4.0 VARIATIONS IN $PM_{2.5}$ MASS AND CHEMICAL COMPOSITION

4.1 Annual $PM_{2.5}$ Mass Concentrations

Table 4-1 summarizes the mass data collected during the study period, from 03/11/97 to 03/12/98, showing the average, standard deviation, minimum, and maximum values and the dates when the extremes occurred for the scheduled days, forecast days, and all days. The indoor site (HS) is consistently lower than the outdoor sites and is not included in the following discussion of mass concentration averages. The averages for scheduled days range from 9.6 ± 4.5 $\mu g/m^3$ at the HT collocated site (denuder on) to 18.0 ± 8.4 $\mu g/m^3$ at the HC collocated site (denuder on). Forecast days averages range from 13.8 ± 4.0 $\mu g/m^3$ at the SM site to 26.4 ± 3.5 $\mu g/m^3$ at the HC site.

The averages for all days (including both scheduled and forecast days) ranged from 9.6 ± 4.5 $\mu g/m^3$ at the HT collocated site (denuder on) to 18.4 ± 8.3 $\mu g/m^3$ at the HC collocated site (denuder on).

Figure 4-1 shows the average of the 24-hour mass measurements taken at each site during this study. Four of the sites (EP, H3, HB, and HC) have averages for all days that exceed 15 $\mu g/m^3$, the annual National Ambient Air Quality Standard (NAAQS) for $PM_{2.5}$. These averages, however, are skewed high owing to the high values contributed by the forecast days. The averages for forecast days are shown in Figure 4-2. With the exception of site SM, all of the sites have averages exceeding 15 $\mu g/m^3$, which is to be expected since these days were chosen when high particulate levels were forecast to occur.

The averages for scheduled days are shown in Figure 4-3, and are approximately 34% lower than the forecast days. Only sites H3 and HC have average concentrations exceeding the annual NAAQS (15 $\mu g/m^3$), but most of the sites (except CC, HG and SA) have average concentrations approaching the standard. More data will be needed to test compliance with the three-year NAAQS.

Figure 4-4 shows the maximum $PM_{2.5}$ concentration measured at each site. Seven of the fifteen maxima occurred at sites in the Houston area during a stagnation period on 08/26/97 and 08/27/97. One site, EP (El Paso), had a maximum (71.2 $\mu g/m^3$) that exceeded the 24-hour NAAQS standard of 65 $\mu g/m^3$.

4.2 Sample Selection for Chemical Analysis

A fraction of the sample sets was subjected to chemical analysis to determine the composition of the particulate collected. The selection criteria emphasized samples that showed unusually high mass concentrations or where meteorological and satellite data indicated that high dust or ozone was present in the sampling area. Additional samples were then selected to represent days with average particulate levels and to obtain equal representation from the collocated sampler with the denuder on and the denuder off.

Table 4-1a. Statistical summary of all days' $PM_{2.5}$ mass measurements in the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

Site Code	Average (µg/m³)	Number in Average	Minimum (µg/m³)	Date of Minimum	Maximum (µg/m³)	Date of Maximum
CC	11.3343 ± 5.0326	61	3.5157 ± 0.4641	09/13/97	23.4399 ± 1.2172	06/20/97
DA	14.7072 ± 6.4645	64	3.0682 ± 0.4246	10/13/97	32.9229 ± 1.7084	09/01/97
SA	11.1725 ± 5.8641	61	3.7140 ± 0.4502	10/13/97	30.8665 ± 1.5691	01/24/98
EP	15.2749 ± 10.6353	60	4.0772 ± 0.4618	10/25/97	71.1677 ± 3.5713	12/18/97
H3	16.8652 ± 6.8086	66	5.5218 ± 0.5146	10/13/97	38.7876 ± 1.9735	08/26/97
H7	14.6432 ± 6.9764	64	6.0413 ± 0.4975	02/16/98	35.9047 ± 1.8321	08/26/97
HB	15.4710 ± 7.4657	59	4.3755 ± 0.4886	10/13/97	36.3009 ± 1.8525	08/26/97
HC	17.3731 ± 7.3513	65	4.7769 ± 0.4936	10/13/97	36.5516 ± 1.8557	12/18/97
HG	11.5454 ± 5.9583	31	4.2556 ± 0.3901	12/30/97	25.5425 ± 1.3185	06/20/97
HM	14.4421 ± 6.4489	68	3.9556 ± 0.3480	01/05/98	32.3158 ± 1.6572	08/26/97
HT	14.1330 ± 7.4119	67	3.7847 ± 0.3996	11/30/97	32.7223 ± 1.6764	08/27/97
HW	13.2939 ± 6.2284	64	3.8147 ± 0.4661	10/13/97	33.4693 ± 1.7126	08/26/97
HS	4.2300 ± 2.3157	27	1.1635 ± 0.2799	01/11/98	10.0713 ± 0.6065	11/24/97
HC-CO-DON	18.4475 ± 8.2705	13	4.8823 ± 0.4714	10/13/97	30.2905 ± 1.5930	09/01/97
HC-CO-DOFF	15.7202 ± 3.7161	9	9.4038 ± 3.8156	05/04/97	20.0088 ± 1.1903	05/02/97
HT-CO-DON	9.5996 ± 4.5042	7	3.0374 ± 0.3479	12/24/97	14.2941 ± 0.7789	12/18/97
HT-CO-DOFF	15.0729 ± 6.8972	10	4.9265 ± 0.4235	11/06/97	29.4432 ± 1.5084	06/06/97
H3-CO-DON	15.2738 ± 4.6326	9	9.8772 ± 0.7238	07/27/97	24.0363 ± 1.3133	07/03/97
H3-CO-DOFF	16.8361 ± 7.0799	13	9.5297 ± 0.6097	02/28/98	33.6583 ± 1.7222	08/26/97
SM	12.9311 ± 4.6488	29	5.7178 ± 0.4339	12/30/97	23.0032 ± 1.1957	12/18/97

Table 4-1b. Statistical summary of scheduled days' $PM_{2.5}$ mass measurements in the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

Site Code	Average (µg/m³)	Number in Average	Minimum (µg/m³)	Date of Minimum	Maximum (µg/m³)	Date of Maximum
CC	10.5727 ± 4.5724	53	3.5157 ± 0.4641	09/13/97	20.6478 ± 1.0982	03/06/98
DA	14.5535 ± 6.3595	57	3.0682 ± 0.4246	10/13/97	32.9229 ± 1.7084	09/01/97
SA	10.4343 ± 4.8845	53	3.7140 ± 0.4502	10/13/97	21.7899 ± 1.1972	09/07/97
EP	14.3291 ± 10.6408	51	4.0772 ± 0.4618	10/25/97	71.1677 ± 3.5713	12/18/97
H3	15.9321 ± 6.2625	58	5.5218 ± 0.5146	10/13/97	38.7876 ± 1.9735	08/26/97
H7	13.5439 ± 6.2344	57	6.0413 ± 0.4975	02/16/98	35.9047 ± 1.8321	08/26/97
HB	14.4229 ± 7.0848	51	4.3755 ± 0.4886	10/13/97	36.3009 ± 1.8525	08/26/97
HC	16.2886 ± 6.9375	58	4.7769 ± 0.4936	10/13/97	36.5516 ± 1.8557	12/18/97
HG	10.2961 ± 5.3020	24	4.2556 ± 0.3901	12/30/97	22.6386 ± 1.2379	09/01/97
HM	13.7041 ± 6.3220	59	3.9556 ± 0.3480	01/05/98	32.3158 ± 1.6572	08/26/97
HT	12.9498 ± 6.7024	58	3.7847 ± 0.3996	11/30/97	31.0485 ± 1.6341	09/07/97
HW	12.6855 ± 5.9523	57	3.8147 ± 0.4661	10/13/97	33.4693 ± 1.7126	08/26/97
HS	4.2300 ± 2.3157	27	1.1635 ± 0.2799	01/11/98	10.0713 ± 0.6065	11/24/97
HC-CO-DON	17.9566 ± 8.4242	12	4.8823 ± 0.4714	10/13/97	30.2905 ± 1.5930	09/01/97
HC-CO-DOFF	15.1841 ± 3.5985	8	9.4038 ± 3.8156	05/04/97	19.4549 ± 1.1574	04/22/97
HT-CO-DON	9.5996 ± 4.5042	7	3.0374 ± 0.3479	12/24/97	14.2941 ± 0.7789	12/18/97
HT-CO-DOFF	13.7546 ± 5.2420	7	4.9265 ± 0.4235	11/06/97	22.0047 ± 1.1492	06/03/97
H3-CO-DON	14.5856 ± 4.4589	8	9.8772 ± 0.7238	07/27/97	24.0363 ± 1.3133	07/03/97
H3-CO-DOFF	15.8445 ± 7.1158	11	9.5297 ± 0.6097	02/28/98	33.6583 ± 1.7222	08/26/97
SM	12.8329 ± 4.7031	26	5.7178 ± 0.4339	12/30/97	23.0032 ± 1.1957	12/18/97

Table 4-1c. Statistical summary of forecast days' $PM_{2.5}$ mass measurements in the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

Site Code	Average (µg/m³)	Number in Average	Minimum (µg/m³)	Date of Minimum	Maximum (µg/m³)	Date of Maximum
CC	16.3801 ± 5.0311	8	8.3476 ± 0.5009	01/27/98	23.4399 ± 1.2172	06/20/97
DA	15.9589 ± 7.1417	7	7.7187 ± 0.4882	06/06/97	30.6320 ± 1.5670	08/27/97
SA	16.0625 ± 8.7534	8	7.5476 ± 0.4963	06/22/97	30.8665 ± 1.5691	01/24/98
EP	20.6345 ± 8.8690	9	10.7328 ± 0.6409	08/22/97	40.1590 ± 2.0262	12/16/97
H3	23.6298 ± 6.7844	8	11.6594 ± 0.6691	06/22/97	34.5858 ± 1.7601	06/05/97
H7	23.5946 ± 6.2068	7	15.5550 ± 0.9255	09/30/97	32.9770 ± 1.6812	06/20/97
HB	22.1532 ± 6.2781	8	13.1487 ± 0.7348	06/22/97	31.6963 ± 1.6271	08/27/97
HC	26.3591 ± 3.5403	7	21.3998 ± 1.1191	06/22/97	32.2141 ± 1.6445	06/05/97
HG	15.8286 ± 6.0943	7	6.2825 ± 0.7134	05/02/97	25.5425 ± 1.3185	06/20/97
HM	19.2802 ± 5.0236	9	12.4555 ± 0.7603	09/30/97	27.2464 ± 1.4021	06/05/97
HT	21.7580 ± 7.2325	9	11.6338 ± 0.6646	06/22/97	32.7223 ± 1.6764	08/27/97
HW	18.2481 ± 6.2145	7	10.7698 ± 0.6561	02/20/98	25.8614 ± 1.3624	10/02/97
HS	N/A ± N/A	N/A	N/A ± N/A		N/A ± N/A	
HC-CO-DON	24.3382 ± 0.0000	1	24.3382 ± 1.2824	10/02/97	24.3382 ± 1.2824	10/02/97
HC-CO-DOFF	20.0088 ± 0.0000	1	20.0088 ± 1.1903	05/02/97	20.0088 ± 1.1903	05/02/97
HT-CO-DON	N/A ± N/A	N/A	N/A ± N/A		N/A ± N/A	
HT-CO-DOFF	18.1489 ± 8.9965	3	7.4287 ± 0.4958	06/22/97	29.4432 ± 1.5084	06/06/97
H3-CO-DON	20.7790 ± 0.0000	1	20.7790 ± 1.1661	07/02/97	20.7790 ± 1.1661	07/02/97
H3-CO-DOFF	22.2899 ± 3.4881	2	18.8018 ± 1.0141	02/07/98	25.7780 ± 1.3396	08/27/97
SM	13.7821 ± 4.0498	3	8.1328 ± 0.7794	05/02/97	17.4226 ± 1.0190	07/02/97

Figure 4-1. Spatial variation of all days' $PM_{2.5}$ mass measurements taken during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

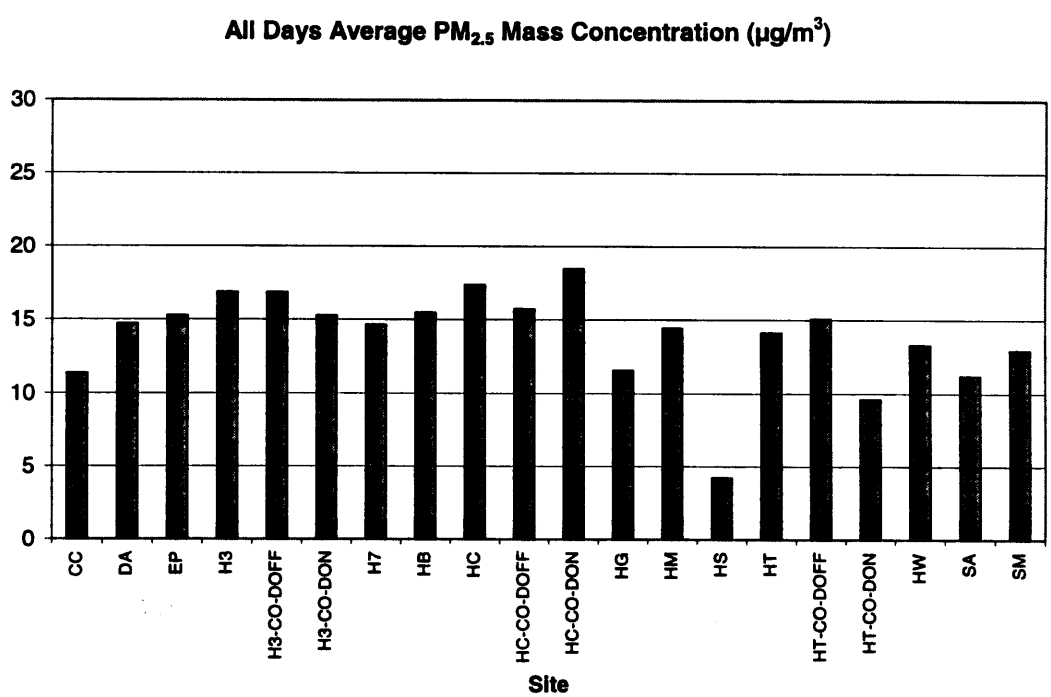


Figure 4-2. Spatial variation of forecast days' $PM_{2.5}$ mass measurements taken during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

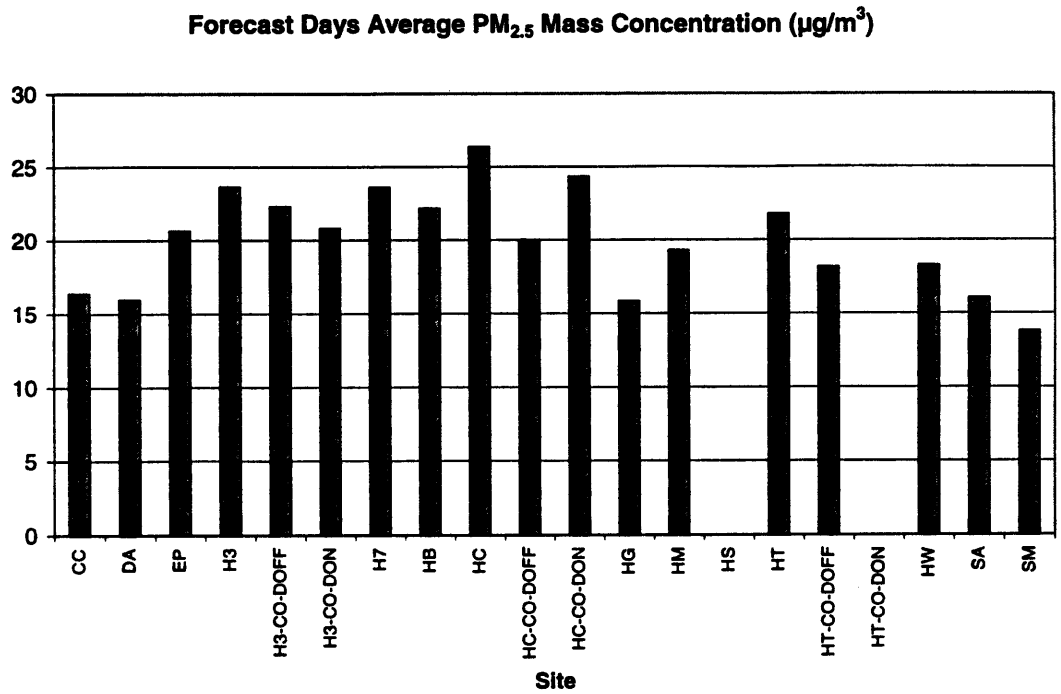


Figure 4-3. Spatial variation of scheduled days' $PM_{2.5}$ mass measurements taken during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

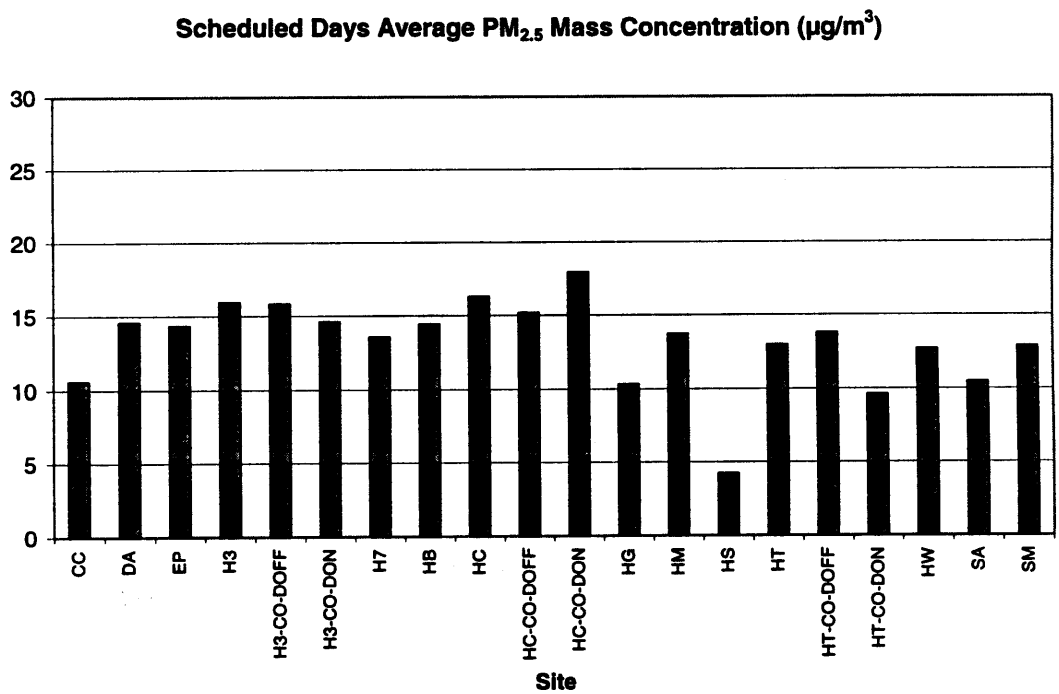
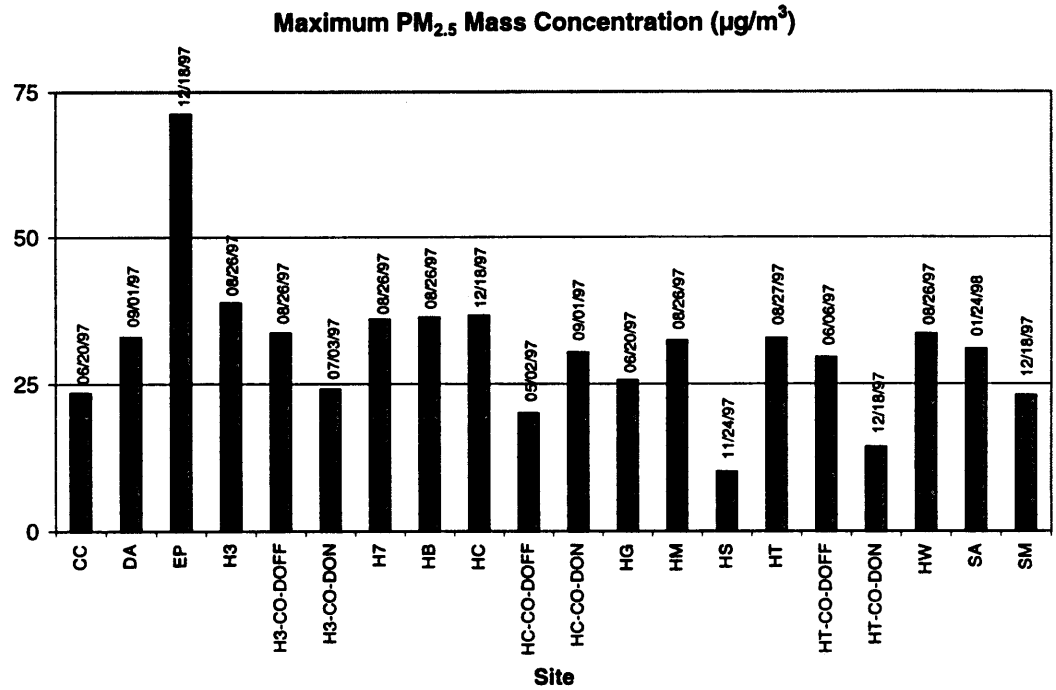


Figure 4-4. Maximum $PM_{2.5}$ concentrations at each site during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.



A total of 291 sample sets (269 ambient and 22 field blanks) were subjected to full chemical analysis which included: 1) x-ray Fluorescence (XRF) for up to 40 elements Na to U; 2) ion chromatography (IC) for chloride, nitrate, and sulfate; 3) automated colorimetry (AC) for ammonium; 4) atomic absorption spectroscopy (AAS) for soluble sodium and potassium; and 5) thermal optical reflectance (TOR) for organic and elemental carbon. One sample (site HW, 09/01/97) was later invalidated by the review committee due to a $PM_{2.5}/PM_{10}$ ratio greater than unity.

4.3 Temporal Variations in $PM_{2.5}$ Chemical Composition

Tables 4-2 and 4-3 summarize the mass and chemical composition measurements for all of the chemically speciated samples, with Table 4-2 showing a summary for all the sites and Table 4-3 showing a summary for each site. Since the selected subset represented mostly high PM concentration days, the average mass values are generally higher than the averages for the entire set of mass measurements. Average $PM_{2.5}$ mass concentrations for the speciated subset of samples are typically 21% higher than the average for the entire monitoring period.

Table 4-2. Statistical summary of $PM_{2.5}$ mass and chemical compositions acquired during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

Species	Average (µg/m³)	Number in Average	Minimum (µg/m³)	Date of Minimum	Site of Minimum	Maximum (µg/m³)	Date of Maximum	Site of Maximum
$PM_{2.5}$ Mass	17.5528 ± 8.7035	262	3.5157 ± 0.3901	09/13/97	CC	71.1677 ± 3.5737	12/18/97	EP
Chloride (Cl^-)	0.0838 ± 0.1815	260	0.0000 ± 0.0343	03/23/97	H7	1.6766 ± 0.1707	12/18/97	EP
Nonvolatilized Nitrate (NO_3^-)	0.5621 ± 1.0559	260	0.0000 ± 0.0394	09/01/97	HG	9.5136 ± 0.5633	12/18/97	EP
Sulfate ($SO_4^=$)	4.6772 ± 3.3726	260	0.5266 ± 0.0433	09/13/97	H7	13.4798 ± 0.8606	09/01/97	HC-CO-DON
Ammonium (NH_4^+)	1.5458 ± 1.1478	260	0.1075 ± 0.0268	07/27/97	HG	4.9449 ± 0.2713	03/23/97	H3
Soluble Sodium (Na^+)	0.1381 ± 0.1407	260	0.0000 ± 0.0340	08/26/97	SA	1.1815 ± 0.0606	10/19/97	HG
Soluble Potassium (K^+)	0.0753 ± 0.0791	259	0.0044 ± 0.0037	09/13/97	H7	0.9852 ± 0.0548	08/26/97	H7
Volatilized Nitrate (NO_3^-)	0.9233 ± 0.7357	30	0.0960 ± 0.0137	05/02/97	HC-CO-DON	3.4650 ± 0.2246	07/27/97	H3-CO-DON
Organic Carbon (OC)	3.3280 ± 2.3963	260	0.0000 ± 0.9338	06/21/97	H3	20.0523 ± 1.5146	12/18/97	EP
Elemental Carbon (EC)	1.5272 ± 1.0893	260	0.0638 ± 0.0395	09/13/97	H7	7.8712 ± 0.4769	12/18/97	EP
Sodium (Na)	0.0888 ± 0.0814	262	0.0000 ± 0.0959	03/23/97	HC-CO-DON	0.4874 ± 0.0397	05/02/97	HG
Magnesium (Mg)	0.0336 ± 0.0385	262	0.0000 ± 0.0436	03/23/97	H3	0.2336 ± 0.0267	06/20/97	HG
Aluminum (Al)	0.1674 ± 0.3404	262	0.0000 ± 0.0149	08/20/97	HG	1.7678 ± 0.0907	06/20/97	H7
Silicon (Si)	0.4500 ± 0.7909	262	0.0139 ± 0.0042	05/02/97	HG	3.9327 ± 0.1974	06/20/97	H7
Phosphorus (P)	0.0007 ± 0.0036	262	0.0000 ± 0.0154	03/11/97	HC-CO-DON	0.0490 ± 0.0056	08/20/97	H3
Sulfur (S)	1.7069 ± 1.1770	262	0.2272 ± 0.0118	02/04/98	EP	5.0226 ± 0.2515	03/23/97	H3
Chlorine (Cl)	0.0404 ± 0.1645	262	0.0000 ± 0.0675	03/23/97	HC-CO-DON	1.8412 ± 0.0937	12/18/97	EP
Potassium (K)	0.1143 ± 0.1065	262	0.0131 ± 0.0037	08/20/97	HG	0.9834 ± 0.0499	08/26/97	H7
Calcium (Ca)	0.2236 ± 0.4243	262	0.0118 ± 0.0071	08/20/97	HG	3.4673 ± 0.1738	01/29/98	EP
Titanium (Ti)	0.0138 ± 0.0255	262	0.0000 ± 0.0238	05/22/97	HT-CO-DON	0.1361 ± 0.0182	06/20/97	H7
Vanadium (V)	0.0034 ± 0.0037	262	0.0000 ± 0.0122	05/22/97	HT-CO-DON	0.0305 ± 0.0079	02/04/98	CC
Chromium (Cr)	0.0013 ± 0.0024	262	0.0000 ± 0.0020	03/23/97	DA	0.0261 ± 0.0024	12/18/97	HM
Manganese (Mn)	0.0051 ± 0.0058	262	0.0000 ± 0.0018	05/02/97	HT	0.0363 ± 0.0024	12/18/97	EP
Iron (Fe)	0.1711 ± 0.2432	262	0.0061 ± 0.0011	05/02/97	HG	1.3758 ± 0.0689	06/20/97	H7
Cobalt (Co)	0.0003 ± 0.0013	262	0.0000 ± 0.0032	03/11/97	HC-CO-DON	0.0149 ± 0.0021	12/18/97	HM
Nickel (Ni)	0.0014 ± 0.0013	262	0.0000 ± 0.0013	03/23/97	SA	0.0088 ± 0.0010	12/18/97	HC
Copper (Cu)	0.0138 ± 0.0231	262	0.0000 ± 0.0010	05/02/97	HT	0.1803 ± 0.0091	12/18/97	EP
Zinc (Zn)	0.0216 ± 0.0241	262	0.0000 ± 0.0012	08/20/97	HG	0.1926 ± 0.0097	12/18/97	HC
Gallium (Ga)	0.0002 ± 0.0003	262	0.0000 ± 0.0018	03/23/97	HC-CO-DON	0.0012 ± 0.0017	04/10/97	HC
Arsenic (As)	0.0024 ± 0.0067	262	0.0000 ± 0.0023	03/23/97	HC-CO-DON	0.0714 ± 0.0064	12/18/97	EP
Selenium (Se)	0.0014 ± 0.0045	262	0.0000 ± 0.0012	06/22/97	HT	0.0679 ± 0.0036	03/04/98	EP
Bromine (Br)	0.0048 ± 0.0045	262	0.0008 ± 0.0007	06/06/97	DA	0.0486 ± 0.0026	12/18/97	CC
Rubidium (Rb)	0.0003 ± 0.0004	262	0.0000 ± 0.0010	03/11/97	HC-CO-DON	0.0022 ± 0.0007	06/20/97	H7
Strontium (Sr)	0.0014 ± 0.0019	262	0.0000 ± 0.0010	03/23/97	HM	0.0116 ± 0.0009	01/29/98	EP
Yttrium (Y)	0.0001 ± 0.0002	262	0.0000 ± 0.0013	03/23/97	HC-CO-DON	0.0012 ± 0.0009	06/20/97	HC
Zirconium (Zr)	0.0008 ± 0.0013	262	0.0000 ± 0.0016	03/23/97	HT	0.0165 ± 0.0013	03/23/97	HB
Molybdenum (Mo)	0.0004 ± 0.0006	262	0.0000 ± 0.0025	03/23/97	HB	0.0047 ± 0.0021	08/20/97	HM
Palladium (Pd)	0.0008 ± 0.0013	262	0.0000 ± 0.0076	03/23/97	CC	0.0060 ± 0.0082	06/06/97	HB
Silver (Ag)	0.0011 ± 0.0015	262	0.0000 ± 0.0095	03/23/97	H3	0.0076 ± 0.0070	12/18/97	HC
Cadmium (Cd)	0.0012 ± 0.0018	262	0.0000 ± 0.0097	03/23/97	CC	0.0156 ± 0.0069	05/02/97	HG
Indium (In)	0.0008 ± 0.0013	262	0.0000 ± 0.0101	03/23/97	HB	0.0079 ± 0.0113	02/07/98	H3-CO-DOFF
Tin (Sn)	0.0018 ± 0.0025	262	0.0000 ± 0.0139	03/11/97	HC-CO-DON	0.0110 ± 0.0101	01/29/98	EP
Antimony (Sb)	0.0028 ± 0.0036	262	0.0000 ± 0.0173	03/23/97	HC-CO-DON	0.0236 ± 0.0124	12/18/97	EP
Barium (Ba)	0.0079 ± 0.0155	262	0.0000 ± 0.0594	03/11/97	HC-CO-DON	0.1041 ± 0.0419	02/04/98	HG
Lanthanum (La)	0.0053 ± 0.0097	262	0.0000 ± 0.0792	03/11/97	HC-CO-DON	0.0552 ± 0.0942	09/07/97	HT
Gold (Au)	0.0002 ± 0.0005	262	0.0000 ± 0.0030	03/23/97	HC-CO-DON	0.0023 ± 0.0032	08/27/97	HM
Mercury (Hg)	0.0002 ± 0.0003	262	0.0000 ± 0.0025	03/23/97	H3	0.0012 ± 0.0027	07/03/97	H3
Thallium (Tl)	0.0001 ± 0.0002	262	0.0000 ± 0.0021	03/11/97	HC-CO-DON	0.0014 ± 0.0026	04/10/97	HC-CO-DOFF
Lead (Pb)	0.0061 ± 0.0131	262	0.0000 ± 0.0038	05/02/97	HB	0.1380 ± 0.0075	11/24/97	EP
Uranium (U)	0.0001 ± 0.0002	262	0.0000 ± 0.0023	03/23/97	HC-CO-DON	0.0012 ± 0.0024	06/06/97	HT-CO-DOFF
Sum of Species	13.0091 ± 6.7032	261	1.1063 ± 0.4585	09/13/97	H7	53.8706 ± 1.7280	12/18/97	EP

Table 4-3a. Statistical summary of $PM_{2.5}$ mass and chemical compositions acquired at the CC site during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

