TOSCO MARKETING COMPANY

FAX

TOSCO

ENVIRONMENTAL COMPLIANCE

2000 Crow Canyon Place, Suite 400
San Ramon, CA 94583
fax (510) 277-2361

TO : Scott Seery (510-567-6783)

COMPANY : ACHCSA

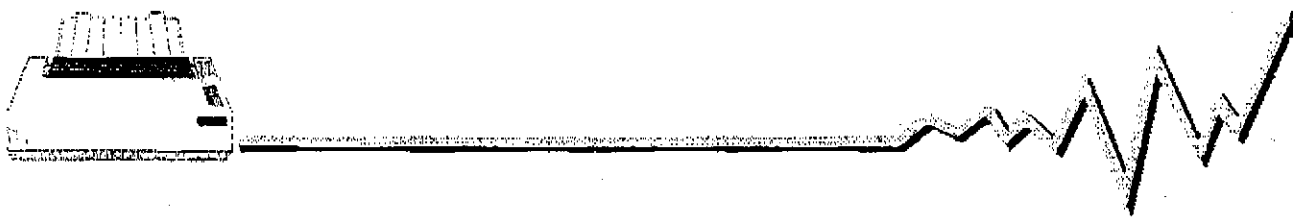
FAX NO : 510-337-9335

DATE: 12/29/97 **PAGES SENT:** 36 (including cover)

FROM: Tina Berry

PHONE: (510) 277-2321

COMMENTS: Scott, here is the fingerprint analysis report for the MW-5 product near UNOCAL SS#7376, 4191 First St. @ Ray, Pleasanton. I am currently trying to obtain documentation which supports the sources of gasoline delivery to this station as the evidence suggests that the gasoline present in the sample product does not originate from the UNOCAL station. Let's discuss!



E N T R I X

Since 1984 - Environmental Excellence

ENTRIX, Inc.
590 Ygnacio Valley Road
Suite 200
Walnut Creek, CA 94596
(510) 935-9920
(510) 935-5368 FAX

Project 351301

December 12, 1997

Ms. T. Berry
TOSCO, Environmental Compliance
2000 Crow Canyon Place, Suite 400
San Ramon, CA 94583

Mr. Sarkis A. Soghomonian
Kaprealian Engineering Inc.,
2401 Stanwell Dr., Suite 400
Concord, CA 94520

Re: Forensic Geochemical Analysis of Free Product from MW-5, UNOCAL SS# 7376, Pleasanton, CA

Dear Tina and Sarkis:

At your request, I have reviewed the following data sets and present the following conclusions:

- Elevation data and associated laboratory analytical data for ground water from site monitoring wells (Tables 1 and 2 from an April 10, 1997 ground water monitoring report);
- High resolution gas chromatography and simulated distillation data recently obtained for free product from the MW-5 well.

The free product obtained from the MW-5 well contains hydrocarbons in the nC_3-nC_{33} range (i.e., in the gasoline, diesel, and residual ranges). Evaluation of the high resolution gas chromatograph (HRGC) trace indicates that the free product is most likely composed of a mixture of refined gasoline and heavier hydrocarbons. The refined gasoline appears to be moderately fresh based on compound distributions and comparison with similar distributions in fresh gasoline. The heavier hydrocarbon mixture has a carbon distribution ranging from about nC_{13} to nC_{33} and, based on the hydrocarbon distribution, does not appear to contain refined petroleum products (e.g., diesel #2, motor oil, lube oil, etc.). Rather, the distribution is similar in nature to what might be expected from the HRGC analysis of a very weathered crude oil. The simulated distillation results clearly support the presence of both gasoline and heavier hydrocarbon fractions in the MW-5 free product and are consistent with the

conclusions derived from evaluation of the HRGC analysis presented above regarding the presence of both gasoline and a heavier hydrocarbon mixture.

The integration of both chromatographic and simulated distillation data types indicates that over 50% of the MW-5 free product is derived from the gasoline source and that this material is relatively fresh. Additionally, the data indicate that the MW-5 free product (1) must contain material which has an ending boiling point similar to crude oils or residual Bunker C fuel, (2) has a distribution of heavier hydrocarbons which are not chromatographically related to refined petroleum mixtures (e.g., motor or lube oils), (3) contains a full range of hydrocarbon compounds in the nC_{10}-nC_{33} range (i.e., hydrocarbons in both the diesel range [e.g., the isoprenoids] and the nC_{20}-nC_{30} range [e.g., the UCM]), and (4) has a heavier hydrocarbon distribution chromatographically consistent with a weathered crude oil.

UCM?

INTRODUCTION

In June, 1997, free product was found in the MW-5 well at the UNOCAL Service Station #7376 in Pleasanton, California. At your request, a sample of this free product was forwarded by Kaprealian Engineering Inc. (KEI) to ENTRIX and on to Global Geochemistry Corporation (GGC) for (1) high resolution gas chromatography (HRGC) and (2) simulated distillation using a modified ASTM 2887.[1] The objective of this analysis was to evaluate the nature (i.e., hydrocarbon distribution) of the free product and to assess potential source(s) of the free product.

RESULTS AND DISCUSSION

The results of the GGC HRGC and simulated distillation analyses (see Attachment 1) consist of (1) a high resolution gas chromatogram for the sample (MW-5) and for a duplicate analysis (MW-5[D]), (2) quantification and tabulation of the hydrocarbon compounds found in both analyses in the gasoline range (nC3-nC12), and (3) simulated distillation curves for MW-5 and MW-5(D). An initial review of both the HRGC analyses and the simulated distillation results suggests that the MW-5 free product is composed of gasoline and a heavier hydrocarbon eluting in the nC_{13}-nC_{33} (i.e., the diesel and heavier) hydrocarbon ranges. The following discussion will first focus on the nC_3-nC_{10} hydrocarbon range in terms of evaluating the likely source(s) of these hydrocarbons and providing an estimate of the degree of weathering that they have been subjected to. The heavier hydrocarbons (nC_{10}-nC_{33}) will also be discussed in terms of their potential source(s) and degree of weathering. These

[1] GGC data report and chain of custody are presented as Attachment 1 to this letter report.

analyses will then be integrated into a conclusion regarding the potential sources of the hydrocarbons measured in the MW-5 free product.

GASOLINE FRACTION EVALUATION

Table 1 presents the relative percent concentrations of gasoline compounds found in the nC_3-nC_{10} range of the sample and duplicate. Of specific interest is the abundance of compounds identified in the nC_3-nC_7 range, especially 2,2,4-trimethylpentane (iso-octane). The presence of this compound provides evidence that the free product contains refined gasoline. The overall nC_3-nC_{10} hydrocarbon distribution as presented in Table 1 and in the gas chromatogram (Figure 1) also indicate that the free product contains gasoline. Finally, Figure 2 provides a comparison of the major compound classes found in the nC_3-C_{10} fraction of the MW-5 free product. These classes include the paraffins (straight chain alkanes), the isoparaffins (branched alkanes), the aromatics, the naphthenes (cyclic alkanes), and the olefins (unsaturated -alkenes and alkynes). The analysis is often called the PIANO analysis. Figure 2 provides a comparison of PIANO results from the MW-5 free product with those obtained using the same analysis from 18 fresh gasolines contained in the ENTRIX gasoline database. While this comparison shows some subtle differences (e.g., lower total aromatics - see below), the general agreement for the relative amount of the various major compound classes supports the prior contention that the MW-5 free product contains gasoline.

In order to assess the degree of weathering of the gasoline component of the MW-5 free product, its important to understand that environmental weathering processes include (1) evaporation, solubilization (water washing), and biodegradation. Each of these processes affects the hydrocarbon distribution in a predictable way. For example, if the gasoline was subjected to considerable evaporation, one would predict a preferential loss of the lighter relative to the heavy ends of the mixture. If one looked at a ratio of nC3-nC7 versus nC7-nC13 compounds, evaporative losses would be expected to move the ratio to lower values as the mixture became preferentially enriched in the higher molecular weight compounds. Thus, comparison of this type of parameter between free product samples and fresh gasolines can provide a sense of the degree of evaporation to which the gasoline in the MW-5 free product has been subjected to. Similarly, parameters such as benzene/cyclohexane or total aromatics/total paraffins can provide insight into the degree to which the gasoline in the free product has been solubilized into the ground water. Finally, comparing branched and non-branched alkanes can be useful in determining the degree to which the gasoline in the free product has been subjected to biodegradation. Due to energetic needs, bacteria will preferentially degrade straight chain hydrocarbons relative to branched hydrocarbons. Thus, comparison of 3-methylhexane to n-heptane can provide information regarding the degree of biodegradation.

The nC_3-nC_7 range of the MW-5 free product sample accounts for 55.1±0.4% of the compounds quantified in the nC_3-nC_{10} range. Comparing this value to values obtained from the ENTRIX fresh gasoline database (n=18 separate gasolines; 35.1 to 57%), suggests that the gasoline present in the MW-5 free product contains a substantial amount of material in the nC_3-nC_7 range (relative to the > nC_7 range). This comparison suggests that the gasoline fraction of the MW-5 free product has not undergone substantial evaporative weathering. A similar comparison of the total aromatic/total paraffins ratios calculated for the MW-5 free product (0.38) and obtained from the ENTRX fresh gasoline database (range: 0.66 to 1.25) argues that the gasoline in the MW-5 free product has preferentially lost aromatic compounds, most likely due to preferential loss of aromatics due to their increased aqueous solubility from the gasoline mixture. Finally, a comparison of 3-methylhexane to n-heptane ratios (1.11 versus 1.28 to 2.33) argues against a substantial amount of biodegradation (biodegradation would preferentially remove the n-heptane and lead to an increase in the ratio).

Taken altogether, the weathering parameters are consistent with the conclusion that the gasoline found in the MW-5 free product has only been subjected to a moderate degree of weathering (predominantly due to aqueous solubilization). Further, these individual parameters are consistent with the results presented in the PIANO analysis (see Figure 2) and support the hypothesis that the gasoline component of the MW-5 free product is relatively fresh.

HEAVIER HYDROCARBON EVALUATION

As noted above, Figure 1 is the gas chromatogram from the HRGC analysis of the MW-5 free product and demonstrates that the sample contains hydrocarbons extending from nC_3 into the nC_{30} range. The slight hump in the gas chromatogram's baseline in the nC_{20}-nC_{33} range is termed an unresolved complex mixture (UCM) and is often indicative of petroleum derived material. In general, a UCM or "hump" results from the inability of the HRGC analysis to completely resolve and separate the complex compounds associated with petroleum mixtures. In environmental samples not related with crude oil, UCM humps are often found in the nC_{10}-nC_{25} or diesel range. Complex compounds known as petroleum biomarkers (e.g., steranes and pentacyclic triterpanes) are found to elute in the nC_{30} range and have been known to fairly stable to degradation processes (e.g., Peters and Moldowan, 1993[2]). The fact that the MW-5 free product (1) does not contain a diesel range UCM and (2)

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[2] Peters, K.E. and Moldowan, J.M. (1993) **The Biomarker Guide, Interpreting Molecular Fossils in Petroleum and Ancient Sediments.** Prentice-Hall, Inc.

does contain a UCM hump in nC_{20}-nC_{33} range is consistent with a heavily degraded crude oil source. Further, the presence of apparently low amounts of isoprenoids in the nC_{10}-nC_{20} range (e.g., pristane and phytane) would seem to indicate that (1) the MW-5 free product has some source of hydrocarbons in the nC_{10}-nC_{20} range and (2) rule out the possibility that the heavier hydrocarbons are derived solely from refined heavier hydrocarbon mixtures (e.g., motor and/or lube oils).

Figure 3 contains the results of the simulated distillation performed on standard mixtures of gasoline, diesel #2, and a bunker C. This figure is presented as a comparison of the amount of material which is distilled from (i.e., boiled off of) the hydrocarbon mixture as a function of the boiling point. The curves provide a view of the cumulative % material that distills out of the mixture (% OFF). For example, the simulated distillation results for the gasoline standard shows that (1) this material has an initial boiling point <200 degrees F, (2) approximately 65% of the gasoline boils off below 300 F, and (3) the mixture has a final boiling point of about 400 F. Comparing this with the Bunker C standard simulated distillation curve indicates that (1) the Bunker C mixture has an initial boiling point well above that of gasoline (>300 F *versus* <200 F), and (2) contains components that do not boil off at temperatures less than 1000 F. As might be expected for a mid-range distillate, the diesel #2 fuel has a simulated distillation curve between that of the heavy Bunker C residual fuel and the much lighter gasoline. One additional point to be made in this discussion of the simulated distillation curves is that a fresh crude oil contains compounds that boil below 200 F and above 1000 F. Thus, the simulated distillation curve for a fresh crude would be expected to begin at about 100-150 F move across the diesel #2 curve and end at a final boiling point over 1000 F.

