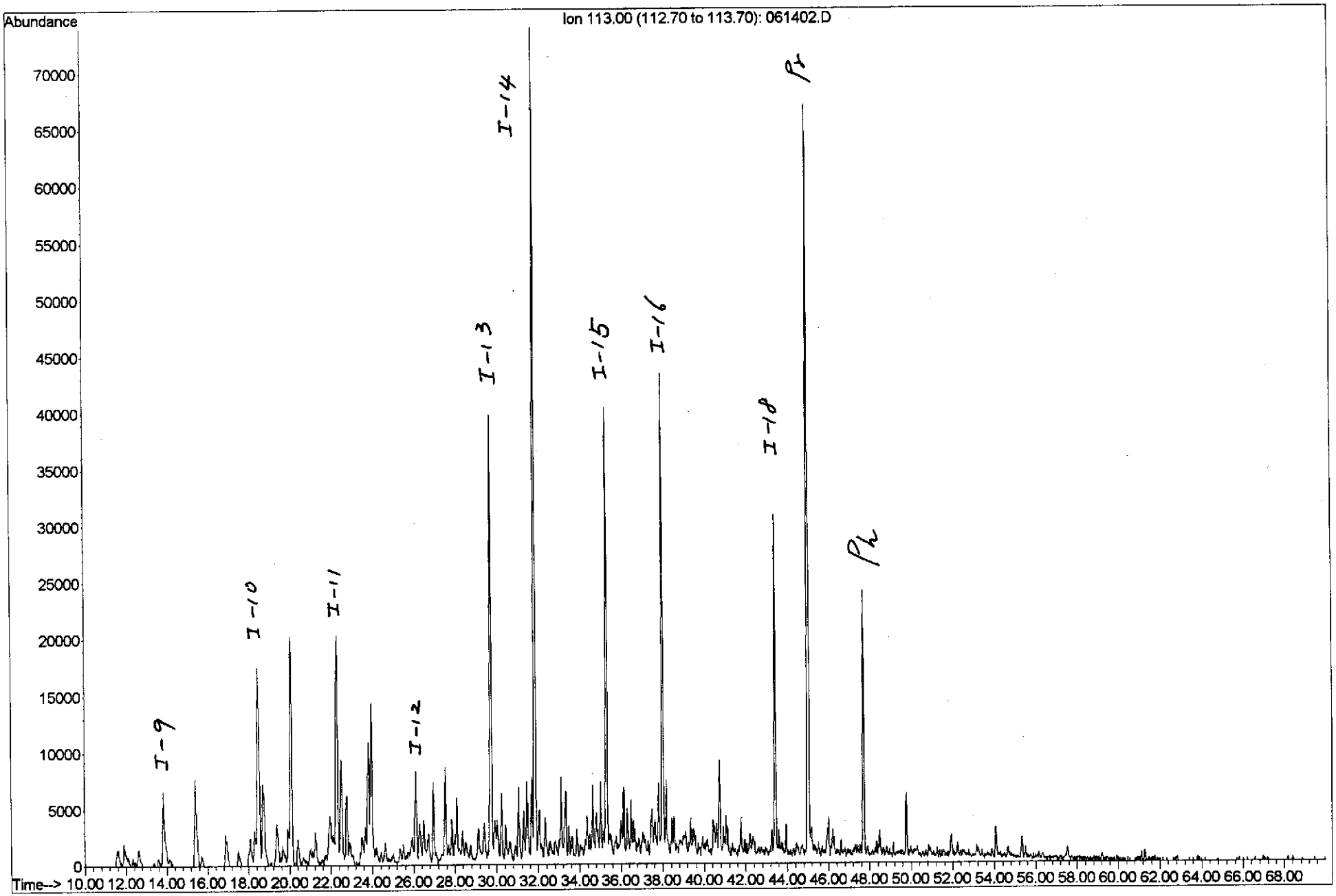
TBW-1 (20097-3) ALI+AROM
CITY OF OAKLAND

Figure 8



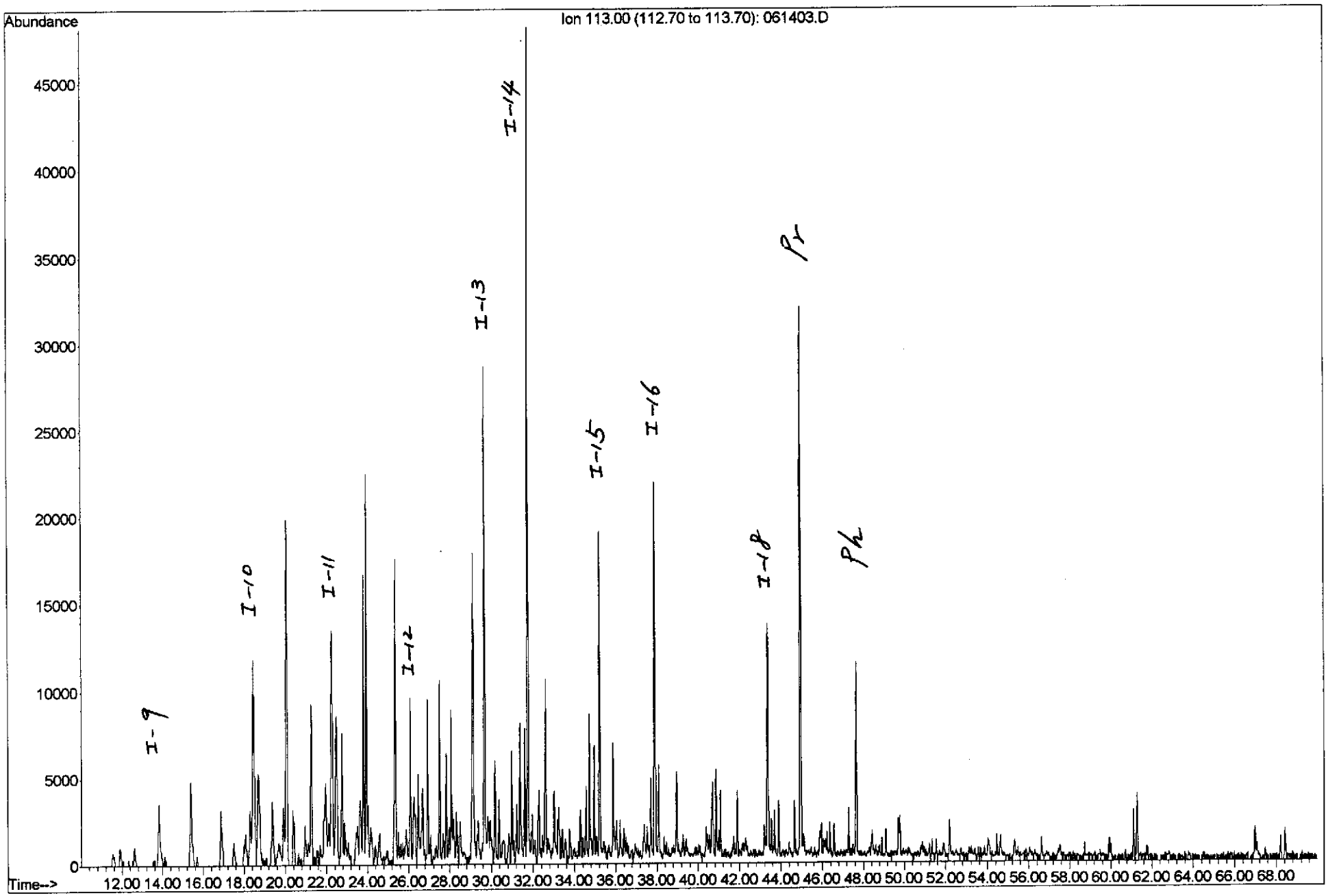
MW-6 (20097-1) ALI+AROM
CITY OF OAKLAND

Figure 9



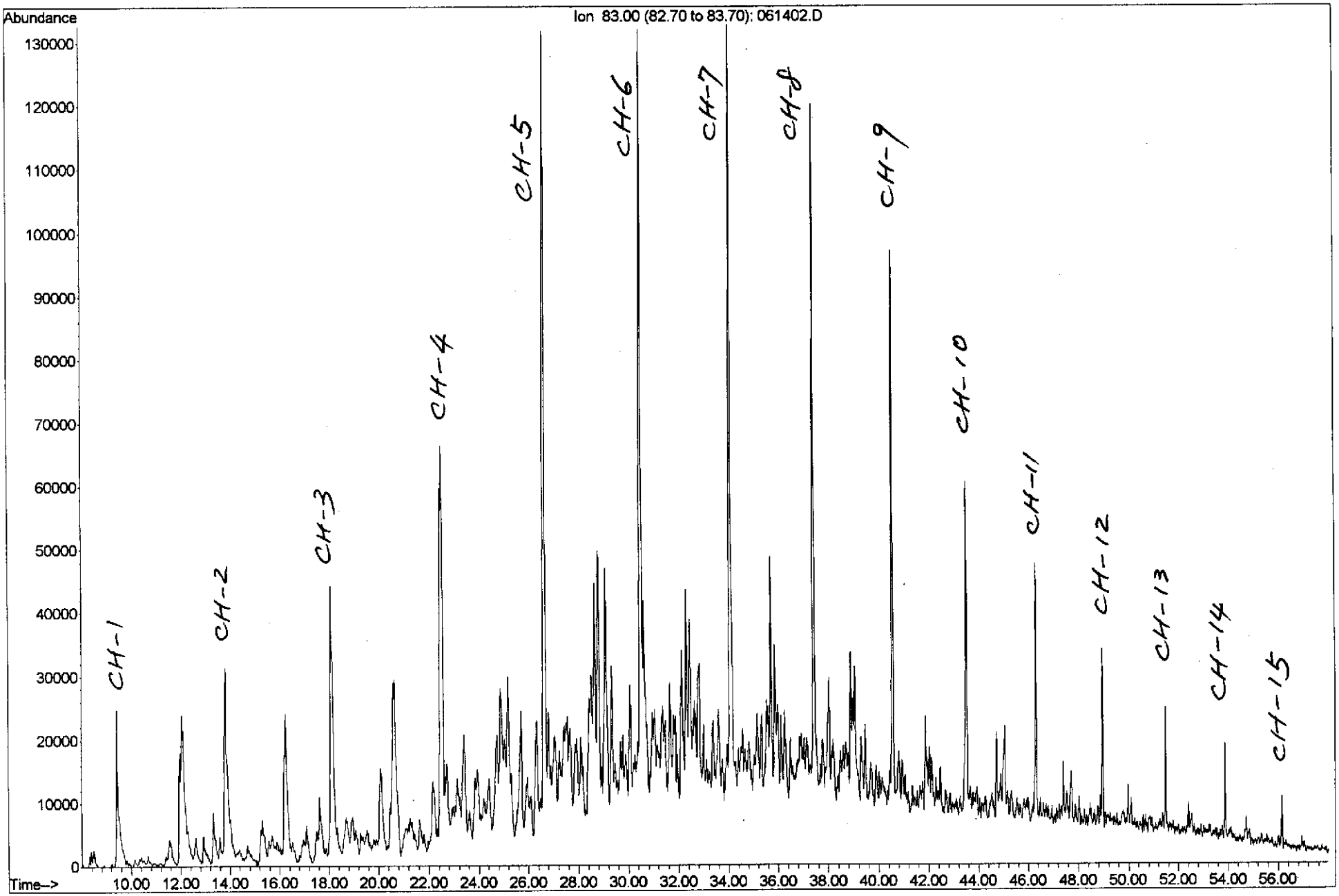
TBW-1 (20097-3) ALI+AROM
CITY OF OAKLAND