Site Code	Average (µg/m³)	Number in Average	Minimum (µg/m³)	Date of Minimum	Maximum (µg/m³)	Date of Maximum
$PM_{2.5}$ Mass	13.5073 ± 6.0022	17	3.5157 ± 0.3901	09/13/97	23.7241 ± 1.2341	06/20/97
Chloride (Cl^-)	0.1036 ± 0.1772	17	0.0032 ± 0.0285	11/06/97	0.7222 ± 0.0470	06/20/97
Nonvolatilized Nitrate (NO_3^-)	0.4415 ± 0.6342	17	0.0604 ± 0.0397	09/01/97	2.7594 ± 0.2939	02/07/98
Sulfate ($SO_4^=$)	4.5583 ± 2.8758	17	1.6083 ± 0.1007	08/20/97	10.6936 ± 0.7224	09/07/97
Ammonium (NH_4^+)	1.6145 ± 1.0115	17	0.4915 ± 0.0370	08/20/97	3.6501 ± 0.1933	09/07/97
Soluble Sodium (Na^+)	0.1437 ± 0.1501	17	0.0060 ± 0.0332	12/18/97	0.5642 ± 0.0353	06/20/97
Soluble Potassium (K^+)	0.0560 ± 0.0625	17	0.0134 ± 0.0048	09/13/97	0.2903 ± 0.0189	05/02/97
Volatilized Nitrate (NO_3^-)	N/A ± N/A	N/A	N/A ± N/A		N/A ± N/A	
Organic Carbon (OC)	1.5898 ± 1.1468	17	0.0000 ± 0.5638	08/20/97	4.7468 ± 0.9509	05/02/97
Elemental Carbon (EC)	1.1258 ± 0.4408	17	0.6691 ± 0.1020	09/13/97	2.5422 ± 0.1600	12/18/97
Sodium (Na)	0.1132 ± 0.0871	17	0.0000 ± 0.0597	03/23/97	0.3101 ± 0.0505	07/03/97
Magnesium (Mg)	0.0355 ± 0.0497	17	0.0000 ± 0.0260	03/23/97	0.2182 ± 0.0260	06/20/97
Aluminum (Al)	0.1632 ± 0.3706	17	0.0039 ± 0.0142	09/13/97	1.4496 ± 0.0750	06/20/97
Silicon (Si)	0.4008 ± 0.8504	17	0.0305 ± 0.0051	09/13/97	3.3625 ± 0.1689	06/20/97
Phosphorus (P)	0.0006 ± 0.0012	17	0.0000 ± 0.0105	03/23/97	0.0032 ± 0.0100	12/18/97
Sulfur (S)	1.6372 ± 1.0149	17	0.6059 ± 0.0307	08/20/97	3.7340 ± 0.1870	08/27/97
Chlorine (Cl)	0.0412 ± 0.1080	17	0.0000 ± 0.0208	03/23/97	0.4411 ± 0.0240	06/20/97
Potassium (K)	0.0889 ± 0.1097	17	0.0141 ± 0.0036	09/13/97	0.3782 ± 0.0198	06/20/97
Calcium (Ca)	0.0984 ± 0.0760	17	0.0320 ± 0.0073	09/13/97	0.3300 ± 0.0173	06/20/97
Titanium (Ti)	0.0133 ± 0.0280	17	0.0000 ± 0.0251	09/01/97	0.1111 ± 0.0176	06/20/97
Vanadium (V)	0.0069 ± 0.0078	17	0.0000 ± 0.0131	09/01/97	0.0305 ± 0.0079	02/04/98
Chromium (Cr)	0.0019 ± 0.0025	17	0.0000 ± 0.0023	09/07/97	0.0110 ± 0.0020	09/13/97
Manganese (Mn)	0.0039 ± 0.0048	17	0.0005 ± 0.0022	09/01/97	0.0172 ± 0.0017	06/20/97
Iron (Fe)	0.1279 ± 0.2503	17	0.0109 ± 0.0014	09/13/97	1.0047 ± 0.0504	06/20/97
Cobalt (Co)	0.0001 ± 0.0001	17	0.0000 ± 0.0161	06/20/97	0.0005 ± 0.0014	06/06/97
Nickel (Ni)	0.0019 ± 0.0016	17	0.0003 ± 0.0010	10/19/97	0.0063 ± 0.0009	02/04/98
Copper (Cu)	0.0183 ± 0.0276	17	0.0006 ± 0.0011	11/06/97	0.1094 ± 0.0056	10/19/97
Zinc (Zn)	0.0116 ± 0.0158	17	0.0018 ± 0.0009	09/13/97	0.0729 ± 0.0038	02/04/98
Gallium (Ga)	0.0003 ± 0.0003	17	0.0000 ± 0.0018	05/04/97	0.0010 ± 0.0018	09/07/97
Arsenic (As)	0.0004 ± 0.0004	17	0.0000 ± 0.0021	05/02/97	0.0015 ± 0.0021	05/04/97
Selenium (Se)	0.0010 ± 0.0006	17	0.0001 ± 0.0010	08/20/97	0.0020 ± 0.0009	11/24/97
Bromine (Br)	0.0059 ± 0.0109	17	0.0010 ± 0.0008	09/13/97	0.0486 ± 0.0026	12/18/97
Rubidium (Rb)	0.0003 ± 0.0004	17	0.0000 ± 0.0009	03/23/97	0.0015 ± 0.0007	06/20/97
Strontium (Sr)	0.0009 ± 0.0014	17	0.0000 ± 0.0011	09/01/97	0.0057 ± 0.0008	06/20/97
Yttrium (Y)	0.0001 ± 0.0002	17	0.0000 ± 0.0013	03/23/97	0.0006 ± 0.0013	06/20/97
Zirconium (Zr)	0.0006 ± 0.0008	17	0.0000 ± 0.0014	05/04/97	0.0032 ± 0.0011	06/20/97
Molybdenum (Mo)	0.0003 ± 0.0004	17	0.0000 ± 0.0027	03/23/97	0.0011 ± 0.0025	05/02/97
Palladium (Pd)	0.0008 ± 0.0013	17	0.0000 ± 0.0076	03/23/97	0.0044 ± 0.0073	05/02/97
Silver (Ag)	0.0015 ± 0.0018	17	0.0000 ± 0.0092	03/23/97	0.0059 ± 0.0087	10/19/97
Cadmium (Cd)	0.0009 ± 0.0013	17	0.0000 ± 0.0097	03/23/97	0.0044 ± 0.0093	02/04/98
Indium (In)	0.0007 ± 0.0014	17	0.0000 ± 0.0114	03/23/97	0.0052 ± 0.0107	02/04/98
Tin (Sn)	0.0010 ± 0.0012	17	0.0000 ± 0.0146	03/23/97	0.0034 ± 0.0138	10/19/97
Antimony (Sb)	0.0016 ± 0.0022	17	0.0000 ± 0.0163	05/04/97	0.0065 ± 0.0162	05/02/97
Barium (Ba)	0.0017 ± 0.0038	17	0.0000 ± 0.0605	05/02/97	0.0150 ± 0.0637	06/06/97
Lanthanum (La)	0.0064 ± 0.0083	17	0.0000 ± 0.0808	05/02/97	0.0277 ± 0.0884	09/01/97
Gold (Au)	0.0004 ± 0.0004	17	0.0000 ± 0.0031	06/06/97	0.0015 ± 0.0031	03/23/97
Mercury (Hg)	0.0002 ± 0.0002	17	0.0000 ± 0.0022	05/02/97	0.0008 ± 0.0027	09/01/97
Thallium (Tl)	0.0001 ± 0.0001	17	0.0000 ± 0.0023	03/23/97	0.0004 ± 0.0024	06/06/97
Lead (Pb)	0.0025 ± 0.0019	17	0.0000 ± 0.0034	09/01/97	0.0064 ± 0.0022	02/04/98
Uranium (U)	0.0001 ± 0.0002	17	0.0000 ± 0.0023	03/23/97	0.0005 ± 0.0023	06/20/97
Sum of Species	10.4801 ± 4.4030	17	3.5291 ± 0.5908	09/13/97	16.9658 ± 0.9687	09/07/97

Table 4-3b. Statistical summary of $PM_{2.5}$ mass and chemical compositions acquired at the DA site during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

Site Code	Average (µg/m³)	Number in Average	Minimum (µg/m³)	Date of Minimum	Maximum (µg/m³)	Date of Maximum
$PM_{2.5}$ Mass	18.3333 ± 7.5693	18	7.3412 ± 0.4814	05/04/97	32.9229 ± 1.6772	09/01/97
Chloride (Cl^-)	0.0297 ± 0.0278	18	0.0000 ± 0.0270	10/19/97	0.1014 ± 0.0482	09/01/97
Nonvolatilized Nitrate (NO_3^-)	1.2104 ± 2.2269	18	0.0751 ± 0.0271	06/06/97	8.7226 ± 0.7045	01/23/98
Sulfate ($SO_4^=$)	4.4600 ± 3.1277	18	0.9893 ± 0.0690	12/18/97	12.6782 ± 0.8055	09/01/97
Ammonium (NH_4^+)	1.7928 ± 1.2249	18	0.4012 ± 0.0334	12/18/97	4.4427 ± 0.2342	09/01/97
Soluble Sodium (Na^+)	0.1486 ± 0.1206	18	0.0104 ± 0.0067	02/07/98	0.4076 ± 0.0378	08/26/97
Soluble Potassium (K^+)	0.0590 ± 0.0288	18	0.0183 ± 0.0060	06/06/97	0.1328 ± 0.0085	08/27/97
Volatilized Nitrate (NO_3^-)	N/A ± N/A	N/A	N/A ± N/A		N/A ± N/A	
Organic Carbon (OC)	4.6308 ± 1.9202	18	1.0388 ± 0.5674	11/06/97	7.8558 ± 0.7694	08/27/97
Elemental Carbon (EC)	1.8175 ± 0.6323	18	0.6115 ± 0.1112	07/27/97	2.8484 ± 0.1792	12/18/97
Sodium (Na)	0.1262 ± 0.0994	18	0.0000 ± 0.0650	01/23/98	0.3378 ± 0.0518	08/26/97
Magnesium (Mg)	0.0241 ± 0.0270	18	0.0000 ± 0.0255	05/04/97	0.1119 ± 0.0200	06/20/97
Aluminum (Al)	0.1095 ± 0.2191	18	0.0111 ± 0.0057	02/07/98	0.9919 ± 0.0519	06/20/97
Silicon (Si)	0.3087 ± 0.4712	18	0.0398 ± 0.0050	06/06/97	2.1600 ± 0.1088	06/20/97
Phosphorus (P)	0.0008 ± 0.0020	18	0.0000 ± 0.0079	03/23/97	0.0078 ± 0.0109	11/24/97
Sulfur (S)	1.7014 ± 1.0675	18	0.3916 ± 0.0201	12/18/97	4.2720 ± 0.2139	09/01/97
Chlorine (Cl)	0.0000 ± 0.0001	18	0.0000 ± 0.0127	03/23/97	0.0004 ± 0.0101	12/18/97
Potassium (K)	0.0868 ± 0.0537	18	0.0237 ± 0.0032	06/06/97	0.2631 ± 0.0139	06/20/97
Calcium (Ca)	0.1382 ± 0.0730	18	0.0217 ± 0.0033	06/06/97	0.2819 ± 0.0158	08/20/97
Titanium (Ti)	0.0101 ± 0.0155	18	0.0017 ± 0.0197	08/26/97	0.0705 ± 0.0154	06/20/97
Vanadium (V)	0.0014 ± 0.0011	18	0.0000 ± 0.0079	08/26/97	0.0041 ± 0.0081	06/20/97
Chromium (Cr)	0.0006 ± 0.0005	18	0.0000 ± 0.0020	03/23/97	0.0013 ± 0.0022	06/20/97
Manganese (Mn)	0.0034 ± 0.0022	18	0.0006 ± 0.0016	05/04/97	0.0105 ± 0.0014	06/20/97
Iron (Fe)	0.1404 ± 0.1346	18	0.0274 ± 0.0017	06/06/97	0.6455 ± 0.0324	06/20/97
Cobalt (Co)	0.0001 ± 0.0003	18	0.0000 ± 0.0014	03/23/97	0.0012 ± 0.0039	07/27/97
Nickel (Ni)	0.0007 ± 0.0005	18	0.0000 ± 0.0010	01/23/98	0.0020 ± 0.0008	08/20/97
Copper (Cu)	0.0049 ± 0.0024	18	0.0017 ± 0.0008	05/04/97	0.0094 ± 0.0010	08/27/97
Zinc (Zn)	0.0155 ± 0.0071	18	0.0059 ± 0.0008	06/20/97	0.0349 ± 0.0020	12/18/97
Gallium (Ga)	0.0002 ± 0.0002	18	0.0000 ± 0.0016	03/23/97	0.0005 ± 0.0016	08/20/97
Arsenic (As)	0.0005 ± 0.0004	18	0.0000 ± 0.0026	03/23/97	0.0018 ± 0.0036	12/18/97
Selenium (Se)	0.0012 ± 0.0006	18	0.0001 ± 0.0010	02/07/98	0.0027 ± 0.0008	11/24/97
Bromine (Br)	0.0038 ± 0.0017	18	0.0008 ± 0.0007	06/06/97	0.0072 ± 0.0009	08/27/97
Rubidium (Rb)	0.0002 ± 0.0003	18	0.0000 ± 0.0009	03/23/97	0.0012 ± 0.0006	06/20/97
Strontium (Sr)	0.0017 ± 0.0014	18	0.0001 ± 0.0008	06/06/97	0.0059 ± 0.0008	09/01/97
Yttrium (Y)	0.0001 ± 0.0001	18	0.0000 ± 0.0012	05/04/97	0.0004 ± 0.0011	08/26/97
Zirconium (Zr)	0.0006 ± 0.0004	18	0.0001 ± 0.0015	12/18/97	0.0021 ± 0.0010	06/20/97
Molybdenum (Mo)	0.0003 ± 0.0003	18	0.0000 ± 0.0024	08/27/97	0.0010 ± 0.0022	07/27/97
Palladium (Pd)	0.0003 ± 0.0005	18	0.0000 ± 0.0069	03/23/97	0.0017 ± 0.0075	01/23/98
Silver (Ag)	0.0007 ± 0.0013	18	0.0000 ± 0.0084	05/04/97	0.0039 ± 0.0082	02/04/98
Cadmium (Cd)	0.0011 ± 0.0010	18	0.0000 ± 0.0083	11/24/97	0.0034 ± 0.0092	01/23/98
Indium (In)	0.0009 ± 0.0016	18	0.0000 ± 0.0101	03/23/97	0.0056 ± 0.0098	11/06/97
Tin (Sn)	0.0018 ± 0.0024	18	0.0000 ± 0.0134	03/23/97	0.0083 ± 0.0129	09/01/97
Antimony (Sb)	0.0022 ± 0.0032	18	0.0000 ± 0.0158	05/04/97	0.0106 ± 0.0111	11/06/97
Barium (Ba)	0.0039 ± 0.0061	18	0.0000 ± 0.0579	03/23/97	0.0222 ± 0.0537	08/26/97
Lanthanum (La)	0.0039 ± 0.0065	18	0.0000 ± 0.0778	03/23/97	0.0236 ± 0.0719	08/27/97
Gold (Au)	0.0002 ± 0.0003	18	0.0000 ± 0.0029	03/23/97	0.0009 ± 0.0024	06/06/97
Mercury (Hg)	0.0002 ± 0.0003	18	0.0000 ± 0.0022	03/23/97	0.0009 ± 0.0021	08/26/97
Thallium (Tl)	0.0001 ± 0.0003	18	0.0000 ± 0.0022	05/04/97	0.0008 ± 0.0022	03/23/97
Lead (Pb)	0.0065 ± 0.0032	18	0.0021 ± 0.0020	11/06/97	0.0157 ± 0.0025	12/18/97
Uranium (U)	0.0001 ± 0.0001	18	0.0000 ± 0.0021	03/23/97	0.0005 ± 0.0021	11/24/97
Sum of Species	14.9117 ± 6.3138	18	5.9913 ± 0.6155	11/06/97	27.9341 ± 1.1649	09/01/97

Table 4-3c. Statistical summary of $PM_{2.5}$ mass and chemical compositions acquired at the SA site during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

Site Code	Average (µg/m³)	Number in Average	Minimum (µg/m³)	Date of Minimum	Maximum (µg/m³)	Date of Maximum
$PM_{2.5}$ Mass	12.7422 ± 5.5503	17	5.0918 ± 0.4319	09/13/97	21.7899 ± 1.1440	09/07/97
Chloride (Cl^-)	0.0379 ± 0.0305	17	0.0000 ± 0.0281	02/04/98	0.1360 ± 0.0524	07/03/97
Nonvolatilized Nitrate (NO_3^-)	0.2804 ± 0.2712	17	0.0365 ± 0.0384	08/26/97	0.9547 ± 0.0815	02/07/98
Sulfate ($SO_4^=$)	3.8099 ± 2.6848	17	0.5874 ± 0.0450	11/06/97	11.1533 ± 0.6690	09/07/97
Ammonium (NH_4^+)	1.3996 ± 0.9885	17	0.2120 ± 0.0287	11/06/97	3.9932 ± 0.2111	09/07/97
Soluble Sodium (Na^+)	0.0552 ± 0.0646	17	0.0000 ± 0.0340	08/26/97	0.2625 ± 0.0368	07/03/97
Soluble Potassium (K^+)	0.0443 ± 0.0230	17	0.0166 ± 0.0048	08/26/97	0.0965 ± 0.0072	12/18/97
Volatilized Nitrate (NO_3^-)	N/A ± N/A	N/A	N/A ± N/A		N/A ± N/A	
Organic Carbon (OC)	2.3616 ± 1.2919	17	0.7215 ± 0.6042	07/27/97	5.1738 ± 0.6924	12/18/97
Elemental Carbon (EC)	1.2446 ± 0.7339	17	0.4804 ± 0.1071	07/27/97	3.7500 ± 0.2315	12/18/97
Sodium (Na)	0.0618 ± 0.0611	17	0.0005 ± 0.0605	02/07/98	0.2531 ± 0.0451	07/03/97
Magnesium (Mg)	0.0260 ± 0.0221	17	0.0000 ± 0.0235	03/23/97	0.0902 ± 0.0191	07/03/97
Aluminum (Al)	0.0773 ± 0.1775	17	0.0114 ± 0.0074	09/13/97	0.7844 ± 0.0421	07/03/97
Silicon (Si)	0.1989 ± 0.4130	17	0.0354 ± 0.0057	09/13/97	1.8411 ± 0.0930	07/03/97
Phosphorus (P)	0.0010 ± 0.0022	17	0.0000 ± 0.0094	03/23/97	0.0079 ± 0.0090	08/20/97
Sulfur (S)	1.5232 ± 1.0117	17	0.2471 ± 0.0128	11/06/97	3.7747 ± 0.1891	09/07/97
Chlorine (Cl)	0.0029 ± 0.0093	17	0.0000 ± 0.0173	03/23/97	0.0395 ± 0.0067	07/03/97
Potassium (K)	0.0651 ± 0.0402	17	0.0215 ± 0.0040	09/13/97	0.1907 ± 0.0106	07/03/97
Calcium (Ca)	0.1063 ± 0.1061	17	0.0340 ± 0.0074	09/13/97	0.4074 ± 0.0218	12/18/97
Titanium (Ti)	0.0060 ± 0.0131	17	0.0000 ± 0.0214	05/04/97	0.0576 ± 0.0170	07/03/97
Vanadium (V)	0.0017 ± 0.0013	17	0.0000 ± 0.0084	05/04/97	0.0042 ± 0.0091	07/03/97
Chromium (Cr)	0.0002 ± 0.0004	17	0.0000 ± 0.0024	03/23/97	0.0014 ± 0.0025	07/03/97
Manganese (Mn)	0.0023 ± 0.0023	17	0.0005 ± 0.0019	03/23/97	0.0099 ± 0.0015	07/03/97
Iron (Fe)	0.0808 ± 0.1210	17	0.0188 ± 0.0016	09/13/97	0.5469 ± 0.0275	07/03/97
Cobalt (Co)	0.0001 ± 0.0002	17	0.0000 ± 0.0016	03/23/97	0.0008 ± 0.0013	02/07/98
Nickel (Ni)	0.0005 ± 0.0004	17	0.0000 ± 0.0013	03/23/97	0.0014 ± 0.0008	12/18/97
Copper (Cu)	0.0029 ± 0.0020	17	0.0001 ± 0.0013	09/13/97	0.0072 ± 0.0010	12/18/97
Zinc (Zn)	0.0100 ± 0.0069	17	0.0018 ± 0.0009	09/13/97	0.0244 ± 0.0015	06/06/97
Gallium (Ga)	0.0001 ± 0.0002	17	0.0000 ± 0.0020	03/23/97	0.0008 ± 0.0017	05/04/97
Arsenic (As)	0.0005 ± 0.0003	17	0.0000 ± 0.0021	09/01/97	0.0010 ± 0.0025	08/26/97
Selenium (Se)	0.0008 ± 0.0006	17	0.0000 ± 0.0010	07/27/97	0.0019 ± 0.0009	11/24/97
Bromine (Br)	0.0031 ± 0.0019	17	0.0008 ± 0.0007	07/27/97	0.0093 ± 0.0010	11/24/97
Rubidium (Rb)	0.0001 ± 0.0002	17	0.0000 ± 0.0009	05/04/97	0.0007 ± 0.0007	07/03/97
Strontium (Sr)	0.0009 ± 0.0013	17	0.0000 ± 0.0010	08/27/97	0.0052 ± 0.0008	12/18/97
Yttrium (Y)	0.0001 ± 0.0001	17	0.0000 ± 0.0016	03/23/97	0.0004 ± 0.0013	07/03/97
Zirconium (Zr)	0.0006 ± 0.0004	17	0.0000 ± 0.0017	08/26/97	0.0019 ± 0.0011	07/03/97
Molybdenum (Mo)	0.0002 ± 0.0004	17	0.0000 ± 0.0033	03/23/97	0.0013 ± 0.0026	02/07/98
Palladium (Pd)	0.0007 ± 0.0014	17	0.0000 ± 0.0086	03/23/97	0.0057 ± 0.0055	06/06/97
Silver (Ag)	0.0009 ± 0.0012	17	0.0000 ± 0.0100	03/23/97	0.0031 ± 0.0086	10/19/97
Cadmium (Cd)	0.0012 ± 0.0016	17	0.0000 ± 0.0088	05/04/97	0.0057 ± 0.0091	10/19/97
Indium (In)	0.0008 ± 0.0010	17	0.0000 ± 0.0122	03/23/97	0.0030 ± 0.0112	09/13/97
Tin (Sn)	0.0013 ± 0.0018	17	0.0000 ± 0.0160	03/23/97	0.0052 ± 0.0128	07/27/97
Antimony (Sb)	0.0030 ± 0.0024	17	0.0000 ± 0.0165	06/06/97	0.0096 ± 0.0192	03/23/97
Barium (Ba)	0.0062 ± 0.0085	17	0.0000 ± 0.0705	03/23/97	0.0256 ± 0.0560	02/07/98
Lanthanum (La)	0.0075 ± 0.0121	17	0.0000 ± 0.0937	03/23/97	0.0445 ± 0.0838	02/07/98
Gold (Au)	0.0003 ± 0.0005	17	0.0000 ± 0.0036	03/23/97	0.0018 ± 0.0029	12/18/97
Mercury (Hg)	0.0003 ± 0.0003	17	0.0000 ± 0.0023	08/20/97	0.0011 ± 0.0024	06/06/97
Thallium (Tl)	0.0001 ± 0.0003	17	0.0000 ± 0.0023	06/06/97	0.0009 ± 0.0028	03/23/97
Lead (Pb)	0.0030 ± 0.0024	17	0.0000 ± 0.0032	09/13/97	0.0085 ± 0.0023	12/18/97
Uranium (U)	0.0001 ± 0.0002	17	0.0000 ± 0.0022	07/03/97	0.0005 ± 0.0022	06/06/97
Sum of Species	9.7388 ± 4.2326	17	3.8731 ± 0.6303	07/27/97	19.3446 ± 0.9546	09/07/97

Table 4-3d. Statistical summary of $PM_{2.5}$ mass and chemical compositions acquired at the EP site during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

Site Code	Average (µg/m³)	Number in Average	Minimum (µg/m³)	Date of Minimum	Maximum (µg/m³)	Date of Maximum
$PM_{2.5}$ Mass	22.4836 ± 14.9745	17	9.2312 ± 0.5311	02/04/98	71.1677 ± 3.5737	12/18/97
Chloride (Cl^-)	0.2852 ± 0.4308	17	0.0181 ± 0.0265	02/04/98	1.6766 ± 0.1707	12/18/97
Nonvolatilized Nitrate (NO_3^-)	1.0970 ± 2.1749	17	0.1406 ± 0.0276	02/04/98	9.5136 ± 0.5633	12/18/97
Sulfate ($SO_4^=$)	1.6731 ± 0.7083	17	0.5390 ± 0.0417	02/04/98	3.2289 ± 0.2092	12/18/97
Ammonium (NH_4^+)	0.8841 ± 0.8889	17	0.1840 ± 0.0269	02/04/98	4.1204 ± 0.2176	12/18/97
Soluble Sodium (Na^+)	0.0812 ± 0.0363	17	0.0200 ± 0.0346	09/13/97	0.1499 ± 0.0343	12/18/97
Soluble Potassium (K^+)	0.0842 ± 0.0534	17	0.0251 ± 0.0028	02/04/98	0.2427 ± 0.0142	12/18/97
Volatilized Nitrate (NO_3^-)	N/A ± N/A	N/A	N/A ± N/A		N/A ± N/A	
Organic Carbon (OC)	5.6671 ± 4.6086	17	1.6525 ± 0.6129	07/27/97	20.0523 ± 1.5146	12/18/97
Elemental Carbon (EC)	3.1851 ± 2.3490	17	0.7634 ± 0.1283	02/04/98	7.8712 ± 0.4769	12/18/97
Sodium (Na)	0.0177 ± 0.0246	17	0.0000 ± 0.1003	11/18/97	0.0906 ± 0.0398	07/03/97
Magnesium (Mg)	0.0529 ± 0.0249	17	0.0136 ± 0.0438	12/04/97	0.1004 ± 0.0166	10/19/97
Aluminum (Al)	0.2434 ± 0.1107	17	0.0685 ± 0.0097	11/18/97	0.4307 ± 0.0248	01/29/98
Silicon (Si)	0.9280 ± 0.4235	17	0.3189 ± 0.0176	11/18/97	1.8010 ± 0.0909	01/29/98
Phosphorus (P)	0.0001 ± 0.0004	17	0.0000 ± 0.0089	05/04/97	0.0018 ± 0.0072	02/20/98
Sulfur (S)	0.5944 ± 0.2198	17	0.2272 ± 0.0118	02/04/98	1.0649 ± 0.0538	12/18/97
Chlorine (Cl)	0.3619 ± 0.5113	17	0.0000 ± 0.0130	07/03/97	1.8412 ± 0.0937	12/18/97
Potassium (K)	0.1914 ± 0.0894	17	0.0781 ± 0.0055	01/13/98	0.4489 ± 0.0244	12/18/97
Calcium (Ca)	1.4074 ± 0.8784	17	0.5460 ± 0.0285	11/18/97	3.4673 ± 0.1738	01/29/98
Titanium (Ti)	0.0199 ± 0.0101	17	0.0069 ± 0.0236	07/27/97	0.0444 ± 0.0174	01/29/98
Vanadium (V)	0.0027 ± 0.0038	17	0.0000 ± 0.0137	07/03/97	0.0154 ± 0.0069	12/18/97
Chromium (Cr)	0.0008 ± 0.0006	17	0.0000 ± 0.0044	07/03/97	0.0020 ± 0.0021	01/29/98
Manganese (Mn)	0.0088 ± 0.0075	17	0.0034 ± 0.0013	07/27/97	0.0363 ± 0.0024	12/18/97
Iron (Fe)	0.3240 ± 0.1703	17	0.1412 ± 0.0075	01/13/98	0.8018 ± 0.0402	12/18/97
Cobalt (Co)	0.0005 ± 0.0008	17	0.0000 ± 0.0052	07/03/97	0.0024 ± 0.0064	03/04/98
Nickel (Ni)	0.0007 ± 0.0008	17	0.0000 ± 0.0012	07/03/97	0.0033 ± 0.0009	12/18/97
Copper (Cu)	0.0608 ± 0.0479	17	0.0097 ± 0.0011	09/13/97	0.1803 ± 0.0091	12/18/97
Zinc (Zn)	0.0642 ± 0.0383	17	0.0137 ± 0.0012	07/03/97	0.1524 ± 0.0077	12/18/97
Gallium (Ga)	0.0001 ± 0.0001	17	0.0000 ± 0.0021	07/03/97	0.0005 ± 0.0017	09/13/97
Arsenic (As)	0.0193 ± 0.0192	17	0.0013 ± 0.0029	08/26/97	0.0714 ± 0.0064	12/18/97
Selenium (Se)	0.0083 ± 0.0158	17	0.0001 ± 0.0013	07/03/97	0.0679 ± 0.0036	03/04/98
Bromine (Br)	0.0085 ± 0.0074	17	0.0018 ± 0.0007	02/04/98	0.0261 ± 0.0016	12/04/97
Rubidium (Rb)	0.0007 ± 0.0005	17	0.0000 ± 0.0009	01/13/98	0.0019 ± 0.0007	01/29/98
Strontium (Sr)	0.0051 ± 0.0027	17	0.0021 ± 0.0008	11/18/97	0.0116 ± 0.0009	01/29/98
Yttrium (Y)	0.0002 ± 0.0002	17	0.0000 ± 0.0012	08/26/97	0.0006 ± 0.0017	11/24/97
Zirconium (Zr)	0.0013 ± 0.0006	17	0.0004 ± 0.0015	11/18/97	0.0027 ± 0.0011	12/18/97
Molybdenum (Mo)	0.0008 ± 0.0008	17	0.0000 ± 0.0031	07/03/97	0.0028 ± 0.0019	01/29/98
Palladium (Pd)	0.0008 ± 0.0011	17	0.0000 ± 0.0084	07/03/97	0.0030 ± 0.0077	03/04/98
Silver (Ag)	0.0011 ± 0.0014	17	0.0000 ± 0.0085	05/04/97	0.0043 ± 0.0081	10/19/97
Cadmium (Cd)	0.0019 ± 0.0016	17	0.0000 ± 0.0100	07/03/97	0.0052 ± 0.0093	11/24/97
Indium (In)	0.0006 ± 0.0009	17	0.0000 ± 0.0117	07/03/97	0.0032 ± 0.0103	01/24/98
Tin (Sn)	0.0032 ± 0.0031	17	0.0000 ± 0.0136	05/04/97	0.0110 ± 0.0101	01/29/98
Antimony (Sb)	0.0082 ± 0.0061	17	0.0000 ± 0.0162	11/06/97	0.0236 ± 0.0124	12/18/97
Barium (Ba)	0.0087 ± 0.0095	17	0.0000 ± 0.0601	11/18/97	0.0278 ± 0.0562	07/27/97
Lanthanum (La)	0.0077 ± 0.0125	17	0.0000 ± 0.0776	05/04/97	0.0523 ± 0.0891	07/03/97
Gold (Au)	0.0001 ± 0.0004	17	0.0000 ± 0.0033	07/03/97	0.0015 ± 0.0029	05/04/97
Mercury (Hg)	0.0001 ± 0.0002	17	0.0000 ± 0.0023	05/04/97	0.0006 ± 0.0023	09/13/97
Thallium (Tl)	0.0001 ± 0.0002	17	0.0000 ± 0.0022	05/04/97	0.0007 ± 0.0029	03/04/98
Lead (Pb)	0.0366 ± 0.0364	17	0.0011 ± 0.0036	07/03/97	0.1380 ± 0.0075	11/24/97
Uranium (U)	0.0001 ± 0.0002	17	0.0000 ± 0.0021	05/04/97	0.0008 ± 0.0022	03/04/98
Sum of Species	16.3157 ± 11.6499	17	5.6422 ± 0.6144	02/04/98	53.8706 ± 1.7280	12/18/97

Table 4-3e. Statistical summary of $PM_{2.5}$ mass and chemical compositions acquired at the H3 site during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