Figure 4 contains the same standard simulated distillation curves along with the curves produced from a simulated distillation analysis of the MW-5 free product. The MW-5 curve closely follows the gasoline simulated distillation curve until about 60% of the MW-5 material has distilled off. After this point, the MW-5 curve clearly indicates the presence of a much heavier (higher boiling point) hydrocarbon. Comparison of the final boiling points shows that the MW-5 free product has a final boiling point comparable to that of residual Bunker C fuel. These results are consistent with a hydrocarbon mixture containing both gasoline and a heavier hydrocarbon fraction. The fact that the final boiling point for the MW-5 free product is similar to what one would see in a residual Bunker C fuel or in a crude oil supports prior assertions that the heavier hydrocarbon mixture is not simply derived from a motor oil or lube oil.

CONCLUSIONS

The free product obtained from the MW-5 well contains hydrocarbons in the nC_3-nC_{33} range (i.e., in the gasoline, diesel, and residual ranges). Evaluation of the HRGC trace indicates

that the free product is most likely composed of a mixture of refined gasoline and heavier hydrocarbons. The refined gasoline appears to be moderately fresh based on individual compound distributions and comparison with similar distributions in fresh gasoline. The heavier hydrocarbon mixture has a carbon distribution ranging from about nC_{13} to nC_{33} and, based on the hydrocarbon distribution, does not appear to contain refined petroleum products (e.g., diesel #2, motor oil, lube oil, etc.). Rather, the distribution is similar in nature to what might be expected from the HRGC analysis of a very weathered crude oil. The simulated distillation results clearly support the presence of both gasoline and heavier hydrocarbon fractions in the MW-5 free product and are consistent with the conclusions derived from evaluation of the HRGC analysis presented above regarding the presence of both gasoline and a heavier hydrocarbon mixture.

The integration of both chromatographic and simulated distillation data types indicates that over 50% of the MW-5 free product is derived from a gasoline source and that this material is relatively fresh. Additionally, the data indicate that the MW-5 free product (1) must contain material which has an final boiling point similar to crude oils or residual fuels, (2) has a distribution of heavier hydrocarbons which are not chromatographically related to refined petroleum mixtures (e.g., motor or lube oils), (3) contains a full range of hydrocarbon compounds in the nC_{10}-nC_{33} range (i.e., hydrocarbons in both the diesel range [e.g., the isoprenoids] and the nC_{20}-nC_{30} range [e.g., the UCM]), and (4) has a heavier hydrocarbon distribution chromatographically consistent with a weathered crude oil.

Please do not hesitate to call me at (510) 935-9920 if you have any questions regarding this letter report.

Sincerely,

ENTRIX, Inc.

Robert I. Haddad, Ph.D.
Senior Consultant, Geochemistry

RIH/dlc

cc: Project Files

E N T R I X

Table 1

Global Geochemistry Corp. C3-C10 Gasoline analysis
ENTRIX Project # 351301
UNOCAL SS#7376 Pleasanton

	Matrix	FP	FP
	Sample ID	MW-5	MW-5D
	Date Collected	6/27/97	6/27/97
	Date Extracted	7/19/97	7/19/97
	Date Analyzed	7/31/97	7/31/97
	Lab ID	4027-1	4027-1D
	Test	C3-C10	C3-C10
	Units	Rel%*	Rel%
1	n-Propane		
2	Isobutane	0.13	0.14
3	Isobutene		
4	Butane/Methanol	0.85	0.87
5	trans-2-Butene		
6	cis-2-Butene		
7	3-Methyl-1-butene	0.07	0.07
8	Isopentane	7.65	7.73
9	1-Pentene	0.29	0.29
10	2-Methyl-1-butene	0.38	0.39
11	n-Pentane	3.27	3.27
12	trans-2-Pentene	0.78	0.78
13	cis-2-Pentene/t-Butanol		
14	2-Methyl-2-butene	1.05	1.06
15	2, 2-Dimethylbutane	0.19	0.19
16	Cyclopentane	0.17	0.17
17	2, 3-Dimethylbutane/MTBE	2.14	2.11
18	2-Methylpentane	5.65	5.55
19	3-Methylpentane	3.37	3.32
20	n-Hexane	3.04	2.95
21	trans-2-Hexene	0.28	0.28
22	3-Methylcyclopentene	0.49	0.49
23	3-Methyl-2-pentene	0.46	0.42
24	cis-2-Hexene	0.43	0.39
25	3-Methyl-trans-2-pentene	0.25	0.24
26	Methylcyclopentane	4.9	4.83
27	2, 4-Dimethylpentane	1.37	1.32
28	Benzene	0.3	0.3
29	5-Methyl-1-hexene	0.39	0.36
30	Cyclohexane	1.69	1.66
31	2-Methylhexane	2.26	2.24
32	2, 3-Dimethylpentane	2.02	2.02
33	3-Methylhexane	3.13	3.07
34	2-Methyl-1-hexene	1.2	1.26
35	2, 2, 4-Trimethylpentane	4.05	3.96
36	n-Heptane	3.11	3.03
37	Methylcyclohexane	3.46	3.39
38	2, 5-Dimethylhexane	1.13	1.09
39	2, 4-Dimethylhexane	1.06	1.07
40	2, 3, 4-Trimethylpentane	1.49	1.48
41	Toluene	1.97	1.95
42	2, 3-Dimethylhexane	0.88	0.88
43	2-Methylheptane	1.13	1.16
44	4-Methylheptane	0.56	0.58

ENTRIX

Table 1

45	3, 4-Dimethylhexane	0.41	0.41
46	3-Ethyl-3-methylpentane	0.96	0.98
47	3-Methylheptane	0.95	0.96
48	2-Methyl-1-heptene	0.43	0.43
49	n-Octane	1.72	1.71
50	2, 2-Dimethylheptane	0.12	0.13
51	2, 4-Dimethylheptane	0.28	0.29
52	Ethylcyclohexane	0.44	0.46
53	2, 6-Dimethylheptane	0.39	0.41
54	Ethylbenzene	0.51	0.54
55	m - p Xylenes	6.09	6.26
56	4-Methyloctane	0.38	0.39
57	2-Methyloctane	1.11	1.12
58	3-Ethylheptane	0.71	0.73
59	3-Methyloctane		
60	o-Xylene	1.75	1.73
61	1-Nonene		
62	n-Nonane	0.27	0.28
63	Isopropylbenzene	0.28	0.3
64	3, 3, 5-Trimethylheptane		
65	2, 4, 5-Trimethylheptane	0.28	0.29
66	n-Propylbenzene	0.12	0.12
67	1-Methyl-3-ethylbenzene	1.12	1.13
68	1-Methyl-4-ethylbenzene	0.9	0.91
69	1, 3, 5-Trimethylbenzene	1.3	1.3
70	3, 3, 4-Trimethylheptane	0.58	0.62
71	1-Methyl-2-ethylbenzene	1	1.04
72	3-Methylnonane	0.17	0.18
73	1, 2, 4-Trimethylbenzene	3.47	3.48
74	Isobutylbenzene	0.18	0.18
75	sec-Butylbenzene	0.11	0.11
76	n-Decane	0.32	0.33
77	1, 2, 3-Trimethylbenzene	0.8	0.84
78	Indan	0.45	0.5
79	1, 3-Diethylbenzene	0.44	0.45
80	1, 4-Diethylbenzene		
81	n-Butylbenzene	0.85	0.88
82	1, 3-Dimethyl-5-ethylbenzene	0.18	0.19
83	1, 4-Dimethyl-2-ethylbenzene	0.21	0.22
84	1, 3-Dimethyl-4-ethylbenzene	1	1
85	1, 2-Dimethyl-4-ethylbenzene	0.78	0.83
86	Undecene		
87	1, 2, 4, 5-Tetramethylbenzene	0.33	0.32
88	1, 2, 3, 5-Tetramethylbenzene	0.94	0.93
89	1, 2, 3, 4-Tetramethylbenzene	0.31	0.31
90	Naphthalene	0.15	0.15
91	2-Methyl-naphthalene	0.04	0.04
92	1-Methyl-naphthalene	0.15	0.16
	* = % of C3-C10		
	Total	100.02	100

Sample Name=4027-1D (MWS + IS3-014)