Figure 10



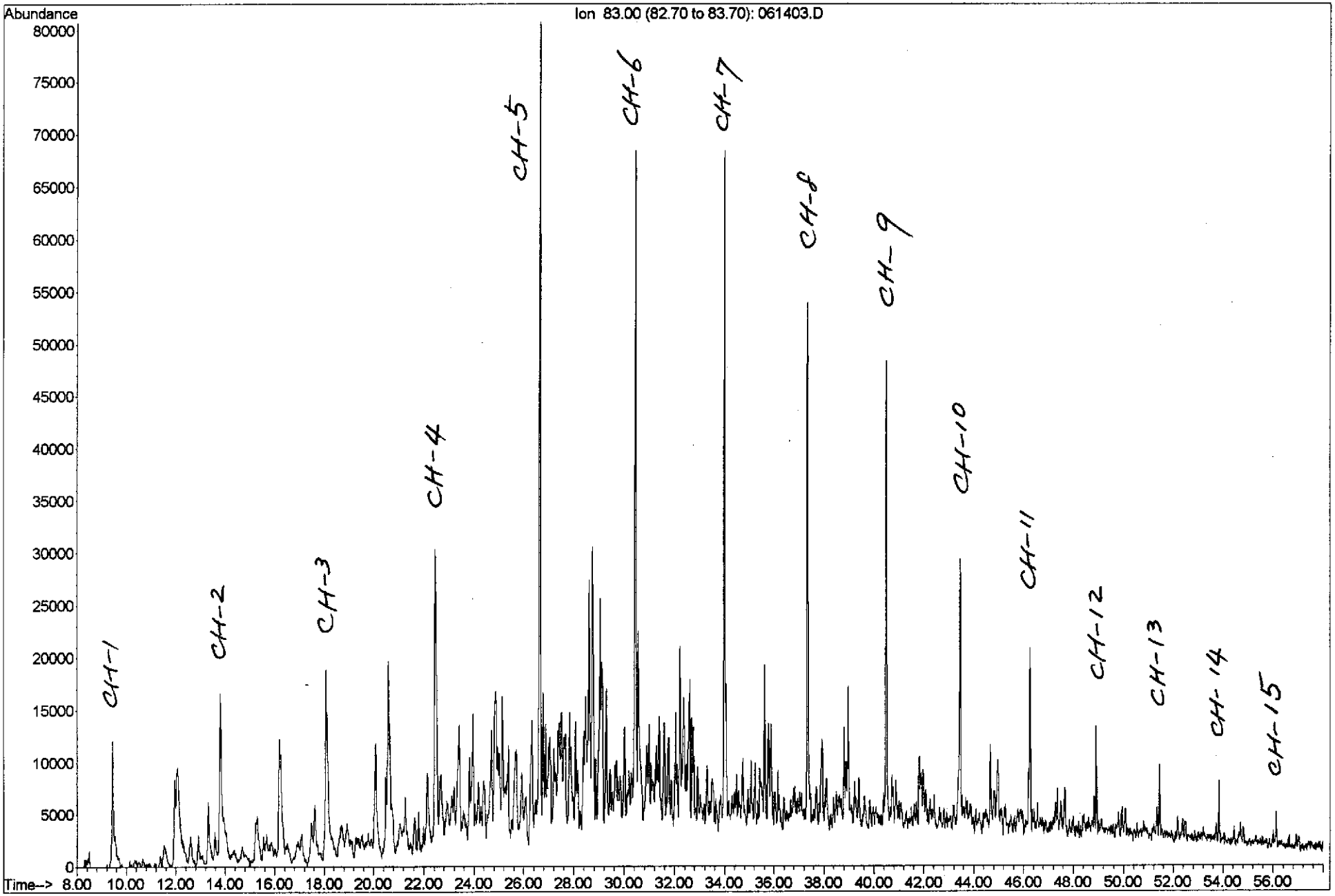
MW-6 (20097-1) ALI+AROM
CITY OF OAKLAND

Figure 11



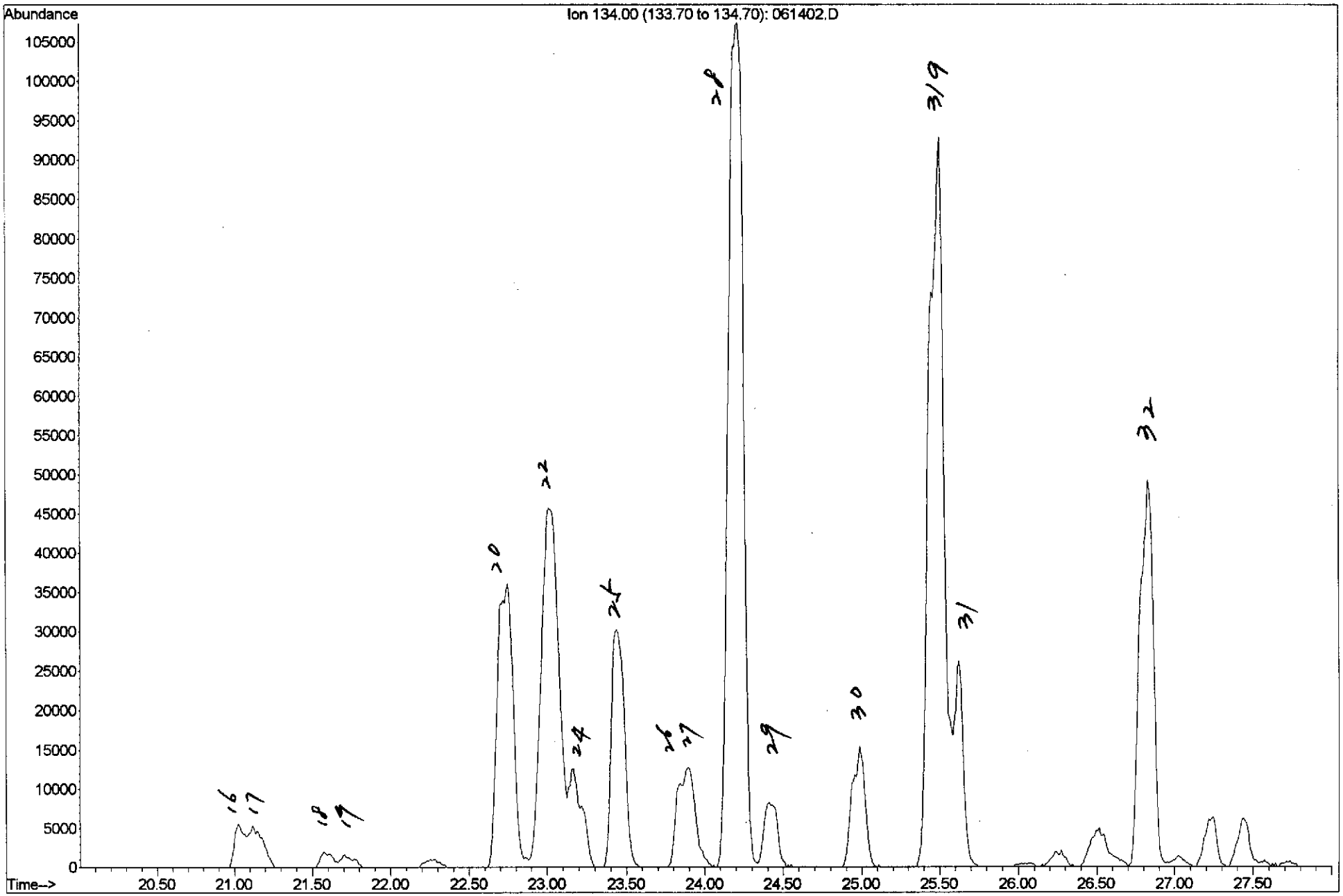
TBW-1 (20097-3) ALI+AROM
CITY OF OAKLAND

