FINAL REPORT

CARBONACEOUS SPECIES METHODS COMPARISON STUDY AT CITRUS COLLEGE

Task: Analysis for Trace Hydrocarbons and Related Halocarbons in Urban Ambient Air Samples

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Submitted to:

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TD890
R377
1987

ARB Agreement No. A6-042-32

OGC No. 55-196

October 1987

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1. OBJECTIVE:

To collect ambient air samples over time-weighted periods of 4 to 8 hours in internally electropolished stainless steel containers. The data obtained from the analysis of these samples were for the support of the Carbonaceous Species Methods Comparison Study at Citrus College between August 11 and August 21, 1986. The species measured included CO, CH_4, CO_2, H_2, and the C_2 through C_{10} hydrocarbons. In addition, N_2O, F-12, F-11, F-113, $CHCl_3$, CH_3CCl_3, CCl_4, C_2HCl_3, and C_2Cl_4 halocarbons were measured.

2. AIR SAMPLE COLLECTION METHOD:

Stainless steel (type 304) cans internally electropolished by the "SUMMA" process were used to provide state-of-the-art collection-storage of ambient air samples for quantitative hydrocarbon and halocarbon analyses at trace levels. The tanks (16L volume) were sent into the field under high vacuum (<100 mTorr) and were fitted with non-contaminating bellows stem (Nupro SS-4H4) high vacuum valves and Cajon® VCR vacuum coupling fittings. Both 4-hour and 8-hour integrated samples were collected in the 16L tanks. Five samplers were used to collect for the following periods: 0-0800, 0800-1200, 1200-1600, 1600-2000, and 2000-0. The sample periods were prescribed by the experiment. The sample lines were flushed with outside air via a purge-tee gauge assembly to eliminate any contamination obtained from storage indoors in the sample connection lines (dead volume 10 mL). The vacuum in the tanks was checked and the system left in the ready to sample position. A Chrontrol® 4CD-115VAC timer was used to activate the sampling start-stop sequence. Non-contaminating back pressure regulators, solenoids,

Teflon®-faced diaphragm FC1121 pumps, and upstream sample dump-crosses were used to provide a contaminant-free, constant rate of sampling at 110 mL/min. Terminal pressures in the flasks were pre-set to be 12 psig $\pm$ 2 psig.

3. HYDROCARBON ANALYSIS METHODS AND SEQUENCE OF ANALYSIS:

The samples were analyzed for CH_4, CO, C_2-C_{10} hydrocarbons, and the halocarbons F-12, F-11, F-113, CH_3CCl_3, CCl_4, C_2HCl_3, and C_2Cl_4. The latter are excellent intrinsic tracers of air masses that have recently come from urban areas since precise quantitation of differences on the order of several parts per trillion are readily measured. Comparison with the known geophysical background levels of these species provides indices of the degree of pollution.

The standard operating procedure used to speciate the C_1-C_{10} hydrocarbons and the selected halocarbons was to use several different gas chromatographs with species-specific and/or very sensitive detectors. Each instrument was dedicated to a specific group of compounds.

The procedure for handling the sample analysis sequence was:

(A) Upon receipt of the samples, logged in the sample container serial number, date, time, and place. Assigned a sample number to each sample.

(B) Measured the pressure in the can. This was verified against the pressure recorded in the field.

(C) First analysis was for CH_4, CO, and CO_2 via a Carle 211M-S gas chromatograph. This analysis established the general background pollutant level of the samples.

(D) Second analysis was for C_2H_6, C_2H_4, C_2H_2, C_3H_8, C_3H_6, i-C_4H_{10}, and n-C_4H_{10} via a PE3920-B or an HP5890-A using a GC system. The C_2H_2/C_2H_4 ratio was used to identify local car exhaust or local geogenic sources.

(E) Third analysis was for the C_4 to C_{10} hydrocarbons using a cryo-focused sample on a capillary column and a temperature-programmed method. This analysis provided the needed hydrocarbon speciation for C_4-C_{10} compounds.

(F) Fourth analysis was for F-12 through C_2Cl_4. Other specific tracers such as CH_3Cl for wood smoke, H_2, SF_6, CH_3Br, CF_2BrCl, etc., that would better characterize the source apportionment of the hydrocarbons species measured were also done on selected samples using dedicated instruments optimized for their analysis. However, these results are not included in this report.

4. CONDITIONS OF ANALYSIS:

CH_4, CO, CO_2

A Carle® 211M-S gas chromatograph with a Hewlett-Packard 3388 data processor was used to measure CH_4, CO, and CO_2. The columns arranged in a back-flush were silica-gel 8-ft. x 1/8-inch and Mol-sieve 5Å, 3-1/2-ft. x 1/8-inch; oven temperature: 76°C; sample size: 3 mL. The Ni-catalyst was thermostatted at 400°C. Total analysis time was 8 minutes. Precision of analysis for CH_4 at 1600 ppbv is 0.2 to 0.3%; CO at 100 ppbv, ± 5%; and CO_2 at 350 ppmv, ± 0.4%. The response for CH_4 and CO was linear from 20 ppbv to 20000 ppbv. Figure 1 shows a sample chromatogram.

C_2 to C_4 Hydrocarbons

An HP 5890-A GC system with a pair of HP 3390 integrators was used for these analyses. A matched pair of phenyl isocyanate/Durapak® 15-ft. x 1/8-inch columns were used. The oven temperature was 40°C, sample size 250 mL, and analysis time 8 minutes. After each analysis the column was cooked out for 15 minutes at 55°C. Detection limit for the C_2-C_4 species was ∿40 pptv. Precision of analysis was typically better than ± 2% at 1 ppbC levels. A chromatogram of the calibration standard is shown in Figure 2.