0.0 to 100.0 min. Low Y=6.29 High Y=180.892 mv Span=174.602

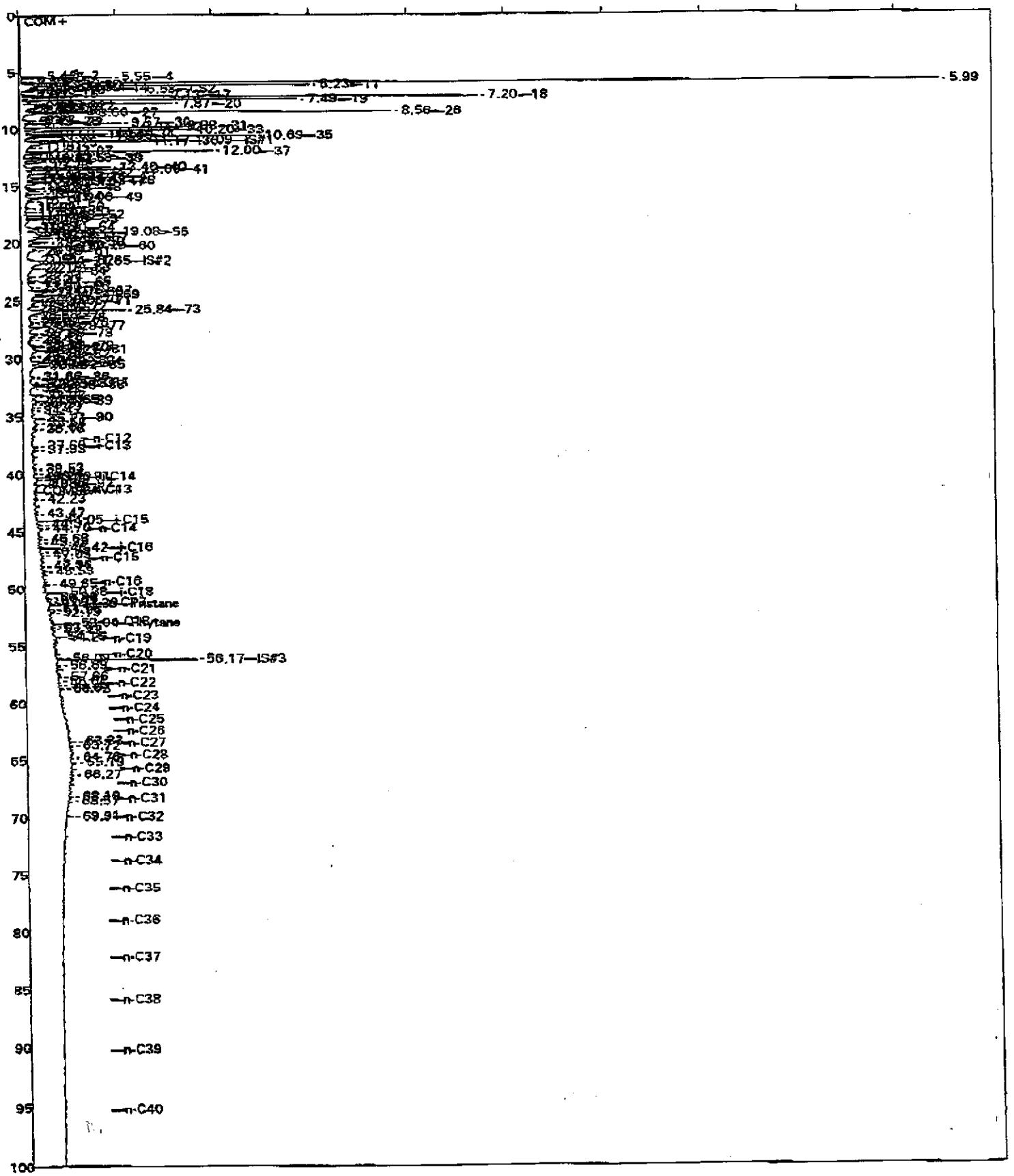


Figure 1

Figure 2

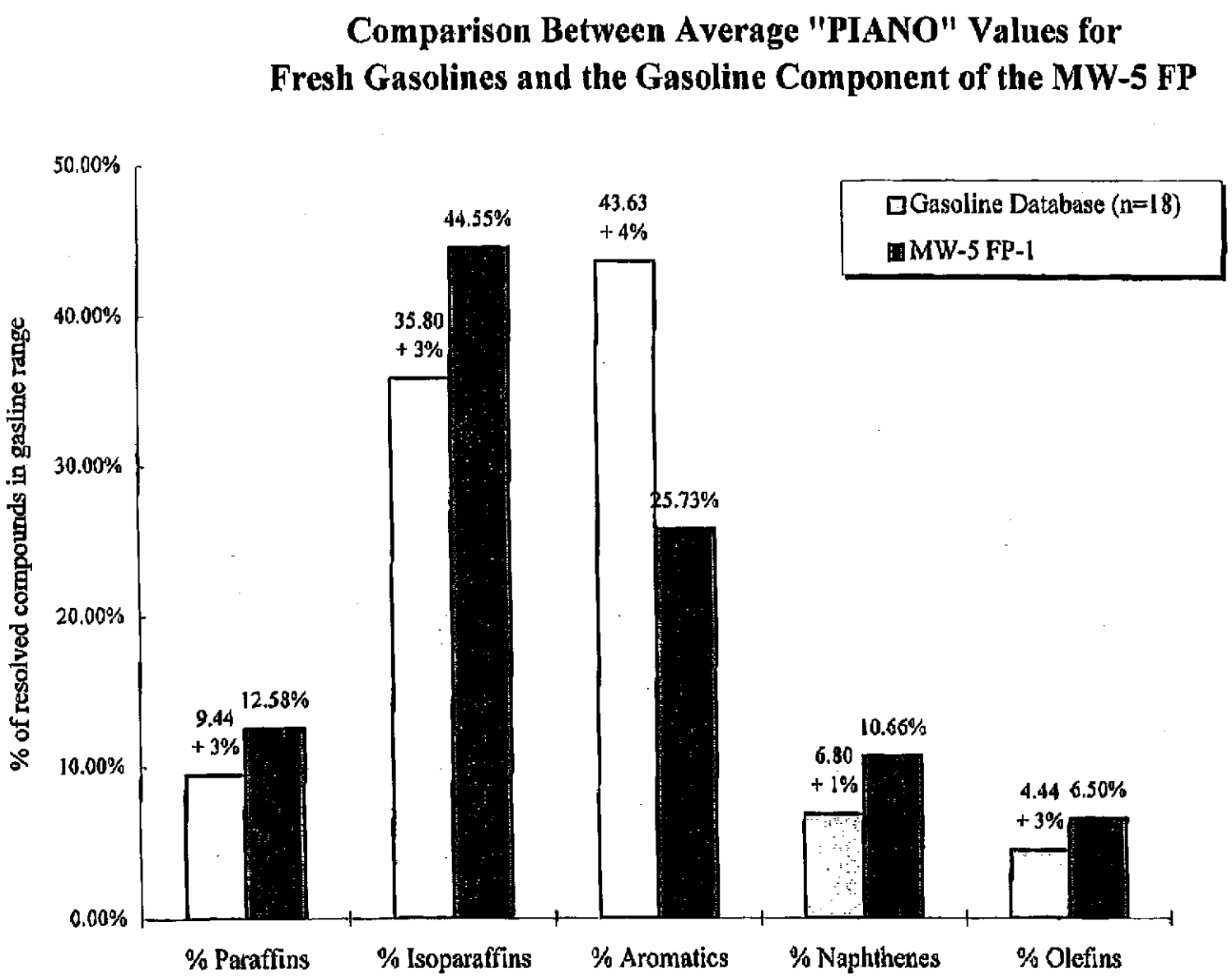


Figure 3

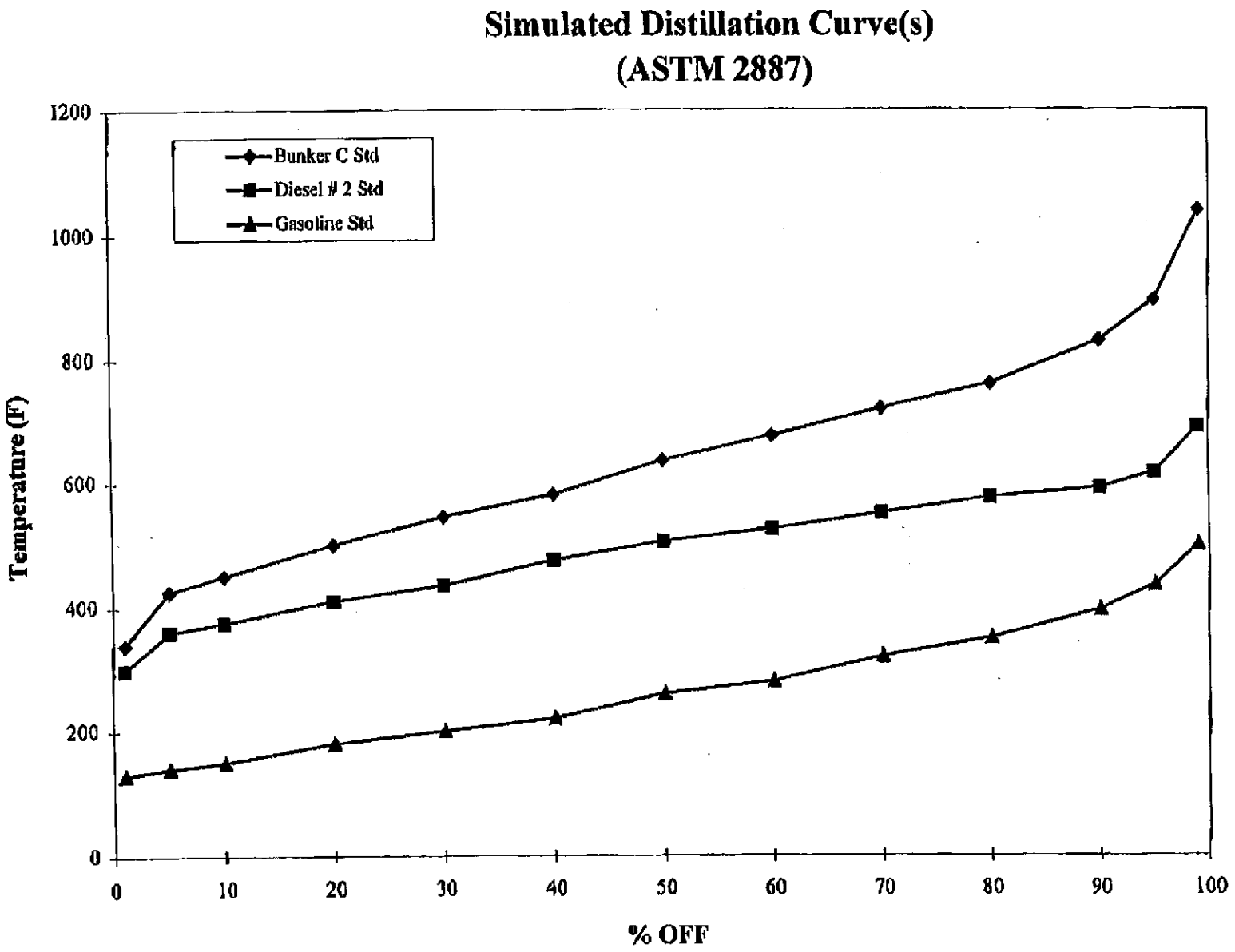
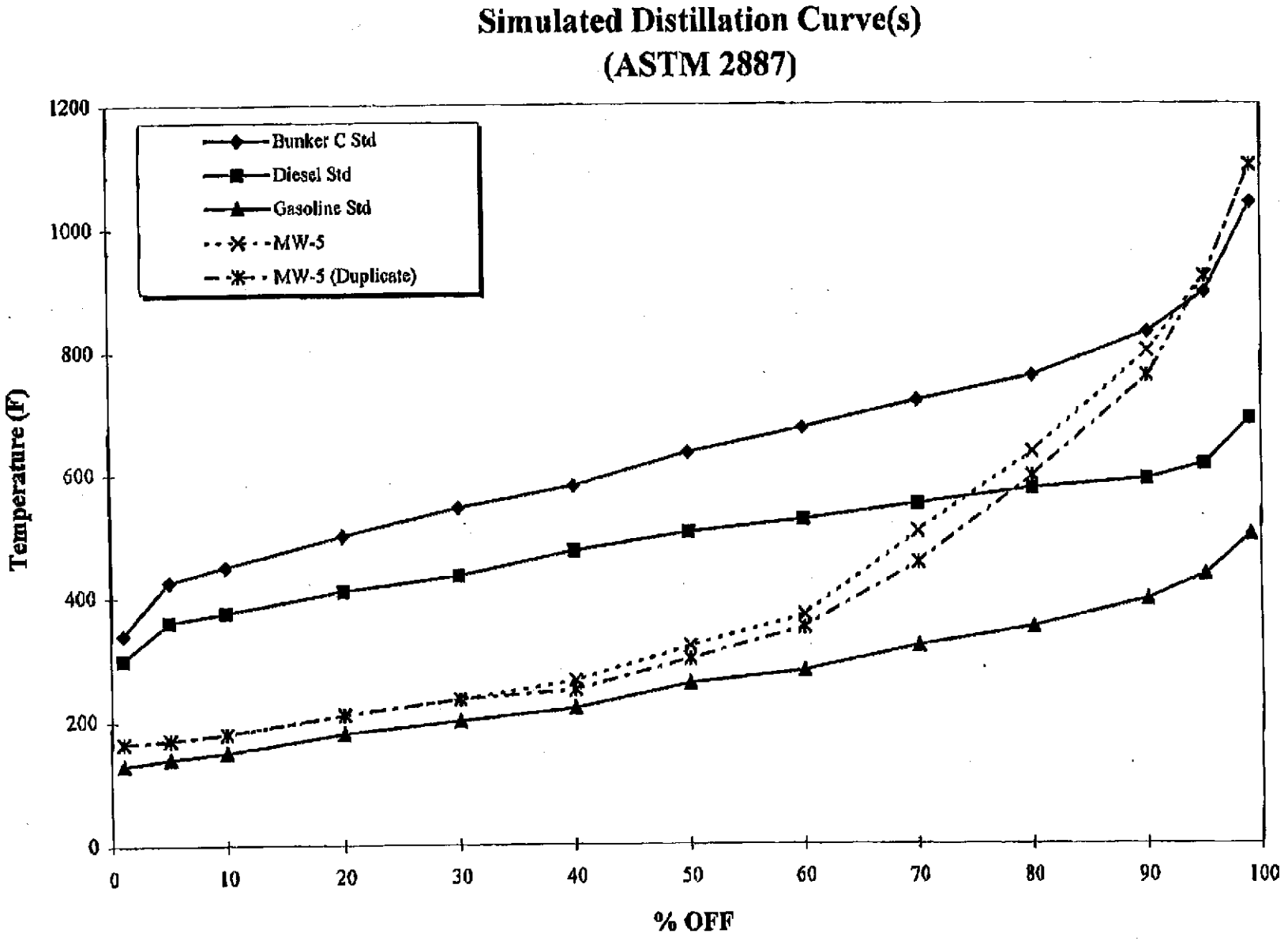