Site Code	Average (µg/m³)	Number in Average	Minimum (µg/m³)	Date of Minimum	Maximum (µg/m³)	Date of Maximum
$PM_{2.5}$ Mass	19.1180 ± 7.6475	20	7.9045 ± 0.5056	11/06/97	38.7876 ± 1.9741	08/26/97
Chloride (Cl^-)	0.0696 ± 0.0583	20	0.0000 ± 0.0298	02/04/98	0.2644 ± 0.0568	11/24/97
Nonvolatilized Nitrate (NO_3^-)	0.8220 ± 0.9463	20	0.1269 ± 0.0284	07/27/97	3.3814 ± 0.2223	12/18/97
Sulfate ($SO_4^=$)	5.3129 ± 3.4725	20	1.4924 ± 0.0877	11/06/97	13.3943 ± 0.7035	03/23/97
Ammonium (NH_4^+)	1.8658 ± 1.2340	20	0.2294 ± 0.0290	06/21/97	4.9449 ± 0.2713	03/23/97
Soluble Sodium (Na^+)	0.1825 ± 0.1225	20	0.0101 ± 0.0073	02/07/98	0.4565 ± 0.0328	01/23/98
Soluble Potassium (K^+)	0.0818 ± 0.0684	20	0.0284 ± 0.0051	08/20/97	0.3532 ± 0.0201	08/26/97
Volatilized Nitrate (NO_3^-)	N/A ± N/A	N/A	N/A ± N/A		N/A ± N/A	
Organic Carbon (OC)	3.1139 ± 1.9824	20	0.0000 ± 0.9338	06/21/97	8.3166 ± 0.8390	08/26/97
Elemental Carbon (EC)	1.5754 ± 0.6093	20	0.5429 ± 0.1311	06/21/97	3.0626 ± 0.1915	08/26/97
Sodium (Na)	0.0789 ± 0.0564	20	0.0000 ± 0.1059	12/18/97	0.1824 ± 0.0477	11/24/97
Magnesium (Mg)	0.0288 ± 0.0344	20	0.0000 ± 0.0436	03/23/97	0.1419 ± 0.0229	07/03/97
Aluminum (Al)	0.2068 ± 0.3427	20	0.0069 ± 0.0196	03/06/98	1.2142 ± 0.0632	06/21/97
Silicon (Si)	0.5719 ± 0.8218	20	0.0673 ± 0.0062	01/23/98	2.9380 ± 0.1478	07/03/97
Phosphorus (P)	0.0030 ± 0.0106	20	0.0000 ± 0.0199	03/23/97	0.0490 ± 0.0056	08/20/97
Sulfur (S)	1.9242 ± 1.2629	20	0.5322 ± 0.0270	11/06/97	5.0226 ± 0.2515	03/23/97
Chlorine (Cl)	0.0138 ± 0.0247	20	0.0000 ± 0.0813	03/23/97	0.0841 ± 0.0092	12/18/97
Potassium (K)	0.1176 ± 0.0935	20	0.0280 ± 0.0042	08/20/97	0.4074 ± 0.0212	08/26/97
Calcium (Ca)	0.1785 ± 0.1080	20	0.0284 ± 0.0052	03/23/97	0.4146 ± 0.0223	08/20/97
Titanium (Ti)	0.0158 ± 0.0252	20	0.0000 ± 0.0283	12/18/97	0.0976 ± 0.0175	06/21/97
Vanadium (V)	0.0057 ± 0.0043	20	0.0011 ± 0.0099	01/23/98	0.0202 ± 0.0079	07/03/97
Chromium (Cr)	0.0011 ± 0.0010	20	0.0000 ± 0.0026	09/13/97	0.0031 ± 0.0019	08/26/97
Manganese (Mn)	0.0081 ± 0.0065	20	0.0015 ± 0.0013	11/06/97	0.0239 ± 0.0019	06/21/97
Iron (Fe)	0.2225 ± 0.2556	20	0.0685 ± 0.0043	03/12/98	1.0160 ± 0.0509	07/03/97
Cobalt (Co)	0.0002 ± 0.0003	20	0.0000 ± 0.0143	06/21/97	0.0011 ± 0.0023	01/17/98
Nickel (Ni)	0.0025 ± 0.0016	20	0.0000 ± 0.0011	11/06/97	0.0080 ± 0.0010	07/03/97
Copper (Cu)	0.0295 ± 0.0242	20	0.0040 ± 0.0005	06/22/97	0.1220 ± 0.0062	10/19/97
Zinc (Zn)	0.0303 ± 0.0243	20	0.0078 ± 0.0009	11/06/97	0.1216 ± 0.0062	12/18/97
Gallium (Ga)	0.0002 ± 0.0003	20	0.0000 ± 0.0020	07/03/97	0.0011 ± 0.0017	06/21/97
Arsenic (As)	0.0012 ± 0.0008	20	0.0000 ± 0.0023	06/22/97	0.0027 ± 0.0016	10/19/97
Selenium (Se)	0.0010 ± 0.0007	20	0.0000 ± 0.0011	11/06/97	0.0025 ± 0.0008	03/06/98
Bromine (Br)	0.0055 ± 0.0031	20	0.0013 ± 0.0009	07/03/97	0.0123 ± 0.0011	12/18/97
Rubidium (Rb)	0.0003 ± 0.0004	20	0.0000 ± 0.0011	08/20/97	0.0014 ± 0.0006	06/21/97
Strontium (Sr)	0.0020 ± 0.0019	20	0.0001 ± 0.0010	11/06/97	0.0074 ± 0.0010	12/18/97
Yttrium (Y)	0.0002 ± 0.0002	20	0.0000 ± 0.0014	07/03/97	0.0005 ± 0.0012	02/07/98
Zirconium (Zr)	0.0007 ± 0.0008	20	0.0000 ± 0.0014	11/06/97	0.0030 ± 0.0010	06/21/97
Molybdenum (Mo)	0.0004 ± 0.0005	20	0.0000 ± 0.0030	08/20/97	0.0018 ± 0.0028	03/23/97
Palladium (Pd)	0.0009 ± 0.0012	20	0.0000 ± 0.0083	08/20/97	0.0037 ± 0.0078	03/06/98
Silver (Ag)	0.0012 ± 0.0018	20	0.0000 ± 0.0095	03/23/97	0.0064 ± 0.0097	02/04/98
Cadmium (Cd)	0.0011 ± 0.0016	20	0.0000 ± 0.0092	06/21/97	0.0051 ± 0.0091	09/01/97
Indium (In)	0.0012 ± 0.0017	20	0.0000 ± 0.0116	06/22/97	0.0061 ± 0.0120	07/03/97
Tin (Sn)	0.0020 ± 0.0022	20	0.0000 ± 0.0153	03/23/97	0.0077 ± 0.0157	11/24/97
Antimony (Sb)	0.0028 ± 0.0027	20	0.0000 ± 0.0177	03/23/97	0.0091 ± 0.0184	11/24/97
Barium (Ba)	0.0251 ± 0.0314	20	0.0000 ± 0.0660	08/20/97	0.1018 ± 0.0500	12/18/97
Lanthanum (La)	0.0054 ± 0.0099	20	0.0000 ± 0.0864	03/23/97	0.0342 ± 0.0870	07/03/97
Gold (Au)	0.0002 ± 0.0003	20	0.0000 ± 0.0034	03/23/97	0.0009 ± 0.0031	06/21/97
Mercury (Hg)	0.0001 ± 0.0003	20	0.0000 ± 0.0025	03/23/97	0.0012 ± 0.0027	07/03/97
Thallium (Tl)	0.0001 ± 0.0002	20	0.0000 ± 0.0021	06/21/97	0.0006 ± 0.0025	02/04/98
Lead (Pb)	0.0047 ± 0.0026	20	0.0009 ± 0.0033	09/13/97	0.0109 ± 0.0026	12/18/97
Uranium (U)	0.0001 ± 0.0002	20	0.0000 ± 0.0024	03/23/97	0.0007 ± 0.0022	09/01/97
Sum of Species	14.3358 ± 5.7282	20	6.2403 ± 0.6756	11/06/97	26.8675 ± 1.1259	08/26/97

Table 4-3f. Statistical summary of $PM_{2.5}$ mass and chemical compositions acquired at the H7 site during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

Site Code	Average (µg/m³)	Number in Average	Minimum (µg/m³)	Date of Minimum	Maximum (µg/m³)	Date of Maximum
$PM_{2.5}$ Mass	19.7545 ± 8.3954	16	7.1884 ± 0.5146	08/20/97	35.9047 ± 1.8326	08/26/97
Chloride (Cl^-)	0.0734 ± 0.1258	16	0.0000 ± 0.0343	03/23/97	0.5459 ± 0.0405	06/20/97
Nonvolatilized Nitrate (NO_3^-)	0.5384 ± 0.5872	16	0.0400 ± 0.0303	09/13/97	2.1833 ± 0.1783	02/07/98
Sulfate ($SO_4^=$)	5.3867 ± 3.7743	16	0.5266 ± 0.0433	09/13/97	11.3313 ± 0.7543	09/01/97
Ammonium (NH_4^+)	1.6500 ± 1.0332	16	0.1308 ± 0.0217	09/13/97	3.6869 ± 0.1952	09/01/97
Soluble Sodium (Na^+)	0.1909 ± 0.1698	16	0.0000 ± 0.0268	09/13/97	0.5504 ± 0.0347	06/20/97
Soluble Potassium (K^+)	0.1302 ± 0.2254	16	0.0044 ± 0.0037	09/13/97	0.9852 ± 0.0548	08/26/97
Volatilized Nitrate (NO_3^-)	N/A ± N/A	N/A	N/A ± N/A		N/A ± N/A	
Organic Carbon (OC)	3.2272 ± 2.0880	16	0.0000 ± 0.4376	09/13/97	8.4664 ± 0.8471	08/26/97
Elemental Carbon (EC)	1.2286 ± 0.8276	16	0.0638 ± 0.0395	09/13/97	3.3318 ± 0.2086	12/18/97
Sodium (Na)	0.1363 ± 0.1055	16	0.0000 ± 0.1421	09/01/97	0.3713 ± 0.0567	08/26/97
Magnesium (Mg)	0.0365 ± 0.0516	16	0.0000 ± 0.0488	08/27/97	0.2026 ± 0.0259	06/20/97
Aluminum (Al)	0.2304 ± 0.4940	16	0.0194 ± 0.0090	09/13/97	1.7678 ± 0.0907	06/20/97
Silicon (Si)	0.5578 ± 1.0963	16	0.0826 ± 0.0062	02/04/98	3.9327 ± 0.1974	06/20/97
Phosphorus (P)	0.0007 ± 0.0018	16	0.0000 ± 0.0183	03/23/97	0.0071 ± 0.0024	11/06/97
Sulfur (S)	1.9737 ± 1.2177	16	0.4926 ± 0.0250	11/06/97	4.2442 ± 0.2126	03/23/97
Chlorine (Cl)	0.0216 ± 0.0628	16	0.0000 ± 0.0691	03/23/97	0.2606 ± 0.0159	06/20/97
Potassium (K)	0.1772 ± 0.2344	16	0.0368 ± 0.0083	03/23/97	0.9834 ± 0.0499	08/26/97
Calcium (Ca)	0.1431 ± 0.1059	16	0.0194 ± 0.0050	03/23/97	0.4427 ± 0.0229	06/20/97
Titanium (Ti)	0.0194 ± 0.0375	16	0.0000 ± 0.0249	08/26/97	0.1361 ± 0.0182	06/20/97
Vanadium (V)	0.0050 ± 0.0037	16	0.0000 ± 0.0100	08/26/97	0.0144 ± 0.0073	12/18/97
Chromium (Cr)	0.0024 ± 0.0033	16	0.0000 ± 0.0026	08/26/97	0.0109 ± 0.0021	12/18/97
Manganese (Mn)	0.0045 ± 0.0060	16	0.0009 ± 0.0018	03/23/97	0.0230 ± 0.0020	06/20/97
Iron (Fe)	0.2091 ± 0.3587	16	0.0379 ± 0.0023	03/23/97	1.3758 ± 0.0689	06/20/97
Cobalt (Co)	0.0001 ± 0.0001	16	0.0000 ± 0.0014	03/23/97	0.0005 ± 0.0017	11/24/97
Nickel (Ni)	0.0019 ± 0.0013	16	0.0000 ± 0.0010	11/06/97	0.0052 ± 0.0009	12/18/97
Copper (Cu)	0.0140 ± 0.0126	16	0.0005 ± 0.0013	08/20/97	0.0504 ± 0.0027	11/06/97
Zinc (Zn)	0.0139 ± 0.0078	16	0.0045 ± 0.0010	09/13/97	0.0318 ± 0.0019	09/01/97
Gallium (Ga)	0.0003 ± 0.0004	16	0.0000 ± 0.0019	06/20/97	0.0011 ± 0.0018	09/01/97
Arsenic (As)	0.0012 ± 0.0006	16	0.0002 ± 0.0023	06/20/97	0.0022 ± 0.0017	09/13/97
Selenium (Se)	0.0009 ± 0.0006	16	0.0000 ± 0.0012	07/27/97	0.0019 ± 0.0009	11/24/97
Bromine (Br)	0.0056 ± 0.0048	16	0.0019 ± 0.0008	06/20/97	0.0225 ± 0.0015	08/26/97
Rubidium (Rb)	0.0004 ± 0.0006	16	0.0000 ± 0.0010	08/20/97	0.0022 ± 0.0007	06/20/97
Strontium (Sr)	0.0012 ± 0.0018	16	0.0000 ± 0.0011	03/23/97	0.0072 ± 0.0009	06/20/97
Yttrium (Y)	0.0001 ± 0.0003	16	0.0000 ± 0.0013	03/23/97	0.0011 ± 0.0010	06/20/97
Zirconium (Zr)	0.0008 ± 0.0014	16	0.0000 ± 0.0014	11/24/97	0.0053 ± 0.0011	06/20/97
Molybdenum (Mo)	0.0003 ± 0.0005	16	0.0000 ± 0.0031	08/26/97	0.0019 ± 0.0029	03/23/97
Palladium (Pd)	0.0005 ± 0.0009	16	0.0000 ± 0.0080	03/23/97	0.0033 ± 0.0079	02/04/98
Silver (Ag)	0.0013 ± 0.0015	16	0.0000 ± 0.0095	06/20/97	0.0043 ± 0.0089	02/07/98
Cadmium (Cd)	0.0005 ± 0.0009	16	0.0000 ± 0.0100	06/20/97	0.0027 ± 0.0100	03/23/97
Indium (In)	0.0004 ± 0.0006	16	0.0000 ± 0.0116	03/23/97	0.0021 ± 0.0107	09/01/97
Tin (Sn)	0.0009 ± 0.0021	16	0.0000 ± 0.0152	03/23/97	0.0087 ± 0.0148	07/27/97
Antimony (Sb)	0.0030 ± 0.0036	16	0.0000 ± 0.0174	06/20/97	0.0105 ± 0.0171	12/18/97
Barium (Ba)	0.0080 ± 0.0161	16	0.0000 ± 0.0657	03/23/97	0.0527 ± 0.0461	06/20/97
Lanthanum (La)	0.0029 ± 0.0061	16	0.0000 ± 0.0873	03/23/97	0.0220 ± 0.0908	07/27/97
Gold (Au)	0.0002 ± 0.0004	16	0.0000 ± 0.0031	03/23/97	0.0016 ± 0.0035	09/01/97
Mercury (Hg)	0.0001 ± 0.0002	16	0.0000 ± 0.0025	06/20/97	0.0007 ± 0.0024	09/13/97
Thallium (Tl)	0.0001 ± 0.0002	16	0.0000 ± 0.0023	07/03/97	0.0008 ± 0.0024	03/23/97
Lead (Pb)	0.0024 ± 0.0022	16	0.0000 ± 0.0033	08/20/97	0.0072 ± 0.0023	02/07/98
Uranium (U)	0.0002 ± 0.0003	16	0.0000 ± 0.0023	08/27/97	0.0011 ± 0.0027	08/26/97
Sum of Species	13.6539 ± 6.5419	16	1.1063 ± 0.4585	09/13/97	26.9718 ± 1.1949	08/26/97

Table 4-3g. Statistical summary of $PM_{2.5}$ mass and chemical compositions acquired at the HB site during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

Site Code	Average (µg/m³)	Number in Average	Minimum (µg/m³)	Date of Minimum	Maximum (µg/m³)	Date of Maximum
$PM_{2.5}$ Mass	20.6856 ± 9.2709	17	5.1022 ± 0.4508	08/20/97	36.3009 ± 1.8531	08/26/97
Chloride (Cl^-)	0.0482 ± 0.0588	17	0.0000 ± 0.0280	11/06/97	0.2651 ± 0.0327	06/20/97
Nonvolatilized Nitrate (NO_3^-)	0.3550 ± 0.4434	17	0.0990 ± 0.0404	08/27/97	2.0473 ± 0.1555	12/18/97
Sulfate ($SO_4^=$)	5.7480 ± 4.0311	17	1.2917 ± 0.0840	11/06/97	12.7871 ± 0.8325	09/07/97
Ammonium (NH_4^+)	1.8800 ± 1.3101	17	0.3659 ± 0.0337	08/20/97	4.1739 ± 0.2206	09/01/97
Soluble Sodium (Na^+)	0.1191 ± 0.1052	17	0.0197 ± 0.0070	11/06/97	0.3914 ± 0.0321	05/02/97
Soluble Potassium (K^+)	0.0892 ± 0.0667	17	0.0194 ± 0.0028	07/27/97	0.2516 ± 0.0148	08/26/97
Volatilized Nitrate (NO_3^-)	N/A ± N/A	N/A	N/A ± N/A		N/A ± N/A	
Organic Carbon (OC)	4.0555 ± 2.5230	17	0.9780 ± 0.5999	08/20/97	10.3665 ± 0.9457	12/18/97
Elemental Carbon (EC)	2.0654 ± 1.1407	17	0.7193 ± 0.1255	07/27/97	5.3322 ± 0.3257	12/18/97
Sodium (Na)	0.0823 ± 0.0524	17	0.0000 ± 0.0826	03/23/97	0.1457 ± 0.0356	08/20/97
Magnesium (Mg)	0.0370 ± 0.0401	17	0.0000 ± 0.0518	09/07/97	0.1692 ± 0.0244	06/20/97
Aluminum (Al)	0.1861 ± 0.3981	17	0.0009 ± 0.0242	05/02/97	1.4710 ± 0.0760	06/20/97
Silicon (Si)	0.4570 ± 0.9038	17	0.0315 ± 0.0068	05/02/97	3.3672 ± 0.1691	06/20/97
Phosphorus (P)	0.0005 ± 0.0013	17	0.0000 ± 0.0144	03/23/97	0.0043 ± 0.0111	12/18/97
Sulfur (S)	2.0965 ± 1.3915	17	0.4963 ± 0.0252	11/06/97	4.6130 ± 0.2310	09/01/97
Chlorine (Cl)	0.0112 ± 0.0267	17	0.0000 ± 0.0435	05/02/97	0.1059 ± 0.0090	06/20/97
Potassium (K)	0.1314 ± 0.0990	17	0.0270 ± 0.0040	08/20/97	0.3652 ± 0.0191	06/20/97
Calcium (Ca)	0.1034 ± 0.1173	17	0.0316 ± 0.0074	09/01/97	0.4625 ± 0.0240	03/23/97
Titanium (Ti)	0.0180 ± 0.0291	17	0.0000 ± 0.0239	08/20/97	0.1076 ± 0.0174	06/20/97
Vanadium (V)	0.0027 ± 0.0015	17	0.0000 ± 0.0096	08/20/97	0.0056 ± 0.0094	06/20/97
Chromium (Cr)	0.0014 ± 0.0021	17	0.0000 ± 0.0026	05/02/97	0.0090 ± 0.0020	12/18/97
Manganese (Mn)	0.0062 ± 0.0077	17	0.0000 ± 0.0020	05/02/97	0.0318 ± 0.0022	12/18/97
Iron (Fe)	0.1992 ± 0.2658	17	0.0289 ± 0.0020	05/02/97	1.0275 ± 0.0515	06/20/97
Cobalt (Co)	0.0002 ± 0.0002	17	0.0000 ± 0.0164	06/20/97	0.0007 ± 0.0018	06/06/97
Nickel (Ni)	0.0017 ± 0.0014	17	0.0000 ± 0.0011	11/06/97	0.0045 ± 0.0009	08/20/97
Copper (Cu)	0.0042 ± 0.0039	17	0.0002 ± 0.0005	05/02/97	0.0152 ± 0.0012	12/18/97
Zinc (Zn)	0.0256 ± 0.0228	17	0.0035 ± 0.0010	08/20/97	0.0925 ± 0.0048	12/18/97
Gallium (Ga)	0.0000 ± 0.0001	17	0.0000 ± 0.0016	03/23/97	0.0006 ± 0.0018	06/20/97
Arsenic (As)	0.0014 ± 0.0008	17	0.0004 ± 0.0023	03/23/97	0.0028 ± 0.0015	07/27/97
Selenium (Se)	0.0008 ± 0.0005	17	0.0000 ± 0.0012	08/20/97	0.0015 ± 0.0009	06/06/97
Bromine (Br)	0.0055 ± 0.0032	17	0.0016 ± 0.0007	06/20/97	0.0118 ± 0.0011	12/18/97
Rubidium (Rb)	0.0003 ± 0.0005	17	0.0000 ± 0.0011	06/06/97	0.0017 ± 0.0007	06/20/97
Strontium (Sr)	0.0010 ± 0.0015	17	0.0000 ± 0.0012	08/26/97	0.0060 ± 0.0008	06/20/97
Yttrium (Y)	0.0001 ± 0.0002	17	0.0000 ± 0.0014	06/06/97	0.0010 ± 0.0009	06/20/97
Zirconium (Zr)	0.0017 ± 0.0038	17	0.0000 ± 0.0019	05/02/97	0.0165 ± 0.0013	03/23/97
Molybdenum (Mo)	0.0004 ± 0.0007	17	0.0000 ± 0.0025	03/23/97	0.0029 ± 0.0021	12/18/97
Palladium (Pd)	0.0012 ± 0.0021	17	0.0000 ± 0.0079	07/03/97	0.0060 ± 0.0082	06/06/97
Silver (Ag)	0.0011 ± 0.0016	17	0.0000 ± 0.0106	05/02/97	0.0044 ± 0.0095	11/24/97
Cadmium (Cd)	0.0010 ± 0.0019	17	0.0000 ± 0.0097	06/06/97	0.0057 ± 0.0094	02/04/98
Indium (In)	0.0009 ± 0.0015	17	0.0000 ± 0.0101	03/23/97	0.0053 ± 0.0112	02/04/98
Tin (Sn)	0.0012 ± 0.0017	17	0.0000 ± 0.0136	03/23/97	0.0056 ± 0.0149	11/24/97
Antimony (Sb)	0.0034 ± 0.0033	17	0.0000 ± 0.0177	06/06/97	0.0095 ± 0.0175	11/24/97
Barium (Ba)	0.0039 ± 0.0068	17	0.0000 ± 0.0762	05/02/97	0.0229 ± 0.0599	06/20/97
Lanthanum (La)	0.0052 ± 0.0063	17	0.0000 ± 0.0775	03/23/97	0.0174 ± 0.0873	08/27/97
Gold (Au)	0.0003 ± 0.0005	17	0.0000 ± 0.0036	05/02/97	0.0019 ± 0.0037	03/23/97
Mercury (Hg)	0.0001 ± 0.0002	17	0.0000 ± 0.0021	03/23/97	0.0007 ± 0.0024	12/18/97
Thallium (Tl)	0.0002 ± 0.0004	17	0.0000 ± 0.0021	03/23/97	0.0014 ± 0.0029	05/02/97
Lead (Pb)	0.0042 ± 0.0038	17	0.0000 ± 0.0038	05/02/97	0.0129 ± 0.0026	08/26/97
Uranium (U)	0.0001 ± 0.0002	17	0.0000 ± 0.0029	05/02/97	0.0008 ± 0.0025	06/06/97
Sum of Species	15.4059 ± 7.1895	17	4.4568 ± 0.6375	08/20/97	25.7124 ± 1.1275	08/26/97

Table 4-3h. Statistical summary of $PM_{2.5}$ mass and chemical compositions acquired at the HC site during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

Site Code	Average (µg/m³)	Number in Average	Minimum (µg/m³)	Date of Minimum	Maximum (µg/m³)	Date of Maximum
$PM_{2.5}$ Mass	20.5512 ± 8.7658	22	6.0311 ± 0.4328	11/06/97	36.5516 ± 1.8609	12/18/97
Chloride (Cl^-)	0.1514 ± 0.3194	22	0.0000 ± 0.0282	10/25/97	1.5403 ± 0.1664	11/06/97
Nonvolatilized Nitrate (NO_3^-)	0.6662 ± 1.0168	22	0.0792 ± 0.0294	06/06/97	3.9483 ± 0.3020	03/11/97
Sulfate ($SO_4^=$)	6.2472 ± 3.4548	22	2.3285 ± 0.2371	05/10/97	13.0732 ± 0.8413	09/01/97
Ammonium (NH_4^+)	1.9244 ± 1.2863	22	0.4524 ± 0.0353	11/06/97	4.6052 ± 0.2430	09/01/97
Soluble Sodium (Na^+)	0.1705 ± 0.1390	22	0.0406 ± 0.0205	05/04/97	0.6606 ± 0.0344	11/06/97
Soluble Potassium (K^+)	0.0739 ± 0.0520	22	0.0233 ± 0.0049	08/20/97	0.2815 ± 0.0163	08/26/97
Volatilized Nitrate (NO_3^-)	N/A ± N/A	N/A	N/A ± N/A		N/A ± N/A	
Organic Carbon (OC)	3.5455 ± 2.4269	22	1.4567 ± 0.5958	11/06/97	13.0587 ± 1.1027	12/18/97
Elemental Carbon (EC)	2.0096 ± 0.9581	22	0.8736 ± 0.1406	07/27/97	5.1842 ± 0.3172	12/18/97
Sodium (Na)	0.0793 ± 0.0618	22	0.0000 ± 0.0966	03/23/97	0.1966 ± 0.0510	07/03/97
Magnesium (Mg)	0.0330 ± 0.0402	22	0.0000 ± 0.0468	06/06/97	0.1629 ± 0.0251	06/20/97
Aluminum (Al)	0.1760 ± 0.3811	22	0.0125 ± 0.0056	11/06/97	1.5181 ± 0.0784	06/20/97
Silicon (Si)	0.4766 ± 0.8784	22	0.0816 ± 0.0058	11/06/97	3.5139 ± 0.1765	06/20/97
Phosphorus (P)	0.0003 ± 0.0011	22	0.0000 ± 0.0183	03/23/97	0.0050 ± 0.0135	11/24/97
Sulfur (S)	2.1510 ± 1.2484	22	0.5226 ± 0.0265	11/06/97	4.3232 ± 0.2165	09/01/97
Chlorine (Cl)	0.0346 ± 0.0670	22	0.0000 ± 0.0652	03/23/97	0.2726 ± 0.0166	06/20/97
Potassium (K)	0.1056 ± 0.0926	22	0.0278 ± 0.0043	08/20/97	0.3699 ± 0.0194	06/20/97
Calcium (Ca)	0.3949 ± 0.4127	22	0.0598 ± 0.0058	03/11/97	1.7608 ± 0.0887	12/18/97
Titanium (Ti)	0.0146 ± 0.0284	22	0.0000 ± 0.0251	10/25/97	0.1104 ± 0.0177	06/20/97
Vanadium (V)	0.0050 ± 0.0032	22	0.0005 ± 0.0137	07/27/97	0.0146 ± 0.0068	03/11/97
Chromium (Cr)	0.0013 ± 0.0017	22	0.0000 ± 0.0023	08/20/97	0.0077 ± 0.0020	12/18/97
Manganese (Mn)	0.0078 ± 0.0081	22	0.0012 ± 0.0020	10/25/97	0.0310 ± 0.0022	12/18/97
Iron (Fe)	0.2104 ± 0.2816	22	0.0430 ± 0.0025	05/04/97	1.0859 ± 0.0544	06/20/97
Cobalt (Co)	0.0001 ± 0.0002	22	0.0000 ± 0.0030	03/11/97	0.0008 ± 0.0022	02/04/98
Nickel (Ni)	0.0023 ± 0.0018	22	0.0003 ± 0.0011	07/27/97	0.0088 ± 0.0010	12/18/97
Copper (Cu)	0.0109 ± 0.0087	22	0.0012 ± 0.0005	03/23/97	0.0363 ± 0.0021	12/18/97
Zinc (Zn)	0.0297 ± 0.0384	22	0.0063 ± 0.0009	05/04/97	0.1926 ± 0.0097	12/18/97
Gallium (Ga)	0.0003 ± 0.0004	22	0.0000 ± 0.0020	03/23/97	0.0012 ± 0.0017	04/10/97
Arsenic (As)	0.0013 ± 0.0010	22	0.0000 ± 0.0026	03/23/97	0.0045 ± 0.0020	12/18/97
Selenium (Se)	0.0009 ± 0.0005	22	0.0001 ± 0.0011	08/20/97	0.0019 ± 0.0008	06/06/97
Bromine (Br)	0.0050 ± 0.0033	22	0.0010 ± 0.0008	07/03/97	0.0125 ± 0.0011	12/18/97
Rubidium (Rb)	0.0003 ± 0.0004	22	0.0000 ± 0.0010	03/11/97	0.0016 ± 0.0007	07/03/97
Strontium (Sr)	0.0016 ± 0.0016	22	0.0001 ± 0.0009	11/06/97	0.0065 ± 0.0008	06/20/97
Yttrium (Y)	0.0002 ± 0.0003	22	0.0000 ± 0.0015	03/23/97	0.0012 ± 0.0009	06/20/97
Zirconium (Zr)	0.0006 ± 0.0008	22	0.0000 ± 0.0015	05/04/97	0.0032 ± 0.0011	06/20/97
Molybdenum (Mo)	0.0006 ± 0.0008	22	0.0000 ± 0.0028	05/04/97	0.0031 ± 0.0022	12/18/97
Palladium (Pd)	0.0006 ± 0.0009	22	0.0000 ± 0.0073	04/22/97	0.0032 ± 0.0081	12/18/97
Silver (Ag)	0.0007 ± 0.0017	22	0.0000 ± 0.0086	03/11/97	0.0076 ± 0.0070	12/18/97
Cadmium (Cd)	0.0009 ± 0.0013	22	0.0000 ± 0.0094	05/04/97	0.0044 ± 0.0095	06/20/97
Indium (In)	0.0010 ± 0.0014	22	0.0000 ± 0.0111	04/10/97	0.0040 ± 0.0112	05/10/97
Tin (Sn)	0.0012 ± 0.0020	22	0.0000 ± 0.0141	03/11/97	0.0073 ± 0.0145	10/19/97
Antimony (Sb)	0.0025 ± 0.0031	22	0.0000 ± 0.0164	04/22/97	0.0123 ± 0.0129	12/18/97
Barium (Ba)	0.0034 ± 0.0066	22	0.0000 ± 0.0611	03/11/97	0.0199 ± 0.0599	08/20/97
Lanthanum (La)	0.0055 ± 0.0094	22	0.0000 ± 0.0809	03/11/97	0.0336 ± 0.0861	10/25/97
Gold (Au)	0.0003 ± 0.0005	22	0.0000 ± 0.0035	03/23/97	0.0020 ± 0.0031	03/11/97
Mercury (Hg)	0.0003 ± 0.0004	22	0.0000 ± 0.0025	05/04/97	0.0011 ± 0.0024	07/03/97
Thallium (Tl)	0.0001 ± 0.0002	22	0.0000 ± 0.0021	03/11/97	0.0006 ± 0.0023	06/20/97
Lead (Pb)	0.0039 ± 0.0036	22	0.0000 ± 0.0032	07/27/97	0.0179 ± 0.0027	12/18/97
Uranium (U)	0.0002 ± 0.0003	22	0.0000 ± 0.0027	03/23/97	0.0010 ± 0.0023	06/20/97
Sum of Species	16.0650 ± 6.2269	22	7.5011 ± 0.6764	07/27/97	29.7328 ± 1.1983	12/18/97

Table 4-3i. Statistical summary of $PM_{2.5}$ mass and chemical compositions acquired at the HG site during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