C_4-C_{10} Hydrocarbons

An HP 5790A GC system with a pair of HP 3393 data processors was used to integrate the C_4-C_{10} hydrocarbons. A pair of wide bore (1 mm) glass capillary columns (DB-1) with 0.25μ film thickness and 30-m lengths were used. The oven temperature was programmed from -70 to 100° C at 4°/minute after an initial 2-minute hold. Sample volume was 500 mL enriched via an 8-inch x 1/8-inch U trap immersed in liquid oxygen and released at +80°C (hot water) where the hydrocarbons were subsequently cryo-focused on the head of the column at -70°C.

Precision of analysis at 10 ppbC is ± 5%. A chromatogram of the secondary standard used daily to check the performance of the system is shown in Figure 3. Primary calibration was against NBS standards.

F-12 through C_2Cl_4

A Perkin-Elmer 3920-B with an HP 3388 data processor was used to speciate N_2O, F-12, F-11, F-113, $CHCl_3$, CH_3CCl_3, CCl_4, C_2HCl_3, and C_2Cl_4. A Porasil® D 10-ft. x 1/8-inch and an OV101 (10%) 10-ft x 1/4-inch column were used. The oven was held isothermal at 70°C and the ECD at 375°C. The carrier gas was Ar/CH_4 (5%). The system was recalibrated

automatically every fifth analysis. Precision at the 100-1000 pptv level was typically 2-3%. A chromatogram of the cal-standard is shown in Figure 4.

5. QUALITY ASSURANCE AND CALIBRATION

Calibration of the hydrocarbon speciation is provided by several standards. The benzene, propane, and methane are NBS SRM primary standards. The C_2-C_{10} calibration standards are traceable to the NBS standards through neo-hexane. Also, periodically intercalibrations are made with EPA, Battelle-Columbus, NCAR, and other laboratories that measure hydrocarbons. Quality control is maintained by daily multiple calibration, day to day FID response records, and related paired peak performance checks as well as resolution and column deterioration tests. Experience over the years has shown that periodic calibration of the working standards against primary standards is the best assurance that quantitation is being maintained and reported correctly.

Data reduction uses either HP3388 or HP3390 series electronic integrators. Each chromatogram is manually inspected to be sure the peaks are properly integrated. This is important to be sure that the chromatography was optimum and the numbers calculated electronically are real.

Figure 1

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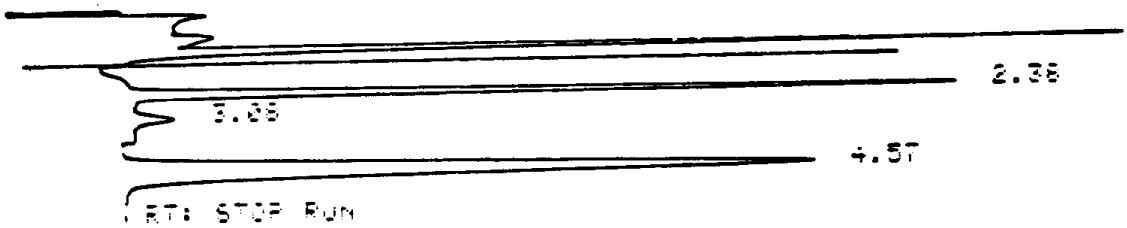
CH_4, CO, CO_2 Standard



[hp] 3356A MANUAL INJECTION @ 18:16 SEP 6, 1985
ESTD

RT	HEIGHT	TYPE	CAL	AMOUNT	NAME
2.38	736.15 +	BB	1	1667.800	CH4
3.08	35.53	BB	2	104.448	CO
4.57	79231.50 +A	BB	3	338.771	CO2

MULTIPLIER = 1

Figure 2 C_2-C_4 Hydrocarbon Standard

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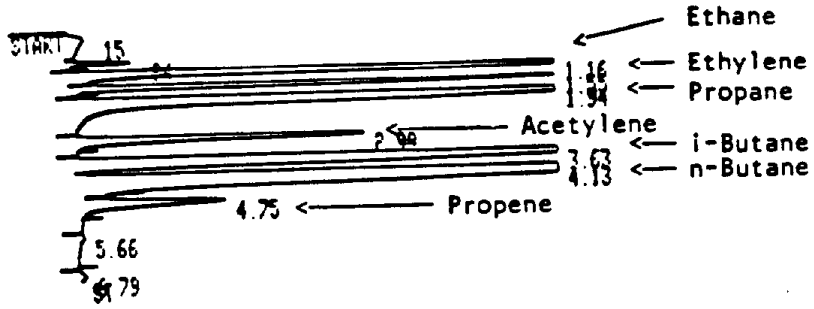

RUN # 1059 OCT/23/86 11:33:15

HEIGHT% RT	HEIGHT	TYPE	AR/HT	HEIGHT%
0.15	489	BV	0.424	0.047
0.84	1947	D VB	0.085	0.186
1.16	270624	D PB	0.072	25.852
1.55	17153	D BB	0.081	1.639
1.94	465013	D PB	0.088	44.421
2.99	9057	PB	0.133	0.865
3.63	84663	PP	0.140	8.088
4.13	193529	PB	0.161	18.487
4.75	4047	BB	0.179	0.387
5.66	109	BB	0.158	0.010
6.79	191	I PH	0.217	0.018