Figure 4



Attachment 1

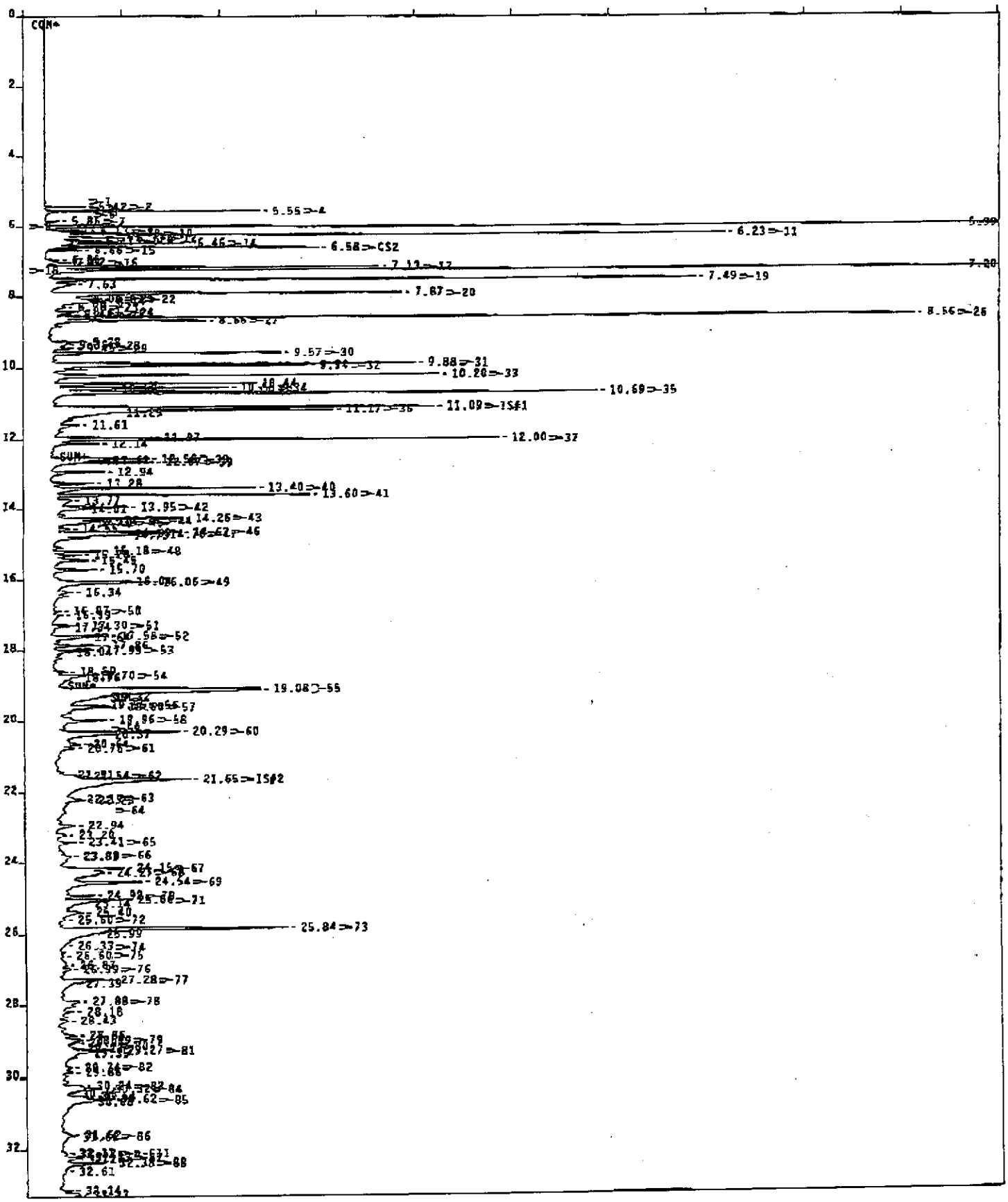
Laboratory Results from Global Geochemistry Corporation

Chain of Custody Document

File=E:\DATA7\C344199.18R Date printed=08-22-1997 Time= 11:12:23

Sample Name=4027-1D (MWS + IS3-014)

0.0 to 33.333 min. Low Y=5.0 High Y=80.0 mv Span=75.0



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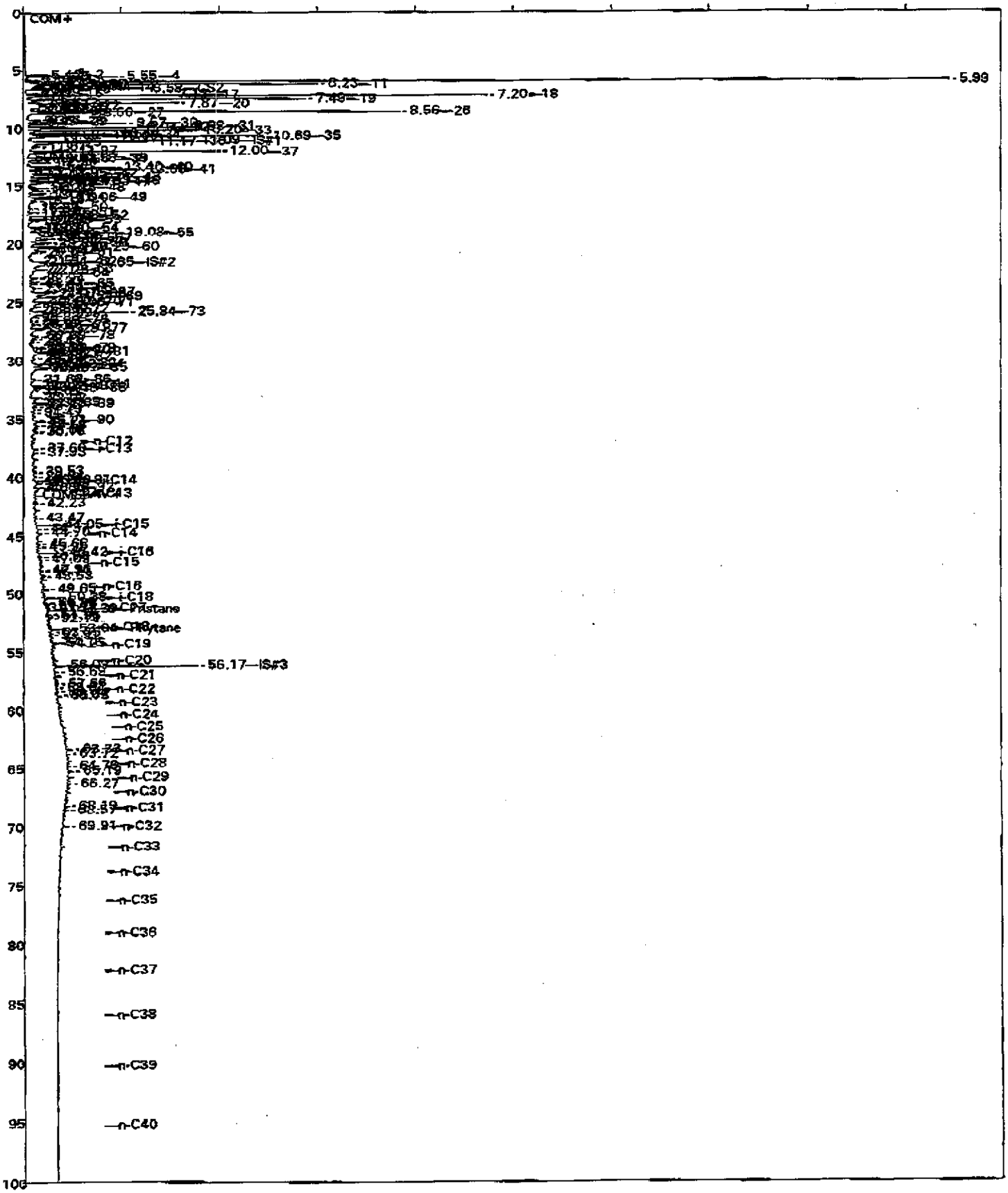
Sample Name=4927-1D (MWB + IS3-014)

0.0 to 100.0 min. Low Y=6.29 High Y=180.892 mv Span=174.602



N4027

07-31-1997

Detailed Gasoline Range (C3-C10) Hydrocarbon Analysis for
One product sample submitted by ENTRIX, Inc.
(relative %)

GGC ID	Sample	MWS 4027-1	MWS 4027-1D
1	Propane		
2	Isobutane	0.12	0.14
3	Isobutene		
4	Butane/Methanol	0.85	0.87
5	trans-2-Butene		
6	cis-2-Butene		
7	3-Methyl-1-butene	0.07	0.07
8	Isopentane	7.65	7.73
9	1-Pentene	0.29	0.29
10	2-Methyl-1-butene	0.28	0.39
11	Pentane	3.27	3.27
12	trans-2-Pentene	0.78	0.78
13	cis-2-Pentene/t-Butanol		
14	2-Methyl-2-butene	1.05	1.06
15	2,2-Dimethylbutane	0.19	0.19
16	Cyclopentane	0.17	0.17
17	2,3-Dimethylbutane/MTBE	2.14	2.11
18	2-Methylpentane	5.65	5.55
19	3-Methylpentane	3.37	3.32
20	Hexane	3.04	2.95
21	trans-2-Hexene	0.28	0.28
22	3-Methylcyclopentene	0.49	0.49
23	3-Methyl-2-pentene	0.46	0.42
24	cis-2-Hexene	0.42	0.39
25	3-Methyl-trans-2-pentene	0.25	0.24
26	Methylcyclopentane	4.90	4.83
27	2,4-Dimethylpentane	1.37	1.32
28	Benzene	0.30	0.30
29	5-Methyl-1-hexene	0.39	0.26
30	Cyclohexane	1.69	1.66
31	2-Methylhexane/TAME	2.26	2.24
32	2,3-Dimethylpentane	2.02	2.02
33	3-Methylhexane	3.13	3.07
34	2-Methyl-1-hexene	1.20	1.26
35	2,2,4-Trimethylpentane	4.05	3.96
36	α,α,α-Trifluorotoluene		
37	n-Heptane	3.11	3.03
	Methylcyclohexane	3.46	3.39
	2,5-Dimethylhexane	1.13	1.09
	2,4-Dimethylhexane	1.06	1.07
	2,2,4-Trimethylpentane	1.49	1.48
	Toluene	1.97	1.95
	2,3-Dimethylhexane	0.88	0.88

07-31-1997

N4027

Detailed Gasoline Range (C3-C10) Hydrocarbon Analysis for
One product sample submitted by ENTRIX, Inc.
(relative %)

Sample		MWS	MWS
GGC ID		4027-1	4027-1D
43	2-Methylheptane	1.13	1.16
44	4-Methylheptane	0.56	0.58
45	3,4-Dimethylhexane	0.41	0.41
46	3-Ethyl-3-methylpentane	0.96	0.98
47	3-Methylheptane	0.95	0.96
48	2-Methyl-1-heptene	0.43	0.43
49	n-Octane	1.72	1.71
50	2,2-Dimethylheptane	0.12	0.13
51	2,4-Dimethylheptane	0.28	0.29
52	Ethylcyclohexane	0.44	0.46
53	2,6-Dimethylheptane	0.39	0.41
54	Ethylbenzene	0.51	0.54
55	m + p Xylenes	6.09	6.26
56	4-Methyloctane	0.38	0.39
57	2-Methyloctane	1.11	1.12
58	3-Ethylheptane	0.71	0.73
59	3-Methyloctane		
60	o-Xylene	1.75	1.73
61	1-Nonene		
62	n-Nonane	0.27	0.28
IS2	p-Bromofluorobenzene		
63	Isopropylbenzene	0.28	0.30
64	3,3,5-Trimethylheptane		
65	2,4,5-Trimethylheptane	0.28	0.29
66	n-Propylbenzene	0.12	0.12
67	1-Methyl-3-ethylbenzene	1.12	1.13
68	1-Methyl-4-ethylbenzene	0.90	0.91
69	1,3,5-Trimethylbenzene	1.30	1.30
70	3,3,4-Trimethylheptane	0.58	0.62
71	1-Methyl-2-ethylbenzene	1.00	1.04
72	3-Methylnonane	0.17	0.18
73	1,2,4-Trimethylbenzene	3.47	3.48
74	Isobutylbenzene	0.18	0.18
75	sec-Butylbenzene	0.11	0.11
76	n-Decane	0.32	0.33
77	1,2,3-Trimethylbenzene	0.80	0.84
78	Indan	0.45	0.50
79	1,3-Diethylbenzene	0.44	0.45
80	1,4-Diethylbenzene		

07-31-1997

N4027

Detailed Gasoline Range (C3-C10) Hydrocarbon Analysis for
One product sample submitted by ENTRIX, Inc.
(relative %)