Figure 12



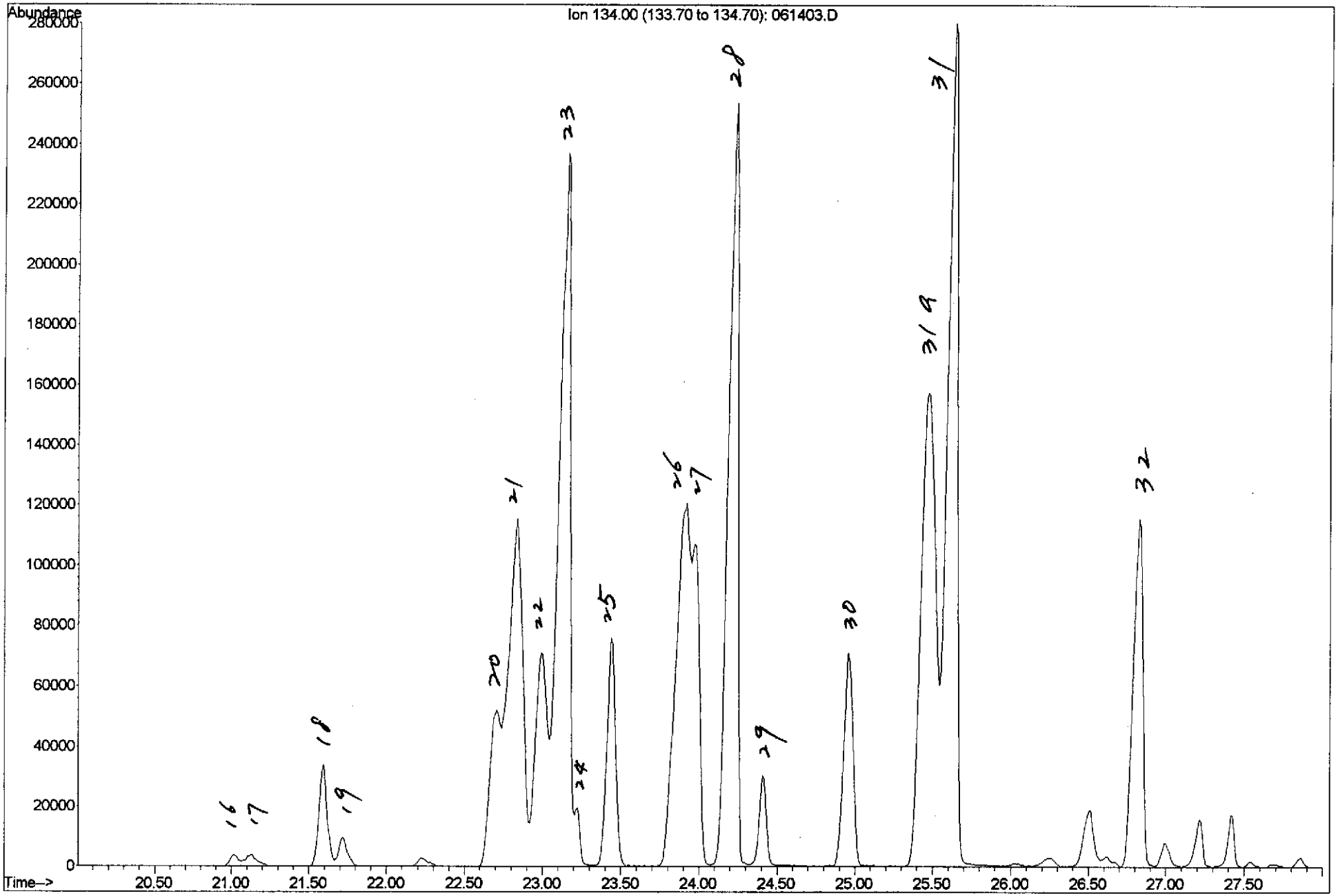
MW-6 (20097-1) ALI+AROM
CITY OF OAKLAND

Figure 13



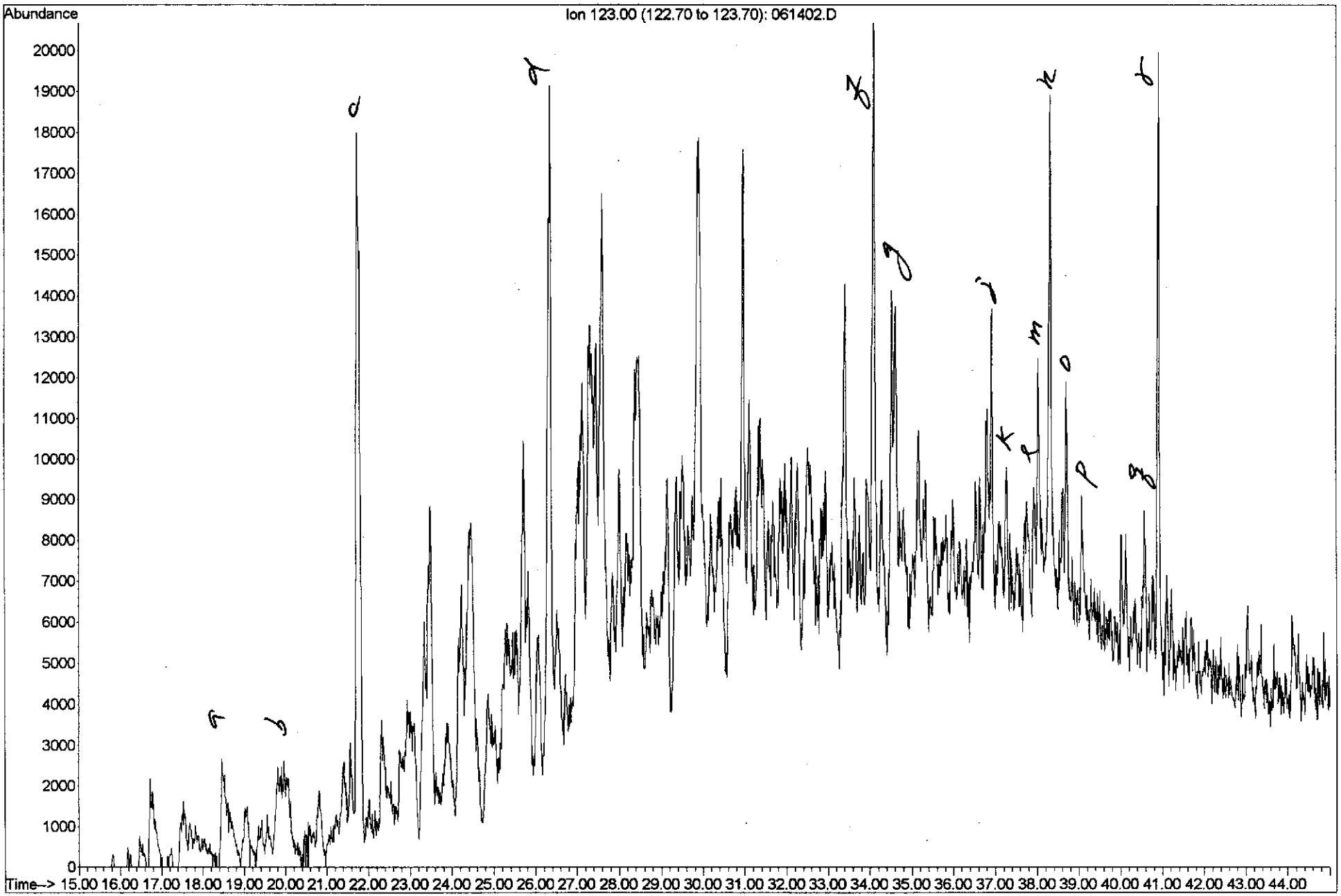
TBW-1 (20097-3) ALI+AROM
CITY OF OAKLAND

Figure 14



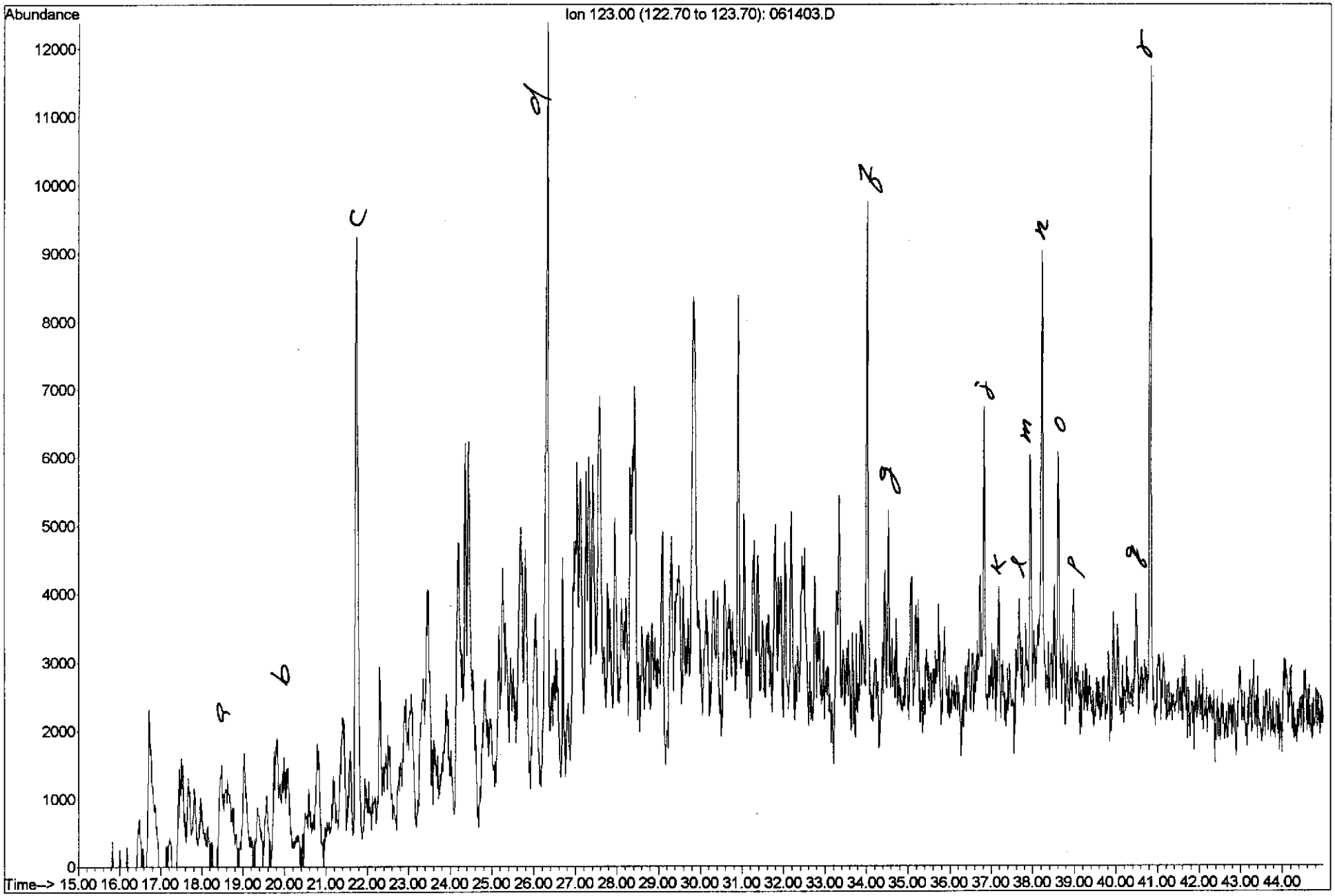
MW-6 (20097-1) ALI+AROM
CITY OF OAKLAND

Figure 15



TBW-1 (20097-3) ALI+AROM
CITY OF OAKLAND

Figure 16



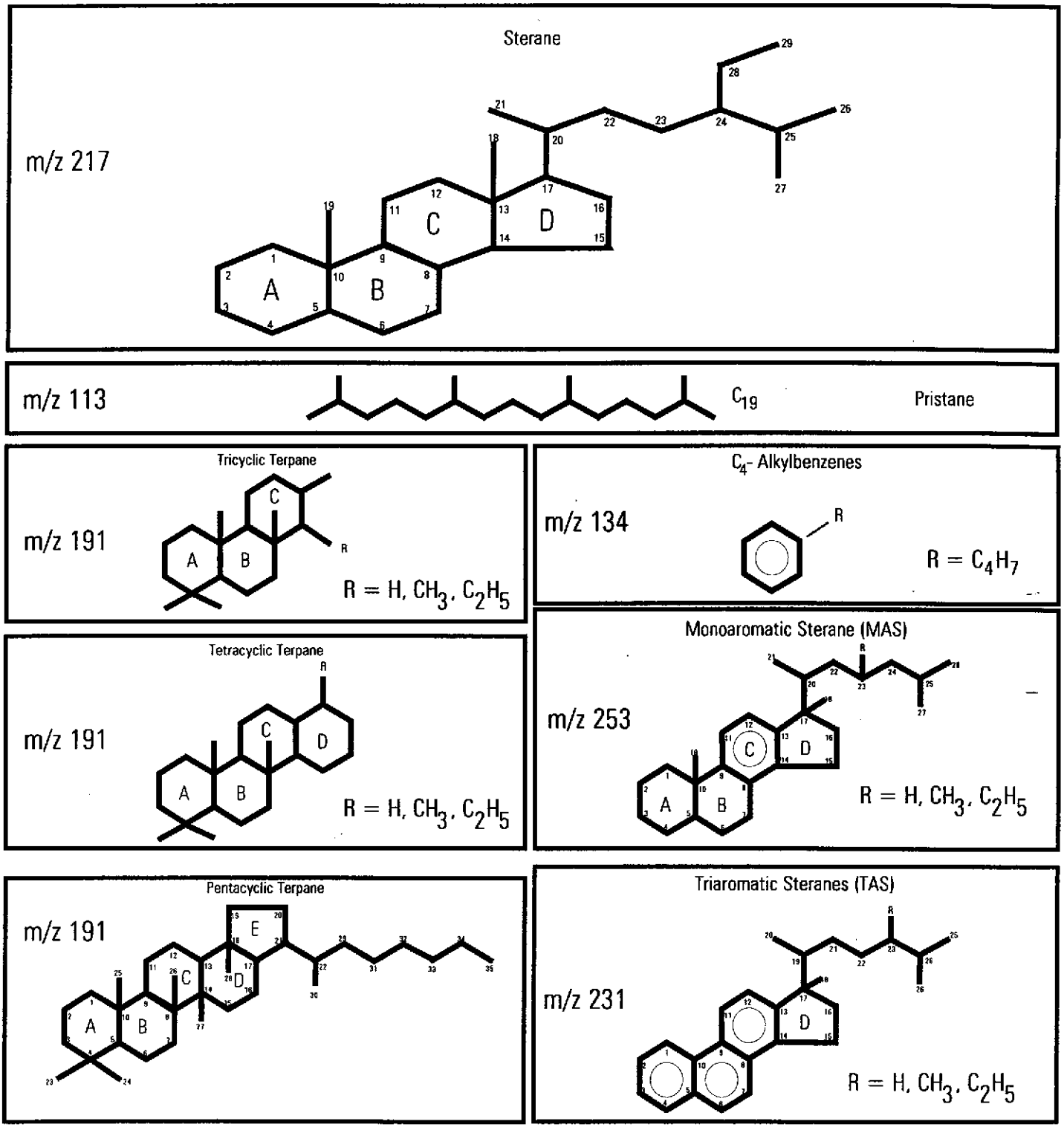


Figure 17: The compound structures of pristane, C_4-alkylbenzene, sterane; terpanes; monoaromatic and triaromatic steranes