TOTAL HGHT= 1046800
MUL FACTOR= 1.0000E+00

Figure 3

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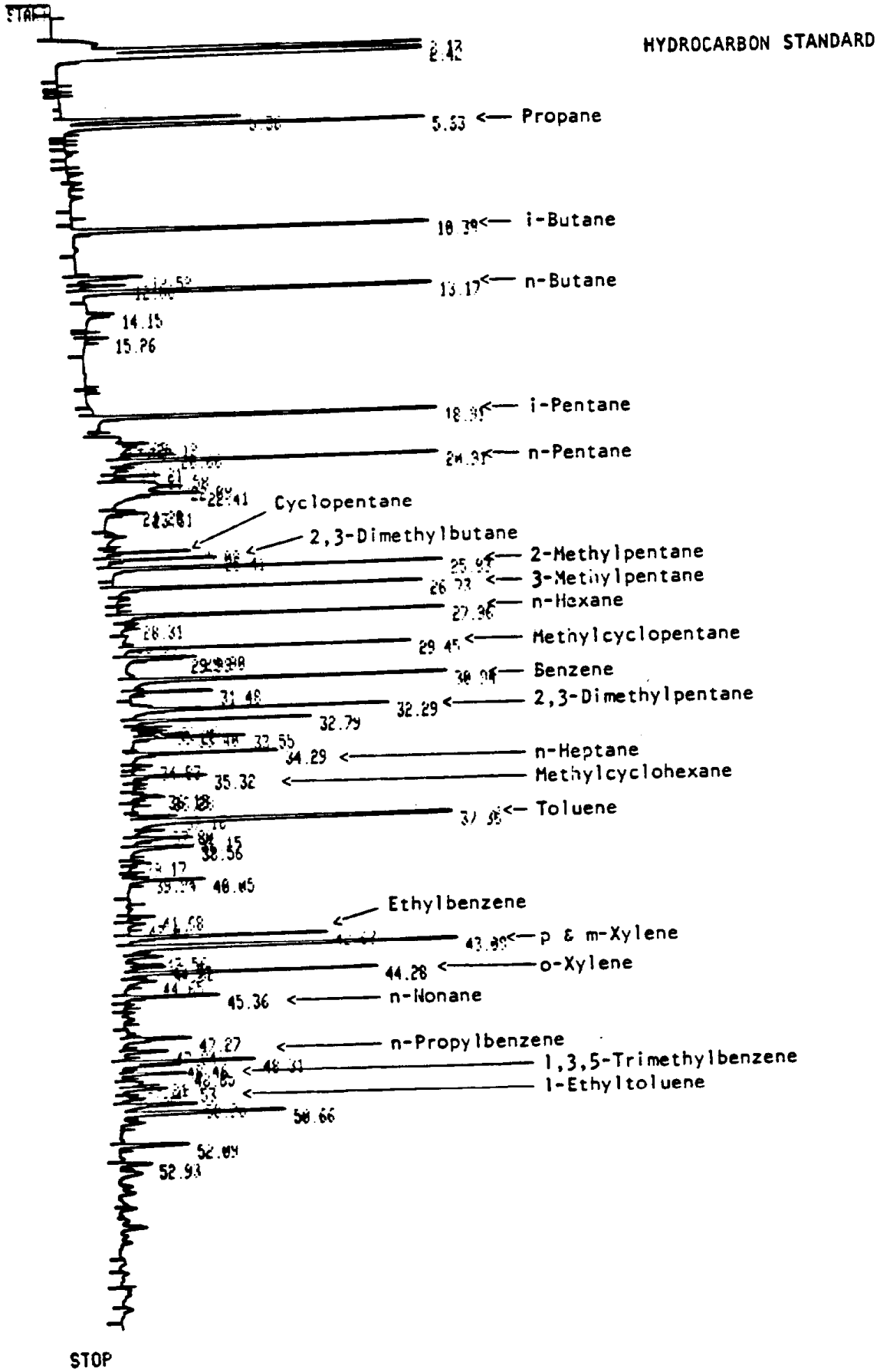
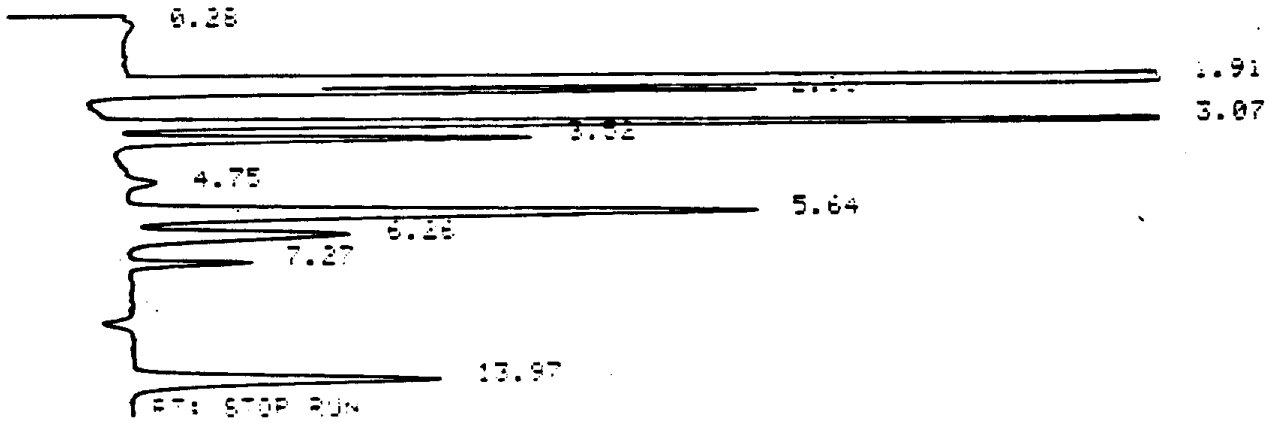


FIGURE 4

START PROM

********** STD=0-325 **********



[HP] 3388A VALVE # 7 INJECTION @ 15:59
0-325
ESTD

RT	HEIGHT	TYPE	CAL	AMOUNT	NAME
2.18	221.56	BB	1	833.500	F-12
3.07	537.13	BB	2	438.100	F-11
3.52	185.58	BB	3	270.000	F-113
4.75	12.33	BB	4	89.400	CHCL3
5.64	281.19 +	BB	5	965.000	CH3CCL3
6.26	96.35	BB	6	172.800	CCL4
7.27	54.37	BB	7	400.800	TRICHLOR
13.97	139.10	BB	8	1740.000	PERCHLOR