Site Code	Average (µg/m³)	Number in Average	Minimum (µg/m³)	Date of Minimum	Maximum (µg/m³)	Date of Maximum
$PM_{2.5}$ Mass	12.9591 ± 6.7306	13	4.3056 ± 0.4100	08/20/97	25.8259 ± 1.3351	06/20/97
Chloride (Cl^-)	0.1510 ± 0.1711	13	0.0000 ± 0.0289	02/04/98	0.4863 ± 0.0387	06/20/97
Nonvolatilized Nitrate (NO_3^-)	0.5147 ± 0.7528	13	0.0000 ± 0.0394	09/01/97	2.3767 ± 0.2142	02/07/98
Sulfate ($SO_4^=$)	4.1111 ± 2.7831	13	0.9300 ± 0.0632	07/27/97	11.1114 ± 0.7431	09/01/97
Ammonium (NH_4^+)	1.0809 ± 0.8681	13	0.1075 ± 0.0268	07/27/97	2.8813 ± 0.1535	09/01/97
Soluble Sodium (Na^+)	0.2788 ± 0.3098	13	0.0211 ± 0.0072	02/07/98	1.1815 ± 0.0606	10/19/97
Soluble Potassium (K^+)	0.0496 ± 0.0267	13	0.0134 ± 0.0027	07/27/97	0.1067 ± 0.0061	10/19/97
Volatilized Nitrate (NO_3^-)	N/A ± N/A	N/A	N/A ± N/A		N/A ± N/A	
Organic Carbon (OC)	1.6410 ± 0.9844	13	0.1510 ± 0.5658	08/20/97	3.2876 ± 0.6413	02/07/98
Elemental Carbon (EC)	0.6733 ± 0.2829	13	0.2445 ± 0.0920	07/27/97	1.1659 ± 0.1733	02/07/98
Sodium (Na)	0.1607 ± 0.1188	13	0.0280 ± 0.0639	02/07/98	0.4874 ± 0.0397	05/02/97
Magnesium (Mg)	0.0543 ± 0.0583	13	0.0000 ± 0.0271	02/07/98	0.2336 ± 0.0267	06/20/97
Aluminum (Al)	0.2236 ± 0.4587	13	0.0000 ± 0.0149	08/20/97	1.6540 ± 0.0851	06/20/97
Silicon (Si)	0.5106 ± 1.0176	13	0.0139 ± 0.0042	05/02/97	3.6421 ± 0.1829	06/20/97
Phosphorus (P)	0.0002 ± 0.0004	13	0.0000 ± 0.0123	03/17/97	0.0015 ± 0.0105	02/07/98
Sulfur (S)	1.4656 ± 1.0970	13	0.3690 ± 0.0189	07/27/97	3.9993 ± 0.2003	09/01/97
Chlorine (Cl)	0.0905 ± 0.1313	13	0.0000 ± 0.0172	05/04/97	0.4420 ± 0.0245	10/19/97
Potassium (K)	0.0905 ± 0.0951	13	0.0131 ± 0.0037	08/20/97	0.3904 ± 0.0203	06/20/97
Calcium (Ca)	0.0838 ± 0.1009	13	0.0118 ± 0.0071	08/20/97	0.3281 ± 0.0173	06/20/97
Titanium (Ti)	0.0158 ± 0.0331	13	0.0000 ± 0.0238	05/04/97	0.1173 ± 0.0179	06/20/97
Vanadium (V)	0.0027 ± 0.0025	13	0.0000 ± 0.0093	05/04/97	0.0067 ± 0.0103	06/20/97
Chromium (Cr)	0.0008 ± 0.0007	13	0.0000 ± 0.0025	09/13/97	0.0021 ± 0.0029	06/20/97
Manganese (Mn)	0.0029 ± 0.0047	13	0.0000 ± 0.0018	08/20/97	0.0176 ± 0.0017	06/20/97
Iron (Fe)	0.1554 ± 0.3000	13	0.0061 ± 0.0011	05/02/97	1.0956 ± 0.0549	06/20/97
Cobalt (Co)	0.0002 ± 0.0003	13	0.0000 ± 0.0012	03/17/97	0.0009 ± 0.0020	07/27/97
Nickel (Ni)	0.0012 ± 0.0005	13	0.0000 ± 0.0011	10/19/97	0.0021 ± 0.0009	08/27/97
Copper (Cu)	0.0033 ± 0.0083	13	0.0000 ± 0.0009	05/02/97	0.0319 ± 0.0019	10/19/97
Zinc (Zn)	0.0083 ± 0.0069	13	0.0000 ± 0.0012	08/20/97	0.0256 ± 0.0016	10/19/97
Gallium (Ga)	0.0001 ± 0.0002	13	0.0000 ± 0.0020	05/04/97	0.0006 ± 0.0017	03/17/97
Arsenic (As)	0.0005 ± 0.0004	13	0.0000 ± 0.0023	05/04/97	0.0014 ± 0.0025	02/07/98
Selenium (Se)	0.0006 ± 0.0004	13	0.0000 ± 0.0012	07/03/97	0.0011 ± 0.0009	08/27/97
Bromine (Br)	0.0035 ± 0.0022	13	0.0009 ± 0.0008	08/20/97	0.0081 ± 0.0009	03/17/97
Rubidium (Rb)	0.0004 ± 0.0005	13	0.0000 ± 0.0010	03/17/97	0.0020 ± 0.0007	06/20/97
Strontium (Sr)	0.0011 ± 0.0015	13	0.0000 ± 0.0011	08/20/97	0.0059 ± 0.0008	06/20/97
Yttrium (Y)	0.0001 ± 0.0002	13	0.0000 ± 0.0013	05/02/97	0.0006 ± 0.0014	06/20/97
Zirconium (Zr)	0.0007 ± 0.0009	13	0.0000 ± 0.0016	05/04/97	0.0035 ± 0.0011	06/20/97
Molybdenum (Mo)	0.0003 ± 0.0005	13	0.0000 ± 0.0029	05/04/97	0.0018 ± 0.0027	05/02/97
Palladium (Pd)	0.0008 ± 0.0012	13	0.0000 ± 0.0081	05/04/97	0.0032 ± 0.0080	10/19/97
Silver (Ag)	0.0007 ± 0.0010	13	0.0000 ± 0.0087	03/17/97	0.0028 ± 0.0093	08/20/97
Cadmium (Cd)	0.0024 ± 0.0040	13	0.0000 ± 0.0100	06/20/97	0.0156 ± 0.0069	05/02/97
Indium (In)	0.0008 ± 0.0011	13	0.0000 ± 0.0109	03/17/97	0.0035 ± 0.0113	08/27/97
Tin (Sn)	0.0015 ± 0.0023	13	0.0000 ± 0.0142	03/17/97	0.0082 ± 0.0146	10/19/97
Antimony (Sb)	0.0011 ± 0.0016	13	0.0000 ± 0.0171	05/02/97	0.0052 ± 0.0164	03/17/97
Barium (Ba)	0.0143 ± 0.0281	13	0.0000 ± 0.0603	03/17/97	0.1041 ± 0.0419	02/04/98
Lanthanum (La)	0.0036 ± 0.0097	13	0.0000 ± 0.0806	03/17/97	0.0365 ± 0.0860	07/27/97
Gold (Au)	0.0002 ± 0.0005	13	0.0000 ± 0.0031	05/04/97	0.0018 ± 0.0029	03/17/97
Mercury (Hg)	0.0001 ± 0.0003	13	0.0000 ± 0.0023	03/17/97	0.0011 ± 0.0025	08/27/97
Thallium (Tl)	0.0002 ± 0.0003	13	0.0000 ± 0.0025	05/04/97	0.0010 ± 0.0023	05/02/97
Lead (Pb)	0.0045 ± 0.0069	13	0.0000 ± 0.0033	08/20/97	0.0277 ± 0.0028	10/19/97
Uranium (U)	0.0003 ± 0.0003	13	0.0000 ± 0.0024	08/20/97	0.0010 ± 0.0022	03/17/97
Sum of Species	9.5276 ± 4.4871	13	2.9994 ± 0.5951	08/20/97	18.5372 ± 1.0055	09/01/97

Table 4-3j. Statistical summary of $PM_{2.5}$ mass and chemical compositions acquired at the HM site during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

Site Code	Average (µg/m³)	Number in Average	Minimum (µg/m³)	Date of Minimum	Maximum (µg/m³)	Date of Maximum
$PM_{2.5}$ Mass	16.9079 ± 8.1385	17	5.7793 ± 0.4726	08/20/97	32.3158 ± 1.6579	08/26/97
Chloride (Cl^-)	0.0455 ± 0.0514	17	0.0000 ± 0.0288	10/19/97	0.2256 ± 0.0318	06/20/97
Nonvolatilized Nitrate (NO_3^-)	0.4636 ± 0.6403	17	0.0902 ± 0.0395	08/27/97	2.4493 ± 0.1745	12/18/97
Sulfate ($SO_4^=$)	4.8910 ± 3.7679	17	1.4440 ± 0.0932	07/27/97	12.7060 ± 0.8243	09/01/97
Ammonium (NH_4^+)	1.5835 ± 1.1953	17	0.2978 ± 0.0314	08/20/97	4.2751 ± 0.2258	09/01/97
Soluble Sodium (Na^+)	0.1080 ± 0.0935	17	0.0085 ± 0.0071	02/07/98	0.3418 ± 0.0394	08/26/97
Soluble Potassium (K^+)	0.0720 ± 0.0584	17	0.0205 ± 0.0051	08/20/97	0.2736 ± 0.0159	08/26/97
Volatilized Nitrate (NO_3^-)	N/A ± N/A	N/A	N/A ± N/A		N/A ± N/A	
Organic Carbon (OC)	3.1886 ± 2.0388	17	1.0171 ± 0.6094	07/27/97	9.1400 ± 0.8830	12/18/97
Elemental Carbon (EC)	1.5781 ± 1.1071	17	0.6918 ± 0.2385	06/20/97	5.3012 ± 0.3251	12/18/97
Sodium (Na)	0.0724 ± 0.0713	17	0.0000 ± 0.0790	03/23/97	0.3076 ± 0.0498	06/20/97
Magnesium (Mg)	0.0306 ± 0.0357	17	0.0000 ± 0.0331	03/23/97	0.1559 ± 0.0239	06/20/97
Aluminum (Al)	0.1768 ± 0.3786	17	0.0106 ± 0.0231	03/23/97	1.3651 ± 0.0708	06/20/97
Silicon (Si)	0.4327 ± 0.8545	17	0.0287 ± 0.0064	03/23/97	3.1253 ± 0.1571	06/20/97
Phosphorus (P)	0.0006 ± 0.0011	17	0.0000 ± 0.0150	03/23/97	0.0041 ± 0.0099	02/07/98
Sulfur (S)	1.7464 ± 1.2203	17	0.5761 ± 0.0292	07/27/97	3.9823 ± 0.1994	09/01/97
Chlorine (Cl)	0.0050 ± 0.0120	17	0.0000 ± 0.0448	03/23/97	0.0486 ± 0.0075	06/20/97
Potassium (K)	0.1064 ± 0.0958	17	0.0185 ± 0.0038	08/20/97	0.3473 ± 0.0182	06/20/97
Calcium (Ca)	0.0929 ± 0.0817	17	0.0299 ± 0.0039	05/04/97	0.2724 ± 0.0145	06/20/97
Titanium (Ti)	0.0159 ± 0.0285	17	0.0000 ± 0.0230	08/27/97	0.1016 ± 0.0173	06/20/97
Vanadium (V)	0.0032 ± 0.0026	17	0.0000 ± 0.0121	11/06/97	0.0097 ± 0.0066	05/04/97
Chromium (Cr)	0.0040 ± 0.0062	17	0.0000 ± 0.0026	09/01/97	0.0261 ± 0.0024	12/18/97
Manganese (Mn)	0.0052 ± 0.0054	17	0.0009 ± 0.0017	10/19/97	0.0192 ± 0.0018	12/18/97
Iron (Fe)	0.1696 ± 0.2491	17	0.0212 ± 0.0016	03/23/97	0.9300 ± 0.0466	06/20/97
Cobalt (Co)	0.0024 ± 0.0045	17	0.0000 ± 0.0149	06/20/97	0.0149 ± 0.0021	12/18/97
Nickel (Ni)	0.0021 ± 0.0017	17	0.0002 ± 0.0013	09/01/97	0.0066 ± 0.0010	12/18/97
Copper (Cu)	0.0089 ± 0.0059	17	0.0018 ± 0.0009	06/20/97	0.0246 ± 0.0016	08/26/97
Zinc (Zn)	0.0170 ± 0.0125	17	0.0034 ± 0.0009	07/27/97	0.0555 ± 0.0030	12/18/97
Gallium (Ga)	0.0003 ± 0.0004	17	0.0000 ± 0.0019	08/27/97	0.0011 ± 0.0017	06/20/97
Arsenic (As)	0.0019 ± 0.0016	17	0.0005 ± 0.0023	03/23/97	0.0072 ± 0.0018	09/01/97
Selenium (Se)	0.0007 ± 0.0005	17	0.0000 ± 0.0011	08/20/97	0.0016 ± 0.0009	11/24/97
Bromine (Br)	0.0045 ± 0.0028	17	0.0011 ± 0.0008	07/03/97	0.0110 ± 0.0010	08/26/97
Rubidium (Rb)	0.0003 ± 0.0005	17	0.0000 ± 0.0009	03/23/97	0.0017 ± 0.0007	06/20/97
Strontium (Sr)	0.0008 ± 0.0014	17	0.0000 ± 0.0010	03/23/97	0.0058 ± 0.0008	06/20/97
Yttrium (Y)	0.0001 ± 0.0002	17	0.0000 ± 0.0012	03/23/97	0.0008 ± 0.0013	07/03/97
Zirconium (Zr)	0.0008 ± 0.0010	17	0.0000 ± 0.0014	05/04/97	0.0036 ± 0.0011	06/20/97
Molybdenum (Mo)	0.0006 ± 0.0011	17	0.0000 ± 0.0028	08/27/97	0.0047 ± 0.0021	08/20/97
Palladium (Pd)	0.0012 ± 0.0015	17	0.0000 ± 0.0077	08/26/97	0.0052 ± 0.0056	05/04/97
Silver (Ag)	0.0019 ± 0.0020	17	0.0000 ± 0.0090	03/23/97	0.0069 ± 0.0096	12/18/97
Cadmium (Cd)	0.0017 ± 0.0019	17	0.0000 ± 0.0090	06/20/97	0.0057 ± 0.0090	05/04/97
Indium (In)	0.0008 ± 0.0011	17	0.0000 ± 0.0109	06/20/97	0.0030 ± 0.0108	03/23/97
Tin (Sn)	0.0014 ± 0.0016	17	0.0000 ± 0.0142	03/23/97	0.0043 ± 0.0158	09/01/97
Antimony (Sb)	0.0032 ± 0.0032	17	0.0000 ± 0.0166	03/23/97	0.0098 ± 0.0168	07/27/97
Barium (Ba)	0.0058 ± 0.0077	17	0.0000 ± 0.0596	08/20/97	0.0282 ± 0.0630	08/27/97
Lanthanum (La)	0.0035 ± 0.0060	17	0.0000 ± 0.0818	03/23/97	0.0223 ± 0.0805	11/06/97
Gold (Au)	0.0004 ± 0.0007	17	0.0000 ± 0.0028	05/04/97	0.0023 ± 0.0032	08/27/97
Mercury (Hg)	0.0003 ± 0.0003	17	0.0000 ± 0.0023	05/04/97	0.0012 ± 0.0027	12/18/97
Thallium (Tl)	0.0000 ± 0.0001	17	0.0000 ± 0.0022	03/23/97	0.0004 ± 0.0022	06/20/97
Lead (Pb)	0.0046 ± 0.0032	17	0.0011 ± 0.0037	09/01/97	0.0152 ± 0.0026	12/18/97
Uranium (U)	0.0001 ± 0.0002	17	0.0000 ± 0.0022	08/20/97	0.0009 ± 0.0024	07/27/97
Sum of Species	12.8905 ± 6.7485	17	4.5955 ± 0.6433	07/27/97	26.1805 ± 1.1222	08/26/97

Table 4-3k. Statistical summary of $PM_{2.5}$ mass and chemical compositions acquired at the HT site during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

Site Code	Average (µg/m³)	Number in Average	Minimum (µg/m³)	Date of Minimum	Maximum (µg/m³)	Date of Maximum
$PM_{2.5}$ Mass	17.2544 ± 8.0537	27	4.7687 ± 0.4421	08/20/97	32.7223 ± 1.6771	08/27/97
Chloride (Cl^-)	0.0377 ± 0.0300	26	0.0000 ± 0.0296	02/04/98	0.1352 ± 0.0297	06/20/97
Nonvolatilized Nitrate (NO_3^-)	0.2836 ± 0.2183	26	0.0540 ± 0.0289	06/06/97	0.7687 ± 0.0597	11/24/97
Sulfate ($SO_4^=$)	4.7271 ± 3.4335	26	1.0621 ± 0.0712	11/06/97	12.1445 ± 0.7367	06/06/97
Ammonium (NH_4^+)	1.5106 ± 1.1849	26	0.2024 ± 0.0286	08/20/97	4.2387 ± 0.2224	06/06/97
Soluble Sodium (Na^+)	0.1180 ± 0.1092	26	0.0000 ± 0.0351	12/18/97	0.3752 ± 0.0277	06/20/97
Soluble Potassium (K^+)	0.0823 ± 0.0636	25	0.0194 ± 0.0029	11/06/97	0.2917 ± 0.0193	05/02/97
Volatilized Nitrate (NO_3^-)	0.3739 ± 0.0902	2	0.2837 ± 0.0189	06/22/97	0.4640 ± 0.0266	06/20/97
Organic Carbon (OC)	3.7780 ± 2.3453	26	0.9335 ± 0.5749	08/20/97	9.4398 ± 0.8966	08/27/97
Elemental Carbon (EC)	1.1836 ± 0.5400	26	0.3702 ± 0.2277	06/22/97	2.3213 ± 0.3105	12/18/97
Sodium (Na)	0.0792 ± 0.0682	27	0.0000 ± 0.0827	05/22/97	0.2433 ± 0.0440	06/22/97
Magnesium (Mg)	0.0321 ± 0.0384	27	0.0000 ± 0.0219	02/04/98	0.1754 ± 0.0237	06/20/97
Aluminum (Al)	0.1857 ± 0.3646	27	0.0024 ± 0.0297	09/01/97	1.4185 ± 0.0733	06/20/97
Silicon (Si)	0.4428 ± 0.8322	27	0.0358 ± 0.0058	05/22/97	3.1860 ± 0.1601	06/20/97
Phosphorus (P)	0.0003 ± 0.0008	27	0.0000 ± 0.0128	03/23/97	0.0039 ± 0.0078	08/20/97
Sulfur (S)	1.6691 ± 1.1215	27	0.4432 ± 0.0226	08/20/97	4.4055 ± 0.2206	06/06/97
Chlorine (Cl)	0.0077 ± 0.0212	27	0.0000 ± 0.0324	03/23/97	0.0967 ± 0.0084	06/22/97
Potassium (K)	0.1199 ± 0.0897	27	0.0257 ± 0.0038	11/06/97	0.3459 ± 0.0181	06/20/97
Calcium (Ca)	0.0641 ± 0.0748	27	0.0135 ± 0.0035	05/22/97	0.2882 ± 0.0152	06/20/97
Titanium (Ti)	0.0139 ± 0.0271	27	0.0000 ± 0.0214	05/28/97	0.0936 ± 0.0169	06/20/97
Vanadium (V)	0.0017 ± 0.0015	27	0.0000 ± 0.0084	05/28/97	0.0058 ± 0.0088	07/03/97
Chromium (Cr)	0.0009 ± 0.0010	27	0.0000 ± 0.0023	05/02/97	0.0037 ± 0.0016	06/20/97
Manganese (Mn)	0.0038 ± 0.0043	27	0.0000 ± 0.0018	05/02/97	0.0178 ± 0.0017	06/20/97
Iron (Fe)	0.1474 ± 0.2477	27	0.0131 ± 0.0013	05/02/97	0.9604 ± 0.0482	06/20/97
Cobalt (Co)	0.0001 ± 0.0001	27	0.0000 ± 0.0013	05/02/97	0.0005 ± 0.0016	06/09/97
Nickel (Ni)	0.0007 ± 0.0006	27	0.0000 ± 0.0014	09/01/97	0.0023 ± 0.0009	11/24/97
Copper (Cu)	0.0117 ± 0.0183	27	0.0000 ± 0.0010	05/02/97	0.0763 ± 0.0040	06/15/97
Zinc (Zn)	0.0127 ± 0.0078	27	0.0014 ± 0.0010	08/20/97	0.0324 ± 0.0019	08/27/97
Gallium (Ga)	0.0001 ± 0.0002	27	0.0000 ± 0.0019	05/02/97	0.0007 ± 0.0017	06/20/97
Arsenic (As)	0.0019 ± 0.0018	27	0.0002 ± 0.0023	05/02/97	0.0081 ± 0.0016	06/03/97
Selenium (Se)	0.0009 ± 0.0007	27	0.0000 ± 0.0012	06/22/97	0.0038 ± 0.0008	12/06/97
Bromine (Br)	0.0038 ± 0.0023	27	0.0012 ± 0.0007	05/22/97	0.0092 ± 0.0010	08/27/97
Rubidium (Rb)	0.0003 ± 0.0004	27	0.0000 ± 0.0010	05/04/97	0.0017 ± 0.0007	06/20/97
Strontium (Sr)	0.0009 ± 0.0014	27	0.0000 ± 0.0012	09/07/97	0.0058 ± 0.0008	06/20/97
Yttrium (Y)	0.0001 ± 0.0002	27	0.0000 ± 0.0014	03/23/97	0.0008 ± 0.0012	06/20/97
Zirconium (Zr)	0.0007 ± 0.0008	27	0.0000 ± 0.0016	03/23/97	0.0031 ± 0.0011	06/20/97
Molybdenum (Mo)	0.0002 ± 0.0003	27	0.0000 ± 0.0026	06/03/97	0.0014 ± 0.0029	03/23/97
Palladium (Pd)	0.0007 ± 0.0011	27	0.0000 ± 0.0082	06/22/97	0.0048 ± 0.0082	05/02/97
Silver (Ag)	0.0010 ± 0.0012	27	0.0000 ± 0.0095	03/23/97	0.0042 ± 0.0091	02/07/98
Cadmium (Cd)	0.0010 ± 0.0018	27	0.0000 ± 0.0100	03/23/97	0.0063 ± 0.0103	08/20/97
Indium (In)	0.0004 ± 0.0009	27	0.0000 ± 0.0117	03/23/97	0.0030 ± 0.0130	09/01/97
Tin (Sn)	0.0021 ± 0.0030	27	0.0000 ± 0.0151	03/23/97	0.0107 ± 0.0160	09/07/97
Antimony (Sb)	0.0022 ± 0.0035	27	0.0000 ± 0.0183	05/02/97	0.0111 ± 0.0198	09/01/97
Barium (Ba)	0.0067 ± 0.0105	27	0.0000 ± 0.0659	03/23/97	0.0403 ± 0.0444	06/20/97
Lanthanum (La)	0.0054 ± 0.0116	27	0.0000 ± 0.0874	03/23/97	0.0552 ± 0.0942	09/07/97
Gold (Au)	0.0003 ± 0.0005	27	0.0000 ± 0.0032	03/23/97	0.0014 ± 0.0027	05/22/97
Mercury (Hg)	0.0002 ± 0.0002	27	0.0000 ± 0.0023	06/03/97	0.0009 ± 0.0027	05/02/97
Thallium (Tl)	0.0001 ± 0.0002	27	0.0000 ± 0.0024	03/23/97	0.0007 ± 0.0026	06/22/97
Lead (Pb)	0.0032 ± 0.0018	27	0.0000 ± 0.0037	07/03/97	0.0056 ± 0.0023	05/04/97
Uranium (U)	0.0001 ± 0.0002	27	0.0000 ± 0.0024	03/23/97	0.0007 ± 0.0024	05/04/97
Sum of Species	12.6788 ± 6.4207	26	3.3635 ± 0.6011	08/20/97	25.3240 ± 1.1809	08/27/97

Table 4-3l. Statistical summary of $PM_{2.5}$ mass and chemical compositions acquired at the HW site during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

Site Code	Average (µg/m³)	Number in Average	Minimum (µg/m³)	Date of Minimum	Maximum (µg/m³)	Date of Maximum
$PM_{2.5}$ Mass	16.4352 ± 7.9364	15	5.4866 ± 0.4191	11/06/97	33.4693 ± 1.7132	08/26/97
Chloride (Cl^-)	0.0774 ± 0.1760	15	0.0000 ± 0.0272	10/19/97	0.7208 ± 0.0471	06/20/97
Nonvolatilized Nitrate (NO_3^-)	0.3617 ± 0.4611	15	0.0466 ± 0.0277	06/06/97	1.6592 ± 0.1046	12/18/97
Sulfate ($SO_4^=$)	4.3976 ± 3.2530	15	1.2317 ± 0.0810	11/06/97	10.7983 ± 0.7237	09/07/97
Ammonium (NH_4^+)	1.4148 ± 1.0298	15	0.3709 ± 0.0348	06/20/97	3.3584 ± 0.1716	06/06/97
Soluble Sodium (Na^+)	0.1112 ± 0.1271	15	0.0194 ± 0.0072	02/07/98	0.5134 ± 0.0333	06/20/97
Soluble Potassium (K^+)	0.0710 ± 0.0544	15	0.0245 ± 0.0029	07/27/97	0.2334 ± 0.0137	08/26/97
Volatilized Nitrate (NO_3^-)	N/A ± N/A	N/A	N/A ± N/A		N/A ± N/A	
Organic Carbon (OC)	2.8015 ± 1.7103	15	0.8434 ± 0.6076	07/27/97	7.2372 ± 0.7743	08/26/97
Elemental Carbon (EC)	1.0705 ± 0.6516	15	0.3432 ± 0.2402	06/20/97	2.7406 ± 0.1736	12/18/97
Sodium (Na)	0.0693 ± 0.0732	15	0.0000 ± 0.0752	03/23/97	0.2314 ± 0.0499	06/20/97
Magnesium (Mg)	0.0316 ± 0.0435	15	0.0000 ± 0.0238	02/04/98	0.1743 ± 0.0244	06/20/97
Aluminum (Al)	0.2142 ± 0.4573	15	0.0077 ± 0.0152	02/07/98	1.5342 ± 0.0790	06/20/97
Silicon (Si)	0.5153 ± 1.0406	15	0.0527 ± 0.0061	03/23/97	3.4208 ± 0.1718	06/20/97
Phosphorus (P)	0.0002 ± 0.0008	15	0.0000 ± 0.0130	03/23/97	0.0032 ± 0.0097	12/18/97
Sulfur (S)	1.7198 ± 1.2586	15	0.5274 ± 0.0269	11/06/97	4.1173 ± 0.2062	09/07/97
Chlorine (Cl)	0.0161 ± 0.0356	15	0.0000 ± 0.0440	04/28/97	0.1375 ± 0.0103	06/20/97
Potassium (K)	0.1273 ± 0.1087	15	0.0386 ± 0.0039	11/06/97	0.3657 ± 0.0191	06/20/97
Calcium (Ca)	0.0896 ± 0.0881	15	0.0221 ± 0.0040	10/19/97	0.3211 ± 0.0169	06/20/97
Titanium (Ti)	0.0177 ± 0.0341	15	0.0000 ± 0.0251	05/04/97	0.1091 ± 0.0173	06/20/97
Vanadium (V)	0.0015 ± 0.0016	15	0.0000 ± 0.0130	05/04/97	0.0062 ± 0.0097	07/03/97
Chromium (Cr)	0.0013 ± 0.0013	15	0.0000 ± 0.0023	04/28/97	0.0052 ± 0.0019	08/26/97
Manganese (Mn)	0.0049 ± 0.0057	15	0.0000 ± 0.0022	05/04/97	0.0175 ± 0.0017	06/20/97
Iron (Fe)	0.1915 ± 0.2993	15	0.0277 ± 0.0018	05/04/97	1.0396 ± 0.0521	06/20/97
Cobalt (Co)	0.0002 ± 0.0002	15	0.0000 ± 0.0028	03/23/97	0.0007 ± 0.0017	07/27/97
Nickel (Ni)	0.0012 ± 0.0012	15	0.0000 ± 0.0012	04/28/97	0.0038 ± 0.0009	08/26/97
Copper (Cu)	0.0049 ± 0.0050	15	0.0008 ± 0.0012	10/19/97	0.0190 ± 0.0014	09/07/97
Zinc (Zn)	0.0211 ± 0.0189	15	0.0021 ± 0.0008	07/27/97	0.0625 ± 0.0033	03/23/97
Gallium (Ga)	0.0001 ± 0.0002	15	0.0000 ± 0.0020	03/23/97	0.0007 ± 0.0018	07/03/97
Arsenic (As)	0.0018 ± 0.0017	15	0.0000 ± 0.0026	03/23/97	0.0059 ± 0.0017	08/26/97
Selenium (Se)	0.0009 ± 0.0005	15	0.0002 ± 0.0012	03/23/97	0.0024 ± 0.0008	04/28/97
Bromine (Br)	0.0044 ± 0.0030	15	0.0010 ± 0.0007	06/20/97	0.0098 ± 0.0010	08/26/97
Rubidium (Rb)	0.0003 ± 0.0005	15	0.0000 ± 0.0010	05/04/97	0.0017 ± 0.0007	06/20/97
Strontium (Sr)	0.0012 ± 0.0018	15	0.0000 ± 0.0011	04/28/97	0.0064 ± 0.0008	06/20/97
Yttrium (Y)	0.0002 ± 0.0003	15	0.0000 ± 0.0015	03/23/97	0.0011 ± 0.0009	06/20/97
Zirconium (Zr)	0.0008 ± 0.0011	15	0.0000 ± 0.0016	05/04/97	0.0036 ± 0.0011	06/20/97
Molybdenum (Mo)	0.0005 ± 0.0006	15	0.0000 ± 0.0028	06/06/97	0.0023 ± 0.0030	04/28/97
Palladium (Pd)	0.0008 ± 0.0012	15	0.0000 ± 0.0082	04/28/97	0.0036 ± 0.0074	07/27/97
Silver (Ag)	0.0012 ± 0.0016	15	0.0000 ± 0.0099	04/28/97	0.0058 ± 0.0089	11/06/97
Cadmium (Cd)	0.0011 ± 0.0012	15	0.0000 ± 0.0096	06/06/97	0.0031 ± 0.0103	03/23/97
Indium (In)	0.0007 ± 0.0010	15	0.0000 ± 0.0120	03/23/97	0.0026 ± 0.0119	05/04/97
Tin (Sn)	0.0014 ± 0.0026	15	0.0000 ± 0.0158	04/28/97	0.0101 ± 0.0159	03/23/97
Antimony (Sb)	0.0012 ± 0.0015	15	0.0000 ± 0.0182	03/23/97	0.0052 ± 0.0176	06/06/97
Barium (Ba)	0.0056 ± 0.0109	15	0.0000 ± 0.0686	03/23/97	0.0326 ± 0.0576	06/20/97
Lanthanum (La)	0.0080 ± 0.0105	15	0.0000 ± 0.0915	03/23/97	0.0275 ± 0.0919	12/18/97
Gold (Au)	0.0003 ± 0.0005	15	0.0000 ± 0.0062	03/23/97	0.0016 ± 0.0027	06/20/97
Mercury (Hg)	0.0002 ± 0.0002	15	0.0000 ± 0.0028	03/23/97	0.0006 ± 0.0024	08/26/97
Thallium (Tl)	0.0001 ± 0.0002	15	0.0000 ± 0.0026	03/23/97	0.0008 ± 0.0026	04/28/97
Lead (Pb)	0.0037 ± 0.0015	15	0.0017 ± 0.0030	11/06/97	0.0060 ± 0.0024	08/26/97
Uranium (U)	0.0001 ± 0.0001	15	0.0000 ± 0.0025	05/04/97	0.0005 ± 0.0021	06/20/97
Sum of Species	11.3990 ± 5.6164	15	4.1023 ± 0.6359	07/27/97	24.3874 ± 1.1185	08/26/97

Table 4-3m. Statistical summary of $PM_{2.5}$ mass and chemical compositions acquired at the HS site during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