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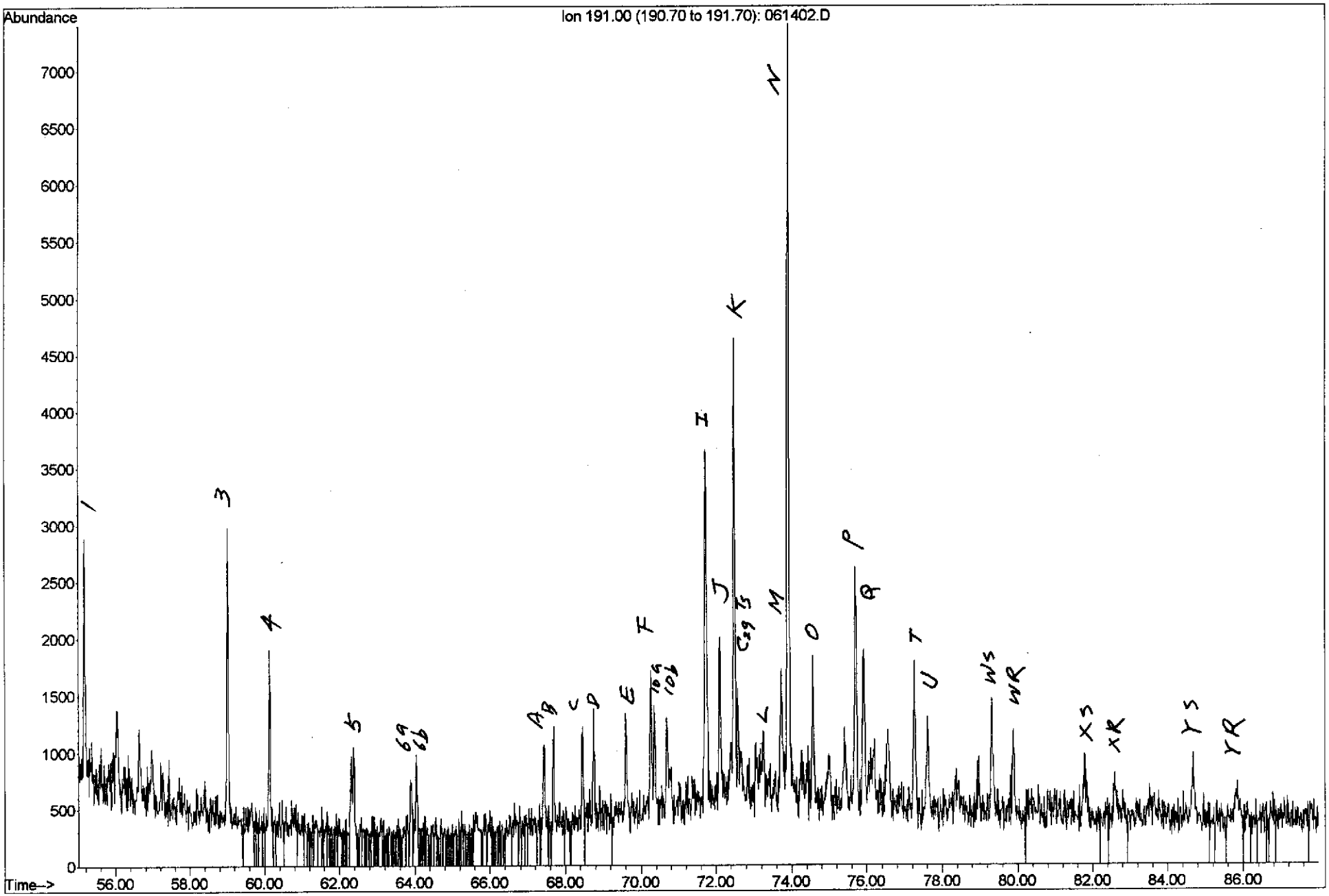
email: forensics@ZymaXusa.com

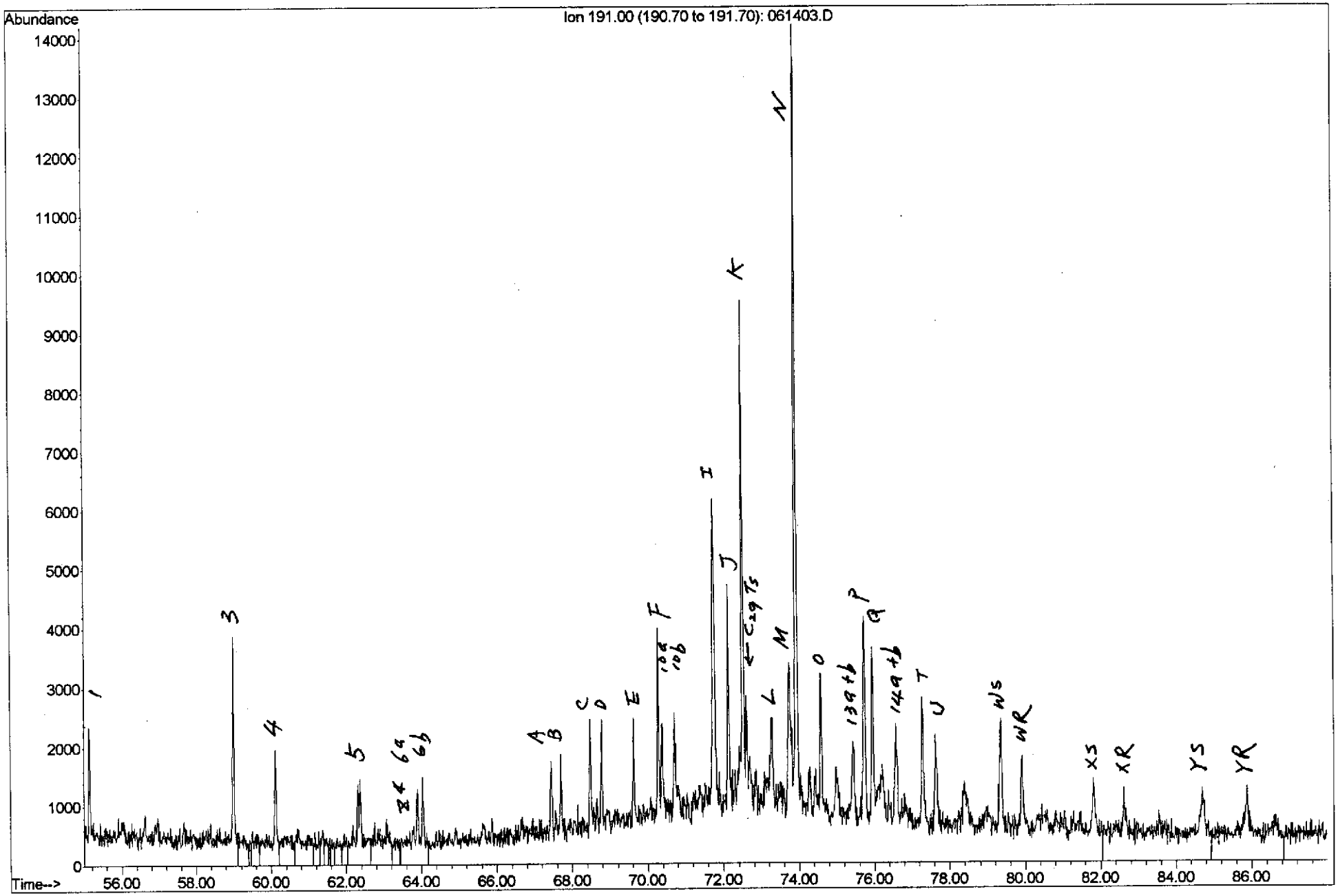
MW-6 (20097-1) ALI+AROM
CITY OF OAKLAND

Figure 18



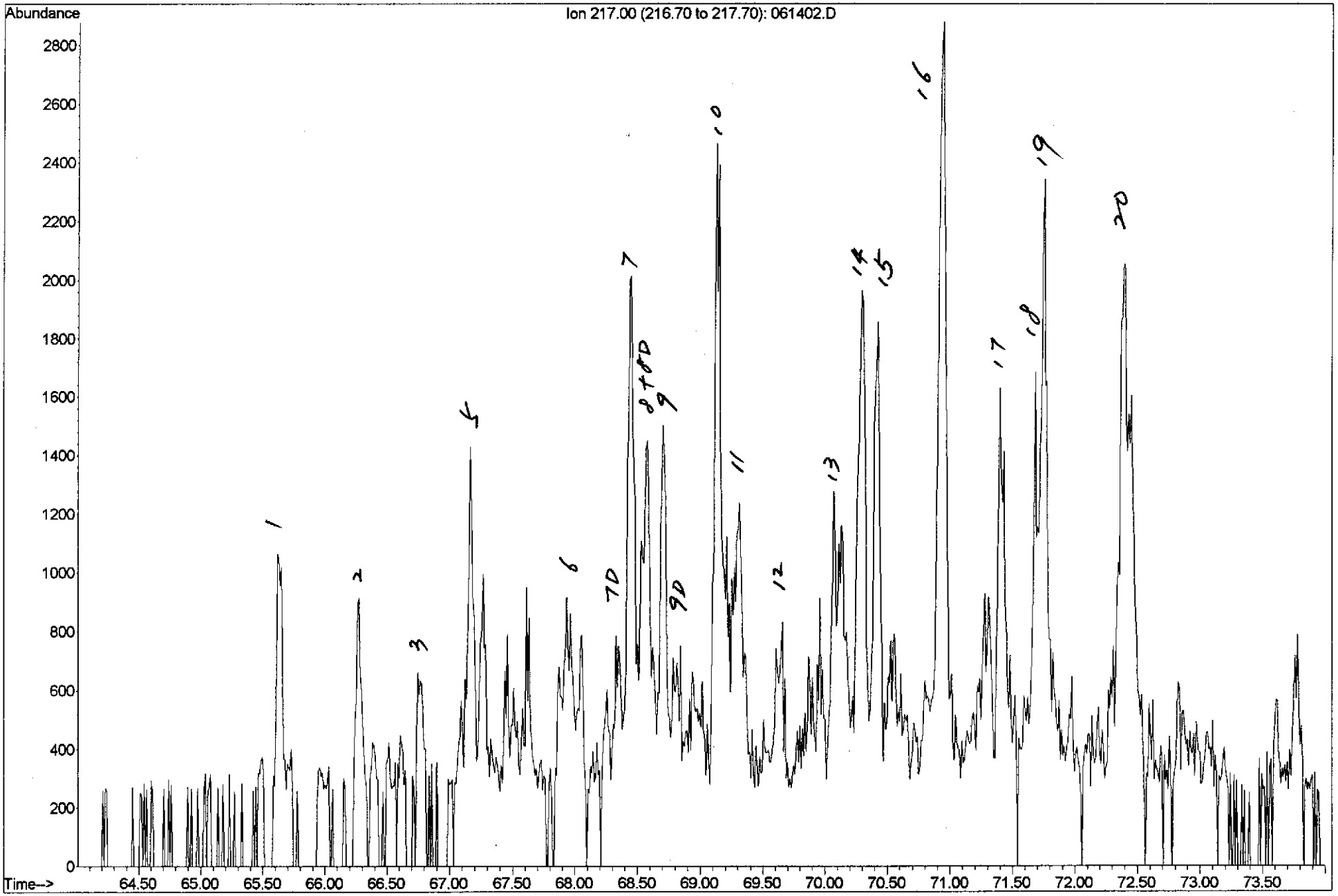
TBW-1 (20097-3) ALI+AROM
CITY OF OAKLAND