TABLE 1

H_2, CO, CH_4, CO_2, N_2O, and Halocarbon Data

CITRUS COLLEGE

Sample No.	S/N	Date	Time	Comments	H2 ppbv	CO ppbv	CH4 ppbv	CO2 ppmv	N2O ppbv	F-12 pptv	F-11 pptv	F-113 pptv	CHCl3 pptv	CH3CCl3 pptv	CCl4 pptv	TCE pptv	PCE pptv
1	WM26	11-Aug-86	2000	1,4,JC	1254	2010	2266	382	346	1087	489	138	107	2739	156	96	2302
			0	12 psig							448						
2	WM31	12-Aug-86	0	1,5JC	1260	1829	3142	404	361	1557	618	244	191	5089	159	168	4437
			800	8 psig							566						
3	WM20	12-Aug-86	800	2,1,JC	1542	3157	2716	405	347	2103	588	350	177	5145	163	229	5538
			1200	6 psig							563						
4	WM21	12-Aug-86	1200	2,2,JC 6 psig	1131	1894	2057	375	344	1474	580	6317		4812	178	198	5047
			1600	5 psig													
5	WM19	12-Aug-86	1600	23 JC 11 psig	1028	2019	1985	365	343	898	364	185	30	2865	152	133	2934
			2000	10 psig													
6	WM4	12-Aug-86	2000	24 JC	1268	3221	2474	383	347	1155	472	320	35	4414	155	152	3459
			0	9.5 psig													
7	WM24	13-Aug-86	0	25 JC 12 psig	1158	1638	3234	398	347	1551	1249	285	134	4502	162	185	3752
			800	13 psig													
8	WM41	13-Aug-86	800	31 JC 13 psig	1478	3340	3210	404	345	1377	432	225	120	4274	161	183	4982
			1200	15 psig													
9	WM13	13-Aug-86	1200	32 JC 6 psig	1071	1524	2081	372	349	1356	514	6184	83	4041	247	181	4122
			1600	7 psig													
10	WM6	13-Aug-86	1600	33 JC 10 psig	1079	1555	2054	374	344	1118	497	315	58	3949	165	174	3903
			2000	9 psig													
11	WM14	13-Aug-86	2000	34 JC 10 psig	1185	2199	2186	378	343	1213	359	124	61	2313	160	113	3299
			0	10 psig													
12	WM15	14-Aug-86	0	35 JC 10 psig	1089	1387	2867	388	345	1200	1155	185	73	4204	165	149	4931
			800	10 psig													

CITRUS COLLEGE

Sample No.	S/N	Date	Time	Comments	H2 ppbv	CO ppbv	CH4 ppbv	CO2 ppmv	N2O ppbv	F-12 pptv	F-11 pptv	F-113 pptv	CHCl3 pptv	CH3CCl3 pptv	CCl4 pptv	TCE pptv	PCE pptv
13	WM32	14-Aug-86	800 1200	41 JC 14 psig 15 psig	1289	2322	2890	393	344	1295	469	318	78	4407	164	119	4657
14	WM17	14-Aug-86	1200 1600	42 JC 6 psig 7 psig	1098	1470	2088	373	342	1564	625	6353	83	4620	172	190	4920
15	WM7	14-Aug-86	1600 2000	43 JC 12 psig 11 psig	1220	1743	2303	380	343	1325	531	288	50	4435	156	157	4729
16	WM27	14-Aug-86	2000 0	44 JC 12 psig 11.5 psig	1175	1810	2359	383	345	1071	388	140	50	2901	160	129	2584
17	WM23	15-Aug-86	0 800	45 JC 10.5 psig 10 psig	1065	1159	2386	386	345	1240	1517	152	73	3324	158	114	2377
18	WM8	15-Aug-86	800 1200	51 JC 1.5 psig 2 psig	1195	1523	2171	384	335	1356	675	357	68	4290	161	184	3392
19	WM12	15-Aug-86	1200 1600	52 JC 11 psig 11 psig	1262	1607	2088	376	341	1405	789	4225	60	4748	162	151	5139
20	WM55	15-Aug-86	1600 2000	53 JC 11 psig 10 psig	1150	1609	1997	369	345	955	409	175	10	3087	155	128	3880
21	WM18	15-Aug-86	2000 0	54 JC 13 psig 12 psig	1087	1653	2136	374	341	969	349	116	42	2900	160	102	2889
22	WM52	16-Aug-86	0 800	55 JC 7 psig 7 psig	1226	1625	2405	398	347	1507	431	250	98	3769	158	137	3112
23	WM3	16-Aug-86	800 1200	61 JC 0 psig phi psi	1320	1717	2631	393	344	1936	656	392	112	4043	159	418	3024
24	WM25	16-Aug-86	1200 1600	62 JC 11 psig 11.5 psig	1050	1367	2128	371	344	1258	1463	4495	62	2570	158	131	3100