Sample GGC ID		MWS 4027-1	MWS 4027-1D
81	n-Butylbenzene	0.85	0.88
82	1,3-Dimethyl-5-ethylbenzene	0.18	0.19
83	1,4-Dimethyl-2-ethylbenzene	0.21	0.22
84	1,3-Dimethyl-4-ethylbenzene	1.00	1.00
85	1,2-Dimethyl-4-ethylbenzene	0.78	0.83
86	Undecene	0.33	0.32
87	1,2,4,5-Tetramethylbenzene	0.94	0.93
88	1,2,3,5-Tetramethylbenzene	0.31	0.31
89	1,2,3,4-Tetramethylbenzene	0.15	0.15
90	Naphthalene	0.04	0.04
91	2-Methyl-naphthalene	0.15	0.16
92	1-Methyl-naphthalene		

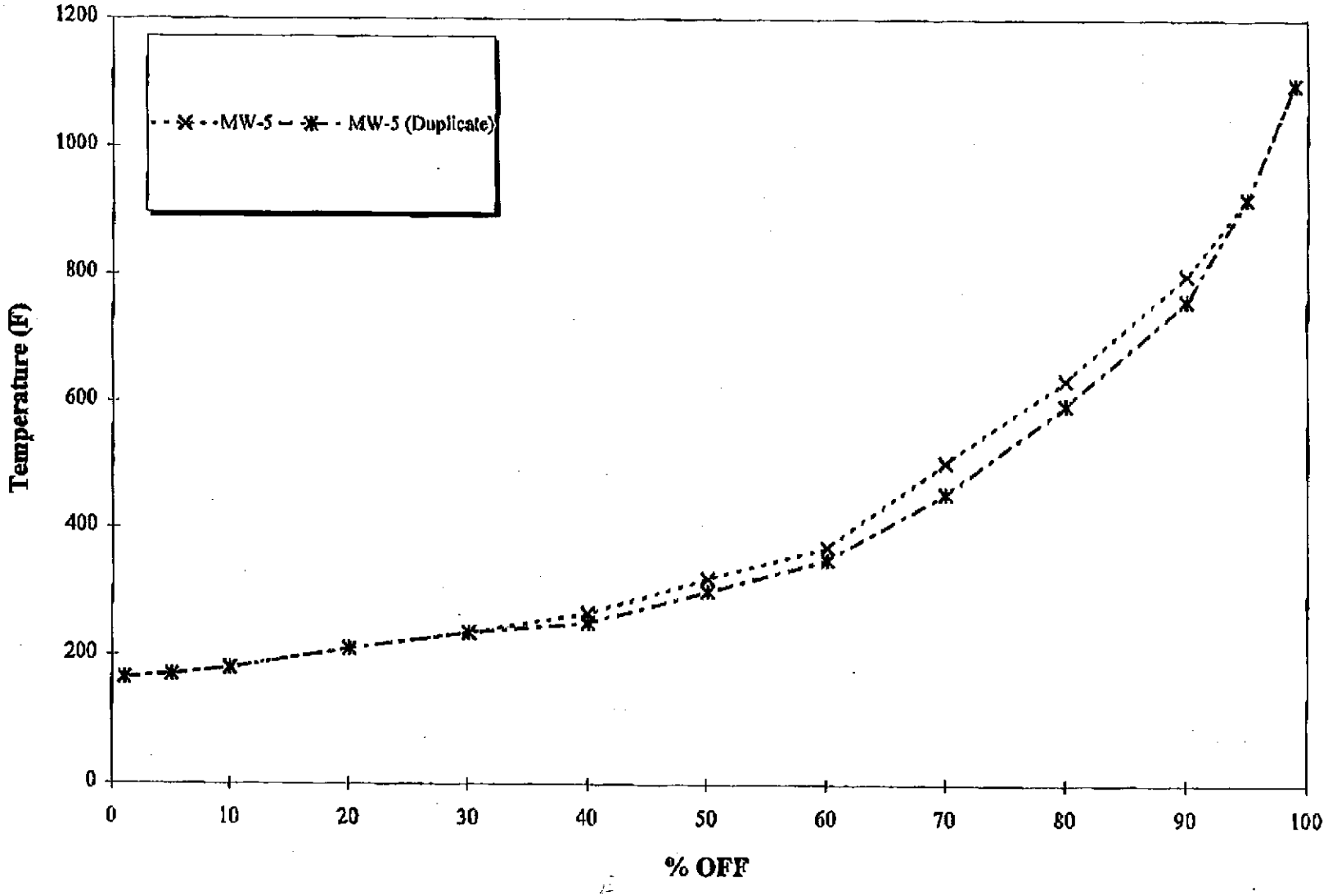
4027H 07-31-1997

Degradation ratios and bulk composition calculated from the gasoline range (C3-C10) analysis
One product sample submitted by ENTRIX, Inc.

Sample	MW5	MW5
GGC ID	4027-1	4027-1D
Evaporation		
n-Pentane/n-Heptane	1.05	1.08
2-Methylpentane/2-Methylheptane	4.99	4.78
Waterwashing		
Benzene/Cyclohexane	0.18	0.18
Toluene/Methylcyclohexane	0.57	0.58
Aromatics/Total Paraffins(n+iso+cyc)	0.35	0.36
Aromatics/Naphthenes	2.23	2.30
Biodegradation		
(C4-C8 Para+Isopara)/C4-C8 Olefins	8.62	8.61
3-Methylhexane/n-Heptane	1.01	1.02
Methylcyclohexane/n-Heptane	1.11	1.12
Isoparaffins+Naphthenes/Total Paraffins	4.39	4.41
Octane rating		
2,2,4-Trimethylpentane/Methylcyclohexane	1.17	1.17
Relative percentages - Bulk hydrocarbon composition as PIANO		
% Paraffinic	12.82	12.69
% Isoparaffinic	45.44	45.29
% Aromatic	24.25	24.70
% Naphthenic	10.86	10.72
% Olefinic	6.62	6.59

Supervisor

Simulated Distillation Curve(s)
(ASTM 2887)



ENTRIX, Inc.
590 Ygnacio Valley Road
Suite 200
Walnut Creek, CA 94596
(510) 935-9920
(510) 935-5368 FAX

351301

July 16, 1997

Mr. Ian Kaplan
Global Geochemistry Corporation
6919 Eton Ave.
Canoga Park, CA 91303

Re: Enclosed Free Product Sample

Dear Mr. Kaplan,

Please analyze the enclosed sample MWS as whole oil and sim-distillation according to ASTM 2887. Please send results to Bob Haddad and invoice directly to ENTRIX referring to project number 351301. Please call Bob Haddad or myself with any questions. Thank you for your assistance.

Sincerely,

ENTRIX, Inc.

Judy Nedoff

Judy Nedoff
Chemist

JN/jn

cc:
Bob Haddad

KAPREALIAN ENGINEERING INCORPORATED

CHAIN OF CUSTODY

SAMPLER	SITE NAME & ADDRESS	TURN AROUND TIME:
Steve Balian	Unocal S/S 7376 4191 - 1st Street Pleasanton, CA	Regular
WITNESSING AGENCY		[redacted]

ANALYSES REQUESTED

SAMPLE ID NO.	DATE	TIME	SOIL	~~WATER~~ Free Product	GRAB	COMP	NO. OF CONT.	SAMPLING LOCATION	~~Fingerprint~~	whole oil	Sim-D:S ASTM 2887					REMARKS
MW5	6/27/97			✓			2	monitoring well	~~✓~~	X	X					

Relinquished by: (Signature)	Date/Time	Received by: (Signature)
STEVE BALIAN	7/2/97	[signature]
[signature]	7-2-97 15:00	
[signature]	7-2-97 15:05	Sharon Conrade
Sharon F. Conrade	7/2/97 15:05	[signature] (At Lab - Color)

Judy Nedoff 7/16/97 1600

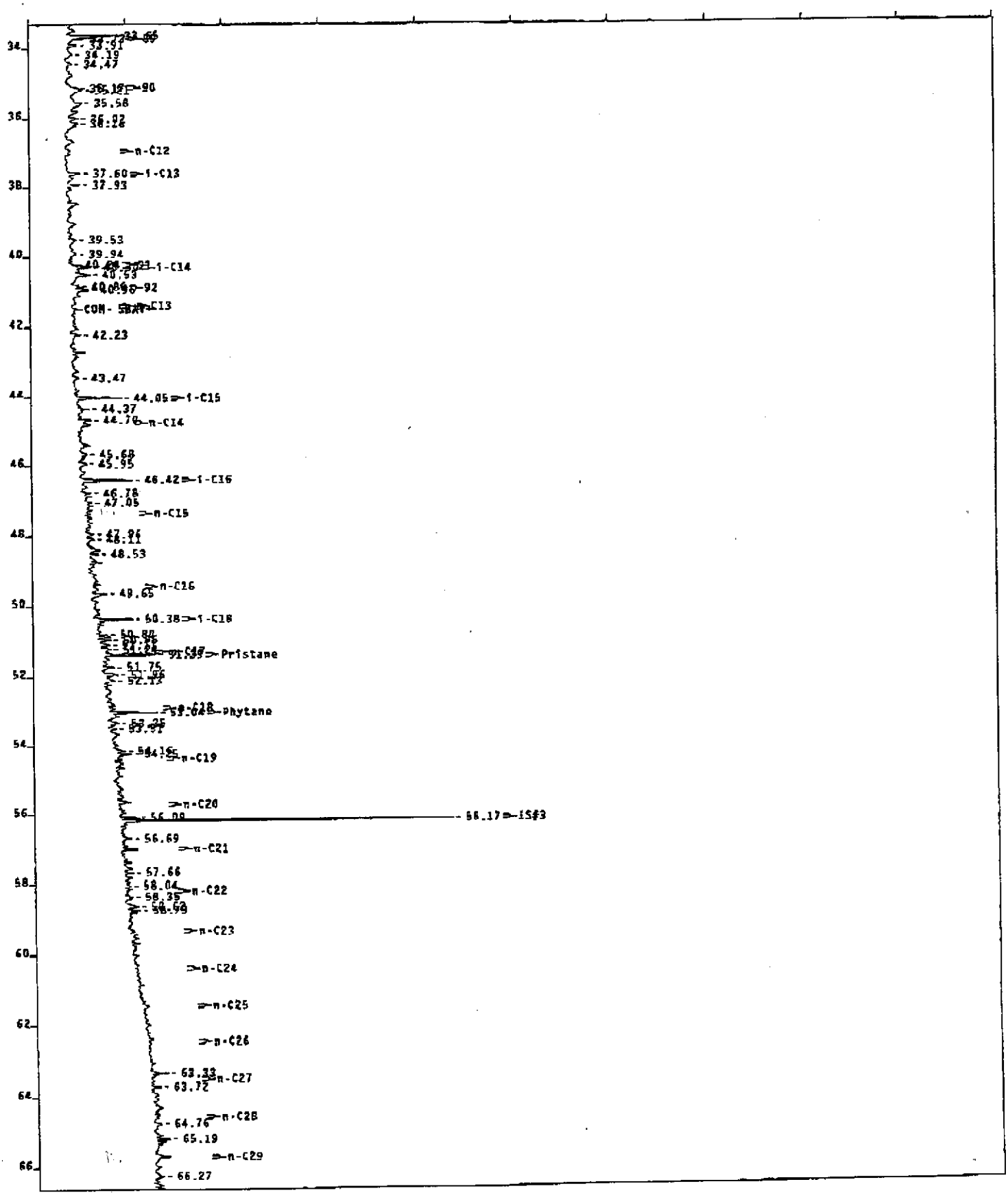
The following MUST BE completed by the laboratory accepting samples for analysis:

1. Have all samples received for analysis been stored in ice?
2. Will samples remain refrigerated until analyzed?
3. Did any samples received for analysis have head space?
4. Were samples in appropriate containers and properly packaged?