Figure 19



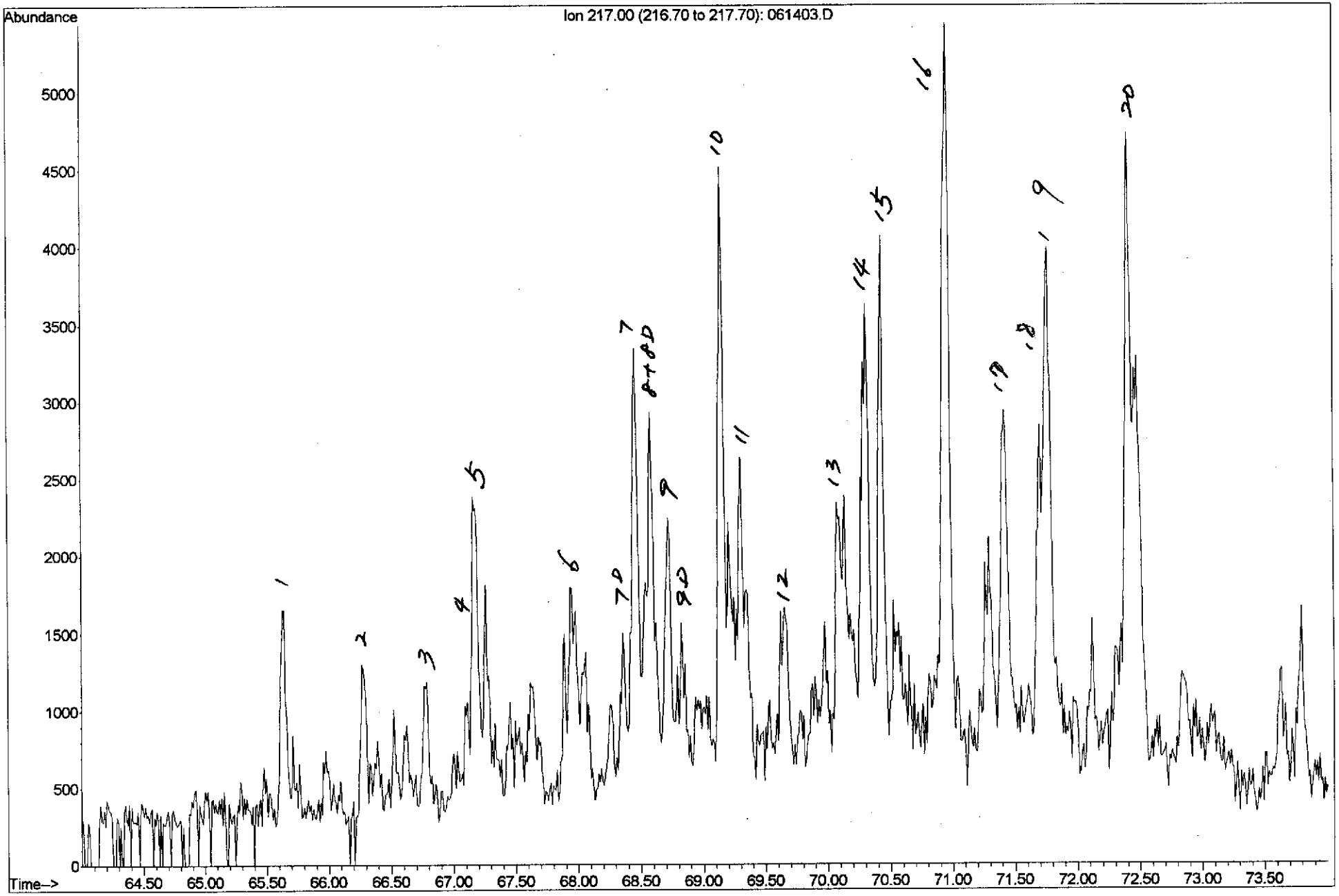
MW-6 (20097-1) ALI+AROM
CITY OF OAKLAND

Figure 20



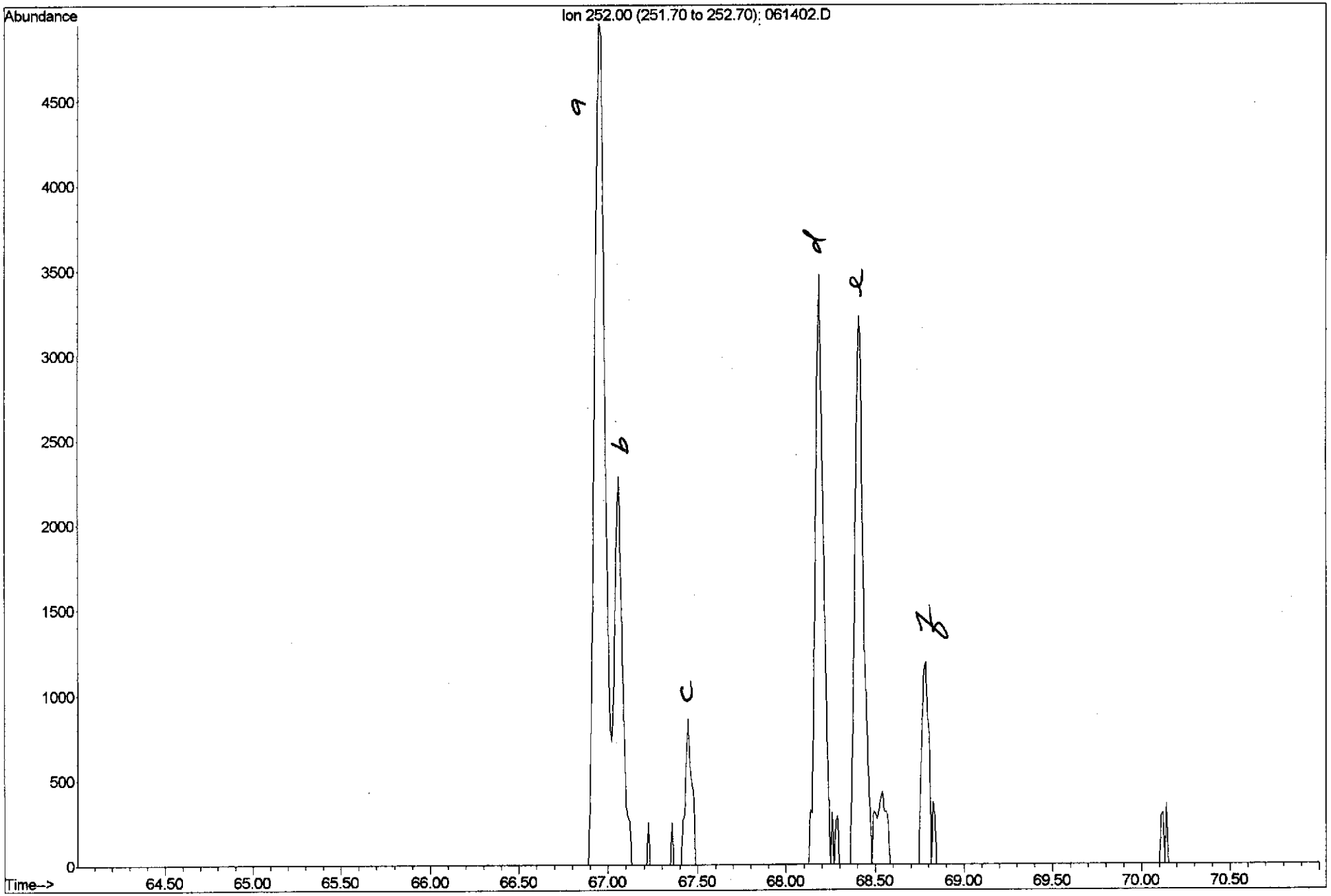
TBW-1 (20097-3) ALI+AROM
CITY OF OAKLAND