Site Code	Average (µg/m³)	Number in Average	Minimum (µg/m³)	Date of Minimum	Maximum (µg/m³)	Date of Maximum
$PM_{2.5}$ Mass	5.1667 ± 2.4844	6	2.3633 ± 0.3254	11/06/97	10.0713 ± 0.6117	11/24/97
Chloride (Cl^-)	0.0130 ± 0.0119	6	0.0000 ± 0.0277	11/06/97	0.0295 ± 0.0506	11/24/97
Nonvolatilized Nitrate (NO_3^-)	0.0662 ± 0.0348	6	0.0360 ± 0.0259	10/19/97	0.1331 ± 0.0387	11/24/97
Sulfate ($SO_4^=$)	1.2850 ± 0.5876	6	0.5901 ± 0.0446	11/06/97	2.2709 ± 0.2281	09/13/97
Ammonium (NH_4^+)	0.4168 ± 0.1801	6	0.2004 ± 0.0278	11/06/97	0.7267 ± 0.0462	09/13/97
Soluble Sodium (Na^+)	0.0086 ± 0.0059	6	0.0000 ± 0.0339	12/18/97	0.0166 ± 0.0339	09/13/97
Soluble Potassium (K^+)	0.0285 ± 0.0138	6	0.0098 ± 0.0026	11/06/97	0.0466 ± 0.0053	11/24/97
Volatilized Nitrate (NO_3^-)	N/A ± N/A	N/A	N/A ± N/A		N/A ± N/A	
Organic Carbon (OC)	2.0074 ± 0.9737	6	1.0280 ± 0.5931	11/06/97	4.0224 ± 0.6367	11/24/97
Elemental Carbon (EC)	0.7024 ± 0.4216	6	0.2909 ± 0.0925	11/06/97	1.5089 ± 0.2036	11/24/97
Sodium (Na)	0.0192 ± 0.0226	6	0.0000 ± 0.0391	02/04/98	0.0665 ± 0.0327	09/13/97
Magnesium (Mg)	0.0307 ± 0.0449	6	0.0001 ± 0.0215	12/18/97	0.1291 ± 0.0165	11/24/97
Aluminum (Al)	0.0034 ± 0.0033	6	0.0000 ± 0.0158	09/13/97	0.0080 ± 0.0065	12/18/97
Silicon (Si)	0.0246 ± 0.0089	6	0.0129 ± 0.0035	10/19/97	0.0362 ± 0.0054	11/24/97
Phosphorus (P)	0.0010 ± 0.0023	6	0.0000 ± 0.0091	09/13/97	0.0062 ± 0.0032	12/18/97
Sulfur (S)	0.5102 ± 0.2177	6	0.2517 ± 0.0130	11/06/97	0.8339 ± 0.0421	09/13/97
Chlorine (Cl)	0.0029 ± 0.0040	6	0.0000 ± 0.0156	09/13/97	0.0111 ± 0.0149	11/24/97
Potassium (K)	0.0356 ± 0.0150	6	0.0147 ± 0.0031	11/06/97	0.0588 ± 0.0048	11/24/97
Calcium (Ca)	0.0102 ± 0.0056	6	0.0035 ± 0.0037	10/19/97	0.0200 ± 0.0070	12/18/97
Titanium (Ti)	0.0010 ± 0.0010	6	0.0001 ± 0.0234	10/19/97	0.0029 ± 0.0228	12/18/97
Vanadium (V)	0.0007 ± 0.0009	6	0.0000 ± 0.0098	11/06/97	0.0025 ± 0.0087	11/24/97
Chromium (Cr)	0.0003 ± 0.0005	6	0.0000 ± 0.0022	09/13/97	0.0013 ± 0.0025	02/04/98
Manganese (Mn)	0.0013 ± 0.0012	6	0.0001 ± 0.0016	10/19/97	0.0034 ± 0.0013	12/18/97
Iron (Fe)	0.0220 ± 0.0132	6	0.0089 ± 0.0013	09/13/97	0.0475 ± 0.0028	12/18/97
Cobalt (Co)	0.0001 ± 0.0001	6	0.0000 ± 0.0011	09/13/97	0.0004 ± 0.0011	02/04/98
Nickel (Ni)	0.0004 ± 0.0004	6	0.0000 ± 0.0011	12/18/97	0.0008 ± 0.0008	11/24/97
Copper (Cu)	0.0012 ± 0.0010	6	0.0000 ± 0.0011	11/06/97	0.0025 ± 0.0009	11/24/97
Zinc (Zn)	0.0095 ± 0.0059	6	0.0025 ± 0.0009	09/13/97	0.0196 ± 0.0014	12/18/97
Gallium (Ga)	0.0002 ± 0.0003	6	0.0000 ± 0.0018	12/18/97	0.0007 ± 0.0018	11/24/97
Arsenic (As)	0.0010 ± 0.0005	6	0.0004 ± 0.0021	11/06/97	0.0017 ± 0.0016	11/24/97
Selenium (Se)	0.0004 ± 0.0002	6	0.0002 ± 0.0010	09/13/97	0.0007 ± 0.0011	11/24/97
Bromine (Br)	0.0023 ± 0.0012	6	0.0006 ± 0.0010	11/06/97	0.0044 ± 0.0008	11/24/97
Rubidium (Rb)	0.0001 ± 0.0001	6	0.0000 ± 0.0009	09/13/97	0.0004 ± 0.0009	10/19/97
Strontium (Sr)	0.0002 ± 0.0001	6	0.0000 ± 0.0009	02/04/98	0.0003 ± 0.0010	09/13/97
Yttrium (Y)	0.0001 ± 0.0001	6	0.0000 ± 0.0012	09/13/97	0.0002 ± 0.0012	11/24/97
Zirconium (Zr)	0.0005 ± 0.0003	6	0.0001 ± 0.0014	09/13/97	0.0011 ± 0.0010	10/19/97
Molybdenum (Mo)	0.0001 ± 0.0002	6	0.0000 ± 0.0027	12/18/97	0.0005 ± 0.0024	02/04/98
Palladium (Pd)	0.0005 ± 0.0007	6	0.0000 ± 0.0075	09/13/97	0.0019 ± 0.0076	11/24/97
Silver (Ag)	0.0009 ± 0.0011	6	0.0000 ± 0.0086	09/13/97	0.0031 ± 0.0087	11/06/97
Cadmium (Cd)	0.0004 ± 0.0008	6	0.0000 ± 0.0090	09/13/97	0.0021 ± 0.0093	11/06/97
Indium (In)	0.0003 ± 0.0007	6	0.0000 ± 0.0105	09/13/97	0.0018 ± 0.0107	11/24/97
Tin (Sn)	0.0026 ± 0.0040	6	0.0000 ± 0.0134	09/13/97	0.0113 ± 0.0106	12/18/97
Antimony (Sb)	0.0034 ± 0.0026	6	0.0000 ± 0.0159	11/24/97	0.0069 ± 0.0165	12/18/97
Barium (Ba)	0.0006 ± 0.0014	6	0.0000 ± 0.0592	11/24/97	0.0038 ± 0.0588	09/13/97
Lanthanum (La)	0.0025 ± 0.0057	6	0.0000 ± 0.0784	09/13/97	0.0152 ± 0.0824	12/18/97
Gold (Au)	0.0002 ± 0.0003	6	0.0000 ± 0.0028	09/13/97	0.0009 ± 0.0029	11/24/97
Mercury (Hg)	0.0001 ± 0.0002	6	0.0000 ± 0.0023	11/24/97	0.0004 ± 0.0023	09/13/97
Thallium (Tl)	0.0000 ± 0.0000	6	0.0000 ± 0.0022	09/13/97	0.0000 ± 0.0022	09/13/97
Lead (Pb)	0.0014 ± 0.0012	6	0.0003 ± 0.0029	09/13/97	0.0040 ± 0.0024	12/18/97
Uranium (U)	0.0001 ± 0.0001	6	0.0000 ± 0.0022	11/24/97	0.0002 ± 0.0022	09/13/97
Sum of Species	4.6182 ± 1.8387	6	2.2344 ± 0.6130	11/06/97	8.1820 ± 0.6890	11/24/97

Table 4-3n. Statistical summary of $PM_{2.5}$ mass and chemical compositions acquired at the HC collocated site (denuder on) during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

Site Code	Average (µg/m³)	Number in Average	Minimum (µg/m³)	Date of Minimum	Maximum (µg/m³)	Date of Maximum
$PM_{2.5}$ Mass	23.8650 ± 6.2526	6	12.2264 ± 0.6953	09/13/97	30.2905 ± 1.5538	09/01/97
Chloride (Cl^-)	0.0901 ± 0.0999	6	0.0235 ± 0.0494	09/13/97	0.3093 ± 0.0617	03/11/97
Nonvolatilized Nitrate (NO_3^-)	0.8924 ± 1.4392	6	0.0896 ± 0.0374	09/13/97	4.0760 ± 0.2944	03/11/97
Sulfate ($SO_4^=$)	8.9597 ± 3.3085	6	5.1394 ± 0.3464	09/13/97	13.4798 ± 0.8606	09/01/97
Ammonium (NH_4^+)	2.7898 ± 1.1561	6	1.2947 ± 0.0725	09/13/97	4.5505 ± 0.2401	09/01/97
Soluble Sodium (Na^+)	0.1727 ± 0.1333	6	0.0713 ± 0.0184	03/23/97	0.3683 ± 0.0392	09/07/97
Soluble Potassium (K^+)	0.0883 ± 0.0562	6	0.0324 ± 0.0118	03/23/97	0.1771 ± 0.0149	05/02/97
Volatilized Nitrate (NO_3^-)	0.7694 ± 0.4617	6	0.0960 ± 0.0137	05/02/97	1.3362 ± 0.0890	09/07/97
Organic Carbon (OC)	3.0106 ± 0.6065	6	2.0697 ± 0.5680	09/13/97	3.8872 ± 0.6454	09/01/97
Elemental Carbon (EC)	1.6954 ± 0.4486	6	1.2034 ± 0.1651	09/01/97	2.3377 ± 0.3985	03/11/97
Sodium (Na)	0.1125 ± 0.0797	6	0.0000 ± 0.0959	03/23/97	0.2206 ± 0.0320	05/02/97
Magnesium (Mg)	0.0180 ± 0.0153	6	0.0016 ± 0.0366	09/13/97	0.0380 ± 0.0492	09/07/97
Aluminum (Al)	0.0375 ± 0.0100	6	0.0246 ± 0.0089	09/13/97	0.0573 ± 0.0123	09/01/97
Silicon (Si)	0.1483 ± 0.0269	6	0.1123 ± 0.0102	09/07/97	0.1854 ± 0.0115	03/11/97
Phosphorus (P)	0.0000 ± 0.0000	6	0.0000 ± 0.0154	03/11/97	0.0000 ± 0.0154	03/11/97
Sulfur (S)	3.1944 ± 0.9814	6	1.7857 ± 0.0896	09/13/97	4.3430 ± 0.2175	09/01/97
Chlorine (Cl)	0.0116 ± 0.0213	6	0.0000 ± 0.0675	03/23/97	0.0584 ± 0.0167	03/11/97
Potassium (K)	0.0954 ± 0.0579	6	0.0349 ± 0.0081	03/23/97	0.2044 ± 0.0134	05/02/97
Calcium (Ca)	0.1771 ± 0.1491	6	0.0726 ± 0.0062	03/11/97	0.5026 ± 0.0260	05/02/97
Titanium (Ti)	0.0040 ± 0.0020	6	0.0000 ± 0.0259	09/01/97	0.0064 ± 0.0220	05/02/97
Vanadium (V)	0.0068 ± 0.0043	6	0.0000 ± 0.0137	09/01/97	0.0146 ± 0.0066	03/11/97
Chromium (Cr)	0.0006 ± 0.0007	6	0.0000 ± 0.0043	09/01/97	0.0019 ± 0.0016	03/11/97
Manganese (Mn)	0.0036 ± 0.0026	6	0.0012 ± 0.0023	09/01/97	0.0091 ± 0.0013	03/11/97
Iron (Fe)	0.0807 ± 0.0469	6	0.0482 ± 0.0028	09/01/97	0.1834 ± 0.0094	03/11/97
Cobalt (Co)	0.0002 ± 0.0002	6	0.0000 ± 0.0032	03/11/97	0.0005 ± 0.0017	03/23/97
Nickel (Ni)	0.0025 ± 0.0012	6	0.0015 ± 0.0009	09/01/97	0.0050 ± 0.0009	03/11/97
Copper (Cu)	0.0055 ± 0.0043	6	0.0008 ± 0.0004	05/02/97	0.0127 ± 0.0008	03/11/97
Zinc (Zn)	0.0150 ± 0.0062	6	0.0093 ± 0.0010	09/13/97	0.0282 ± 0.0016	03/11/97
Gallium (Ga)	0.0002 ± 0.0004	6	0.0000 ± 0.0018	03/23/97	0.0010 ± 0.0016	03/11/97
Arsenic (As)	0.0008 ± 0.0005	6	0.0000 ± 0.0023	03/23/97	0.0015 ± 0.0022	09/13/97
Selenium (Se)	0.0010 ± 0.0003	6	0.0005 ± 0.0011	05/02/97	0.0015 ± 0.0009	09/07/97
Bromine (Br)	0.0060 ± 0.0027	6	0.0026 ± 0.0008	09/13/97	0.0114 ± 0.0010	03/11/97
Rubidium (Rb)	0.0001 ± 0.0002	6	0.0000 ± 0.0010	03/11/97	0.0004 ± 0.0009	05/02/97
Strontium (Sr)	0.0004 ± 0.0003	6	0.0000 ± 0.0012	09/01/97	0.0010 ± 0.0007	05/02/97
Yttrium (Y)	0.0000 ± 0.0000	6	0.0000 ± 0.0013	03/23/97	0.0001 ± 0.0012	03/11/97
Zirconium (Zr)	0.0004 ± 0.0003	6	0.0000 ± 0.0014	09/07/97	0.0007 ± 0.0017	09/01/97
Molybdenum (Mo)	0.0007 ± 0.0008	6	0.0000 ± 0.0031	09/01/97	0.0023 ± 0.0018	03/11/97
Palladium (Pd)	0.0014 ± 0.0012	6	0.0000 ± 0.0076	09/13/97	0.0030 ± 0.0072	05/02/97
Silver (Ag)	0.0006 ± 0.0006	6	0.0000 ± 0.0099	09/01/97	0.0015 ± 0.0087	05/02/97
Cadmium (Cd)	0.0018 ± 0.0024	6	0.0000 ± 0.0093	09/07/97	0.0065 ± 0.0096	03/23/97
Indium (In)	0.0012 ± 0.0010	6	0.0000 ± 0.0107	05/02/97	0.0026 ± 0.0110	03/23/97
Tin (Sn)	0.0021 ± 0.0035	6	0.0000 ± 0.0139	03/11/97	0.0096 ± 0.0155	09/01/97
Antimony (Sb)	0.0021 ± 0.0027	6	0.0000 ± 0.0173	03/23/97	0.0074 ± 0.0163	03/11/97
Barium (Ba)	0.0016 ± 0.0022	6	0.0000 ± 0.0594	03/11/97	0.0048 ± 0.0676	09/01/97
Lanthanum (La)	0.0066 ± 0.0134	6	0.0000 ± 0.0792	03/11/97	0.0366 ± 0.0900	09/01/97
Gold (Au)	0.0003 ± 0.0006	6	0.0000 ± 0.0030	03/23/97	0.0017 ± 0.0030	03/11/97
Mercury (Hg)	0.0005 ± 0.0003	6	0.0000 ± 0.0028	09/01/97	0.0008 ± 0.0025	03/23/97
Thallium (Tl)	0.0002 ± 0.0004	6	0.0000 ± 0.0021	03/11/97	0.0010 ± 0.0023	03/23/97
Lead (Pb)	0.0033 ± 0.0021	6	0.0005 ± 0.0031	09/13/97	0.0068 ± 0.0021	03/11/97
Uranium (U)	0.0001 ± 0.0001	6	0.0000 ± 0.0023	03/23/97	0.0001 ± 0.0021	03/11/97
Sum of Species	18.1402 ± 4.6656	6	10.3910 ± 0.7021	09/13/97	23.8917 ± 1.1255	09/01/97

Table 4-3o. Statistical summary of $PM_{2.5}$ mass and chemical compositions acquired at the HC collocated site (denuder off) during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

Site Code	Average (µg/m³)	Number in Average	Minimum (µg/m³)	Date of Minimum	Maximum (µg/m³)	Date of Maximum
$PM_{2.5}$ Mass	14.7421 ± 3.9571	6	9.4038 ± 0.5836	05/04/97	19.4549 ± 1.0610	04/22/97
Chloride (Cl^-)	0.0569 ± 0.0754	6	0.0044 ± 0.0293	10/25/97	0.2172 ± 0.0503	04/10/97
Nonvolatilized Nitrate (NO_3^-)	0.1853 ± 0.1327	6	0.0715 ± 0.0265	10/25/97	0.4611 ± 0.0376	04/10/97
Sulfate ($SO_4^=$)	5.0131 ± 2.6148	6	2.2249 ± 0.2311	05/10/97	8.9754 ± 0.4905	04/22/97
Ammonium (NH_4^+)	1.5257 ± 0.8240	6	0.6646 ± 0.0429	05/04/97	2.8018 ± 0.1458	04/22/97
Soluble Sodium (Na^+)	0.1428 ± 0.0798	6	0.0544 ± 0.0208	05/04/97	0.2630 ± 0.0151	10/25/97
Soluble Potassium (K^+)	0.0547 ± 0.0089	6	0.0371 ± 0.0067	05/04/97	0.0655 ± 0.0122	04/22/97
Volatilized Nitrate (NO_3^-)	0.9815 ± 0.7959	4	0.3100 ± 0.0259	10/25/97	2.3230 ± 0.1644	10/19/97
Organic Carbon (OC)	2.4554 ± 0.4783	6	1.8803 ± 0.9134	04/22/97	3.2495 ± 0.6259	10/19/97
Elemental Carbon (EC)	1.3035 ± 0.6140	6	0.5618 ± 0.2350	05/10/97	2.2615 ± 0.3872	04/22/97
Sodium (Na)	0.0646 ± 0.0479	6	0.0000 ± 0.0655	10/19/97	0.1441 ± 0.0337	10/25/97
Magnesium (Mg)	0.0177 ± 0.0189	6	0.0000 ± 0.0370	04/10/97	0.0429 ± 0.0159	10/25/97
Aluminum (Al)	0.0556 ± 0.0120	6	0.0351 ± 0.0078	05/04/97	0.0707 ± 0.0108	04/10/97
Silicon (Si)	0.1674 ± 0.0613	6	0.1064 ± 0.0073	05/04/97	0.2549 ± 0.0146	04/10/97
Phosphorus (P)	0.0000 ± 0.0000	6	0.0000 ± 0.0147	04/10/97	0.0000 ± 0.0147	04/10/97
Sulfur (S)	1.8531 ± 0.9767	6	0.7778 ± 0.0393	05/04/97	3.2179 ± 0.1613	04/22/97
Chlorine (Cl)	0.0120 ± 0.0254	6	0.0000 ± 0.0514	04/22/97	0.0687 ± 0.0149	04/10/97
Potassium (K)	0.0690 ± 0.0114	6	0.0498 ± 0.0043	05/04/97	0.0827 ± 0.0094	04/10/97
Calcium (Ca)	0.2206 ± 0.0837	6	0.0817 ± 0.0056	05/10/97	0.3139 ± 0.0165	10/25/97
Titanium (Ti)	0.0055 ± 0.0021	6	0.0034 ± 0.0231	10/25/97	0.0093 ± 0.0228	10/19/97
Vanadium (V)	0.0054 ± 0.0016	6	0.0029 ± 0.0096	10/19/97	0.0075 ± 0.0102	04/10/97
Chromium (Cr)	0.0008 ± 0.0003	6	0.0005 ± 0.0026	10/25/97	0.0012 ± 0.0021	05/10/97
Manganese (Mn)	0.0036 ± 0.0025	6	0.0019 ± 0.0013	05/04/97	0.0091 ± 0.0014	04/10/97
Iron (Fe)	0.0751 ± 0.0332	6	0.0399 ± 0.0023	05/04/97	0.1209 ± 0.0066	10/19/97
Cobalt (Co)	0.0004 ± 0.0002	6	0.0000 ± 0.0018	04/22/97	0.0007 ± 0.0023	10/19/97
Nickel (Ni)	0.0015 ± 0.0002	6	0.0012 ± 0.0008	04/22/97	0.0018 ± 0.0008	05/10/97
Copper (Cu)	0.0054 ± 0.0021	6	0.0017 ± 0.0004	04/22/97	0.0085 ± 0.0010	05/04/97
Zinc (Zn)	0.0354 ± 0.0282	6	0.0078 ± 0.0010	05/04/97	0.0827 ± 0.0043	10/25/97
Gallium (Ga)	0.0002 ± 0.0003	6	0.0000 ± 0.0019	04/10/97	0.0007 ± 0.0018	05/04/97
Arsenic (As)	0.0007 ± 0.0005	6	0.0001 ± 0.0026	04/10/97	0.0017 ± 0.0015	10/25/97
Selenium (Se)	0.0010 ± 0.0003	6	0.0007 ± 0.0011	10/25/97	0.0016 ± 0.0008	04/10/97
Bromine (Br)	0.0050 ± 0.0030	6	0.0025 ± 0.0008	05/04/97	0.0111 ± 0.0010	04/10/97
Rubidium (Rb)	0.0002 ± 0.0002	6	0.0000 ± 0.0009	05/04/97	0.0005 ± 0.0010	04/22/97
Strontium (Sr)	0.0010 ± 0.0003	6	0.0007 ± 0.0011	04/22/97	0.0015 ± 0.0008	05/04/97
Yttrium (Y)	0.0001 ± 0.0002	6	0.0000 ± 0.0014	04/10/97	0.0006 ± 0.0012	10/19/97
Zirconium (Zr)	0.0004 ± 0.0003	6	0.0001 ± 0.0016	04/10/97	0.0010 ± 0.0016	04/22/97
Molybdenum (Mo)	0.0004 ± 0.0004	6	0.0000 ± 0.0028	04/22/97	0.0011 ± 0.0030	04/10/97
Palladium (Pd)	0.0012 ± 0.0016	6	0.0000 ± 0.0075	05/04/97	0.0039 ± 0.0079	04/22/97
Silver (Ag)	0.0013 ± 0.0014	6	0.0000 ± 0.0089	05/04/97	0.0043 ± 0.0099	04/10/97
Cadmium (Cd)	0.0021 ± 0.0026	6	0.0000 ± 0.0098	04/22/97	0.0069 ± 0.0068	10/19/97
Indium (In)	0.0001 ± 0.0002	6	0.0000 ± 0.0121	04/10/97	0.0005 ± 0.0106	10/19/97
Tin (Sn)	0.0000 ± 0.0000	6	0.0000 ± 0.0157	04/10/97	0.0000 ± 0.0157	04/10/97
Antimony (Sb)	0.0012 ± 0.0020	6	0.0000 ± 0.0171	04/22/97	0.0054 ± 0.0186	04/10/97
Barium (Ba)	0.0013 ± 0.0028	6	0.0000 ± 0.0686	04/10/97	0.0075 ± 0.0603	05/10/97
Lanthanum (La)	0.0015 ± 0.0026	6	0.0000 ± 0.0918	04/10/97	0.0071 ± 0.0827	10/25/97
Gold (Au)	0.0002 ± 0.0003	6	0.0000 ± 0.0034	04/10/97	0.0009 ± 0.0028	05/04/97
Mercury (Hg)	0.0001 ± 0.0003	6	0.0000 ± 0.0026	04/10/97	0.0007 ± 0.0025	04/22/97
Thallium (Tl)	0.0004 ± 0.0005	6	0.0000 ± 0.0022	05/04/97	0.0014 ± 0.0026	04/10/97
Lead (Pb)	0.0037 ± 0.0010	6	0.0029 ± 0.0023	05/04/97	0.0056 ± 0.0023	04/10/97
Uranium (U)	0.0001 ± 0.0002	6	0.0000 ± 0.0024	04/22/97	0.0004 ± 0.0026	04/10/97
Sum of Species	11.3055 ± 3.8010	6	6.7221 ± 0.5069	05/04/97	16.7924 ± 1.1243	04/22/97

Table 4-3p. Statistical summary of $PM_{2.5}$ mass and chemical compositions acquired at the HT collocated site (denuder on) during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

Site Code	Average (µg/m³)	Number in Average	Minimum (µg/m³)	Date of Minimum	Maximum (µg/m³)	Date of Maximum
$PM_{2.5}$ Mass	13.3660 ± 1.0754	4	11.5819 ± 0.6481	12/06/97	14.2941 ± 0.7904	12/18/97
Chloride (Cl^-)	0.0234 ± 0.0139	4	0.0077 ± 0.0299	12/06/97	0.0451 ± 0.0511	12/18/97
Nonvolatilized Nitrate (NO_3^-)	0.3530 ± 0.1646	4	0.2158 ± 0.0388	05/22/97	0.6311 ± 0.0530	12/18/97
Sulfate ($SO_4^=$)	2.9032 ± 1.4374	4	1.4427 ± 0.0929	12/06/97	4.8593 ± 0.3454	05/22/97
Ammonium (NH_4^+)	0.7597 ± 0.3073	4	0.3788 ± 0.0326	12/06/97	1.2250 ± 0.0676	05/22/97
Soluble Sodium (Na^+)	0.0627 ± 0.0501	4	0.0011 ± 0.0338	12/18/97	0.1408 ± 0.0225	05/28/97
Soluble Potassium (K^+)	0.0590 ± 0.0167	4	0.0328 ± 0.0068	05/22/97	0.0791 ± 0.0078	05/28/97
Volatilized Nitrate (NO_3^-)	0.4758 ± 0.5663	4	0.1393 ± 0.0148	05/28/97	1.4565 ± 0.0955	12/18/97
Organic Carbon (OC)	3.3464 ± 1.4800	4	1.7409 ± 0.3868	05/22/97	5.6016 ± 0.7027	12/18/97
Elemental Carbon (EC)	1.2785 ± 0.6019	4	0.6348 ± 0.2426	05/22/97	2.2614 ± 0.3029	12/18/97
Sodium (Na)	0.0661 ± 0.0259	4	0.0424 ± 0.0681	12/18/97	0.1091 ± 0.0410	05/28/97
Magnesium (Mg)	0.0179 ± 0.0120	4	0.0037 ± 0.0332	05/28/97	0.0333 ± 0.0133	12/06/97
Aluminum (Al)	0.0340 ± 0.0111	4	0.0169 ± 0.0195	05/22/97	0.0480 ± 0.0068	12/06/97
Silicon (Si)	0.0940 ± 0.0432	4	0.0424 ± 0.0059	05/22/97	0.1621 ± 0.0095	12/06/97
Phosphorus (P)	0.0003 ± 0.0003	4	0.0000 ± 0.0123	05/22/97	0.0006 ± 0.0081	12/18/97
Sulfur (S)	1.0902 ± 0.5266	4	0.5627 ± 0.0285	12/06/97	1.6973 ± 0.0852	05/22/97
Chlorine (Cl)	0.0040 ± 0.0040	4	0.0000 ± 0.0313	05/22/97	0.0086 ± 0.0136	12/06/97
Potassium (K)	0.0757 ± 0.0231	4	0.0404 ± 0.0040	05/22/97	0.1038 ± 0.0066	05/28/97
Calcium (Ca)	0.0967 ± 0.1036	4	0.0129 ± 0.0036	05/22/97	0.2722 ± 0.0145	12/06/97
Titanium (Ti)	0.0014 ± 0.0015	4	0.0000 ± 0.0238	05/22/97	0.0037 ± 0.0216	12/18/97
Vanadium (V)	0.0010 ± 0.0011	4	0.0000 ± 0.0122	05/22/97	0.0025 ± 0.0093	05/28/97
Chromium (Cr)	0.0011 ± 0.0012	4	0.0000 ± 0.0038	05/22/97	0.0030 ± 0.0018	12/18/97
Manganese (Mn)	0.0030 ± 0.0022	4	0.0007 ± 0.0021	05/22/97	0.0066 ± 0.0014	12/18/97
Iron (Fe)	0.0551 ± 0.0257	4	0.0260 ± 0.0017	05/22/97	0.0855 ± 0.0046	12/18/97
Cobalt (Co)	0.0002 ± 0.0002	4	0.0000 ± 0.0013	05/28/97	0.0006 ± 0.0017	12/06/97
Nickel (Ni)	0.0008 ± 0.0006	4	0.0000 ± 0.0010	12/06/97	0.0015 ± 0.0008	12/18/97
Copper (Cu)	0.0043 ± 0.0032	4	0.0012 ± 0.0009	05/22/97	0.0092 ± 0.0010	12/18/97
Zinc (Zn)	0.0120 ± 0.0064	4	0.0060 ± 0.0009	05/22/97	0.0227 ± 0.0015	12/18/97
Gallium (Ga)	0.0000 ± 0.0000	4	0.0000 ± 0.0019	05/22/97	0.0000 ± 0.0019	05/22/97
Arsenic (As)	0.0018 ± 0.0008	4	0.0009 ± 0.0024	12/06/97	0.0031 ± 0.0017	12/18/97
Selenium (Se)	0.0017 ± 0.0014	4	0.0004 ± 0.0012	05/28/97	0.0040 ± 0.0008	12/06/97
Bromine (Br)	0.0033 ± 0.0013	4	0.0015 ± 0.0008	05/22/97	0.0046 ± 0.0008	05/28/97
Rubidium (Rb)	0.0002 ± 0.0002	4	0.0000 ± 0.0010	05/22/97	0.0003 ± 0.0009	12/18/97
Strontium (Sr)	0.0004 ± 0.0003	4	0.0000 ± 0.0011	05/28/97	0.0009 ± 0.0007	12/06/97
Yttrium (Y)	0.0001 ± 0.0001	4	0.0000 ± 0.0013	05/22/97	0.0002 ± 0.0012	12/06/97
Zirconium (Zr)	0.0002 ± 0.0002	4	0.0000 ± 0.0016	05/28/97	0.0004 ± 0.0014	12/18/97
Molybdenum (Mo)	0.0000 ± 0.0000	4	0.0000 ± 0.0028	05/22/97	0.0001 ± 0.0029	05/28/97
Palladium (Pd)	0.0012 ± 0.0010	4	0.0000 ± 0.0073	12/06/97	0.0025 ± 0.0075	12/18/97
Silver (Ag)	0.0005 ± 0.0007	4	0.0000 ± 0.0094	05/22/97	0.0017 ± 0.0086	12/06/97
Cadmium (Cd)	0.0005 ± 0.0008	4	0.0000 ± 0.0097	05/22/97	0.0018 ± 0.0091	12/06/97
Indium (In)	0.0000 ± 0.0000	4	0.0000 ± 0.0115	05/22/97	0.0000 ± 0.0115	05/22/97
Tin (Sn)	0.0021 ± 0.0020	4	0.0000 ± 0.0135	12/18/97	0.0048 ± 0.0134	12/06/97
Antimony (Sb)	0.0040 ± 0.0024	4	0.0000 ± 0.0178	05/28/97	0.0064 ± 0.0159	12/18/97
Barium (Ba)	0.0076 ± 0.0077	4	0.0000 ± 0.0655	05/28/97	0.0175 ± 0.0554	12/06/97
Lanthanum (La)	0.0062 ± 0.0107	4	0.0000 ± 0.0871	05/28/97	0.0248 ± 0.0845	05/22/97
Gold (Au)	0.0001 ± 0.0001	4	0.0000 ± 0.0030	05/22/97	0.0003 ± 0.0030	12/18/97
Mercury (Hg)	0.0001 ± 0.0001	4	0.0000 ± 0.0025	05/22/97	0.0003 ± 0.0022	12/06/97
Thallium (Tl)	0.0002 ± 0.0002	4	0.0000 ± 0.0025	05/28/97	0.0005 ± 0.0024	05/22/97
Lead (Pb)	0.0028 ± 0.0024	4	0.0002 ± 0.0032	05/22/97	0.0060 ± 0.0022	12/06/97
Uranium (U)	0.0004 ± 0.0003	4	0.0000 ± 0.0021	12/06/97	0.0008 ± 0.0025	05/28/97
Sum of Species	9.1200 ± 1.2606	4	7.7765 ± 0.6787	12/06/97	11.1785 ± 0.7829	12/18/97

Table 4-3q. Statistical summary of $PM_{2.5}$ mass and chemical compositions acquired at the HT collocated site (denuder off) during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