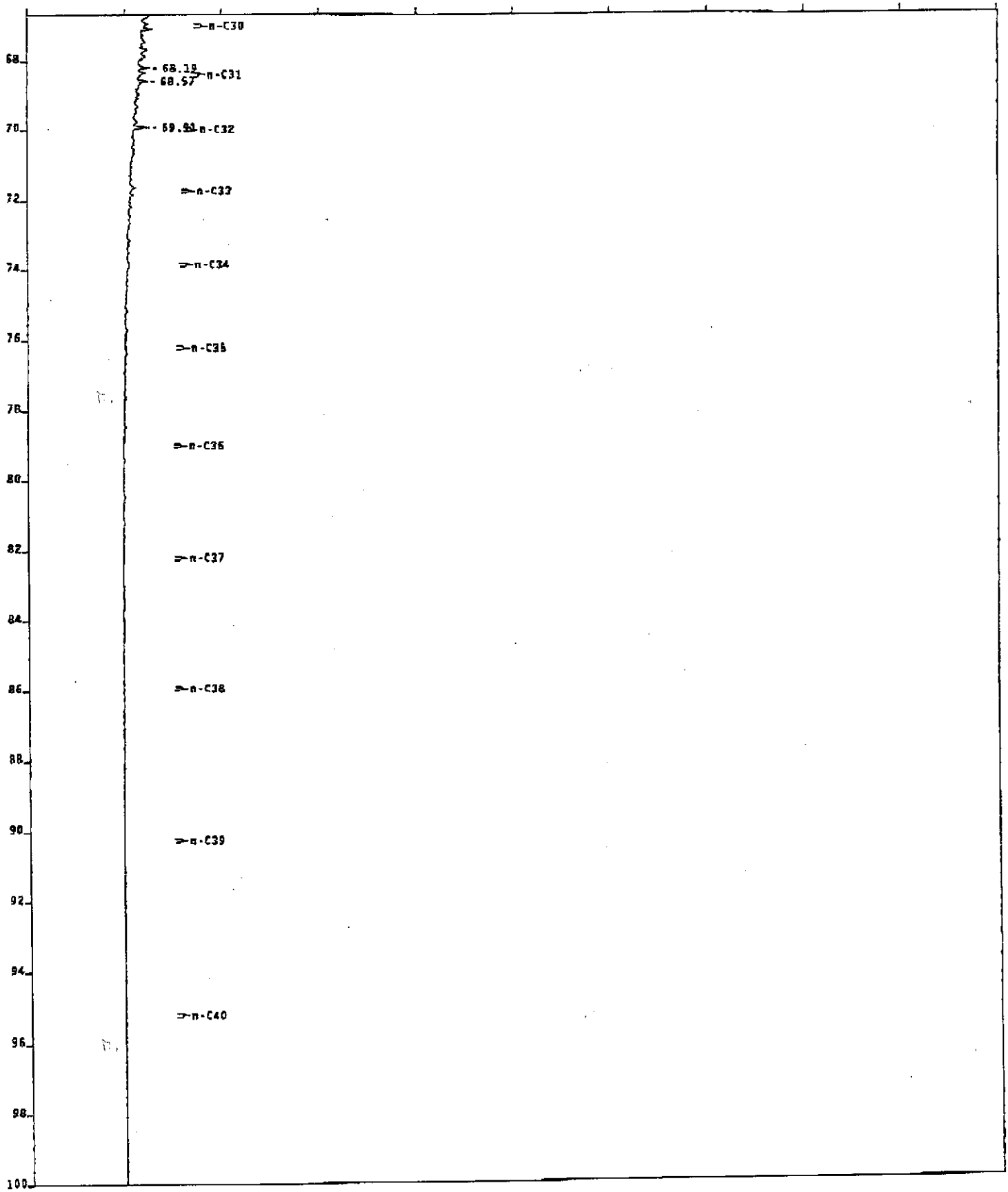
Signature	Title	Date

2401 Stanwell Drive, Suite 400
Concord, California 94520
Tel: 510 602 5100 Fax: 510 687 0602

File=E:\DATA7\C344199.18R Date printed=08-22-1997 Time= 11:13:26
Sample Name=4027-1D (MWS + IS3-014)
33.333 to 66.667 min. Low Y=5.0 High Y=80.0 mv Span=75.0



File=E:\DATA7\C344199.18R Date printed=08-22-1997 Time= 11:14:28
Sample Name=40Z7-1D (MWS + IS3-014)
66.667 to 100.0 min. Low Y=5.0 High Y=80.0 mv Span=75.0