Figure 21



MW-6 (20097-1) ALI+AROM
CITY OF OAKLAND

Figure 22



TBW-1 (20097-3) ALI+AROM
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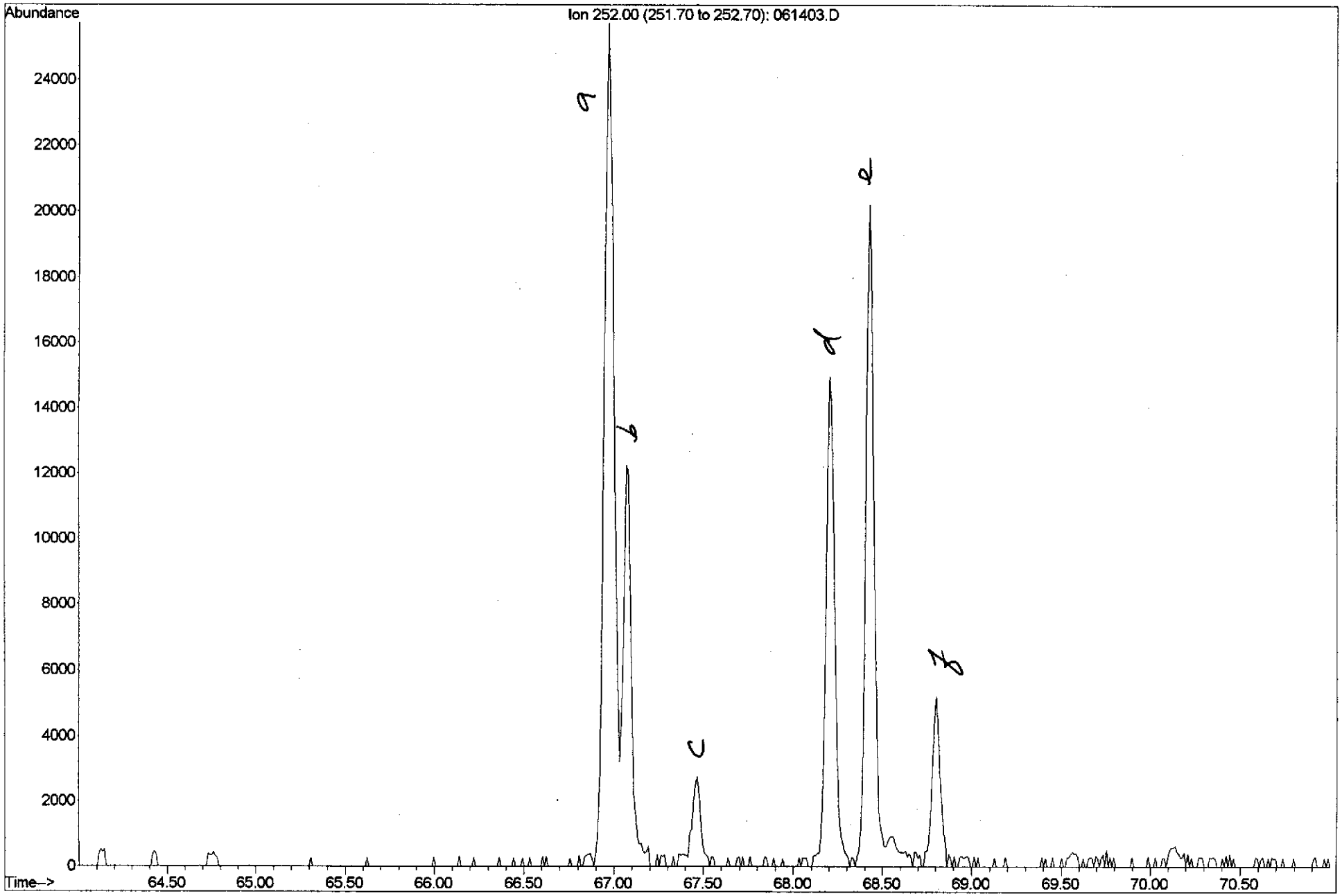
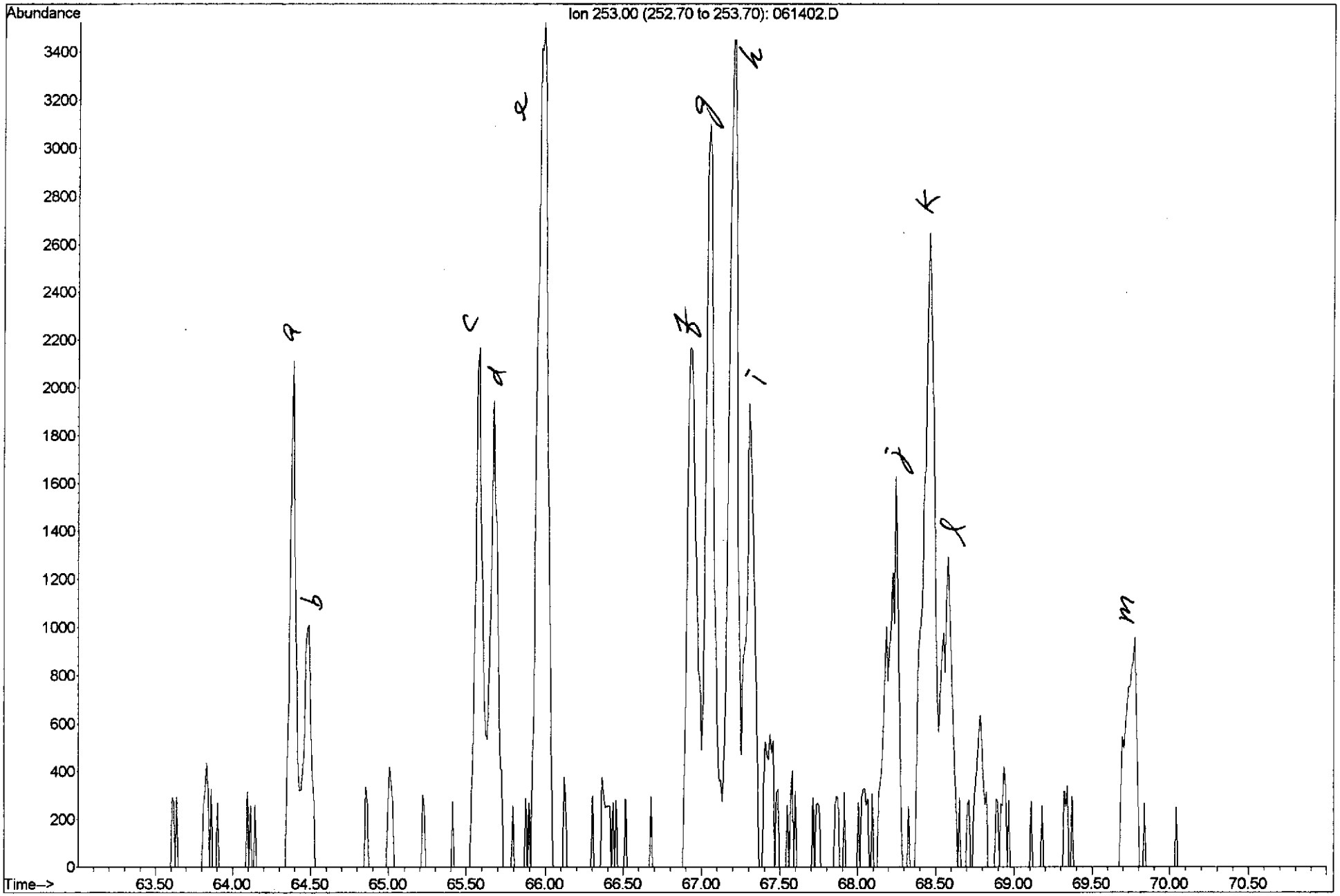
Figure 23



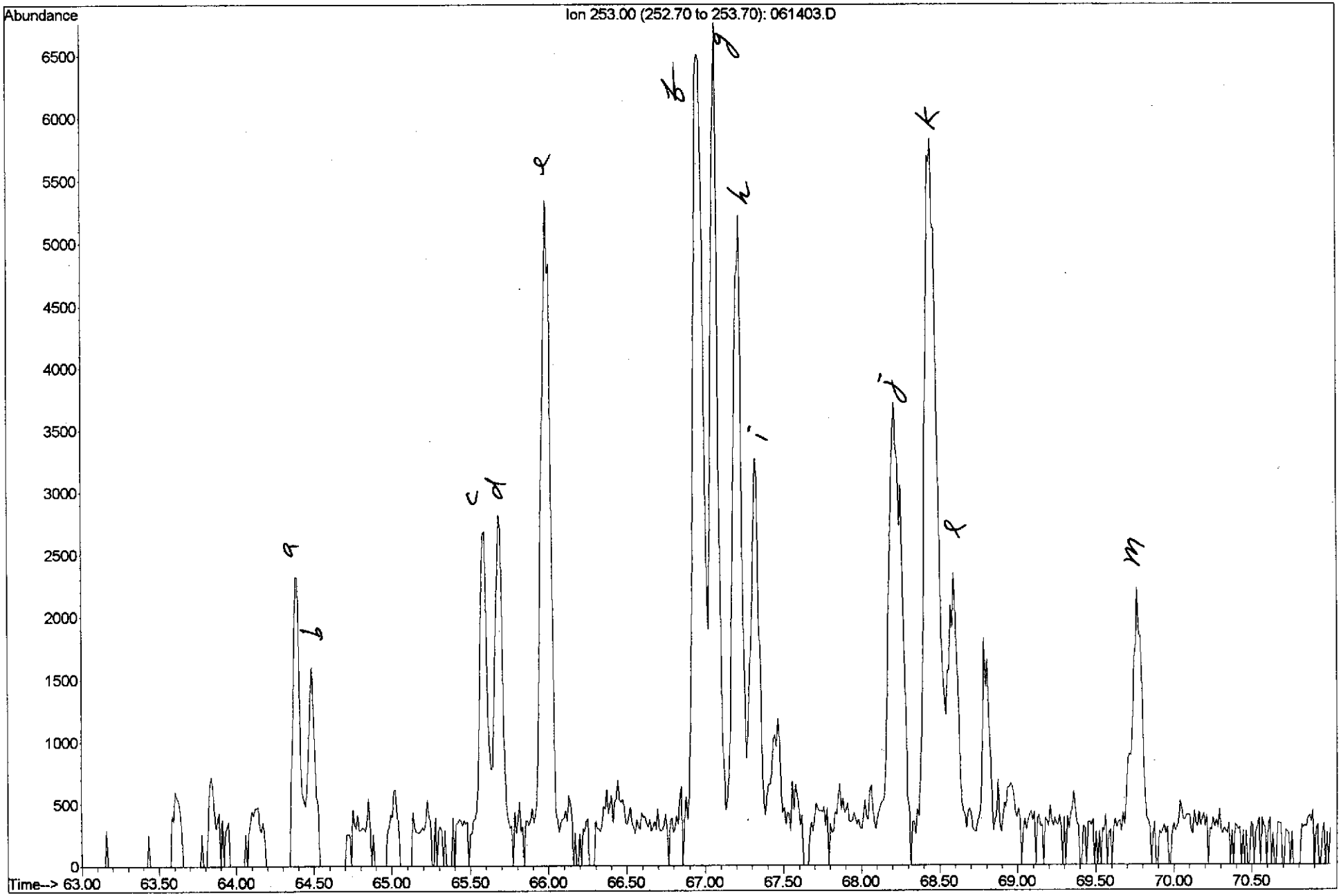
MW-6 (20097-1) ALI+AROM
CITY OF OAKLAND

Figure 24



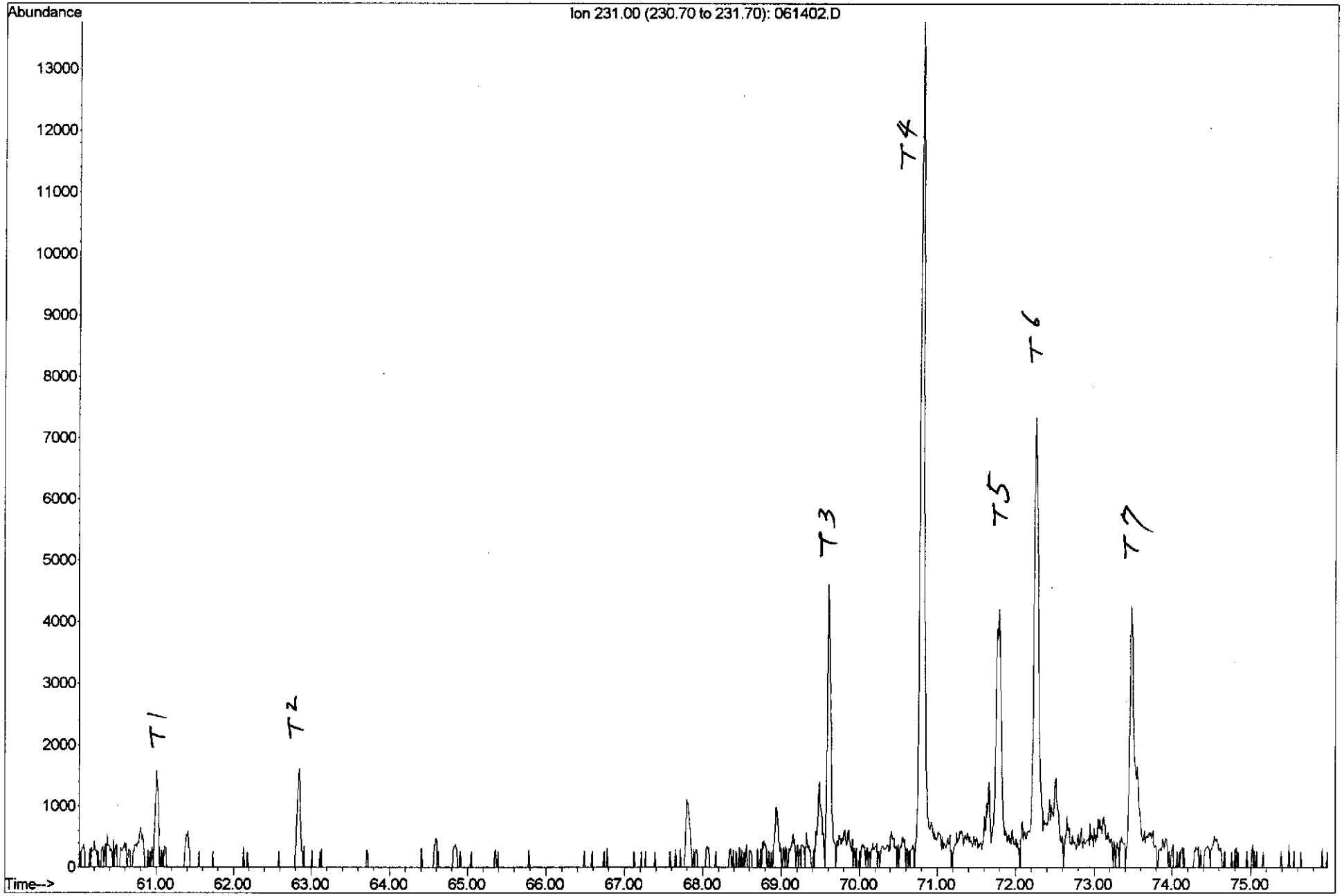
TBW-1 (20097-3) ALI+AROM
CITY OF OAKLAND