CITRUS COLLEGE

Sample No.	S/N	Date	Time	Comments	H2 ppbv	CO ppbv	CH4 ppbv	CO2 ppmv	N2O ppbv	F-12 pptv	F-11 pptv	F-113 pptv	CHCl3 pptv	CH3CCl3 pptv	CCl4 pptv	TCE pptv	PCE pptv
25	WM5	16-Aug-86	1600 2000	63 JC 11 psig 11 psig	1116	1517	2144	374	345	1008	406	167	47	2081	160	110	2512
26	WM28	16-Aug-86	2000 2400	64 JC 12 psig 12.2 psig	1255	2033	2194	384	339	1302	391	143	72	2073	160	104	1772
27	WM29	17-Aug-86	0 800	65 JC 7 psig 6.5 psig	1142	1714	2394	405	340	1725	409	144	171	2624	158	121	2075
28	WM54	17-Aug-86	805 1200	71 JC 4 psig 5.5 psig	1270	1696	2120	383	341	1286	412	131	133	1722	156	204	1691
29	WM51	17-Aug-86	1200 1600	72 JC 10 psig 10 psig	1146	1520	2240	377	345	1230	434	7775	91	1926	151	136	1486
30	WM44	17-Aug-86	1600 2000	73 JC 9.5 psig 9.5 psig	991	1369	2026	364	343	976	341	126	49	1159	155	133	729
31	WM53	17-Aug-86	2000 2400	74 JC 12 psig 11.5 psig	1044	1624	2186	378	346	885	358	149	62	1489	162	113	994
32	WM43	18-Aug-86	0 800	75 JC 8 psig 8 psig	1100	1435	2323	397	347	1233	354	188	128	1611	163	131	1267
33	WM56	18-Aug-86	800 1200	81 JC 12 psig	Lost												
34	WM37	18-Aug-86	1200 1600	82 JC 11 psig	1084	1261	1981	370	344	1088	470	10050	91	3507	165	176	3075
35	WM34	18-Aug-86	1600 2000	83 JC 13 psig	1117	1325	1943	371	343	1678	433	207	52	2681	134	164	2753
36	WM11	18-Aug-86	2000 0	84 JC 13 psig	1163	1646	2056	391	342	2567	412	230	117	3132	161	143	1935
37	WM22	19-Aug-86	0 800	85 JC 9 psig	988	1058	2073	399	344	1739	395	140	161	3307	157	149	1775

CITRUS COLLEGE

Sample No.	S/N	Date	Time	Comments	H2 ppbv	CO ppbv	CH4 ppbv	CO2 ppmv	N2O ppbv	F-12 pptv	F-11 pptv	F-113 pptv	CHCl3 pptv	CH3CCl3 pptv	CCl4 pptv	TCE pptv	PCE pptv
38	WM30	19-Aug-86	600 900	99 JC 12.5 psig	1276	1839	2087	407	344	1428	518	2820	160	4854	154	135	2340
39	WM50	19-Aug-86	800 1200	91 JC 2 psig	1220	1545	1896	382	345	1232	662	188	92	2478	154	236	2644
40	WM33	19-Aug-86	1200 1600	92 JC 8 psig	1066	1206	2004	371	342	1455	629	8970	75	4134	155	170	4693
41	WM49	19-Aug-86	1600 2000	93 JC 13 psig	1054	1370	1842	366	342	1340	363	151	30	1876	150	136	2694
42	WM36	19-Aug-86	2000 0	94 JC 13 psig	1257	1969	2026	390	346	2222	436	139	105	3946	156	140	2892
43	WM16	20-Aug-86	0 800	95 JC 9 psig	987	1242	2174	410	340	1772	457	138	166	3568	157	162	2436
44	WM38	20-Aug-86	600 900	109 JC 8 psig	1579	2716	2318	426	350	1997	604	2536	213	4384	158	173	4134
45	WM40	20-Aug-86	800 1200	101 JC 15 psig	2132	4136	2574	441	347	2613	842	273	210	4238	160	229	6859
46	WM45	20-Aug-86	1200 1600	102 JC 6 psig	1180	1390	2030	375	343	2101	881	8225	94	4926	148	178	5333
47	WM10	20-Aug-86	1600 2000	103 JC 11 psig	1047	1469	1986	369	344	1337	448	165	38	2791	157	149	3232
48	WM9	20-Aug-86	2000 0	104 JC 11 psig	1279	1873	2108	386	347	1784	529	307	83	4918	141	160	3628
49	WM2	21-Aug-86	0 800	105 JC 7 psig	1265	1850	2425	420	347	2501	951	294	188	4830	165	195	3263
50	WM46	21-Aug-86	600 900	119 JC	1741	3180	2634	440	346	2693	548	2963	268	5697	166	237	4476

TABLE 2

C_2-C_4 Hydrocarbons

CITRUS COLLEGE

Sample No.	S/N	Date	Time	Comments	H2 ppbv	CO ppbv	CH4 ppbv	CO2 ppmv	N2O ppbv	C2H6 pptv	C2H4 pptv	C2H2 pptv	C3H8 pptv	C3H6 pptv	i-C4 pptv	n-C4 pptv
1	WM26	11-Aug-86	2000 0	1,4,JC 12 psig	1254	2010	2266	382	346	14300	7340	10200	7700	4860	5500	11900
2	WM31	12-Aug-86	0 800	1,5JC 8 psig	1260	1829	3142	404	361	19600	8030	10300	11000	5480	5250	10000
3	WM20	12-Aug-86	800 1200	2,1,JC 6 psig	1542	3157	2716	405	347	19700	9290	13200	13000	4800	6520	12400
4	WM21	12-Aug-86	1200 1600	2,2,JC 6 psig 5 psig	1131	1894	2057	375	344	12800	9400	7810	19500	1600	6070	9990
5	WM19	12-Aug-86	1600 2000	23 JC 11 psig 10 psig	1028	2019	1985	365	343	10300	12100	7230	9610	3170	3100	6060
6	WM4	12-Aug-86	2000 0	24 JC 9.5 psig	1268	3221	2474	383	347	16100	19000	10100	13700	5450	4690	9240
7	WM24	13-Aug-86	0 800	25 JC 12 psig 13 psig	1158	1638	3234	398	347	22800	16800	8390	18500	5010	5420	10500
8	WM41	13-Aug-86	800 1200	31 JC 13 psig 15 psig	1478	3340	3210	404	345	28600	24300	13000	27600	6680	6910	12500
9	WM13	13-Aug-86	1200 1600	32 JC 6 psig 7 psig	1071	1524	2081	372	349	12200	9010	6720	18500	1560	5650	9940
10	WM6	13-Aug-86	1600 2000	33 JC 10 psig 9 psig	1079	1555	2054	374	344	11400	12500	7270	18500	2680	5920	9950
11	WM14	13-Aug-86	2000 0	34 JC 10 psig 10 psig	1185	2199	2186	378	343	12800	17500	9310	12000	5320	4770	9600
12	WM15	14-Aug-86	0 800	35 JC 10 psig 10 psig	1089	1387	2867	388	345	20400	14400	7430	18500	4130	5720	10900