********** Gas Chromatography by Global GeoChemistry **********

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*                                                                    *
* TODAY'S DATE....07-31-1997          TIME.....15:09:45              *
* RAW DATA FILE NAME..E:\DATA7\C344199.18R                           *
* SAMPLE NAME.....4027-1D (MWS + IS3-014)                            *
* DATE TAKEN..Jul 19, 1997  19:06:31                                 *
* METHOD FILE.....!!!!!!E:\DATA7\C344199Q.MET                        *
* METHOD:..Whole Oil Analysis
* CALIBRATION FILE...!!!!!!!E:\DATA7\C344199Q.CALCAL. FILE VERSION...-4
* INSTRUMENT..... HP6890 FID--FID          OPERATOR.... Lev Baycher  *
* RUN TIME..... 100                                                  *
* AREA REJECT..... 0                  COM PORT....  7                *
* HEADING 1..C3-C44 Analysis
* HEADING 2..GC-analysis: method 1 (split 400:1)
* FORMAT FILE..E:\DATA7\NORMAL.FMT
**********************************************************************
```

duplicate?

********* PEAKS DETECTED IN THIS CHROMATOGRAM **********

Peak #	Ret Time (min)	Peak Name	Peak Area	Peak Height
1	5.423	2	3085	3136
2	5.548	4	19782	16508
3	5.857	7	1623	1099
4	5.986	8	175907	165187
5	6.132	9	6502	3233
6	6.187	10	8811	5682
7	6.227	11	74552	52230
8	6.326	12	17771	5966
9	6.415	DCM	8013	3655
10	6.462	14	24031	10623
11	6.580	CS2	34240	20996
12	6.663	15	4219	2794
13	6.948		2039	1065
14	7.000		1100	1065
15	7.020	16	3976	1447
16	7.135	17	48011	25669
17	7.205	18	126411	82608
18	7.487	19	75563	49972
19	7.627		17302	2273
20	7.872	20	67140	27380
21	8.046	21	6475	2655
22	8.067	22	11185	4307
23	8.136		17613	4468
24	8.275	23	9546	1480
25	8.411	24	8927	2624
26	8.494	25	5491	1964
27	8.558	26	109900	66832
28	8.661	27	29980	12224
29	9.284		9110	2555
30	9.359	28	6805	1544
31	9.451	29	8175	2091
32	9.575	30	37799	18058
33	9.879	31	51087	28355
34	9.939	32	45901	20020
35	10.196	33	70006	30109
36	10.442		33730	15546
37	10.549	34	28623	13878
38	10.582		6783	5027

99	22.228		12385	2476
100	22.940		11286	1725
101	23.205		8223	972
102	23.413	65	6673	1708
103	23.802	66	2661	1304
104	23.812		7122	1258
105	24.148	67	25840	5351
106	24.274	68	20719	3818
107	24.543	69	29612	6697
108	24.923	70	14039	3027
109	25.055	71	23707	5354
110	25.144		6631	2079
111	25.405		14708	2173
112	25.599	72	4145	761
113	25.839	73	79344	17910
114	25.986		30760	2933
115	26.326	74	4039	742
116	26.598	75	2452	593
117	26.873		10920	862
118	26.987	76	7619	1102
119	27.277	77	19148	3981
120	27.391		12402	1304
121	27.882	78	11342	1788
122	28.179		6893	1357
123	28.434		5740	849
124	28.861		11782	1487
125	28.992	79	10299	1953
126	29.066		5863	1446
127	29.228		6984	1328
128	29.269	81	20048	4350
129	29.350		20844	1793
130	29.737	82	4371	1104
131	29.856		17211	1165
132	30.239	83	5092	1948
133	30.325	84	22819	3334
134	30.458		1726	839
135	30.544		8261	2256
136	30.621	85	18812	3797
137	30.682		33136	2068
138	31.622		3732	1039
139	31.661	86	9891	865
140	32.109		1090	526
141	32.134	n-C11	1892	630
142	32.229	87	7340	1791
143	32.272		2814	1250
144	32.375	88	21104	3599
145	32.614		8689	530
146	33.143		2842	982
147	33.267		15392	1562
148	33.652		17434	3969
149	33.731	89	6977	1321
150	33.913		7038	1219
151	34.187		9927	849
152	34.474		7155	715
153	35.166	90	3452	1148
154	35.214		14460	1526
155	35.582		16327	1435
156	36.023		6384	1154
157	36.161		26109	1100
158	37.599	i-C13	5390	1176

39	10.650		26254	15199
40	10.695	35	90149	42314
41	11.087	IS#1	80381	29746
42	11.168	36	68933	21958
43	11.252		34937	5087
44	11.610		14696	2466
45	11.969		12643	7929
46	12.002	37	77208	34750
47	12.144		14561	3936
48	12.581	38	24773	7711
49	12.624		8155	4051
50	12.670	39	24275	8002
51	12.939		19383	4331
52	13.280		11636	3499
53	13.400	40	33736	15925
54	13.596	41	44455	20109
55	13.768		17066	1809
56	13.951	42	19991	6065
57	14.006		9473	2281
58	14.257	43	26426	10234
59	14.339	44	13144	4808
60	14.376		3970	2966
61	14.397	45	9321	2677
62	14.547		7366	1621
63	14.633	46	22365	10057
64	14.689		3291	5900
65	14.703	47	21757	8277
66	14.732		10506	5494
67	15.175	48	9886	3942
68	15.281		9544	2462
69	15.445		18978	3000
70	15.697		14812	3636
71	16.041		6385	5924
72	16.065	49	38929	7678
73	16.337		8145	1816
74	16.874	50	3016	860
75	16.994		3688	983
76	17.298	51	6549	2210
77	17.339		2530	951
78	17.584	52	10459	4432
79	17.636		8764	2437
80	17.859		11359	3759
81	17.989	53	9439	3295
82	18.043		3471	1024
83	18.588		5008	1287
84	18.700	54	12287	2720
85	18.760		9154	1618
86	19.080	55	142622	16105
87	19.316		34984	3838
88	19.549	56	8896	3597
89	19.600	57	25567	4912
90	19.963	58	16667	4175
91	20.291	60	39385	9766
92	20.373		19821	3835
93	20.645		9833	2187
94	20.761	61	9131	1722
95	21.509		1704	983
96	21.536	62	6394	2199
97	21.645	IS#2	118706	10535
98	22.191	63	6855	1611

159	37.935		29198	1115
160	39.529		4173	712
161	39.942		5119	684
162	40.239	91	1002	382
163	40.303	i-C14	6339	1845
164	40.528		14615	1694
165	40.860	92	3549	832
166	40.955		36181	1512
167	42.233		2027	624
168	43.469		2492	483
169	44.054	i-C15	9196	3550
170	44.368		3686	820
171	44.698		2727	830
172	45.679		1705	440
173	45.952		2659	532
174	46.420	i-C16	9662	3931
175	46.781		1297	613
176	47.051		1104	413
177	47.956		2635	625
178	48.113		3005	589
179	48.527		1895	688
180	49.653		1551	843
181	50.376	i-C18	7017	2851
182	50.805		1339	757
183	50.961		2142	933
184	51.114		1916	636
185	51.236		2652	595
186	51.389	Pristane	9117	3964
187	51.747		2881	915
188	51.959		3415	1026
189	52.131		2967	725
190	53.040	Phytane	8039	3618
191	53.353		2388	700
192	53.514		1959	519
193	54.163		1772	690
194	54.251		1961	993
195	56.089		2518	1321
196	56.169	IS#3	43425	25709
197	56.688		3251	781
198	57.660		1737	676
199	58.038		2565	404
200	58.346		3438	588
201	58.624		3896	875
202	58.728		1522	851
203	63.330		2202	1210
204	63.719		1664	724
205	64.756		2358	555
206	65.186		2482	1071
207	66.271		4476	765
208	68.190		2634	822
209	68.565		1669	685
210	69.907		3737	1182

Group	Group Amount	Group Percent
0	0.0000	0.0000%

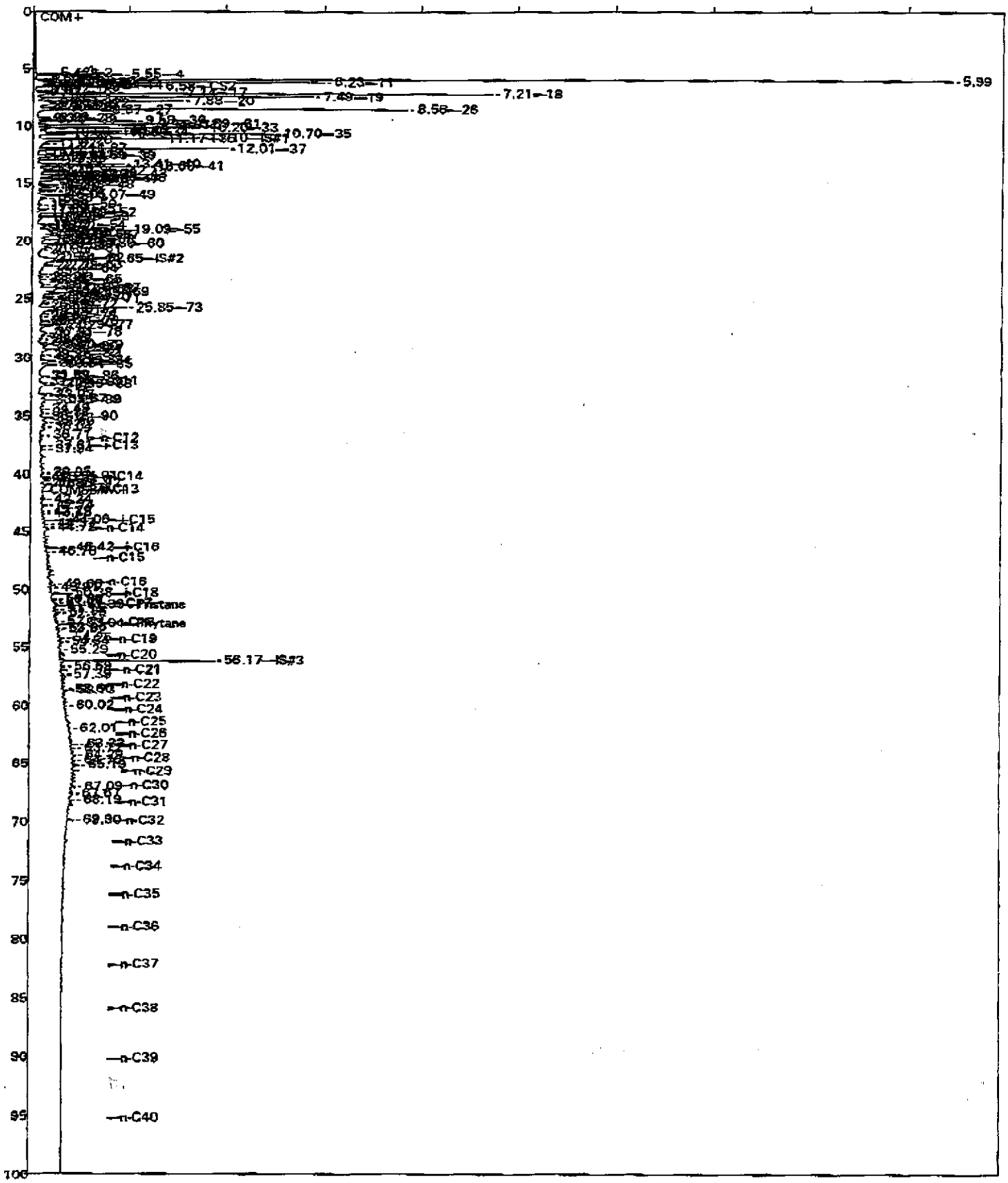
TOTAL AREA DETECTED = 3641084

Checked by _____ Date 7/31/97

File=K:\DATA7\C344199.17R Date printed=07-21-1997 Time= 15:08:06

Sample Name=4027-1 (MWS + IS3-014)

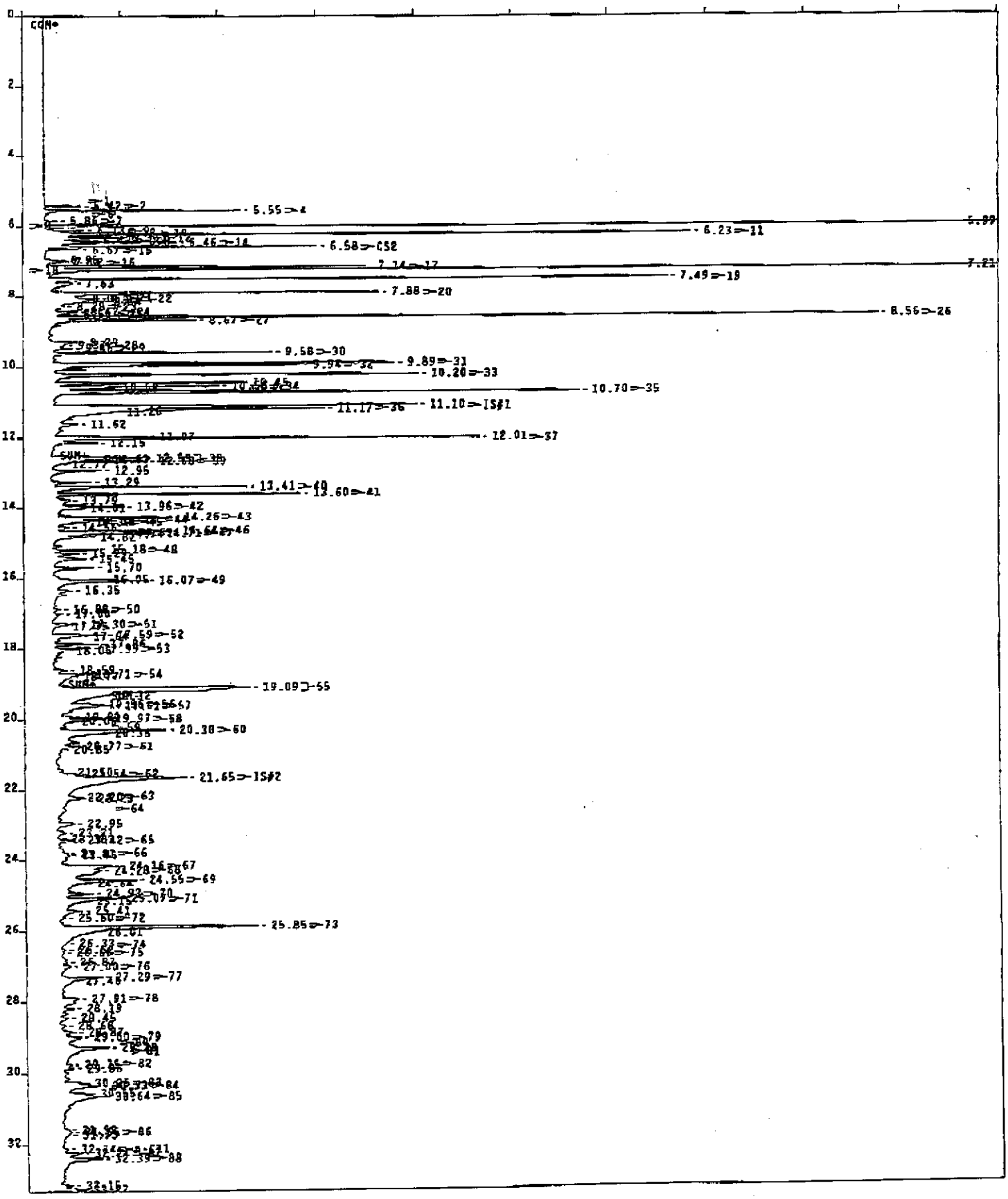
0.0 to 100.0 min. Low Y=6.293 High Y=173.076 mv Span=166.783



File=E:\DATA7\C344199.17R Date printed=08-22-1997 Time= 11:08:53

Sample Name=4027-1 (MWS + IS3-014)

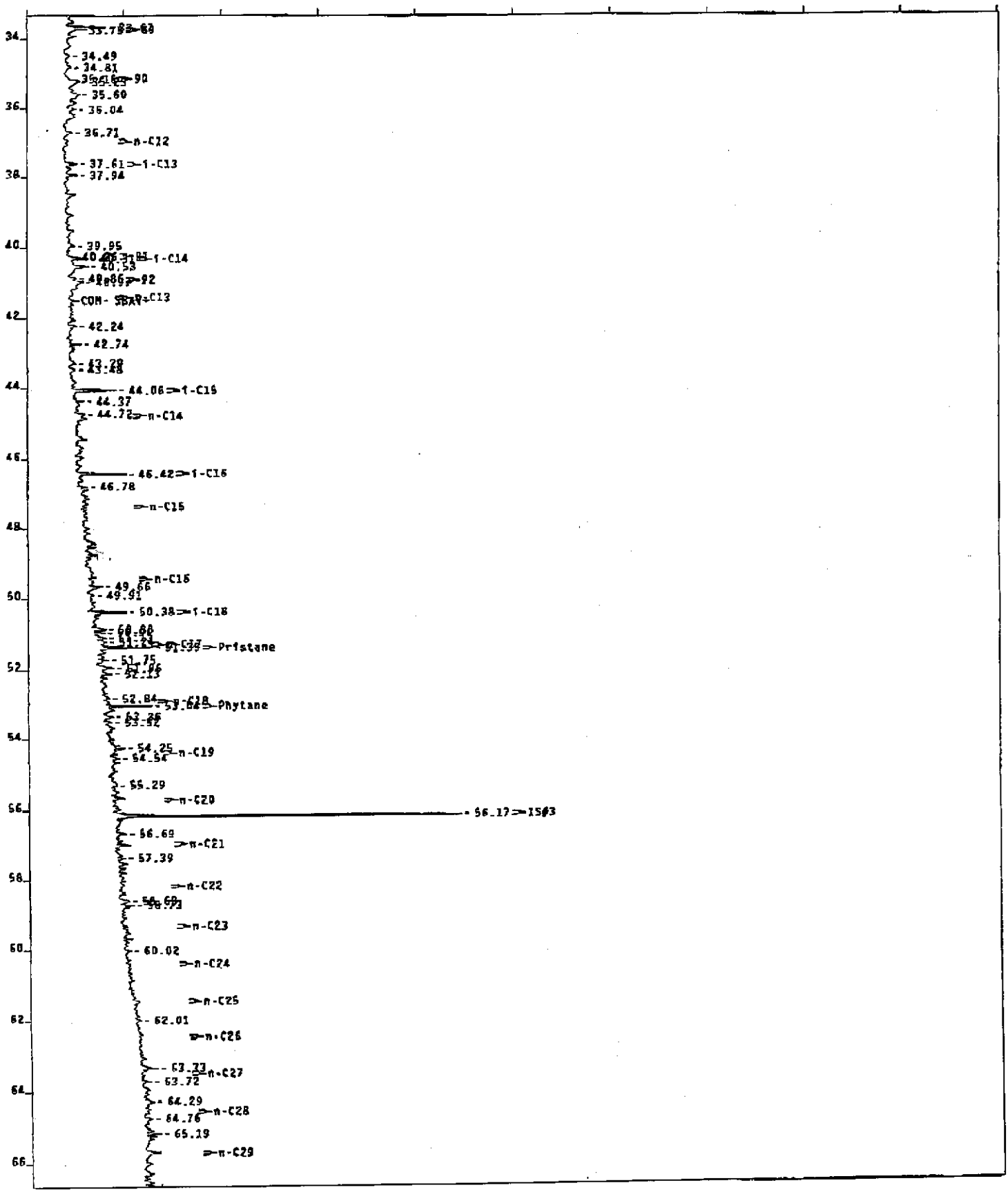
0.0 to 33.333 min. Low Y=5.0 High Y=80.0 mv Span=75.0



File=E:\DATA7\C344199.17R Date printed=08-22-1997 Time= 11:09:53

Sample Name=4027-1 (MWS + IS3-014)

33.333 to 66.667 min. Low Y=5.0 High Y=80.0 mv Span=75.0

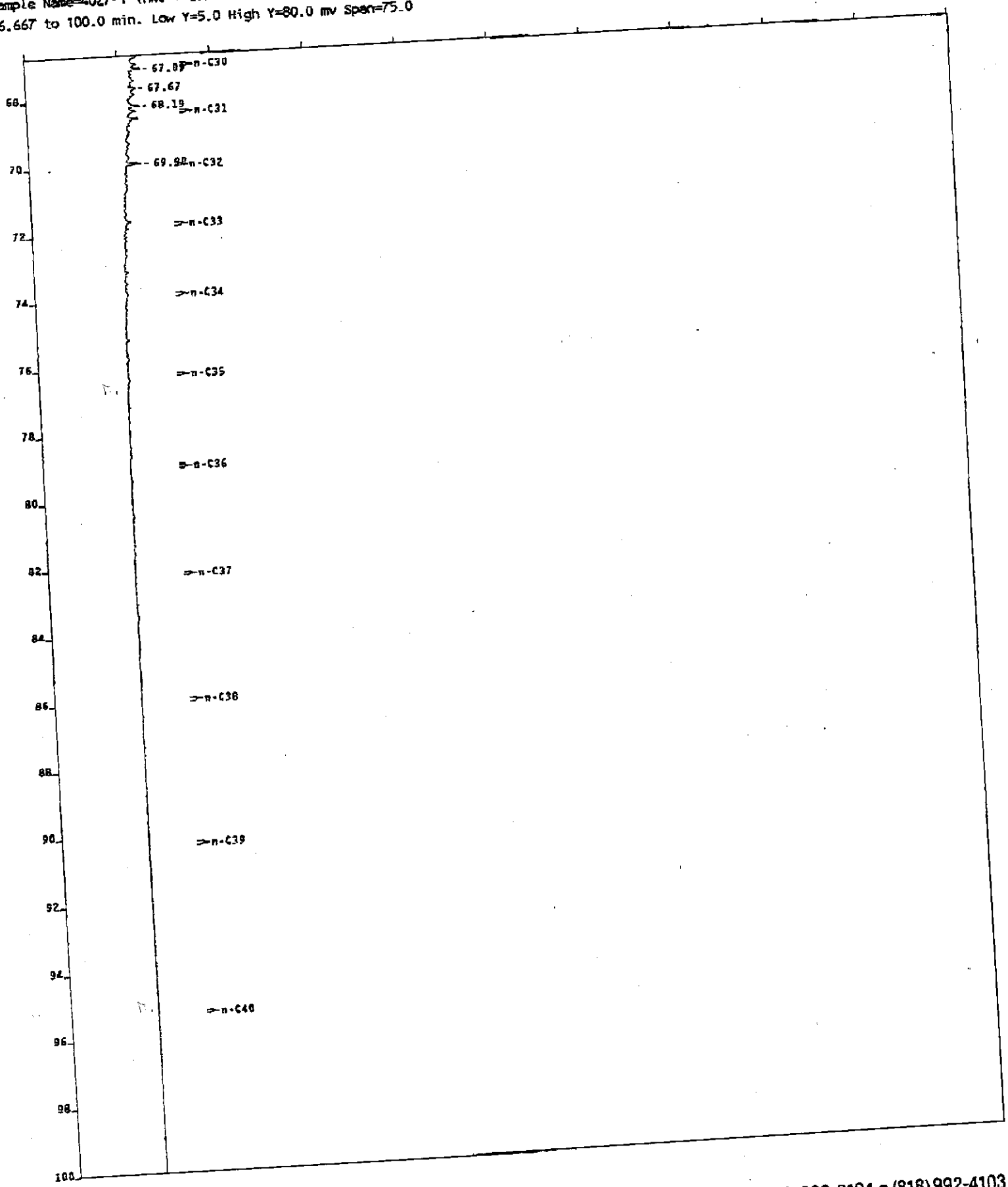


DEC-29-97 16:54 FROM:TOSCO ENVIRONMENTAL

File=E:\DATA7\C344199.17R Date printed=08-22-1997 Time= 11:10:57

Sample Name=4027-1 (MWS + IS3-014)

66.667 to 100.0 min. Low Y=5.0 High Y=80.0 mv Span=75.0



GLOBAL GEOCHEMISTRY CORP. 6919 ETON AVENUE • CANOGA PARK, CA 91303-2194 • (818) 992-4103

********** Gas Chromatography by Global GeoChemistry **********