Site Code	Average (µg/m³)	Number in Average	Minimum (µg/m³)	Date of Minimum	Maximum (µg/m³)	Date of Maximum
$PM_{2.5}$ Mass	15.7468 ± 7.6129	8	4.9265 ± 0.3951	11/06/97	29.7271 ± 1.5248	06/06/97
Chloride (Cl^-)	0.0401 ± 0.0314	8	0.0198 ± 0.0323	06/09/97	0.1157 ± 0.0301	06/20/97
Nonvolatilized Nitrate (NO_3^-)	0.2122 ± 0.2229	8	0.0517 ± 0.0282	06/06/97	0.7163 ± 0.0558	11/24/97
Sulfate ($SO_4^=$)	4.4359 ± 3.2827	8	1.0621 ± 0.0706	11/06/97	12.0631 ± 0.7310	06/06/97
Ammonium (NH_4^+)	1.3392 ± 1.2122	8	0.2974 ± 0.0305	06/20/97	4.1401 ± 0.2172	06/06/97
Soluble Sodium (Na^+)	0.0937 ± 0.0861	8	0.0108 ± 0.0070	11/06/97	0.2760 ± 0.0249	06/20/97
Soluble Potassium (K^+)	0.0516 ± 0.0216	8	0.0182 ± 0.0027	11/06/97	0.0799 ± 0.0064	11/24/97
Volatilized Nitrate (NO_3^-)	0.9546 ± 0.5454	5	0.1072 ± 0.0137	11/06/97	1.6805 ± 0.1073	11/24/97
Organic Carbon (OC)	3.0782 ± 1.8346	8	1.1439 ± 0.5952	11/06/97	6.1520 ± 0.5750	06/03/97
Elemental Carbon (EC)	1.0016 ± 0.6196	8	0.3332 ± 0.2384	06/22/97	1.9719 ± 0.2634	11/24/97
Sodium (Na)	0.0913 ± 0.0541	8	0.0000 ± 0.0380	11/06/97	0.1800 ± 0.0409	06/15/97
Magnesium (Mg)	0.0445 ± 0.0350	8	0.0000 ± 0.0182	11/06/97	0.1062 ± 0.0213	06/20/97
Aluminum (Al)	0.2112 ± 0.3167	8	0.0141 ± 0.0055	11/06/97	1.0000 ± 0.0526	06/20/97
Silicon (Si)	0.5013 ± 0.7346	8	0.0528 ± 0.0045	11/06/97	2.3399 ± 0.1178	06/20/97
Phosphorus (P)	0.0000 ± 0.0000	8	0.0000 ± 0.0134	06/03/97	0.0000 ± 0.0134	06/03/97
Sulfur (S)	1.5168 ± 0.9863	8	0.4660 ± 0.0236	11/06/97	3.6133 ± 0.1810	06/06/97
Chlorine (Cl)	0.0055 ± 0.0104	8	0.0000 ± 0.0381	06/03/97	0.0305 ± 0.0067	06/20/97
Potassium (K)	0.0990 ± 0.0739	8	0.0267 ± 0.0034	11/06/97	0.2785 ± 0.0149	06/20/97
Calcium (Ca)	0.0637 ± 0.0603	8	0.0202 ± 0.0037	06/09/97	0.2173 ± 0.0119	06/20/97
Titanium (Ti)	0.0164 ± 0.0272	8	0.0000 ± 0.0235	06/09/97	0.0863 ± 0.0176	06/20/97
Vanadium (V)	0.0016 ± 0.0016	8	0.0000 ± 0.0121	06/09/97	0.0050 ± 0.0102	06/20/97
Chromium (Cr)	0.0016 ± 0.0027	8	0.0000 ± 0.0038	06/09/97	0.0086 ± 0.0017	06/06/97
Manganese (Mn)	0.0039 ± 0.0032	8	0.0014 ± 0.0013	11/06/97	0.0121 ± 0.0016	06/20/97
Iron (Fe)	0.1760 ± 0.2342	8	0.0311 ± 0.0029	11/06/97	0.7747 ± 0.0389	06/20/97
Cobalt (Co)	0.0001 ± 0.0002	8	0.0000 ± 0.0013	06/03/97	0.0005 ± 0.0038	06/22/97
Nickel (Ni)	0.0008 ± 0.0007	8	0.0000 ± 0.0012	06/22/97	0.0023 ± 0.0008	11/24/97
Copper (Cu)	0.0037 ± 0.0030	8	0.0000 ± 0.0014	06/20/97	0.0071 ± 0.0010	06/09/97
Zinc (Zn)	0.0215 ± 0.0167	8	0.0029 ± 0.0009	06/15/97	0.0612 ± 0.0032	06/20/97
Gallium (Ga)	0.0002 ± 0.0003	8	0.0000 ± 0.0018	06/09/97	0.0010 ± 0.0019	06/03/97
Arsenic (As)	0.0023 ± 0.0023	8	0.0000 ± 0.0020	11/06/97	0.0078 ± 0.0017	06/03/97
Selenium (Se)	0.0010 ± 0.0008	8	0.0000 ± 0.0013	06/22/97	0.0024 ± 0.0009	06/03/97
Bromine (Br)	0.0031 ± 0.0022	8	0.0011 ± 0.0008	06/20/97	0.0083 ± 0.0009	11/24/97
Rubidium (Rb)	0.0003 ± 0.0002	8	0.0000 ± 0.0010	06/09/97	0.0008 ± 0.0011	06/20/97
Strontium (Sr)	0.0012 ± 0.0015	8	0.0001 ± 0.0010	11/24/97	0.0050 ± 0.0008	06/20/97
Yttrium (Y)	0.0001 ± 0.0001	8	0.0000 ± 0.0013	06/03/97	0.0004 ± 0.0015	06/20/97
Zirconium (Zr)	0.0006 ± 0.0007	8	0.0000 ± 0.0016	06/06/97	0.0025 ± 0.0011	06/20/97
Molybdenum (Mo)	0.0003 ± 0.0004	8	0.0000 ± 0.0026	06/15/97	0.0011 ± 0.0027	06/09/97
Palladium (Pd)	0.0012 ± 0.0014	8	0.0000 ± 0.0079	06/06/97	0.0046 ± 0.0078	06/09/97
Silver (Ag)	0.0001 ± 0.0002	8	0.0000 ± 0.0092	06/03/97	0.0007 ± 0.0098	06/22/97
Cadmium (Cd)	0.0009 ± 0.0013	8	0.0000 ± 0.0090	06/15/97	0.0036 ± 0.0095	06/03/97
Indium (In)	0.0001 ± 0.0003	8	0.0000 ± 0.0114	06/03/97	0.0010 ± 0.0121	06/22/97
Tin (Sn)	0.0028 ± 0.0032	8	0.0000 ± 0.0149	06/03/97	0.0082 ± 0.0157	06/22/97
Antimony (Sb)	0.0017 ± 0.0028	8	0.0000 ± 0.0173	06/03/97	0.0082 ± 0.0175	06/06/97
Barium (Ba)	0.0102 ± 0.0090	8	0.0000 ± 0.0597	11/24/97	0.0230 ± 0.0614	06/09/97
Lanthanum (La)	0.0076 ± 0.0144	8	0.0000 ± 0.0843	06/03/97	0.0443 ± 0.0832	06/09/97
Gold (Au)	0.0003 ± 0.0003	8	0.0000 ± 0.0051	06/20/97	0.0010 ± 0.0030	06/09/97
Mercury (Hg)	0.0002 ± 0.0002	8	0.0000 ± 0.0024	06/09/97	0.0006 ± 0.0028	06/22/97
Thallium (Tl)	0.0001 ± 0.0001	8	0.0000 ± 0.0024	06/03/97	0.0003 ± 0.0020	11/06/97
Lead (Pb)	0.0035 ± 0.0021	8	0.0000 ± 0.0035	06/20/97	0.0062 ± 0.0023	06/03/97
Uranium (U)	0.0003 ± 0.0004	8	0.0000 ± 0.0022	06/15/97	0.0012 ± 0.0024	06/06/97
Sum of Species	11.3052 ± 5.6735	8	3.2445 ± 0.6177	11/06/97	22.4614 ± 0.9437	06/06/97

Table 4-3r. Statistical summary of $PM_{2.5}$ mass and chemical compositions acquired at the H3 collocated site (denuder on) during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

Site Code	Average (µg/m³)	Number in Average	Minimum (µg/m³)	Date of Minimum	Maximum (µg/m³)	Date of Maximum
$PM_{2.5}$ Mass	14.2005 ± 5.7224	4	9.8772 ± 0.5736	07/27/97	24.0363 ± 1.2490	07/03/97
Chloride (Cl^-)	0.0440 ± 0.0204	4	0.0213 ± 0.0279	07/27/97	0.0719 ± 0.0524	07/03/97
Nonvolatilized Nitrate (NO_3^-)	0.5361 ± 0.4548	4	0.1101 ± 0.0279	07/27/97	1.3013 ± 0.1337	01/17/98
Sulfate ($SO_4^=$)	3.6686 ± 1.0776	4	2.7705 ± 0.1848	01/17/98	5.5072 ± 0.3233	01/23/98
Ammonium (NH_4^+)	1.1568 ± 0.3857	4	0.8640 ± 0.0526	07/03/97	1.8197 ± 0.0962	01/23/98
Soluble Sodium (Na^+)	0.1564 ± 0.0650	4	0.0964 ± 0.0101	01/17/98	0.2597 ± 0.0373	07/03/97
Soluble Potassium (K^+)	0.0531 ± 0.0160	4	0.0273 ± 0.0030	07/27/97	0.0706 ± 0.0062	07/03/97
Volatilized Nitrate (NO_3^-)	1.5596 ± 1.1389	4	0.5031 ± 0.0386	01/17/98	3.4650 ± 0.2246	07/27/97
Organic Carbon (OC)	2.4392 ± 0.3441	4	1.8523 ± 0.6186	07/27/97	2.7141 ± 0.6226	01/17/98
Elemental Carbon (EC)	1.0447 ± 0.2140	4	0.8237 ± 0.1384	07/27/97	1.3982 ± 0.2036	01/17/98
Sodium (Na)	0.0924 ± 0.0836	4	0.0081 ± 0.0592	01/17/98	0.2314 ± 0.0456	07/03/97
Magnesium (Mg)	0.0288 ± 0.0324	4	0.0065 ± 0.0248	01/23/98	0.0846 ± 0.0183	07/03/97
Aluminum (Al)	0.1976 ± 0.1443	4	0.0169 ± 0.0065	01/23/98	0.4010 ± 0.0238	07/03/97
Silicon (Si)	0.4274 ± 0.4585	4	0.0657 ± 0.0059	01/23/98	1.2019 ± 0.0612	07/03/97
Phosphorus (P)	0.0000 ± 0.0000	4	0.0000 ± 0.0114	07/03/97	0.0000 ± 0.0114	07/03/97
Sulfur (S)	1.2516 ± 0.3336	4	0.8135 ± 0.0410	01/17/98	1.6909 ± 0.0848	01/23/98
Chlorine (Cl)	0.0098 ± 0.0113	4	0.0000 ± 0.0288	07/27/97	0.0276 ± 0.0074	01/17/98
Potassium (K)	0.0680 ± 0.0264	4	0.0491 ± 0.0044	07/27/97	0.1132 ± 0.0072	07/03/97
Calcium (Ca)	0.0917 ± 0.0635	4	0.0411 ± 0.0044	01/23/98	0.2007 ± 0.0126	07/03/97
Titanium (Ti)	0.0100 ± 0.0115	4	0.0030 ± 0.0220	01/23/98	0.0300 ± 0.0175	07/03/97
Vanadium (V)	0.0048 ± 0.0039	4	0.0011 ± 0.0093	01/23/98	0.0106 ± 0.0078	01/17/98
Chromium (Cr)	0.0003 ± 0.0002	4	0.0000 ± 0.0027	07/27/97	0.0005 ± 0.0027	01/17/98
Manganese (Mn)	0.0069 ± 0.0050	4	0.0023 ± 0.0013	07/27/97	0.0151 ± 0.0016	07/03/97
Iron (Fe)	0.1569 ± 0.1223	4	0.0559 ± 0.0037	01/23/98	0.3660 ± 0.0185	07/03/97
Cobalt (Co)	0.0004 ± 0.0005	4	0.0000 ± 0.0060	07/03/97	0.0012 ± 0.0021	01/17/98
Nickel (Ni)	0.0015 ± 0.0010	4	0.0004 ± 0.0011	07/27/97	0.0029 ± 0.0008	01/17/98
Copper (Cu)	0.0170 ± 0.0131	4	0.0037 ± 0.0008	01/23/98	0.0384 ± 0.0022	07/27/97
Zinc (Zn)	0.0235 ± 0.0083	4	0.0133 ± 0.0011	01/23/98	0.0363 ± 0.0020	01/17/98
Gallium (Ga)	0.0003 ± 0.0003	4	0.0000 ± 0.0019	07/03/97	0.0007 ± 0.0016	01/23/98
Arsenic (As)	0.0012 ± 0.0004	4	0.0006 ± 0.0022	01/23/98	0.0018 ± 0.0015	01/17/98
Selenium (Se)	0.0011 ± 0.0009	4	0.0000 ± 0.0011	07/27/97	0.0024 ± 0.0008	01/23/98
Bromine (Br)	0.0027 ± 0.0007	4	0.0020 ± 0.0007	07/27/97	0.0038 ± 0.0007	01/17/98
Rubidium (Rb)	0.0002 ± 0.0002	4	0.0000 ± 0.0009	01/17/98	0.0004 ± 0.0010	07/03/97
Strontium (Sr)	0.0017 ± 0.0008	4	0.0007 ± 0.0007	01/23/98	0.0025 ± 0.0007	01/17/98
Yttrium (Y)	0.0001 ± 0.0001	4	0.0000 ± 0.0013	07/03/97	0.0002 ± 0.0011	01/23/98
Zirconium (Zr)	0.0005 ± 0.0003	4	0.0001 ± 0.0015	07/27/97	0.0009 ± 0.0015	07/03/97
Molybdenum (Mo)	0.0004 ± 0.0004	4	0.0000 ± 0.0024	01/23/98	0.0010 ± 0.0025	01/17/98
Palladium (Pd)	0.0000 ± 0.0000	4	0.0000 ± 0.0080	07/03/97	0.0000 ± 0.0080	07/03/97
Silver (Ag)	0.0024 ± 0.0010	4	0.0016 ± 0.0086	01/17/98	0.0042 ± 0.0092	07/03/97
Cadmium (Cd)	0.0022 ± 0.0017	4	0.0000 ± 0.0096	07/27/97	0.0039 ± 0.0094	07/03/97
Indium (In)	0.0025 ± 0.0016	4	0.0000 ± 0.0112	07/03/97	0.0045 ± 0.0113	07/27/97
Tin (Sn)	0.0026 ± 0.0026	4	0.0003 ± 0.0133	01/17/98	0.0067 ± 0.0144	07/27/97
Antimony (Sb)	0.0006 ± 0.0006	4	0.0000 ± 0.0155	01/17/98	0.0013 ± 0.0168	07/27/97
Barium (Ba)	0.0222 ± 0.0191	4	0.0000 ± 0.0527	01/23/98	0.0525 ± 0.0476	07/03/97
Lanthanum (La)	0.0006 ± 0.0008	4	0.0000 ± 0.0811	01/17/98	0.0019 ± 0.0835	07/03/97
Gold (Au)	0.0002 ± 0.0003	4	0.0000 ± 0.0032	07/03/97	0.0007 ± 0.0027	01/23/98
Mercury (Hg)	0.0001 ± 0.0001	4	0.0000 ± 0.0024	07/27/97	0.0003 ± 0.0025	07/03/97
Thallium (Tl)	0.0000 ± 0.0000	4	0.0000 ± 0.0024	07/03/97	0.0000 ± 0.0024	07/03/97
Lead (Pb)	0.0030 ± 0.0019	4	0.0000 ± 0.0032	07/27/97	0.0053 ± 0.0022	01/23/98
Uranium (U)	0.0002 ± 0.0001	4	0.0000 ± 0.0023	07/27/97	0.0003 ± 0.0021	01/17/98
Sum of Species	10.0620 ± 1.4203	4	7.8238 ± 0.6831	07/27/97	11.6248 ± 0.7292	01/23/98

Table 4-3s. Statistical summary of $PM_{2.5}$ mass and chemical compositions acquired at the H3 collocated site (denuder off) during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

Site Code	Average (µg/m³)	Number in Average	Minimum (µg/m³)	Date of Minimum	Maximum (µg/m³)	Date of Maximum
$PM_{2.5}$ Mass	19.6851 ± 7.4335	7	10.7439 ± 0.6023	02/04/98	33.6583 ± 1.7228	08/26/97
Chloride (Cl^-)	0.0422 ± 0.0273	6	0.0033 ± 0.0293	02/04/98	0.0894 ± 0.0294	03/12/98
Nonvolatilized Nitrate (NO_3^-)	0.8775 ± 0.9468	6	0.1483 ± 0.0400	08/20/97	2.3456 ± 0.2113	03/12/98
Sulfate ($SO_4^=$)	4.5140 ± 2.7039	6	2.3015 ± 0.1705	02/04/98	9.9290 ± 0.6836	08/26/97
Ammonium (NH_4^+)	1.6894 ± 0.8073	6	0.7584 ± 0.0479	08/20/97	3.1104 ± 0.1653	08/26/97
Soluble Sodium (Na^+)	0.1309 ± 0.0843	6	0.0372 ± 0.0073	02/07/98	0.2677 ± 0.0375	08/26/97
Soluble Potassium (K^+)	0.1118 ± 0.1100	6	0.0231 ± 0.0050	08/20/97	0.3528 ± 0.0201	08/26/97
Volatilized Nitrate (NO_3^-)	1.0988 ± 0.4715	5	0.4133 ± 0.0311	08/20/97	1.8765 ± 0.1190	08/26/97
Organic Carbon (OC)	4.0090 ± 2.1652	6	1.4726 ± 0.5830	08/20/97	8.3054 ± 0.8387	08/26/97
Elemental Carbon (EC)	1.5759 ± 0.6019	6	1.0634 ± 0.1632	03/12/98	2.8117 ± 0.1773	08/26/97
Sodium (Na)	0.0898 ± 0.1000	7	0.0152 ± 0.0648	02/07/98	0.2549 ± 0.0522	08/26/97
Magnesium (Mg)	0.0373 ± 0.0303	7	0.0098 ± 0.0501	08/27/97	0.0929 ± 0.0203	08/26/97
Aluminum (Al)	0.0385 ± 0.0161	7	0.0184 ± 0.0075	03/06/98	0.0712 ± 0.0080	02/07/98
Silicon (Si)	0.3311 ± 0.3659	7	0.0641 ± 0.0067	03/06/98	1.1656 ± 0.0593	08/20/97
Phosphorus (P)	0.0037 ± 0.0088	7	0.0000 ± 0.0186	08/26/97	0.0253 ± 0.0050	08/20/97
Sulfur (S)	2.0375 ± 1.1283	7	0.9630 ± 0.0485	02/04/98	3.7517 ± 0.1879	08/26/97
Chlorine (Cl)	0.0030 ± 0.0051	7	0.0000 ± 0.0222	08/20/97	0.0140 ± 0.0245	02/07/98
Potassium (K)	0.1265 ± 0.1162	7	0.0282 ± 0.0041	08/20/97	0.4039 ± 0.0211	08/26/97
Calcium (Ca)	0.1249 ± 0.0481	7	0.0684 ± 0.0053	02/04/98	0.2003 ± 0.0110	02/07/98
Titanium (Ti)	0.0053 ± 0.0021	7	0.0021 ± 0.0240	03/06/98	0.0085 ± 0.0223	08/26/97
Vanadium (V)	0.0041 ± 0.0031	7	0.0002 ± 0.0137	02/04/98	0.0101 ± 0.0078	03/12/98
Chromium (Cr)	0.0008 ± 0.0009	7	0.0000 ± 0.0042	02/04/98	0.0024 ± 0.0019	08/26/97
Manganese (Mn)	0.0075 ± 0.0041	7	0.0024 ± 0.0013	03/12/98	0.0159 ± 0.0016	08/26/97
Iron (Fe)	0.1325 ± 0.0532	7	0.0595 ± 0.0039	03/12/98	0.2046 ± 0.0104	08/26/97
Cobalt (Co)	0.0001 ± 0.0002	7	0.0000 ± 0.0036	08/26/97	0.0006 ± 0.0015	03/06/98
Nickel (Ni)	0.0020 ± 0.0011	7	0.0001 ± 0.0011	03/06/98	0.0037 ± 0.0009	08/26/97
Copper (Cu)	0.0113 ± 0.0111	7	0.0024 ± 0.0008	03/12/98	0.0362 ± 0.0021	08/20/97
Zinc (Zn)	0.0298 ± 0.0145	7	0.0153 ± 0.0012	08/27/97	0.0617 ± 0.0033	02/07/98
Gallium (Ga)	0.0001 ± 0.0002	7	0.0000 ± 0.0020	08/20/97	0.0005 ± 0.0018	08/26/97
Arsenic (As)	0.0013 ± 0.0005	7	0.0003 ± 0.0022	03/12/98	0.0016 ± 0.0031	08/20/97
Selenium (Se)	0.0010 ± 0.0007	7	0.0003 ± 0.0012	08/20/97	0.0023 ± 0.0008	03/06/98
Bromine (Br)	0.0066 ± 0.0025	7	0.0035 ± 0.0007	02/07/98	0.0116 ± 0.0011	08/26/97
Rubidium (Rb)	0.0003 ± 0.0002	7	0.0000 ± 0.0010	03/06/98	0.0005 ± 0.0010	08/26/97
Strontium (Sr)	0.0011 ± 0.0005	7	0.0005 ± 0.0010	03/06/98	0.0022 ± 0.0007	03/12/98
Yttrium (Y)	0.0000 ± 0.0001	7	0.0000 ± 0.0014	08/20/97	0.0003 ± 0.0012	03/12/98
Zirconium (Zr)	0.0005 ± 0.0003	7	0.0001 ± 0.0014	08/27/97	0.0009 ± 0.0015	02/07/98
Molybdenum (Mo)	0.0003 ± 0.0003	7	0.0000 ± 0.0028	02/07/98	0.0007 ± 0.0028	02/04/98
Palladium (Pd)	0.0008 ± 0.0007	7	0.0000 ± 0.0077	08/27/97	0.0023 ± 0.0078	03/06/98
Silver (Ag)	0.0014 ± 0.0015	7	0.0000 ± 0.0089	08/27/97	0.0038 ± 0.0089	03/06/98
Cadmium (Cd)	0.0012 ± 0.0010	7	0.0000 ± 0.0098	08/20/97	0.0030 ± 0.0092	08/27/97
Indium (In)	0.0017 ± 0.0029	7	0.0000 ± 0.0115	08/20/97	0.0079 ± 0.0113	02/07/98
Tin (Sn)	0.0033 ± 0.0028	7	0.0000 ± 0.0138	08/27/97	0.0077 ± 0.0149	08/20/97
Antimony (Sb)	0.0043 ± 0.0036	7	0.0000 ± 0.0169	02/04/98	0.0103 ± 0.0175	08/20/97
Barium (Ba)	0.0164 ± 0.0173	7	0.0000 ± 0.0590	02/07/98	0.0392 ± 0.0594	02/04/98
Lanthanum (La)	0.0048 ± 0.0102	7	0.0000 ± 0.0859	08/20/97	0.0297 ± 0.0872	02/04/98
Gold (Au)	0.0002 ± 0.0004	7	0.0000 ± 0.0033	08/20/97	0.0009 ± 0.0029	08/27/97
Mercury (Hg)	0.0001 ± 0.0002	7	0.0000 ± 0.0025	02/04/98	0.0007 ± 0.0023	08/26/97
Thallium (Tl)	0.0001 ± 0.0001	7	0.0000 ± 0.0025	08/20/97	0.0002 ± 0.0022	08/26/97
Lead (Pb)	0.0050 ± 0.0031	7	0.0001 ± 0.0032	02/04/98	0.0114 ± 0.0025	08/20/97
Uranium (U)	0.0000 ± 0.0001	7	0.0000 ± 0.0025	08/20/97	0.0002 ± 0.0022	08/26/97
Sum of Species	11.9651 ± 6.9085	7	1.7619 ± 0.5910	08/27/97	25.7305 ± 1.1180	08/26/97

Table 4-3t. Statistical summary of $PM_{2.5}$ mass and chemical compositions acquired at the SM site during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

Site Code	Average (ug/m^3)	Number in Average	Minimum (ug/m^3)	Date of Minimum	Maximum (ug/m^3)	Date of Maximum
$PM_{2.5}$ Mass	14.9263 ± 4.9317	11	8.1328 ± 0.6058	05/02/97	23.0032 ± 1.2040	12/18/97
Chloride (Cl^-)	0.0623 ± 0.0923	11	0.0000 ± 0.0274	07/27/97	0.3458 ± 0.0684	05/02/97
Nonvolatilized Nitrate (NO_3^-)	0.3031 ± 0.3601	11	0.0391 ± 0.0258	07/27/97	1.3292 ± 0.1476	02/07/98
Sulfate ($SO_4^=$)	3.5750 ± 1.9061	11	1.6598 ± 0.1419	02/04/98	8.3216 ± 0.6174	09/01/97
Ammonium (NH_4^+)	0.8618 ± 0.4659	11	0.4348 ± 0.0353	07/03/97	1.9280 ± 0.1049	09/01/97
Soluble Sodium (Na^+)	0.1348 ± 0.1298	11	0.0295 ± 0.0206	05/04/97	0.5204 ± 0.0375	05/02/97
Soluble Potassium (K^+)	0.0958 ± 0.0358	11	0.0455 ± 0.0068	05/04/97	0.1512 ± 0.0097	11/24/97
Volatilized Nitrate (NO_3^-)	N/A ± N/A	N/A	N/A ± N/A		N/A ± N/A	
Organic Carbon (OC)	3.3758 ± 1.6593	11	0.9417 ± 0.5823	07/03/97	7.2297 ± 0.8005	12/18/97
Elemental Carbon (EC)	1.1153 ± 0.5076	11	0.4864 ± 0.1227	05/02/97	2.4494 ± 0.3276	12/18/97
Sodium (Na)	0.1155 ± 0.0744	11	0.0160 ± 0.0656	02/04/98	0.2892 ± 0.0315	05/02/97
Magnesium (Mg)	0.0303 ± 0.0227	11	0.0026 ± 0.0278	07/27/97	0.0844 ± 0.0198	07/03/97
Aluminum (Al)	0.1103 ± 0.2316	11	0.0056 ± 0.0189	11/24/97	0.8355 ± 0.0447	07/03/97
Silicon (Si)	0.3436 ± 0.5532	11	0.0360 ± 0.0059	08/20/97	1.9970 ± 0.1008	07/03/97
Phosphorus (P)	0.0004 ± 0.0010	11	0.0000 ± 0.0098	05/02/97	0.0036 ± 0.0121	12/18/97
Sulfur (S)	1.2799 ± 0.6834	11	0.6142 ± 0.0311	05/04/97	3.0074 ± 0.1507	09/01/97
Chlorine (Cl)	0.0117 ± 0.0271	11	0.0000 ± 0.0191	07/03/97	0.0907 ± 0.0091	05/02/97
Potassium (K)	0.1274 ± 0.0479	11	0.0558 ± 0.0045	05/04/97	0.2095 ± 0.0116	07/03/97
Calcium (Ca)	0.1927 ± 0.3110	11	0.0192 ± 0.0072	08/20/97	0.8550 ± 0.0433	02/04/98
Titanium (Ti)	0.0114 ± 0.0187	11	0.0012 ± 0.0246	11/24/97	0.0678 ± 0.0176	07/03/97
Vanadium (V)	0.0026 ± 0.0017	11	0.0003 ± 0.0106	02/04/98	0.0056 ± 0.0096	07/03/97
Chromium (Cr)	0.0005 ± 0.0004	11	0.0000 ± 0.0025	05/02/97	0.0012 ± 0.0029	02/04/98
Manganese (Mn)	0.0044 ± 0.0052	11	0.0000 ± 0.0020	05/02/97	0.0175 ± 0.0017	07/03/97
Iron (Fe)	0.1422 ± 0.1844	11	0.0116 ± 0.0013	05/02/97	0.6178 ± 0.0310	07/03/97
Cobalt (Co)	0.0002 ± 0.0002	11	0.0000 ± 0.0013	05/02/97	0.0007 ± 0.0063	02/04/98
Nickel (Ni)	0.0010 ± 0.0006	11	0.0000 ± 0.0011	02/07/98	0.0020 ± 0.0009	09/01/97
Copper (Cu)	0.0155 ± 0.0234	11	0.0000 ± 0.0011	05/02/97	0.0660 ± 0.0035	02/07/98
Zinc (Zn)	0.0107 ± 0.0053	11	0.0015 ± 0.0007	05/02/97	0.0185 ± 0.0014	12/18/97
Gallium (Ga)	0.0000 ± 0.0001	11	0.0000 ± 0.0021	05/02/97	0.0002 ± 0.0019	09/01/97
Arsenic (As)	0.0009 ± 0.0006	11	0.0000 ± 0.0025	05/02/97	0.0018 ± 0.0017	09/13/97
Selenium (Se)	0.0005 ± 0.0003	11	0.0000 ± 0.0013	11/24/97	0.0010 ± 0.0013	12/18/97
Bromine (Br)	0.0036 ± 0.0017	11	0.0012 ± 0.0008	07/03/97	0.0076 ± 0.0010	12/18/97
Rubidium (Rb)	0.0004 ± 0.0003	11	0.0000 ± 0.0012	12/18/97	0.0012 ± 0.0007	07/03/97
Strontium (Sr)	0.0010 ± 0.0010	11	0.0000 ± 0.0011	09/13/97	0.0032 ± 0.0008	07/03/97
Yttrium (Y)	0.0001 ± 0.0002	11	0.0000 ± 0.0016	05/02/97	0.0006 ± 0.0013	02/04/98
Zirconium (Zr)	0.0006 ± 0.0007	11	0.0000 ± 0.0015	09/01/97	0.0024 ± 0.0012	07/03/97
Molybdenum (Mo)	0.0000 ± 0.0000	11	0.0000 ± 0.0033	05/02/97	0.0001 ± 0.0029	07/27/97
Palladium (Pd)	0.0000 ± 0.0001	11	0.0000 ± 0.0088	05/02/97	0.0005 ± 0.0082	09/13/97
Silver (Ag)	0.0007 ± 0.0010	11	0.0000 ± 0.0090	05/04/97	0.0030 ± 0.0095	07/27/97
Cadmium (Cd)	0.0007 ± 0.0012	11	0.0000 ± 0.0091	05/04/97	0.0040 ± 0.0110	05/02/97
Indium (In)	0.0011 ± 0.0010	11	0.0000 ± 0.0116	09/13/97	0.0032 ± 0.0116	02/04/98
Tin (Sn)	0.0037 ± 0.0033	11	0.0000 ± 0.0167	05/02/97	0.0089 ± 0.0142	05/04/97
Antimony (Sb)	0.0029 ± 0.0024	11	0.0000 ± 0.0196	05/02/97	0.0071 ± 0.0170	02/07/98
Barium (Ba)	0.0067 ± 0.0159	11	0.0000 ± 0.0733	05/02/97	0.0557 ± 0.0499	12/18/97
Lanthanum (La)	0.0036 ± 0.0050	11	0.0000 ± 0.0837	07/03/97	0.0123 ± 0.0929	12/18/97
Gold (Au)	0.0000 ± 0.0001	11	0.0000 ± 0.0035	05/02/97	0.0004 ± 0.0029	05/04/97
Mercury (Hg)	0.0002 ± 0.0002	11	0.0000 ± 0.0029	05/02/97	0.0006 ± 0.0024	08/20/97
Thallium (Tl)	0.0001 ± 0.0002	11	0.0000 ± 0.0023	05/04/97	0.0006 ± 0.0028	05/02/97
Lead (Pb)	0.0078 ± 0.0168	11	0.0000 ± 0.0033	07/27/97	0.0603 ± 0.0040	02/07/98
Uranium (U)	0.0001 ± 0.0002	11	0.0000 ± 0.0028	05/02/97	0.0008 ± 0.0024	02/04/98
Sum of Species	10.3752 ± 3.4087	11	6.4184 ± 0.6457	08/20/97	16.9651 ± 0.9247	12/18/97

The most abundant species (>1 $\mu g/m^3$) were sulfate, ammonium, organic carbon, and elemental carbon. These species accounted for over 63% of the measured mass. Soil related crustal species (Al, Si, K, Ca, Ti, Fe and Zn), without counting their associated oxides, accounted for only about 7% of the mass

4.3.1 Sulfate

The annual average $PM_{2.5}$ sulfate was 4.7 ± 3.4 $\mu g/m^3$ for all sites. Temporal variations of site average sulfate concentrations are shown in Figure 4-5. An apparent concentration buildup appears between 08/26/97 and 09/07/97. This is consistent with findings in Central and Southern California where elevated sulfate concentrations were often found during the summer and fall seasons (Chow et al., 1992a, 1992b, 1993b, 1994b, 1996a, 1996b). The highest sulfate concentration (13.5 ± 0.9 $\mu g/m^3$) was found on 09/01/97 at the HC site, with the other sites ranging from 7.3 ± 0.6 $\mu g/m^3$ at SA, to 12.9 ± 0.8 $\mu g/m^3$ at H3.

4.3.2 Nitrate and Volatilized Nitrate

In contrast to sulfate, $PM_{2.5}$ nitrate was lowest during the summer. The annual average nitrate was 0.6 ± 1.1 $\mu g/m^3$, which was only about 12% of the average sulfate. The highest nitrate was 9.5 ± 0.6 $\mu g/m^3$ on 12/18/97 at the EP site, with the other sites ranging from 0.0 ± 0.04 $\mu g/m^3$ at HG, to 3.4 ± 0.2 $\mu g/m^3$ at H3. Temporal variations of nitrate concentrations are shown in Figure 4-6. Concentrations are relatively low during the spring and summer and then show a substantial increase during the late fall and winter. It is suspected that much of the sampled particulate nitrate volatilizes prior to sample collection, especially during the non-winter periods.

Figures 4-7 and 4-8 show the comparison of total particulate nitrate (nitrate measured on the front quartz-fiber filter + nitrate measured on the back-up cellulose-fiber filter) versus volatilized nitrate (nitrate measured on the back-up cellulose-fiber filter). Figure 4-7 shows that the extent of nitrate volatilization is enhanced during summer time as shown for the period of 07/03/97 to 10/19/97. The scatter plots in Figure 4-8 compare the nitrate measurements with the denuder on and the denuder off, showing moderate correlation coefficients of 0.58 with the denuder off, 0.79 with the denuder on. The slopes through zero indicate that the percentage of total particulate nitrate attributed to volatilized nitrate was 52% when the denuder was on and 67% when the denuder was off.

The presence of the aluminum denuder did not make a significant difference in the percentage of total particulate nitrate attributed to volatilized nitrate, this indicates that the sampler surface is acting as an efficient nitric acid denuder and over 50% of the particulate nitrate were volatilized prior to collection. In addition, the high temperatures in Texas enhance the rate of nitrate volatilization.