Figure 25



MW-6 (20097-1) ALI+AROM
CITY OF OAKLAND

Figure 26



TBW-1 (20097-3) ALI+AROM
CITY OF OAKLAND

Figure 27

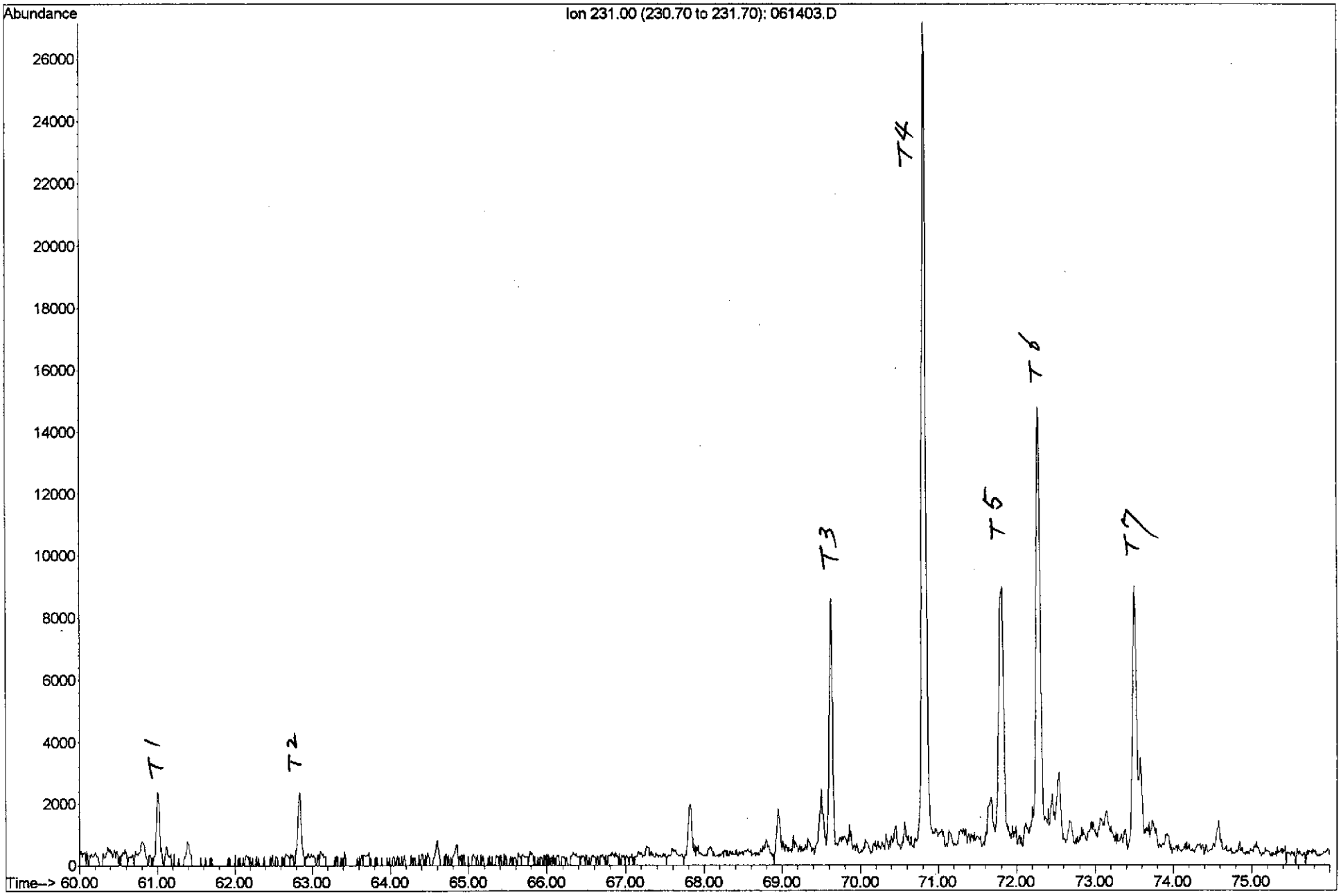


Figure 28

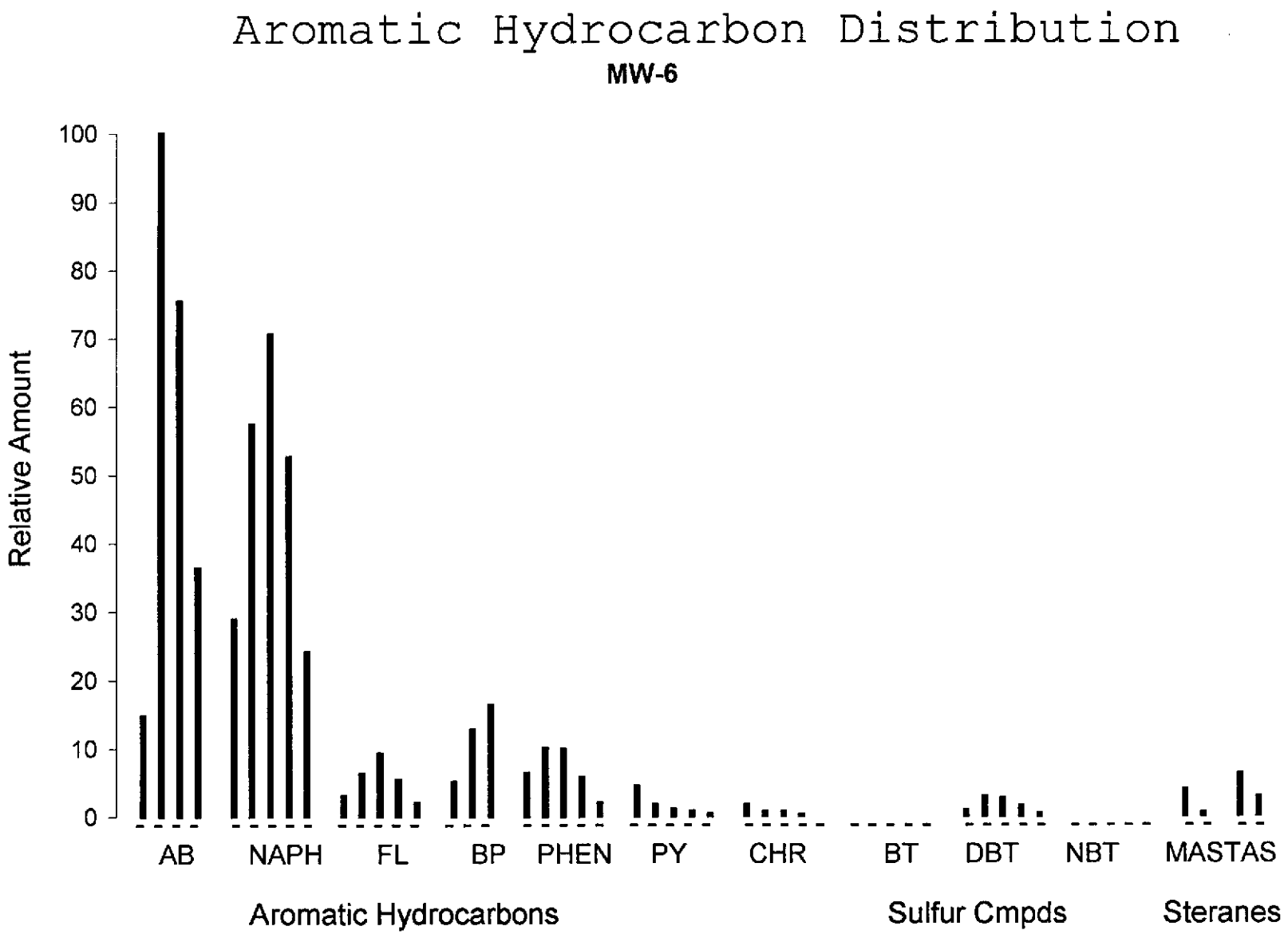

Aromatic Hydrocarbon Distribution
MW-6
Relative Amount
100
90
80
70
60
50
40
30
20
10
0
AB
NAPH
FL
BP
PHEN
PY
CHR
BT
DBT
NBT
MASTAS
Aromatic Hydrocarbons
Sulfur Cmpds
Steranes

Figure 29

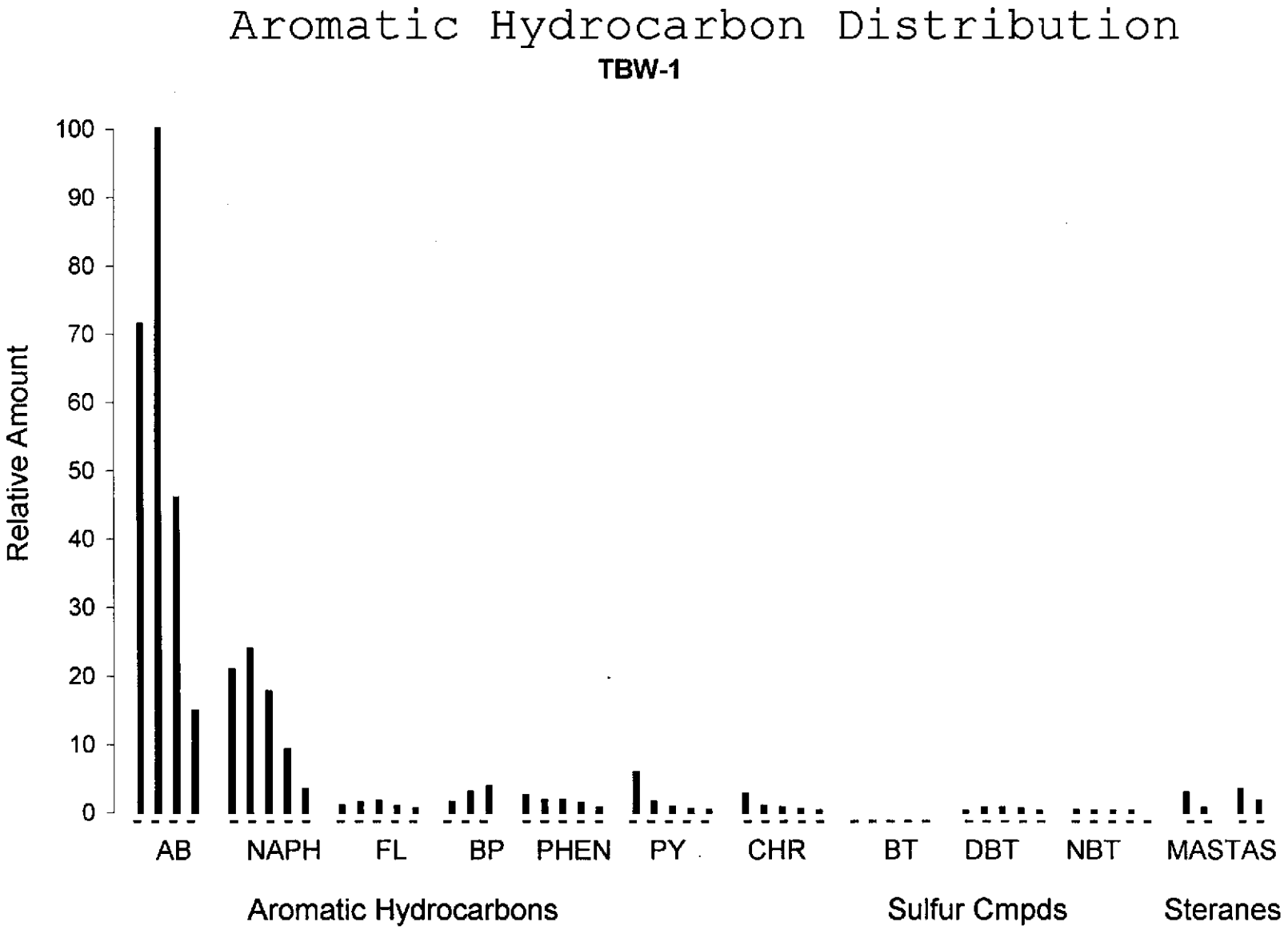

Aromatic Hydrocarbon Distribution
TBW-1
Relative Amount
100
90
80
70
60
50
40
30
20
10
0
AB
NAPH
FL
BP
PHEN
PY
CHR
BT
DBT
NBT
MASTAS
Aromatic Hydrocarbons
Sulfur Cmpds
Steranes