CITRUS COLLEGE

Sample No.	S/N	Date	Time	Comments	H2 ppbv	CO ppbv	CH4 ppbv	CO2 ppmv	N2O ppbv	C2H6 pptv	C2H4 pptv	C2H2 pptv	C3H8 pptv	C3H6 pptv	i-C4 pptv	n-C4 pptv
13	WM32	14-Aug-86	800 1200	41 JC 14 psig 15 psig	1289	2322	2890	393	344	23700	19100	10400	23500	4870	6710	12000
14	WM17	14-Aug-86	1200 1600	42 JC 6 psig 7 psig	1098	1470	2088	373	342	12000	9370	7360	19800	1540	6580	11700
15	WM7	14-Aug-86	1600 2000	43 JC 12 psig 11 psig	1220	1743	2303	380	343	16700	13000	8780	24800	2640	6390	10600
16	WM27	14-Aug-86	2000 0	44 JC 12 psig 11.5 psig	1175	1810	2359	383	345	17300	16000	9300	16300	4820	5020	9590
17	WM23	15-Aug-86	0 800	45 JC 10.5 psig 10 psig	1065	1159	2386	386	345	14300	12600	6140	13700	3780	4020	6980
18	WM8	15-Aug-86	800 1200	51 JC 1.5 psig 2 psig	1195	1523	2171	384	335	13100	14100	8430	15700	3150	4470	8060
19	WM12	15-Aug-86	1200 1600	52 JC 11 psig 11 psig	1262	1607	2088	376	341	11900	9590	7050	15800	1380	5000	7790
20	WM55	15-Aug-86	1600 2000	53 JC 11 psig 10 psig	1150	1609	1997	369	345	8910	12900	8090	10200	3060	3420	6860
21	WM18	15-Aug-86	2000 0	54 JC 13 psig 12 psig	1087	1653	2136	374	341	9440	16200	8430	8460	4990	3400	6530
22	WM52	16-Aug-86	0 800	55 JC 7 psig 7 psig	1226	1625	2405	398	347	13400	17400	9310	13500	5410	4640	8690
23	WM3	16-Aug-86	800 1200	61 JC 0 psig phi psi	1320	1717	2631	393	344	13800	16400	10700	17000	5660	5240	9680
24	WM25	16-Aug-86	1200 1600	62 JC 11 psig 11.5 psig	1050	1367	2128	371	344	10500	7550	7040	14100	1300	4850	8660

CITRUS COLLEGE

Sample No.	S/N	Date	Time	Comments	H2 ppbv	CO ppbv	CH4 ppbv	CO2 ppmv	N2O ppbv	C2H6 pptv	C2H4 pptv	C2H2 pptv	C3H8 pptv	C3H6 pptv	i-C4 pptv	n-C4 pptv
25	WM5	16-Aug-86	1600	63 JC 11 psig	1116	1517	2144	374	345	11600	10800	7680	13300	2390	4970	8740
			2000	11 psig												
26	WM28	16-Aug-86	2000	64 JC 12 psig	1255	2033	2194	384	339	17700	21600	12200	15400	6140	5650	11000
			2400	12.2 psig												
27	WM29	17-Aug-86	0	65 JC 7 psig	1142	1714	2394	405	340	17300	14900	9040	14500	3690	5130	10300
			800	6.5 psig												
28	WM54	17-Aug-86	805	71 JC 4 psig	1270	1696	2120	383	341	11400	10800	8910	12900	1920	5100	9710
			1200	5.5 psig												
29	WM51	17-Aug-86	1200	72 JC 10 psig	1146	1520	2240	377	345	10400	6710	7100	10400	966	4650	9120
			1600	10 psig												
30	WM44	17-Aug-86	1600	73 JC 9.5 psig	991	1369	2026	364	343	10800	10300	6250	10000	2610	4480	8730
			2000	9.5 psig												
31	WM53	17-Aug-86	2000	74 JC 12 psig	1044	1624	2186	378	346	11400	13700	7090	9890	4570	3760	7270
			2400	11.5 psig												
32	WM43	18-Aug-86	0	75 JC 8 psig	1100	1435	2323	397	347	14200	14300	7330	21000	4720	7070	11100
			800	8 psig												
33	WM56	18-Aug-86	800	81 JC												
			1200	12 psig												
34	WM37	18-Aug-86	1200	82 JC	1084	1261	1981	370	344	7240	7140	6170	9760	1370	4280	7800
			1600	11 psig												
35	WM34	18-Aug-86	1600	83 JC	1117	1325	1943	371	343	9510	10100	6220	12100	2640	4410	8550
			2000	13 psig												
36	WM11	18-Aug-86	2000	84 JC	1163	1646	2056	391	342	11800	15000	8280	13000	5040	5420	10200
			0	13 psig												
37	WM22	19-Aug-86	0	85 JC	988	1058	2073	399	344	13600	9650	6190	13300	2670	4290	8730
			800	9 psig												