4.3.3 Ammonium

Temporal variations in $PM_{2.5}$ ammonium are shown in Figure 4-9. The concentration pattern closely resembles the pattern exhibited by sulfate, with the same concentration

Figure 4-5a. Temporal variations of site-average $PM_{2.5}$ sulfate in Houston during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

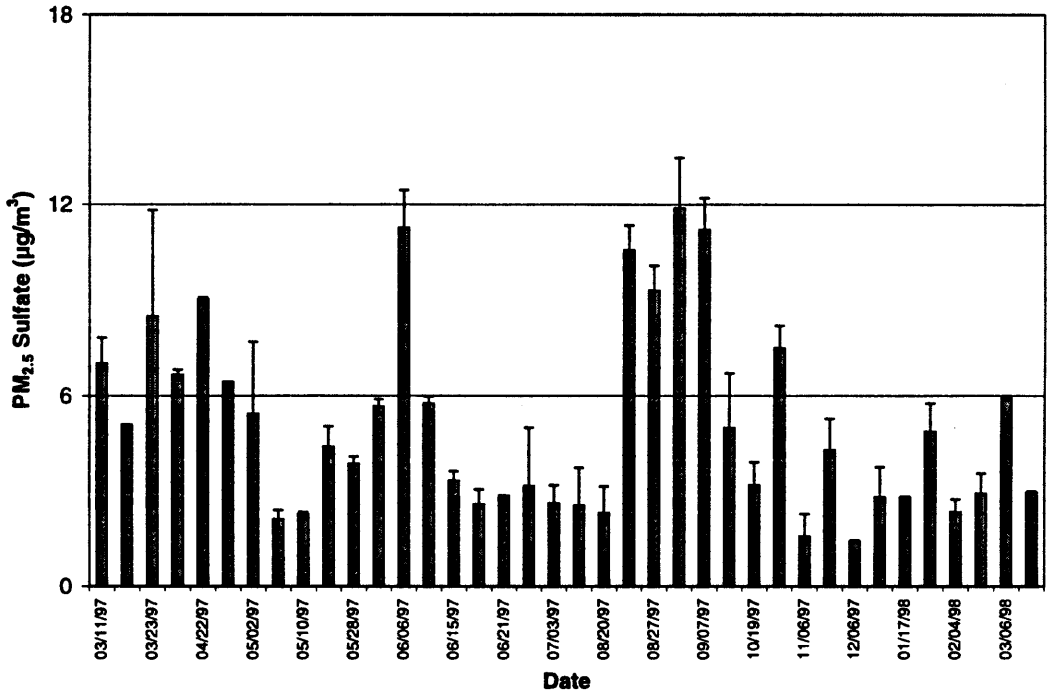


Figure 4-5b. Temporal variations of site-average $PM_{2.5}$ sulfate in other Texas cities during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

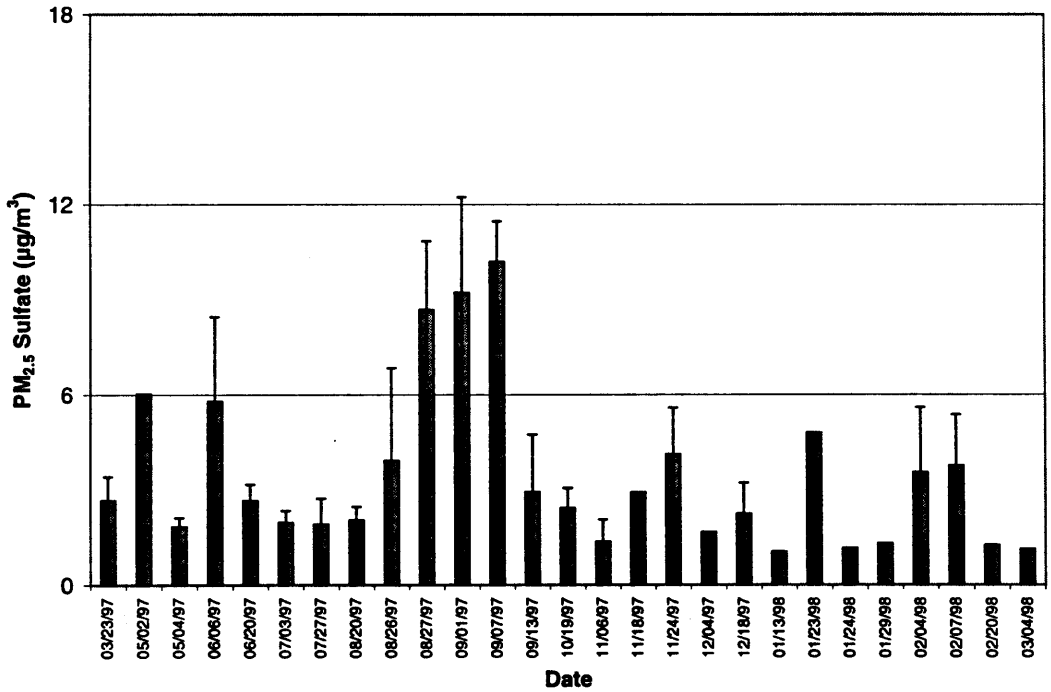


Figure 4-6a. Temporal variations of site-average $PM_{2.5}$ nitrate in Houston during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

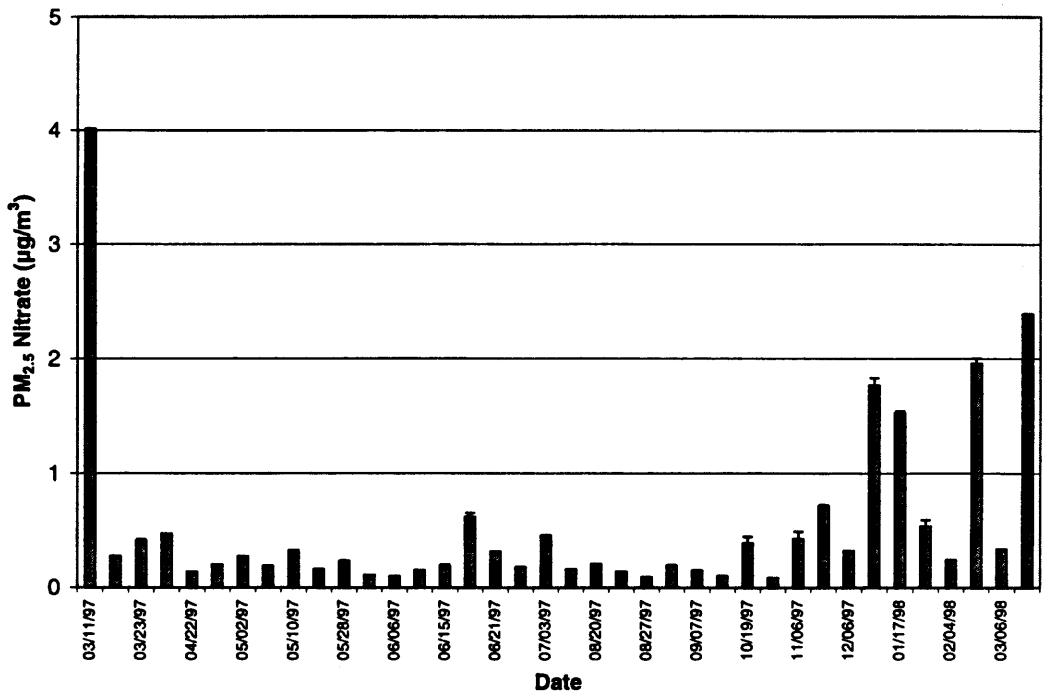


Figure 4-6b. Temporal variations of site-average $PM_{2.5}$ nitrate in other Texas cities during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

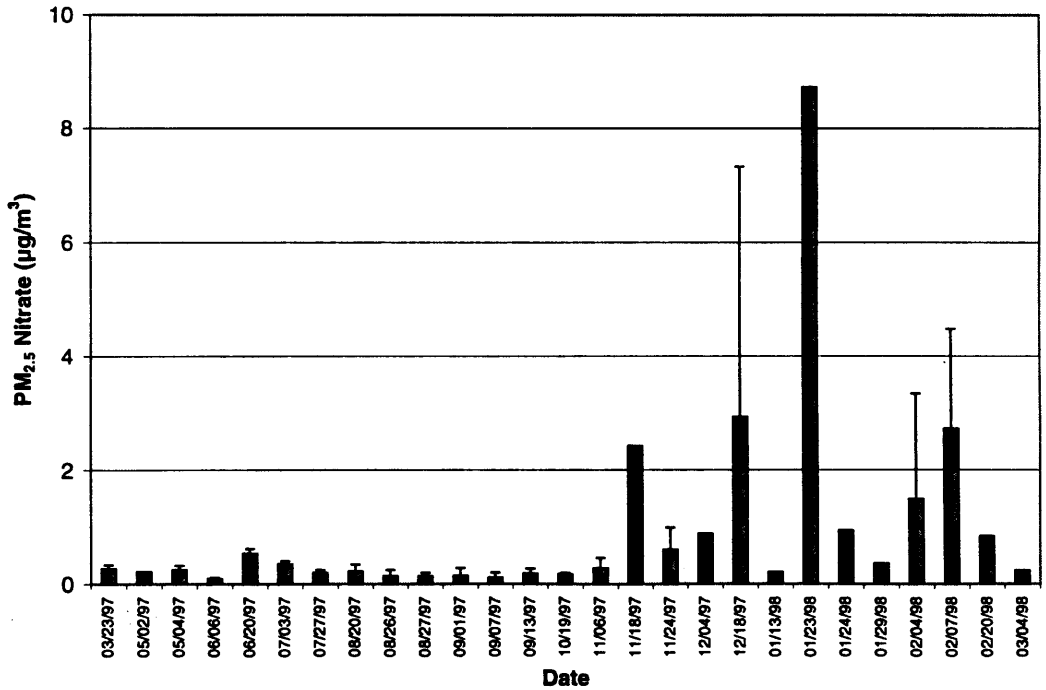
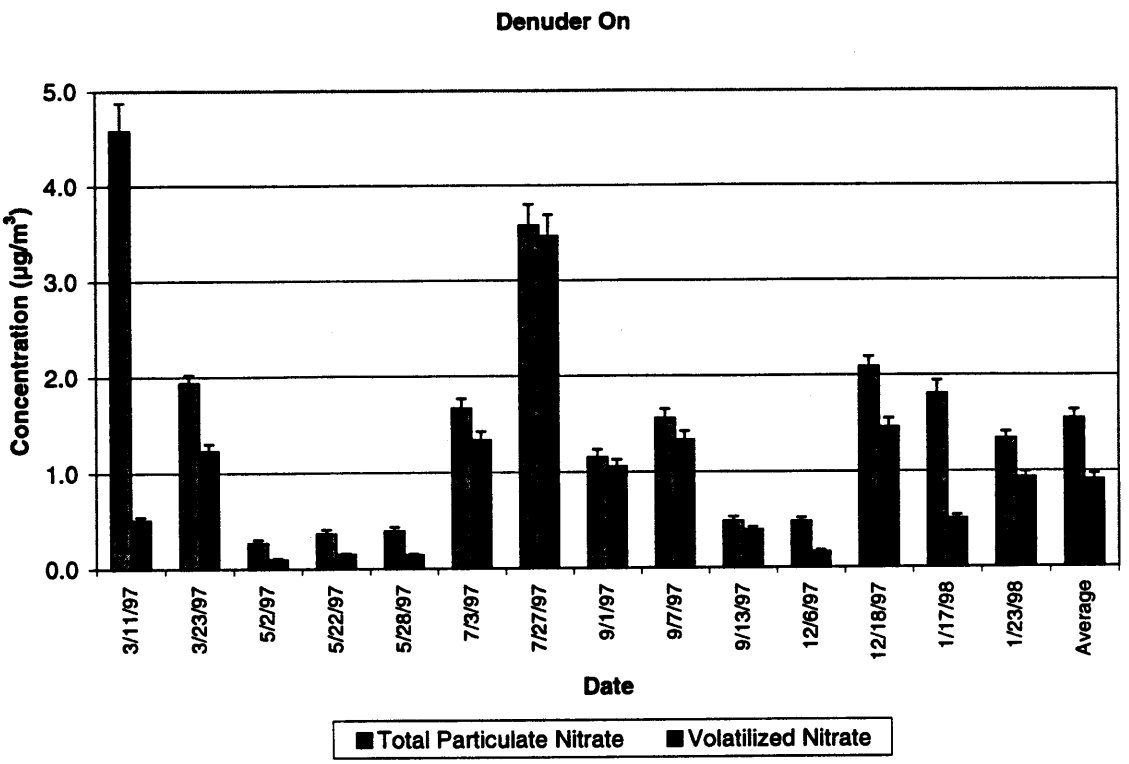


Figure 4-7. Side-by-side comparison of $PM_{2.5}$ total particulate nitrate and volatilized nitrate during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.



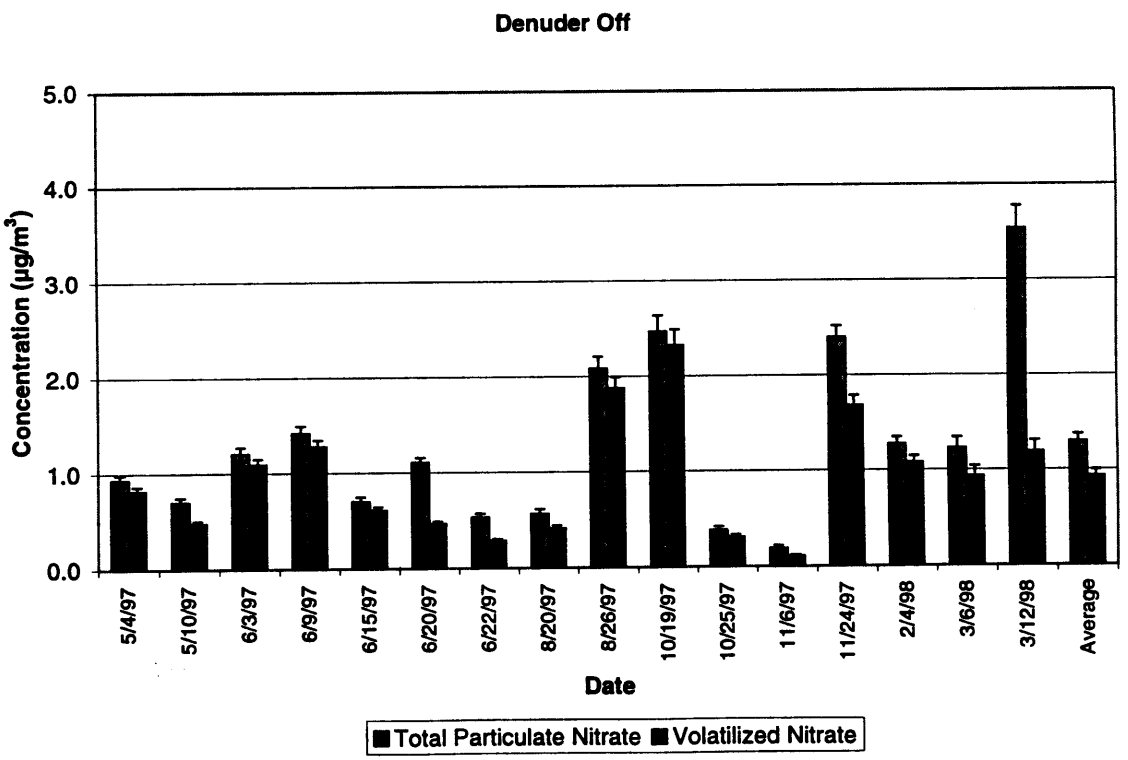
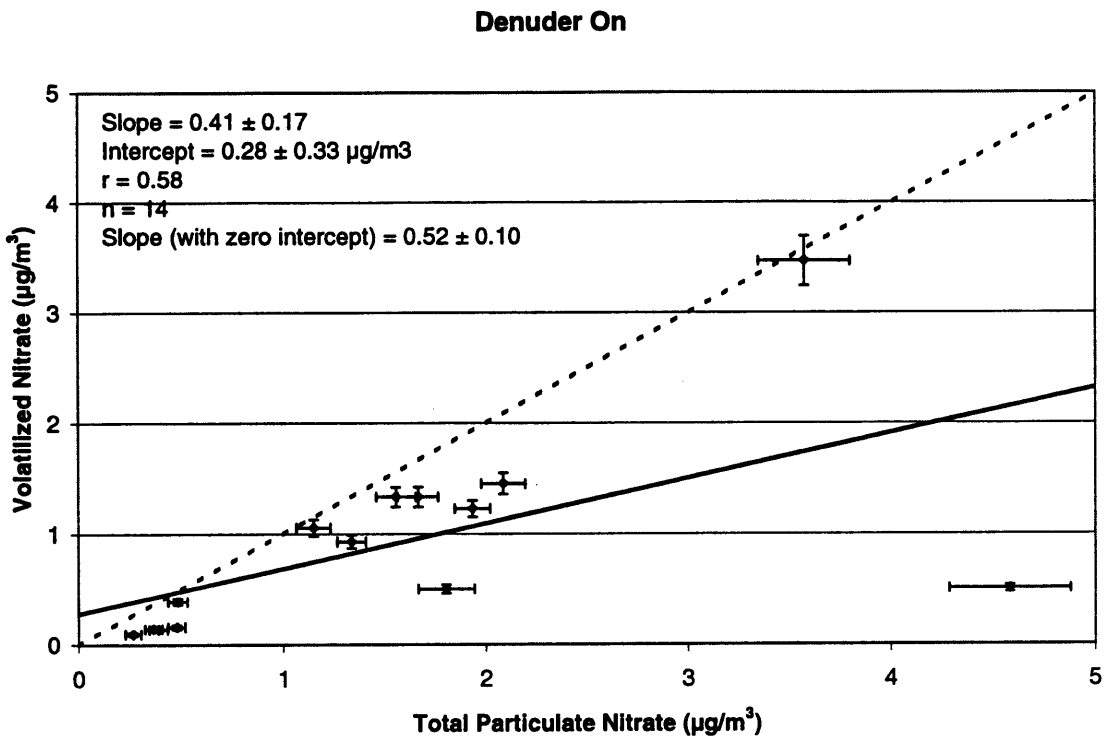


Figure 4-8. Scatter plot of $PM_{2.5}$ particulate nitrate versus volatilized nitrate during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.



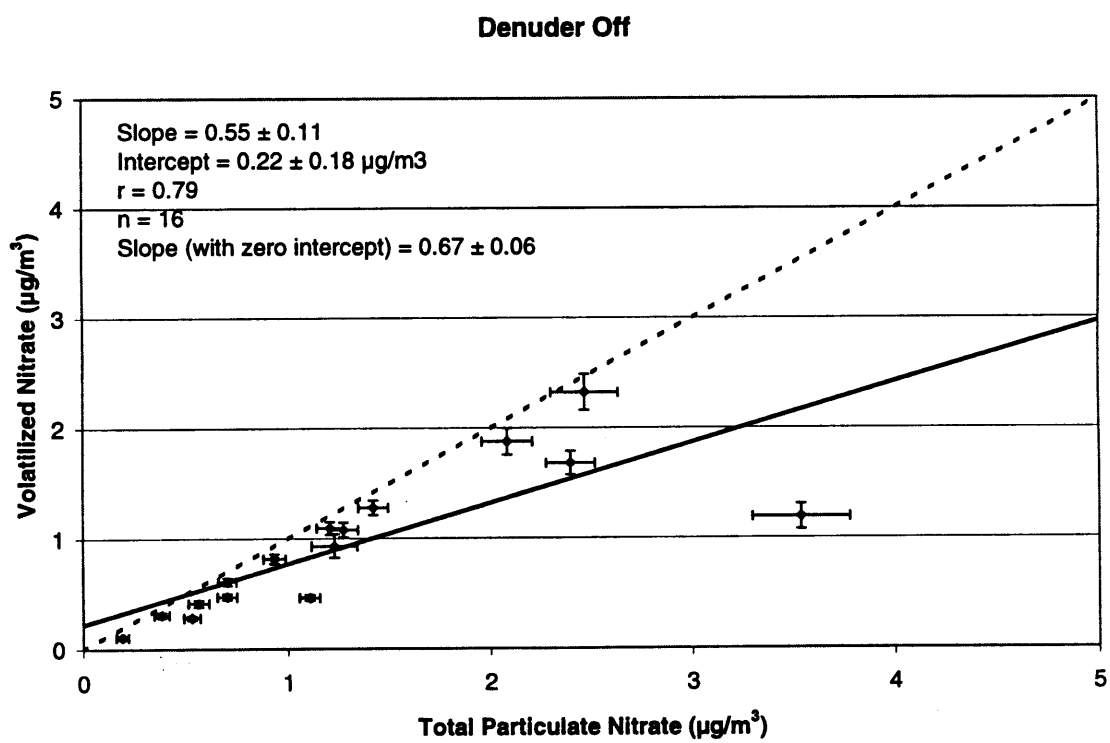


Figure 4-9a. Temporal variations of site-average $PM_{2.5}$ ammonium in Houston during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

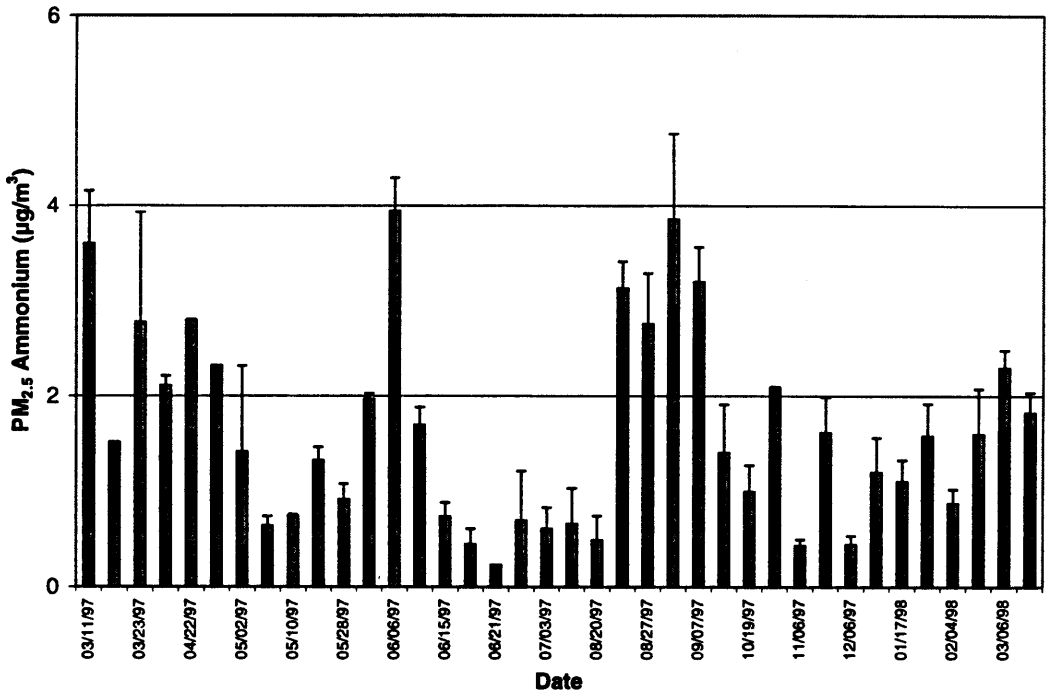
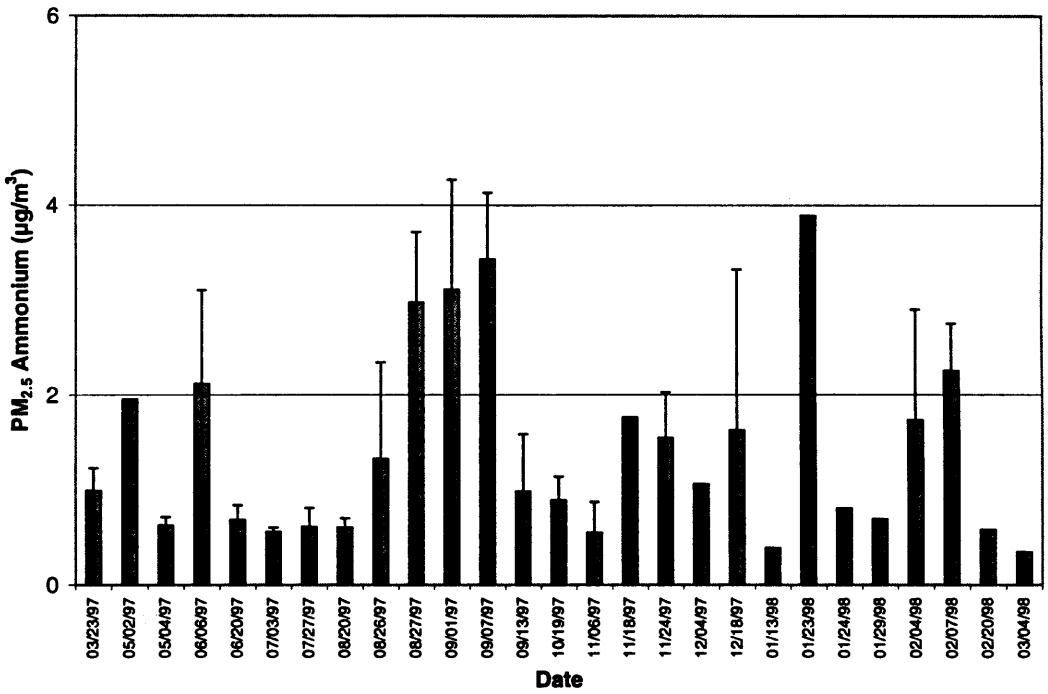


Figure 4-9b. Temporal variations of site-average $PM_{2.5}$ ammonium in other Texas cities during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.



buildup appearing between 08/26/97 and 09/07/97. The highest ammonium (4.9 ± 0.3 $\mu g/m^3$) was found on 03/23/97 at the H3 site, with the other sites ranging from 0.1 ± 0.0 $\mu g/m^3$ at HG to 3.5 ± 0.2 $\mu g/m^3$ at H7. The annual average ammonium concentration was 1.5 ± 1.1 $\mu g/m^3$.

4.3.4 Carbon

Table 4-2 shows that total carbon (organic carbon + elemental carbon) was the largest component of $PM_{2.5}$, accounting for more than 27% of the mass, on average. The annual average was 3.3 ± 2.4 $\mu g/m^3$ for organic carbon and 1.5 ± 1.1 $\mu g/m^3$ for elemental carbon.

The ratios of organic carbon to total carbon (sum of organic and elemental carbon) averaged 65%. Elemental carbon originates primarily from direct emissions of particles, whereas organic carbon may originate from direct primary emissions and from atmospheric transformations of organic gases with high molecular weights. The OC/TC ratio has been used to identify the presence of secondary organic aerosol when the OC to EC ratio exceeds ~2 (i.e., OC/TC > 0.67) (Turpin et al., 1990; Hildemann et al., 1991). The proximity of combustion sources to the monitoring sites might have a direct effect on the higher OC/TC ratios.

Figures 4-10 and 4-11 show an increase in both average organic and average elemental carbon during the winter months. The highest organic carbon concentration (20.1 ± 1.5 $\mu g/m^3$) was seen on 12/18/97 at the EP site, with the other sites ranging from 0.0 ± 0.9 $\mu g/m^3$ at H3, to 13.1 ± 1.1 $\mu g/m^3$ at HC. The same site (EP) and date (12/18/97) exhibited the highest elemental carbon concentration (7.9 ± 0.5 $\mu g/m^3$), with the other sites ranging from 0.1 ± 0.04 $\mu g/m^3$ at H7, to 5.3 ± 0.3 $\mu g/m^3$ at HB. The OC/TC ratios on this day ranged from 0.54 to 0.73, all within one standard deviation of the average.

4.4 Spatial Variations of PM Mass and Chemical Composition

Table 4-3 shows that for the selected subset of samples, annual average $PM_{2.5}$ mass concentrations varied among the outdoor sites from 12.7 ± 5.6 $\mu g/m^3$ at the SA site to 23.9 ± 6.3 $\mu g/m^3$ at the HC collocated (denuder on) site. Site maximum concentrations among the outdoor sites varied from 14.3 ± 0.8 $\mu g/m^3$ at the HT collocated site (denuder on) to 71.2 ± 3.6 $\mu g/m^3$ at the EP site, with both of these extremes occurring on the same day, 12/18/97.

Table 4-3 shows that annual averages of the most prominent chemical species varied substantially among the sites. Average sulfate ranged from 1.7 ± 0.7 $\mu g/m^3$ at the EP site to 9.0 ± 3.3 $\mu g/m^3$ at the HC collocated (denuder on) site, nitrate ranged from 0.2 ± 0.1 $\mu g/m^3$ at the HC collocated (denuder off) site to 1.2 ± 2.2 $\mu g/m^3$ at the DA site, ammonium ranged from 0.8 ± 0.3 $\mu g/m^3$ at the HT collocated (denuder on) site to 2.8 ± 1.2 $\mu g/m^3$ at the HC collocated (denuder on) site. Carbonaceous aerosol showed significant variability among sites, with organic carbon ranging from 1.6 ± 1.1 $\mu g/m^3$ at the CC site to 5.7 ± 4.6 $\mu g/m^3$ at the EP site and elemental carbon ranging from 0.7 ± 0.3 $\mu g/m^3$ at the HG site to 3.2 ± 2.3 $\mu g/m^3$ at the EP site.

Figure 4-12 shows the spatial variations of average $PM_{2.5}$ sulfate, nitrate, chloride, ammonium, organic carbon, and elemental carbon measured at the five major cities across Texas, with the area of the entire pie indicating the mass concentration. The Houston area average includes measurements from the outdoor sites HB, HC, HG, HM, HT, HW, H3, H7, SM, and the collocated sampler, CO.