Table 1

N20097

06-07-2000

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

	Sample	MW-6	TBW-1
	Zymax ID	20097-1	20097-3
1	Propane		
2	Isobutane		
3	Isobutene		
4	Butane/Methanol		
5	trans-2-Butene		
6	cis-2-Butene		
7	3-Methyl-1-butene		
8	Isopentane	0.44	0.23
9	1-Pentene		
10	2-Methyl-1-butene		
11	Pentane	0.19	
12	trans-2-Pentene		
13	cis-2-Pentene/t-Butanol		
14	2-Methyl-2-butene	0.19	
15	2,2-Dimethylbutane		
16	Cyclopentane		
17	2,3-Dimethylbutane/MTBE	0.63	0.13
18	2-Methylpentane	1.58	0.45
19	3-Methylpentane	1.35	0.38
20	Hexane	0.78	
21	trans-2-Hexene		
22	3-Methylcyclopentene	0.13	
23	3-Methyl-2-pentene		
24	cis-2-Hexene	0.12	
25	3-Methyl-trans-2-pentene	0.07	
26	Methylcyclopentane	2.54	0.85
27	2,4-Dimethylpentane	1.20	0.33
28	Benzene	0.19	
29	5-Methyl-1-hexene	0.10	
30	Cyclohexane	0.64	0.22
31	2-Methylhexane/TAME	2.28	0.45
32	2,3-Dimethylpentane	3.33	1.08
33	3-Methylhexane	2.94	0.84
34	2-Methyl-1-hexene	1.55	0.54
35	2,2,4-Trimethylpentane	4.34	1.38
IS1	α,α,α-Trifluorotoluene		
36	n-Heptane	2.11	
37	Methylcyclohexane	4.01	2.36
38	2,5-Dimethylhexane	2.58	0.95
39	2,4-Dimethylhexane	1.49	0.62
40	2,3,4-Trimethylpentane	2.58	1.08
41	Toluene	2.59	1.24
42	2,3-Dimethylhexane	1.52	0.65

Table 1 (continued)

N20097

06-07-2000

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

	Sample	MW-6	TBW-1
	Zymax ID	20097-1	20097-3
43	2-Methylheptane	2.99	0.74
44	4-Methylheptane	1.38	0.47
45	3,4-Dimethylhexane	0.56	0.27
46	3-Ethyl-3-methylpentane	3.17	0.88
47	3-Methylheptane	2.45	1.12
48	2-Methyl-1-heptene	0.72	0.35
49	n-Octane	1.19	0.27
50	2,2-Dimethylheptane	0.22	0.13
51	2,4-Dimethylheptane	1.43	0.82
52	Ethylcyclohexane	2.08	0.88
53	2,6-Dimethylheptane	1.74	0.94
54	Ethylbenzene	0.75	0.46
55	m + p Xylenes	1.26	2.16
56	4-Methyloctane	1.87	1.02
57	2-Methyloctane	2.44	1.61
58	3-Ethylheptane	3.13	1.62
59	3-Methyloctane	1.12	0.61
60	o-Xylene	0.61	0.64
61	1-Nonene		
62	n-Nonane	1.09	1.51
IS2	p-Bromofluorobenzene		
63	Isopropylbenzene	0.79	0.78
64	3,3,5-Trimethylheptane	1.06	0.81
65	2,4,5-Trimethylheptane	0.86	0.56
66	n-Propylbenzene	1.03	0.85
67	1-Methyl-3-ethylbenzene	0.29	2.54
68	1-Methyl-4-ethylbenzene		1.84
69	1,3,5-Trimethylbenzene	0.74	4.09
70	3,3,4-Trimethylheptane	0.85	0.92
71	1-Methyl-2-ethylbenzene	0.57	2.37
72	3-Methylnonane		0.34
73	1,2,4-Trimethylbenzene	1.21	6.53
74	Isobutylbenzene	1.54	0.97
75	sec-Butylbenzene	0.64	0.35
76	n-Decane		2.47
77	1,2,3-Trimethylbenzene	0.67	3.17
78	Indan	0.49	1.13
79	1,3-Diethylbenzene	0.82	2.96
80	1,4-Diethylbenzene	0.69	1.31

Table 1 (continued)

N20097

06-07-2000

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

Sample		MW-6	TBW-1
Zymax ID		20097-1	20097-3
81	n-Butylbenzene	0.43	4.79
82	1,3-Dimethyl-5-ethylbenzene	0.75	1.16
83	1,4-Dimethyl-2-ethylbenzene	1.74	3.99
84	1,3-Dimethyl-4-ethylbenzene	0.52	3.77
85	1,2-Dimethyl-4-ethylbenzene	4.02	7.54
86	Undecene		
87	1,2,4,5-Tetramethylbenzene	2.07	3.42
88	1,2,3,5-Tetramethylbenzene	2.75	3.21
89	1,2,3,4-Tetramethylbenzene	2.66	6.37
90	Naphthalene	0.19	0.32
91	2-Methyl-naphthalene	0.53	0.70
92	1-Methyl-naphthalene	0.38	0.46

Table 2

20097H

06-07-2000

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

Sample	MW-6	TBW-1
Zymax ID	20097-1	20097-3
Evaporation		
n-Pentane/n-Heptane	0.09	
2-Methylpentane/2-Methylheptane	0.53	0.62
Waterwashing		
Benzene/Cyclohexane	0.29	
Toluene/Methylcyclohexane	0.65	0.52
Aromatics/Total Paraffins(n+iso+cyc)	0.43	2.13
Aromatics/Naphthenes	3.09	14.79
Biodegradation		
(C4-C8 Para+Isopara)/C4-C8 Olefins	19.06	22.95
3-Methylhexane/n-Heptane	1.39	
Methylcyclohexane/n-Heptane	1.89	
Isoparaffins+Naphthenes/Paraffins	11.34	6.06
Octane rating		
2,2,4-Trimethylpentane/Methylcyclohexane	1.08	0.59
Relative percentages - Bulk hydrocarbon composition as PIANO		
% Paraffinic	5.49	4.48
% Isoparaffinic	52.78	22.61
% Aromatic	29.30	67.42
% Naphthenic	9.48	4.56
% Olefinic	2.95	0.93

Supervisor

Table 3

ZymaX FORENSICS

Hydrocarbon fractions for sample submitted by Cambria Environmental

June 15, 2000

Sample ID	Zymax ID	Saturate + Aromatic(%)	Polar+ Asphaltenes (%)
MW-6	20097-1	35.1	64.9
TRW-1	20097-3	52.5	47.5

Supervisor

20097.fraction.wpd

ZymaX FORENSICS

Table 4

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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email: forensics@ZymaXusa.com

ZymaX FORENSICS

Table 5

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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email: forensics@ZymaXusa.com

Table 6

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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email: forensics@ZymaXusa.com

Table 7

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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Table 13

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 14

Chemical characteristics of fuel types in free products MW-6, TBW-1 and MW-16

Sample Name	Fuel Type	Relative Amount (%)	Condition of Weathering
MW-6	Diesel #2 Gasoline Heating oil #6 Coal tar oil	95 5 trace trace	moderate-severe mild severe ?
TBW-1	Jet fuel Diesel #2 Gasoline Heating oil #6 Coal tar oil	70 30 trace trace	mild moderate moderate moderate ?
MW-16	Jet fuel Gasoline Heating oil #6	50 40 10	moderate moderate moderate
FDP-54-L	Gasoline Kerosene	75 25	moderate moderate

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SAMPLE CHAIN OF CUSTODY

PAGE 2 OF 2

LAB ORDER #: A050354

PROJECT # / PROJECT NAME: 153-1247 / CITY OF OAKLAND

P.O. #:

CLIENT: CAMBRIA ENV. TECH.

REPORT TO: CATHY BELL

ADDRESS: 1144 65TH STREET, EMERYVILLE, CA. 94608

CITY: STATE: ZIP:

BILLING ADDRESS: SAME

PHONE #: (510) 420-0700

FAX PHONE: (510) 420-0701

SAMPLER (PRINT & SIGN NAME): MARK ERICKSON

TURN-AROUND TIME: [X] STANDARD [ ] RUSH

DUE DATE:

ANALYSES REQUESTED

CALTEST #	DATE SAMPLED	TIME SAMPLED	MATRIX	CONTAINER AMOUNT/TYPE	PRESERVATIVE	SAMPLE IDENTIFICATION SITE	CLIENT LAB #	COMP. or GRAB	* CALL FOR ANALYTES	Cr-Cu	GCMS full scan	GCMS column scan	Hold	Sim Dis	REMARKS
-10	5/11	10:30a	FP	40ml/VOA	NONE	MW-6 *	2005-1		X	⊗	⊗	⊗		△	2 VOAS PER SAMPLE
-11		11:10a	FP	3		MW-16 **	-2		X				⊗		
-12		3:35	FP	3		TBW-1 ***	-3		X	⊗	⊗	⊗		△	

* DAVID ELIAS (510) 420-3307

⊗ Analyses per D. Elias 5-17-00 AS TBP

✓ All VOA strong hydrocarbon odor

△ per C.E.T. 6-16-00cm

By submittal of sample(s), client agrees to abide by the Terms and Conditions set forth on the reverse of this document.

RELINQUISHED BY	DATE/TIME	RECEIVED BY	RELINQUISHED BY	DATE/TIME	RECEIVED BY
	5/12/00 9:00 am			051200 1330	
	051500 1830	24hour 5/17/00 1630			

Samples: WC____ MICRO____ BIO____ AA____ SV____ VOA____ | pH? Y/N | TEMP: 55 | SEALED? Y/N | INTACT? Y/N

FOR LAB USE ONLY

BD: BIO____ WC____ AA____

CC: AA____ SV____ VOA____

SIL: HP____ PT____ QT____ VOA____

W/HNO$_3$____ H$_2$SO$_4$____ NaOH____

PIL: HNO$_3$____ H$_2$SO$_4$____ NaOH____ HCL____

COMMENTS * 4 of 4 VOA - 1 VOA 1/4 full - 1 VOA 2.5cm wide 3mm deep - 1 VOA 2cm - 1 VOA 1.5cm

** 2 of 2 VOA - 1 VOA 1.5cm bubble - 2nd VOA headspace is total - 5mm deep x 3cm wide

*** Sample is very dirty oily strong

MATRIX: AQ = Aqueous Nondrinking Water, Digested Metals; FE = Low R.L.s, Aqueous Nondrinking Water, Digested Metals; DW = Drinking Water; SL = Soil, Sludge, Solid; FP = Free Product

CONTAINER TYPES: AL = Amber Liter; AHL = 500 ml Amber; PT = Pint (Plastic); QT=Quart (Plastic); HG = Half Gallon (Plastic); SJ = Soil Jar; B4 = 4 oz. BACT; BT = Brass Tube; VOA = 40 mL VOA; OTC = Other Type Container

REV. 2/99

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