CITRUS COLLEGE

Sample No.	S/N	Date	Time	Comments	H2 ppbv	CO ppbv	CH4 ppbv	CO2 ppmv	N2O ppbv	C2H6 pptv	C2H4 pptv	C2H2 pptv	C3H8 pptv	C3H6 pptv	i-C4 pptv	n-C4 pptv
38	WM30	19-Aug-86	600 900	99 JC 12.5 psig	1276	1839	2087	407	344	14700	16300	10800	27800	4190	5290	9310
39	WM50	19-Aug-86	800 1200	91 JC 2 psig	1220	1545	1896	382	345	7260	9860	7150	11300	2640	4140	7830
40	WM33	19-Aug-86	1200 1600	92 JC 8 psig	1066	1206	2004	371	342	8410	6800	5750	11100	1220	4230	8110
41	WM49	19-Aug-86	1600 2000	93 JC 13 psig	1054	1370	1842	366	342	6810	11100	6340	7250	3110	2850	6680
42	WM36	19-Aug-86	2000 0	94 JC 13 psig	1257	1969	2026	390	346	15400	21600	11400	15200	7000	6260	13500
43	WM16	20-Aug-86	0 800	95 JC 9 psig	987	1242	2174	410	340	16200	10900	6700	13800	2690	4570	9630
44	WM38	20-Aug-86	600 900	109 JC 8 psig	1579	2716	2318	426	350	19900	24200	15700	26800	6370	7460	13800
45	WM40	20-Aug-86	800 1200	101 JC 15 psig	2132	4136	2574	441	347	21700	36900	19700	25100	8140	8240	16300
46	WM45	20-Aug-86	1200 1600	102 JC 6 psig	1180	1390	2030	375	343	10900	8540	6520	13600	1350	4600	8840
47	WM10	20-Aug-86	1600 2000	103 JC 11 psig	1047	1469	1986	369	344	7370	11600	7000	8390	3040	3310	7480
48	WM9	20-Aug-86	2000 0	104 JC 11 psig	1279	1873	2108	386	347	12100	16800	9210	13000	5190	4260	9030
49	WM2	21-Aug-86	0 800	105 JC 7 psig	1265	1850	2425	420	347	18900	18300	10300	18400	4890	6160	13200
50	WM46	21-Aug-86	600 900	119 JC	1741	3180	2634	440	346	22800	31400	18600	23500	8220	8930	16800

TABLE 3

Summary TNMHC Data

CITRUS COLLEGE

Sample No.	S/N	Date	Time	Comments	H2 ppbv	CO ppbv	CH4 ppbv	TNMHC ppbC	ID %	UID %	Alkanes* %	Alkenes* %	Aromatics* %	C2H2 ppbC	C2H6 ppbC	E/A Ratio
1	WM26	11-Aug-86	2000 0	1,4,JC 12 psig	1254	2010	2266	658	91	9	59	13	28	16.3	26.3	1.6
2	WM31	12-Aug-86	0 800	1,5JC 8 psig	1260	1829	3142	679	89	11	59	12	29	16.4	36.1	2.2
3	WM20	12-Aug-86	800 1200	2,1,JC 6 psig	1542	3157	2716	713	91	9	61	10	29	21.1	36.3	1.7
4	WM21	12-Aug-86	1200 1600	2,2,JC 6 p 5 psig	1131	1894	2057	435	92	8	71	9	20	12.5	23.6	1.9
5	WM19	12-Aug-86	1600 2000	23 JC 11 p 10 psig	1028	2019	1985	394	91	9	57	14	29	11.5	19.0	1.7
6	WM4	12-Aug-86	2000 0	24 JC 9.5 psig	1268	3221	2474	660	87	13	56	15	28	16.1	29.6	1.8
7	WM24	13-Aug-86	0 800	25 JC 12 p 13 psig	1158	1638	3234	671	87	13	61	14	25	13.4	42.0	3.1
8	WM41	13-Aug-86	800 1200	31 JC 13 p 15 psig	1478	3340	3210	811	90	10	61	14	25	20.7	52.6	2.5
9	WM13	13-Aug-86	1200 1600	32 JC 6 ps 7 psig	1071	1524	2081	377	93	7	71	10	20	10.7	22.5	2.1
10	WM6	13-Aug-86	1600 2000	33 JC 10 p 9 psig	1079	1555	2054	483	88	12	66	11	23	11.6	21.0	1.8
11	WM14	13-Aug-86	2000 0	34 JC 10 p 10 psig	1185	2199	2186	561	91	9	57	15	27	14.9	23.6	1.6
12	WM15	14-Aug-86	0 800	35 JC 10 p 10 psig	1089	1387	2867	594	88	12	63	13	24	11.9	37.5	3.2

CITRUS COLLEGE

Sample No.	S/N	Date	Time	Comments	H2 ppbv	CO ppbv	CH4 ppbv	TNMHC ppbC	ID %	UID %	Alkanes* %	Alkenes* %	Aromatics* %	C2H2 ppbC	C2H6 ppbC	E/A Ratio
13	WM32	14-Aug-86	800 1200	41 JC 14 p 15 psig	1289	2322	2890	653	91	9	64	13	23	16.6	43.6	2.6
14	WM17	14-Aug-86	1200 1600	42 JC 6 ps 7 psig	1098	1470	2088	421	94	6	73	9	18	11.7	22.1	1.9
15	WM7	14-Aug-86	1600 2000	43 JC 12 p 11 psig	1220	1743	2303	560	89	11	66	11	23	14.0	30.7	2.2
16	WM27	14-Aug-86	2000 0	44 JC 12 p 11.5 psig	1175	1810	2359	546	92	8	60	13	26	14.8	31.8	2.1
17	WM23	15-Aug-86	0 800	45 JC 10.5 10 psig	1065	1159	2386	497	86	14	59	15	26	9.8	26.3	2.7
18	WM8	15-Aug-86	800 1200	51 JC 1.5 2 psig	1195	1523	2171	425	94	6	64	11	25	13.4	24.1	1.8
19	WM12	15-Aug-86	1200 1600	52 JC 11 p 11 psig	1262	1607	2088	384	94	6	67	10	23	11.2	21.9	2.0
20	WM55	15-Aug-86	1600 2000	53 JC 11 p 10 psig	1150	1609	1997	391	92	8	59	13	28	12.9	16.4	1.3
21	WM18	15-Aug-86	2000 0	54 JC 13 p 12 psig	1087	1653	2136	484	91	9	53	18	30	13.4	17.4	1.3
22	WM52	16-Aug-86	0 800	55 JC 7 ps 7 psig	1226	1625	2405	598	90	10	56	15	29	14.9	24.7	1.7
23	WM3	16-Aug-86	800 1200	61 JC 0 ps phi psi	1320	1717	2631	560	92	8	61	13	26	17.1	25.4	1.5
24	WM25	16-Aug-86	1200 1600	62 JC 11 p 11.5 psig	1050	1367	2128	359	94	6	70	9	21	11.2	19.3	1.7