```
*
* TODAY'S DATE....07-31-1997          TIME.....13:33:13                    *
* RAW DATA FILE NAME..E:\DATA7\C344199.17R                                 *
* SAMPLE NAME.....4027-1 (MWS + IS3-014)                                   *
* DATE TAKEN..Jul 19, 1997  17:15:02                                       *
* METHOD FILE.....!!!e:\data7\C344199Q.MET                                 *
* METHOD:..Whole Oil Analysis
* CALIBRATION FILE...!!!E:\DATA7\C344199Q.CALCAL. FILE VERSION...-2        *
* INSTRUMENT..... HP6890 FID--FID          OPERATOR.... Lev Baycher        *
* RUN TIME..... 100                                                        *
* AREA REJECT..... 0                  COM PORT....  7                      *
* HEADING 1..C3-C44 Analysis
* HEADING 2..GC-analysis: method 1 (split 400:1)
* FORMAT FILE..E:\DATA7\NORMAL.FMT
****************************************************************************
```

********* PEAKS DETECTED IN THIS CHROMATOGRAM **********

Peak #	Ret Time (min)	Peak Name	Peak Area	Peak Height
1	5.422	2	2791	2819
2	5.547	4	18704	15165
3	5.857	7	1624	1026
4	5.986	8	169098	157758
5	6.133	9	6331	3077
6	6.189	10	8427	5429
7	6.228	11	72262	49811
8	6.329	12	17143	5707
9	6.418	DCM	7900	3521
10	6.465	14	23128	10173
11	6.582	CS2	34379	20985
12	6.665	15	4252	2697
13	6.952		2262	1139
14	7.021		1801	1334
15	7.022	16	3759	1485
16	7.138	17	47247	24812
17	7.208	18	124945	79038
18	7.491	19	74470	48023
19	7.634		18426	2296
20	7.878	20	67087	25781
21	8.053	21	6178	2752
22	8.073	22	10852	4261
23	8.141		25224	4425
24	8.283	23	10175	1548
25	8.421	24	9443	2606
26	8.499	25	5437	2051
27	8.563	26	108271	64165
28	8.667	27	30266	11728
29	9.292		10138	2499
30	9.374	28	6650	1562
31	9.456	29	8634	2120
32	9.581	30	37263	17492
33	9.886	31	50015	26859
34	9.945	32	44719	19597
35	10.202	33	69265	28654
36	10.448		33309	14990

********** Gas Chromatography by Global GeoChemistry **********

* TODAY'S DATE....07-31-1997 TIME.....13:33:13
* RAW DATA FILE NAME..E:\DATA7\C344199.17R
* SAMPLE NAME.....4027-1 (MWS + IS3-014)
* DATE TAKEN..Jul 19, 1997 17:15:02
* METHOD FILE.....!!!e:\data7\C344199Q.MET
* METHOD:..Whole Oil Analysis
* CALIBRATION FILE...!!!E:\DATA7\C344199Q.CALCAL. FILE VERSION...-2
* INSTRUMENT..... HP6890 FID--FID OPERATOR.... Lev Baycher
* RUN TIME..... 100
* AREA REJECT..... 0 COM PORT.... 7
* HEADING 1..C3-C44 Analysis
* HEADING 2..GC-analysis: method 1 (split 400:1)
* FORMAT FILE..E:\DATA7\NORMAL.FMT

********** PEAKS DETECTED IN THIS CHROMATOGRAM **********

Peak #	Ret Time (min)	Peak Name	Peak Area	Peak Height
1	5.422	2	2791	2819
2	5.547	4	18704	15165
3	5.857	7	1624	1026
4	5.986	8	169098	157758
5	6.133	9	6331	3077
6	6.189	10	8427	5429
7	6.228	11	72262	49811
8	6.329	12	17143	5707
9	6.418	DCM	7900	3521
10	6.465	14	23128	10173
11	6.582	CS2	34379	20985
12	6.665	15	4252	2697
13	6.952		2262	1139
14	7.021		1801	1334
15	7.022	16	3759	1485
16	7.138	17	47247	24812
17	7.208	18	124945	79038
18	7.491	19	74470	48023
19	7.634		18426	2296
20	7.878	20	67087	25781
21	8.053	21	6178	2752
22	8.073	22	10852	4261
23	8.141		25224	4425
24	8.283	23	10175	1548
25	8.421	24	9443	2606
26	8.499	25	5437	2051
27	8.563	26	108271	64165
28	8.667	27	30266	11728
29	9.292		10138	2499
30	9.374	28	6650	1562
31	9.456	29	8634	2120
32	9.581	30	37263	17492
33	9.886	31	50015	26859
34	9.945	32	44719	19597
35	10.202	33	69265	28654
36	10.448		33309	14990

37	10.556	34	26613	13359
38	10.592		8348	4958
39	10.656		25483	14711
40	10.700	35	89586	41092
41	11.096	IS#1	78414	28516
42	11.175	36	68754	21403
43	11.258		35937	5219
44	11.619		15233	2418
45	11.975		12313	7721
46	12.008	37	76372	33284
47	12.150		14808	3899
48	12.588	38	24907	7411
49	12.629		7191	4123
50	12.676	39	23470	7679
51	12.770		4303	1006
52	12.945		16235	4135
53	13.286		11158	3376
54	13.405	40	32893	15350
55	13.601	41	43605	19415
56	13.791		16147	1664
57	13.958	42	19338	5821
58	14.010		9340	2286
59	14.265	43	25041	9487
60	14.346	44	12457	4626
61	14.380		4550	3009
62	14.394	45	8970	2776
63	14.556		7428	1581
64	14.640	46	21152	9320
65	14.689		4439	5824
66	14.709	47	20909	8090
67	14.741		9322	5170
68	14.819		14975	2975
69	15.181	48	9493	3738
70	15.289		8808	2283
71	15.452		15169	2847
72	15.704		13513	3413
73	16.047		4755	4880
74	16.070	49	38110	7412
75	16.345		7405	1667
76	16.884	50	2662	746
77	16.999		6023	869
78	17.303	51	6175	2030
79	17.354		2220	697
80	17.589	52	9629	4060
81	17.642		8009	2237
82	17.863		10148	3542
83	17.994	53	8590	2993
84	18.051		2901	907
85	18.595		4196	1122
86	18.706	54	11295	2383
87	18.774		7477	1445
88	19.092	55	134471	15194
89	19.320		34605	3849
90	19.557	56	8361	3306
91	19.606	57	24578	4551
92	19.913		6481	1496
93	19.968	58	15789	3809
94	20.056		5377	1231
95	20.301	60	38591	8751
96	20.382		19012	3792

97	20.767	61	8246	1536
98	20.851		3574	566
99	21.505		1589	821
100	21.544	62	5917	1885
101	21.651	IS#2	115153	10224
102	22.197	63	6175	1564
103	22.229		12025	2362
104	22.948		9425	1502
105	23.213		5399	824
106	23.379		691	298
107	23.419	65	6230	1497
108	23.809	66	2569	932
109	23.852		5753	1021
110	24.161	67	24845	4677
111	24.283	68	19796	3484
112	24.555	69	28674	6180
113	24.642		13071	2233
114	24.927	70	12709	2826
115	25.066	71	22106	4761
116	25.150		11678	2097
117	25.409		12994	1982
118	25.597	72	3857	672
119	25.849	73	76604	15482
120	26.008		28033	2904
121	26.334	74	3944	707
122	26.522		2641	642
123	26.597	75	2332	501
124	26.873		7661	743
125	27.000	76	7050	978
126	27.292	77	17750	3432
127	27.402		10225	1150
128	27.912	78	9972	1559
129	28.186		5848	1165
130	28.448		4383	698
131	28.677		2500	506
132	28.865		4314	1264
133	29.001	79	9717	1705
134	29.281	81	18747	3804
135	29.749	82	4045	899
136	29.858		12250	1056
137	30.253	83	4588	1613
138	30.333	84	22097	2962
139	30.554		6475	2011
140	30.640	85	17281	3165
141	31.590		1782	500
142	31.653	86	3430	733
143	31.728		4501	585
144	32.135	n-C11	1707	409
145	32.243	87	7245	1446
146	32.390	88	20692	2995
147	33.151		2733	901
148	33.273		14380	1463
149	33.667		17284	3572
150	33.752	89	6837	1254
151	34.485		6698	670
152	34.810		8194	776
153	35.156	90	3279	599
154	35.227		15544	1396
155	35.602		16060	1386
156	36.036		6652	1062