CITRUS COLLEGE

Sample No.	S/N	Date	Time	Comments	H2 ppbv	CO ppbv	CH4 ppbv	TNMHC ppbC	ID %	UID %	Alkanes* %	Alkenes* %	Aromatics* %	C2H2 ppbC	C2H6 ppbC	E/A Ratio
25	WM5	16-Aug-86	1600 2000	63 JC 11 p 11 psig	1116	1517	2144	385	93	7	65	11	24	12.3	21.3	1.7
26	WM28	16-Aug-86	2000 2400	64 JC 12 p 12.2 psig	1255	2033	2194	631	90	10	57	16	27	19.5	32.6	1.7
27	WM29	17-Aug-86	0 800	65 JC 7 ps 6.5 psig	1142	1714	2394	619	88	12	61	12	27	14.4	31.8	2.2
28	WM54	17-Aug-86	805 1200	71 JC 4 ps 5.5 psig	1270	1696	2120	438	90	10	66	12	22	14.2	21.0	1.5
29	WM51	17-Aug-86	1200 1600	72 JC 10 p 10 psig	1146	1520	2240	339	90	10	71	10	20	11.3	19.1	1.7
30	WM44	17-Aug-86	1600 2000	73 JC 9.5 9.5 psig	991	1369	2026	343	94	6	65	13	22	10.0	19.9	2.0
31	WM53	17-Aug-86	2000 2400	74 JC 12 p 11.5 psig	1044	1624	2186	397	94	6	59	15	27	11.3	21.0	1.9
32	WM43	18-Aug-86	0 800	75 JC 8 ps 8 psig	1100	1435	2323	572	93	7	64	12	24	11.7	26.1	2.2
33	WM56	18-Aug-86	800 1200	81 JC 12 psig												
34	WM37	18-Aug-86	1200 1600	82 JC 11 psig	1084	1261	1981	317	93	7	67	11	21	9.8	13.3	1.4
35	WM34	18-Aug-86	1600 2000	83 JC 13 psig	1117	1325	1943	383	95	5	64	14	22	9.9	17.5	1.8
36	WM11	18-Aug-86	2000 0	84 JC 13 psig	1163	1646	2056	598	90	10	59	13	28	13.2	21.7	1.6
37	WM22	19-Aug-86	0 800	85 JC 9 psig	988	1058	2073	493	92	8	62	11	27	9.9	25.0	2.5

CITRUS COLLEGE

Sample No.	S/N	Date	Time	Comments	H2 ppbv	CO ppbv	CH4 ppbv	TNMHC ppbC	ID %	UID %	Alkanes* %	Alkenes* %	Aromatics* %	C2H2 ppbC	C2H6 ppbC	E/A Ratio
38	WM30	19-Aug-86	600 900	99 JC 12.5 psig	1276	1839	2087	615	91	9	61	13	26	17.2	27.1	1.6
39	WM50	19-Aug-86	800 1200	91 JC 2 psig	1220	1545	1896	354	93	7	65	12	23	11.4	13.4	1.2
40	WM33	19-Aug-86	1200 1600	92 JC 8 psig	1066	1206	2004	313	94	6	68	10	21	9.2	15.5	1.7
41	WM49	19-Aug-86	1600 2000	93 JC 13 psig	1054	1370	1842	364	93	7	58	16	27	10.1	12.5	1.2
42	WM36	19-Aug-86	2000 0	94 JC 13 psig	1257	1969	2026	698	93	7	59	15	27	18.2	28.3	1.6
43	WM16	20-Aug-86	0 800	95 JC 9 psig	987	1242	2174	533	91	9	63	10	27	10.7	29.8	2.8
44	WM38	20-Aug-86	600 900	109 JC 8 psig	1579	2716	2318	863	92	8	60	14	26	25.0	36.6	1.5
45	WM40	20-Aug-86	800 1200	101 JC 15 psig	2132	4136	2574	1218	91	9	56	15	29	31.4	39.9	1.3
46	WM45	20-Aug-86	1200 1600	102 JC 6 psig	1180	1390	2030	384	95	5	68	10	22	10.4	20.1	1.9
47	WM10	20-Aug-86	1600 2000	103 JC 11 psig	1047	1469	1986	396	93	7	59	15	26	11.2	13.6	1.2
48	WM9	20-Aug-86	2000 0	104 JC 11 psig	1279	1873	2108	550	92	8	59	13	28	14.7	22.3	1.5
49	WM2	21-Aug-86	0 800	105 JC 7 psig	1265	1850	2425	796	92	8	60	12	28	16.4	34.8	2.1
50	WM46	21-Aug-86	600 900	119 JC	1741	3180	2634	1125	91	9	58	15	28	29.7	42.0	1.4