Figure 4-10a. Temporal variations of site-average $PM_{2.5}$ organic carbon in Houston during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

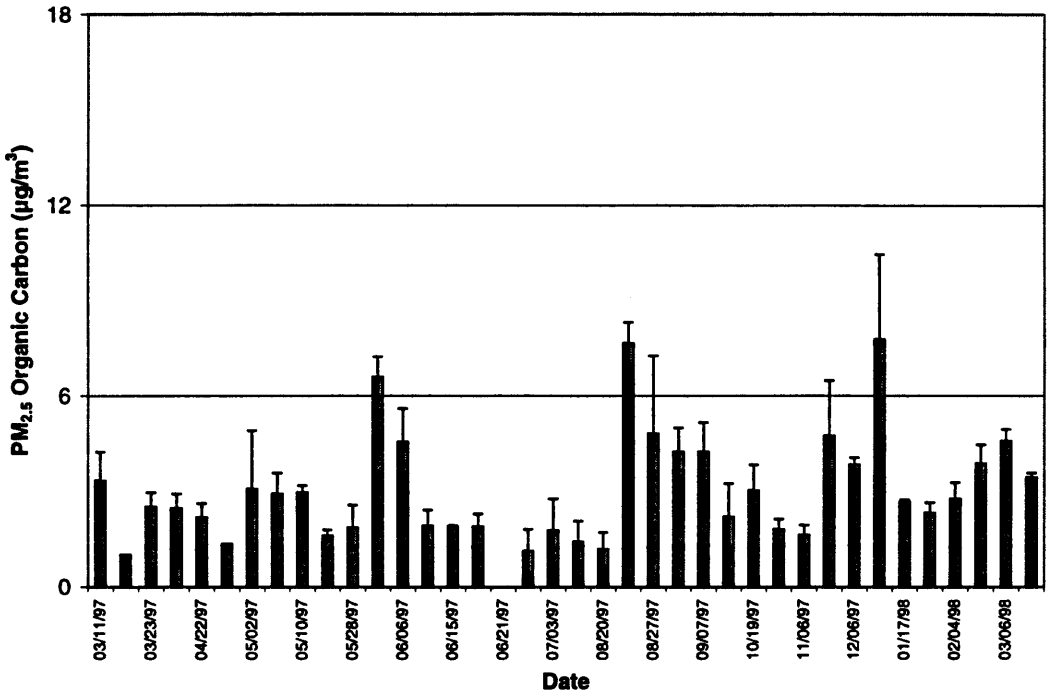


Figure 4-10b. Temporal variations of site-average $PM_{2.5}$ organic carbon in other Texas cities during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

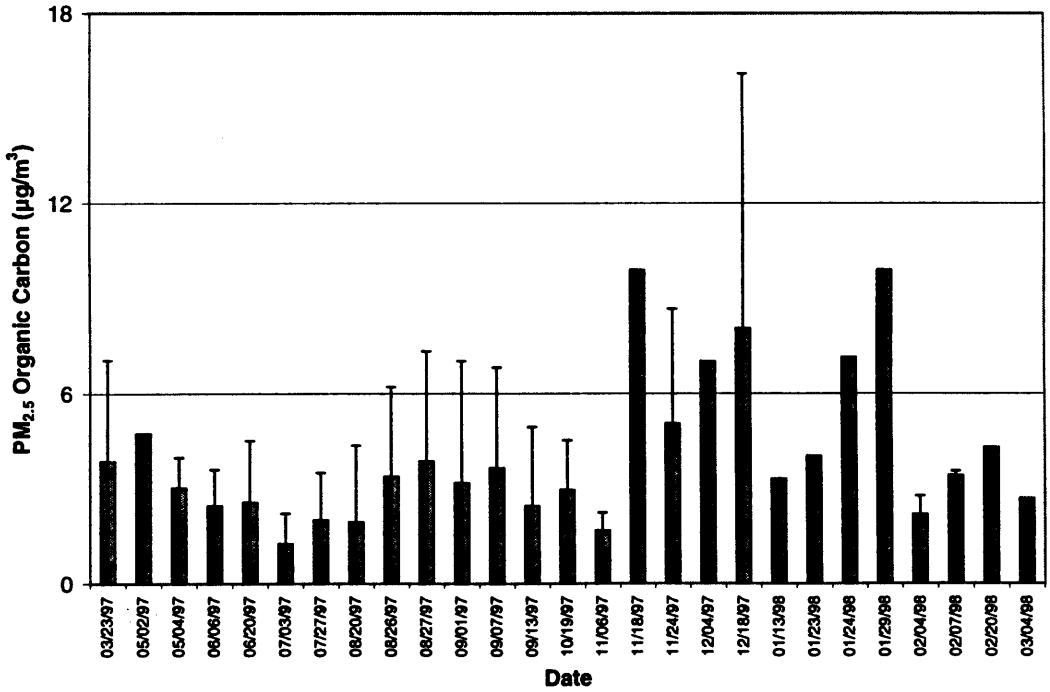


Figure 4-11a. Temporal variations of site-average $PM_{2.5}$ elemental carbon in Houston during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

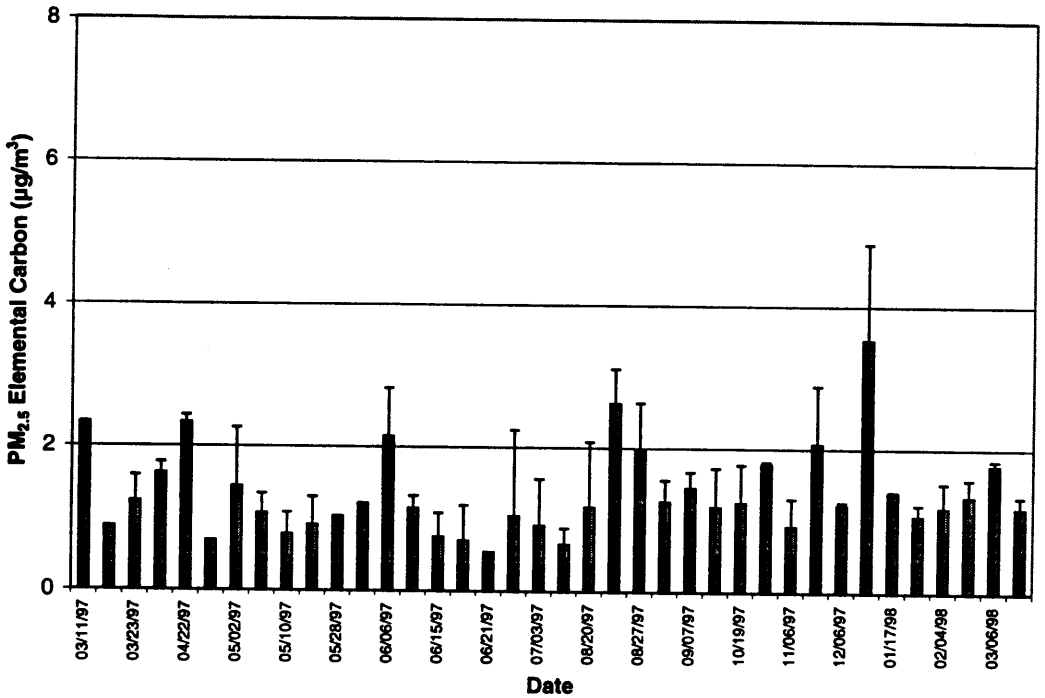


Figure 4-11b. Temporal variations of site-average $PM_{2.5}$ elemental carbon in other Texas cities during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

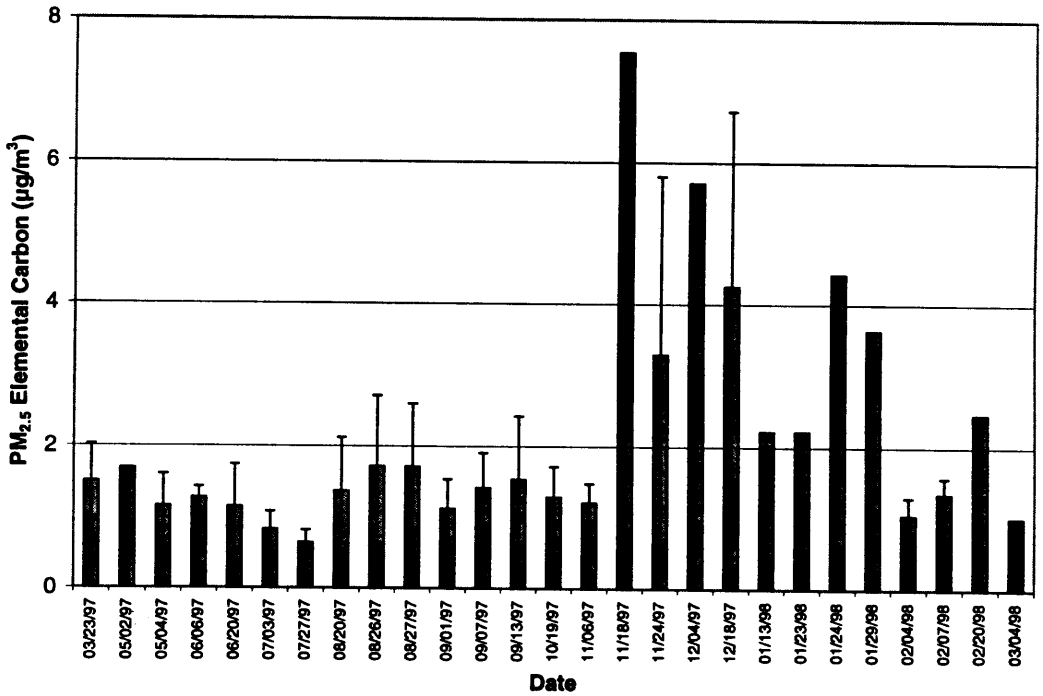
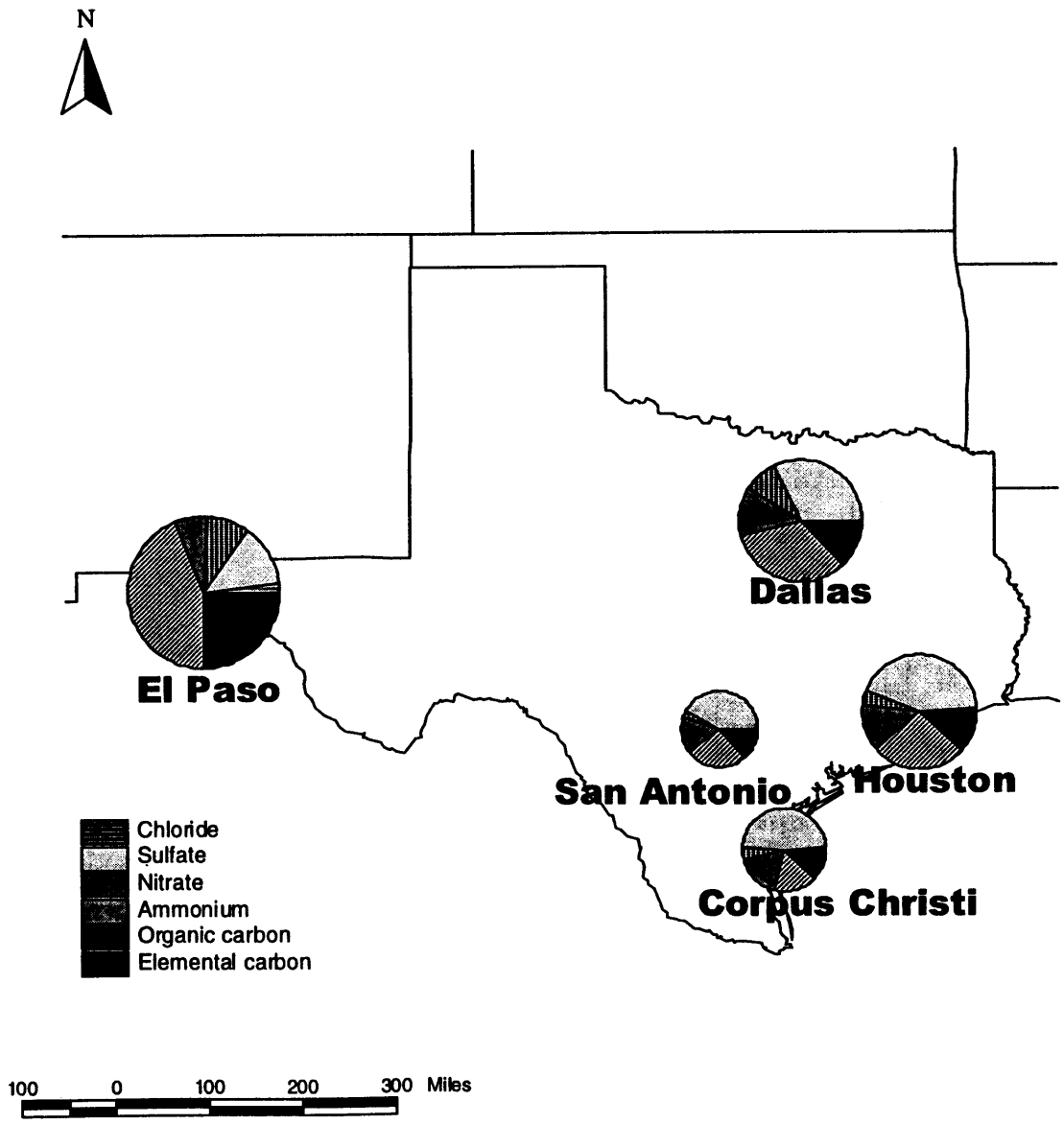


Figure 4-12. Spatial distributions of major chemical components during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.



Average sulfate concentrations in El Paso (1.7 ± 0.7 $\mu g/m^3$) were less than half those measured in the other cities, which ranged from 3.8 ± 2.8 $\mu g/m^3$ in San Antonio to 4.9 ± 3.1 $\mu g/m^3$ in Houston. San Antonio reported the lowest nitrate concentrations (0.3 ± 0.3 $\mu g/m^3$) while the other cities ranged from 0.4 ± 0.7 in Corpus Christi to 1.2 ± 2.3 in Dallas.

Ammonium concentrations exhibited a pattern similar to sulfate, with the lowest concentrations in El Paso (0.9 ± 0.9 $\mu g/m^3$) and the other cities reporting comparable concentrations, ranging from 1.4 ± 1.0 $\mu g/m^3$ in San Antonio to 1.8 ± 1.3 $\mu g/m^3$ in Dallas. Chloride concentrations in El Paso (0.3 ± 0.4 $\mu g/m^3$) were much higher than those found in the other cities, 0.03 ± 0.03 $\mu g/m^3$ in Dallas to 0.1 ± 0.2 $\mu g/m^3$ in Corpus Christi.

El Paso reported the highest organic carbon (5.7 ± 4.8 $\mu g/m^3$) and the highest elemental carbon (3.2 ± 2.4 $\mu g/m^3$) concentrations. Organic carbon in the other cities ranged from 1.6 ± 1.2 $\mu g/m^3$ in Corpus Christi to 4.6 ± 2.0 $\mu g/m^3$ in Dallas. Elemental carbon exhibited the same pattern as organic carbon with the values ranging from 1.1 ± 0.5 $\mu g/m^3$ in Corpus Christi to 1.8 ± 0.7 $\mu g/m^3$ in Dallas.

4.5 Characteristics of $PM_{2.5}$ Chemical Composition

Figures 4-13 through 4-19 show pie charts of the chemical components of the collected particulate for each site, calculated as follows:

1. unidentified = measured mass – the sum of components 2 through 9
2. geological = $\overline{(AlO + AlO_2)} + SiO_2 + CaO + \overline{(FeO + FeO_2)}$
3. organics = 1.2*organic carbon
4. soot = elemental carbon
5. nitrate = nitrate
6. sulfate = sulfate
7. ammonium = ammonium
8. salt = 1.65*Cl (XRF)
9. trace elements = sum of XRF measured species – (Al + Si + Ca + Fe + S + Cl)

On average, 88% of the collected particulate for the ambient (outdoor) sites was characterized, whereas 99% of the particulate for the indoor site (HS) was characterized.

The multiplier (1.2) used to calculate the organic fraction is based on the assumption that a large portion of the organic carbon in an area is in the form of hydrocarbons which have not yet fully oxidized. This would be the case in an urbanized area with many sources of hydrocarbon (e.g., automobiles, refineries). Higher multiplication factors can be applied if organic speciation shows the presence of highly oxygenated compounds in the particulate

Figure 4-13. Material balance of major $PM_{2.5}$ chemical compositions at the EP, DA, SA, and CC sites during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

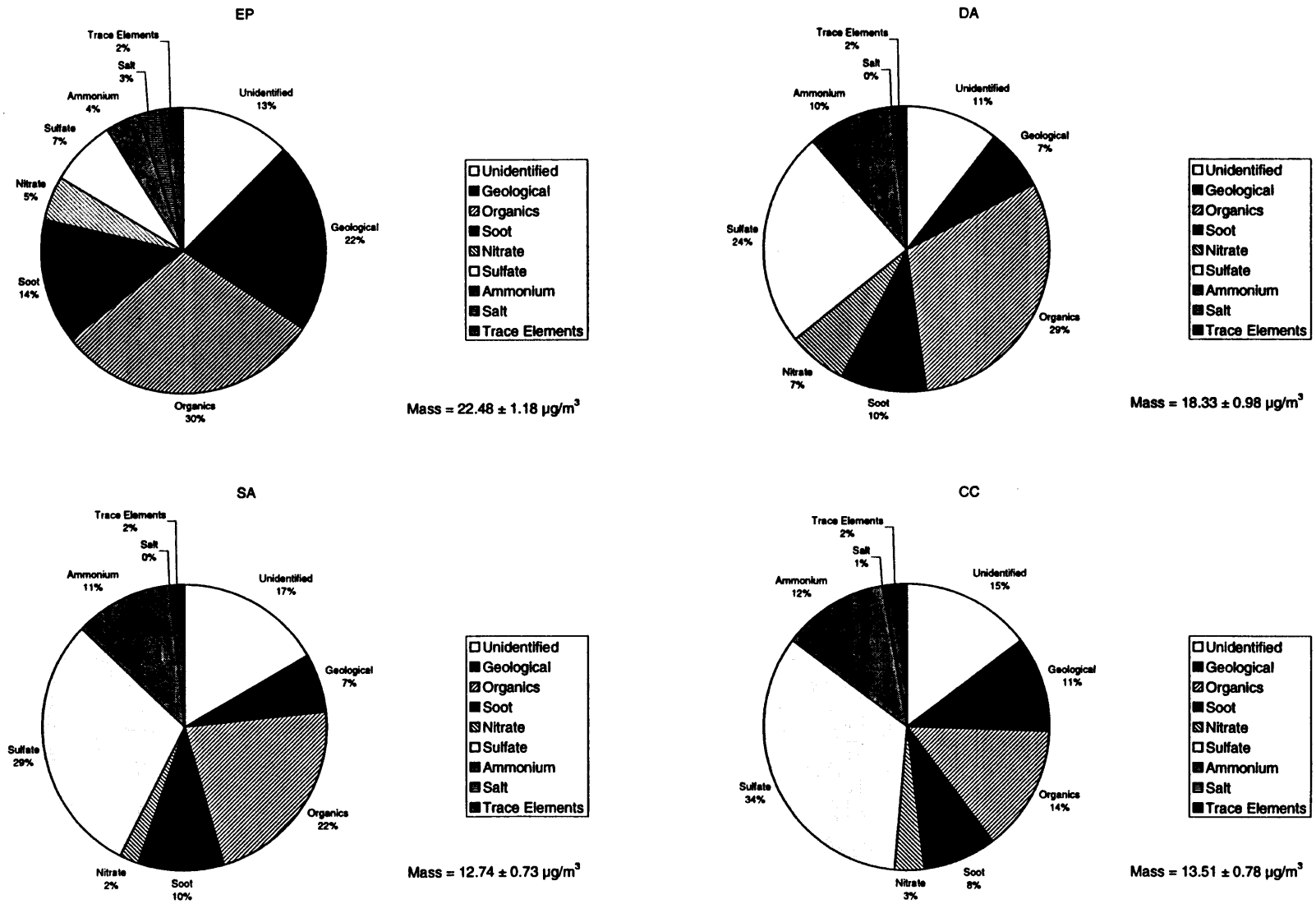


Figure 4-14. Material balance of major $PM_{2.5}$ chemical compositions at the HB, H7, and HM sites during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

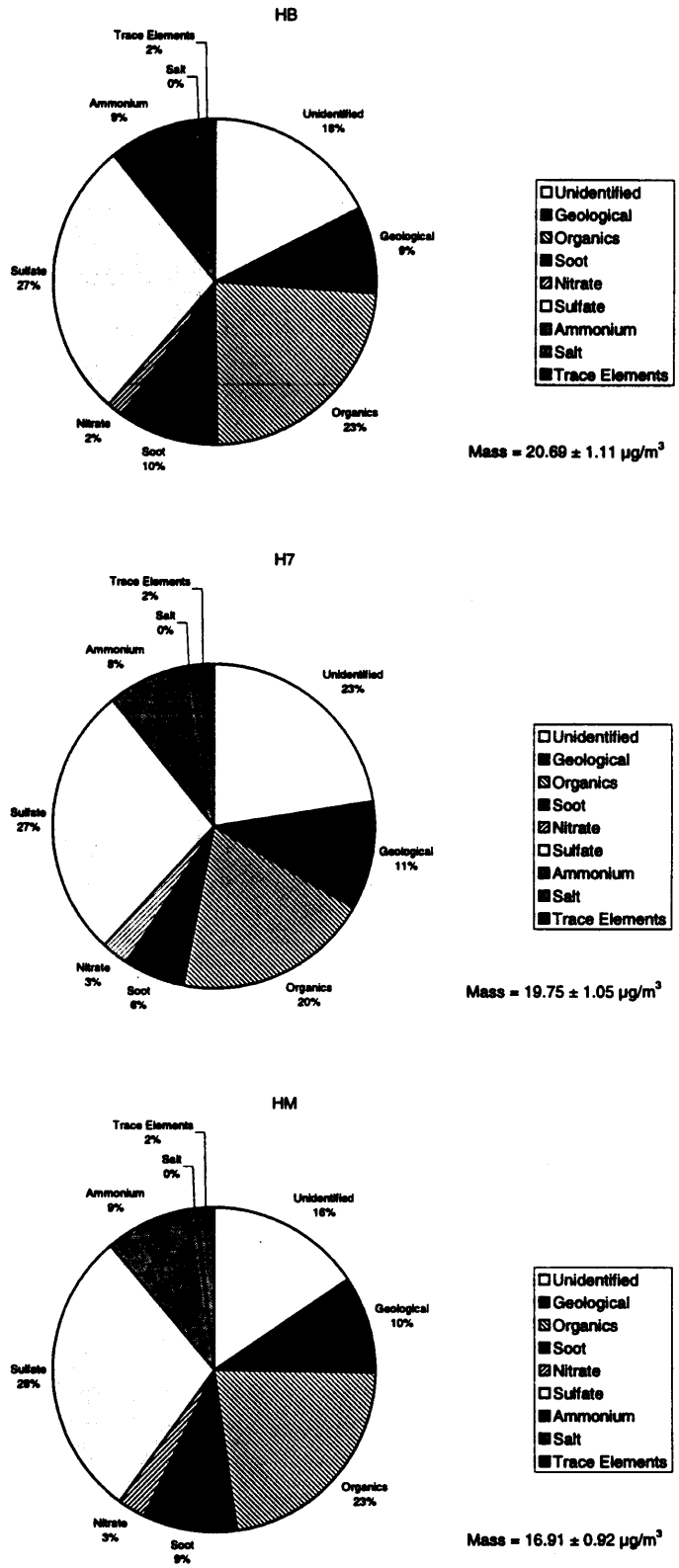


Figure 4-15. Material balance of major $PM_{2.5}$ chemical compositions at the HT site during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

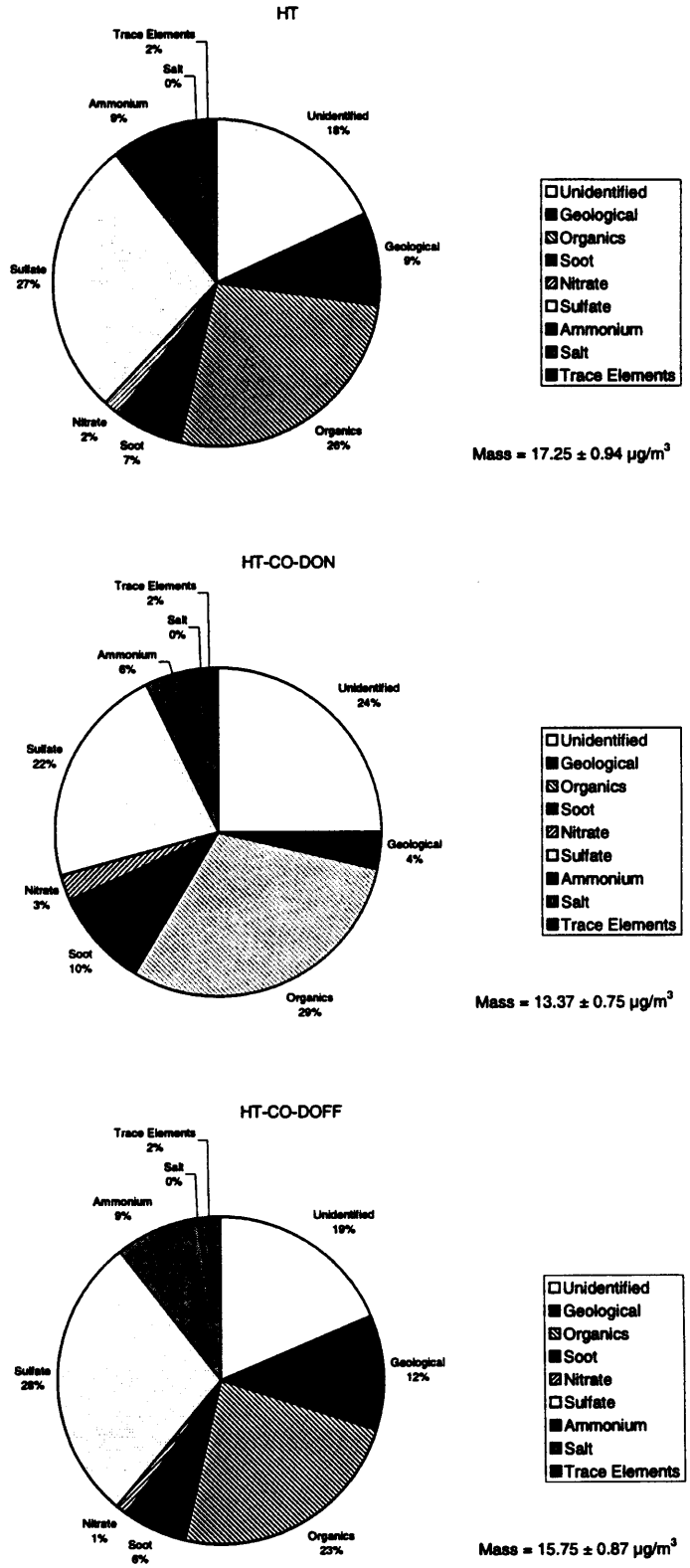


Figure 4-16. Material balance of major $PM_{2.5}$ chemical compositions at the H3 site during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

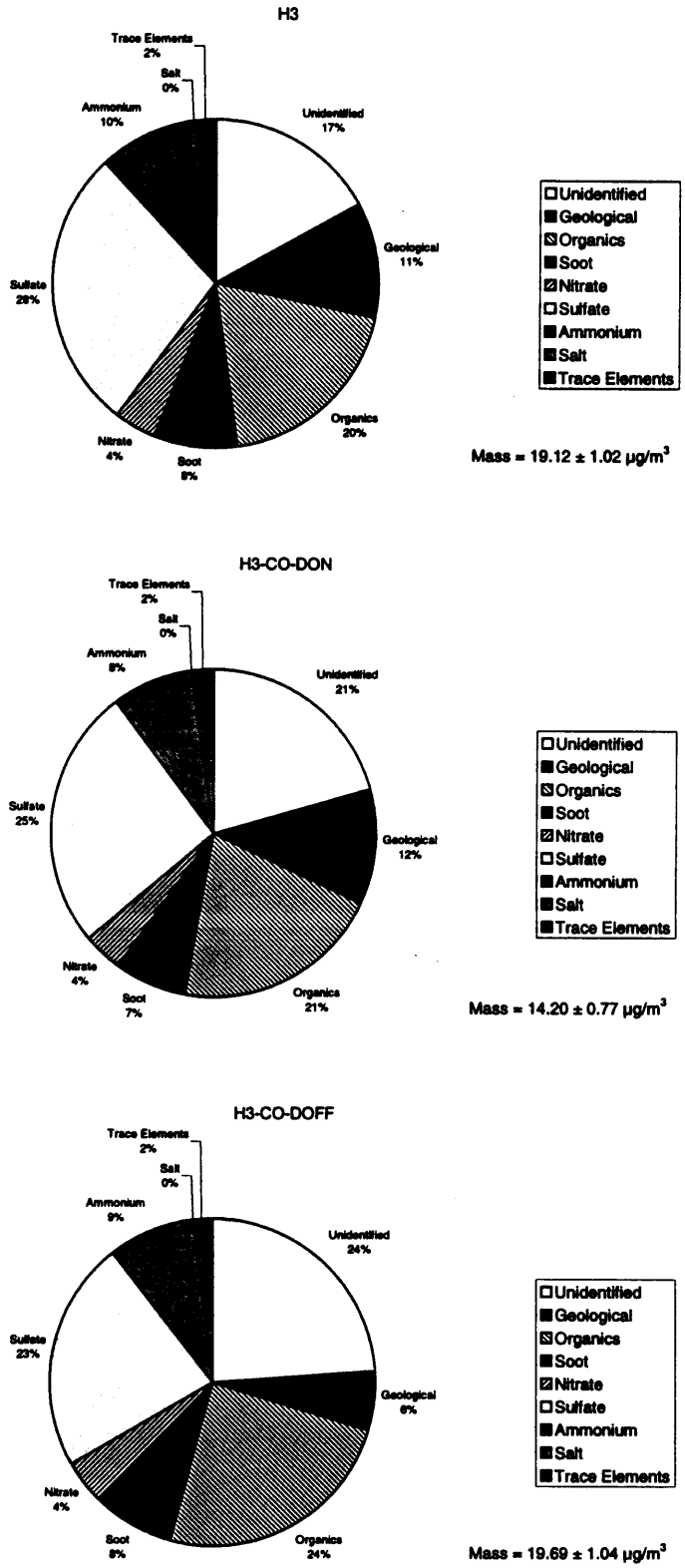


Figure 4-17. Material balance of major $PM_{2.5}$ chemical compositions at the HC site during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

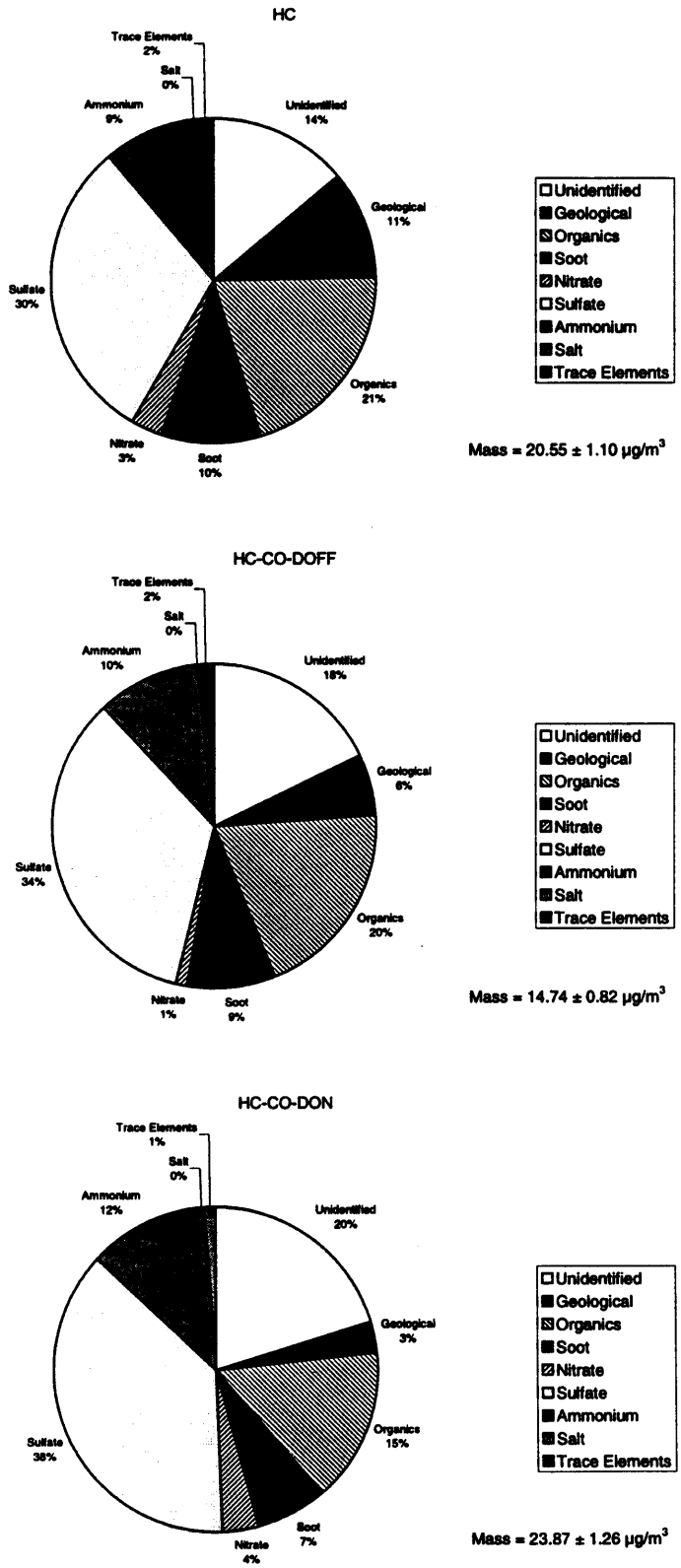


Figure 4-18. Material balance of major $PM_{2.5}$ chemical compositions at the HG, SM, and HW sites during the Texas $PM_{2.5}$ Sampling and Analysis Study between 03/11/97 and 03/12/98.

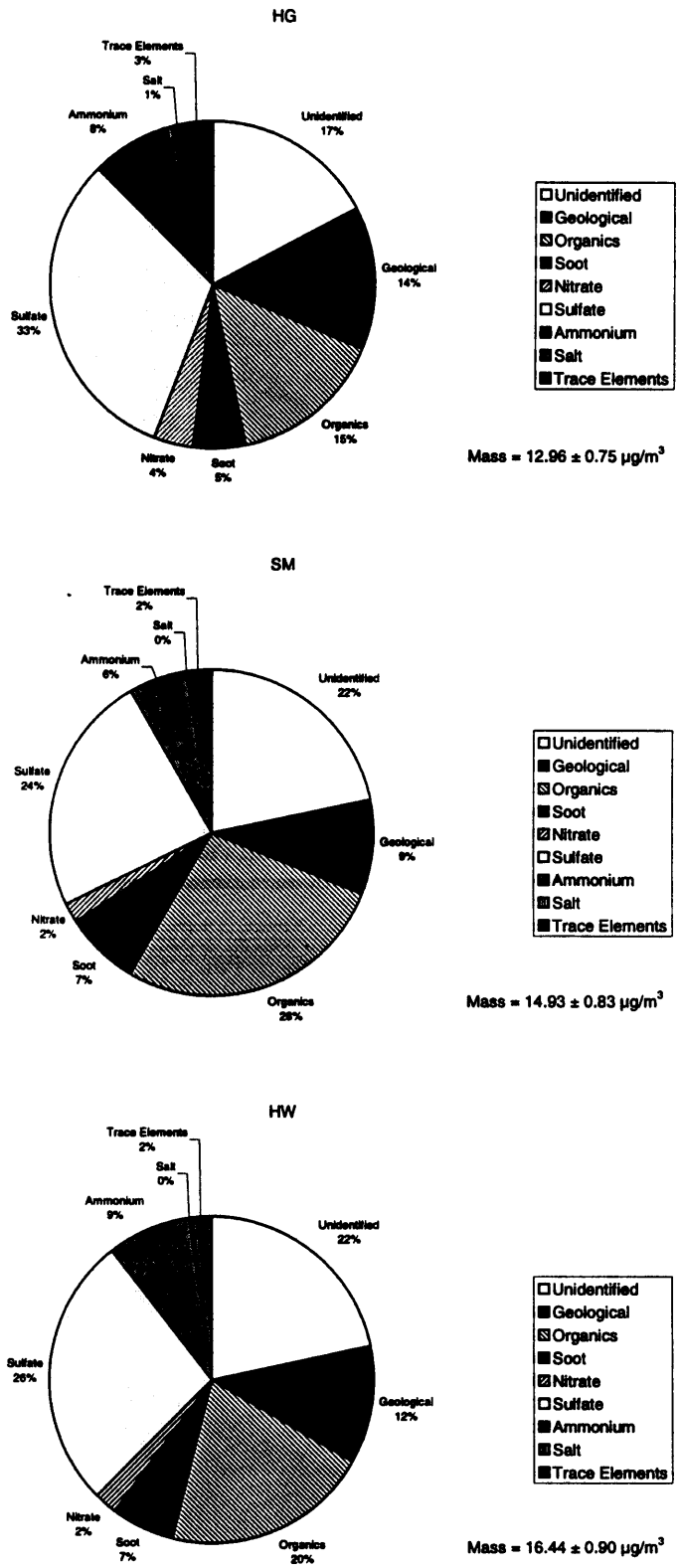
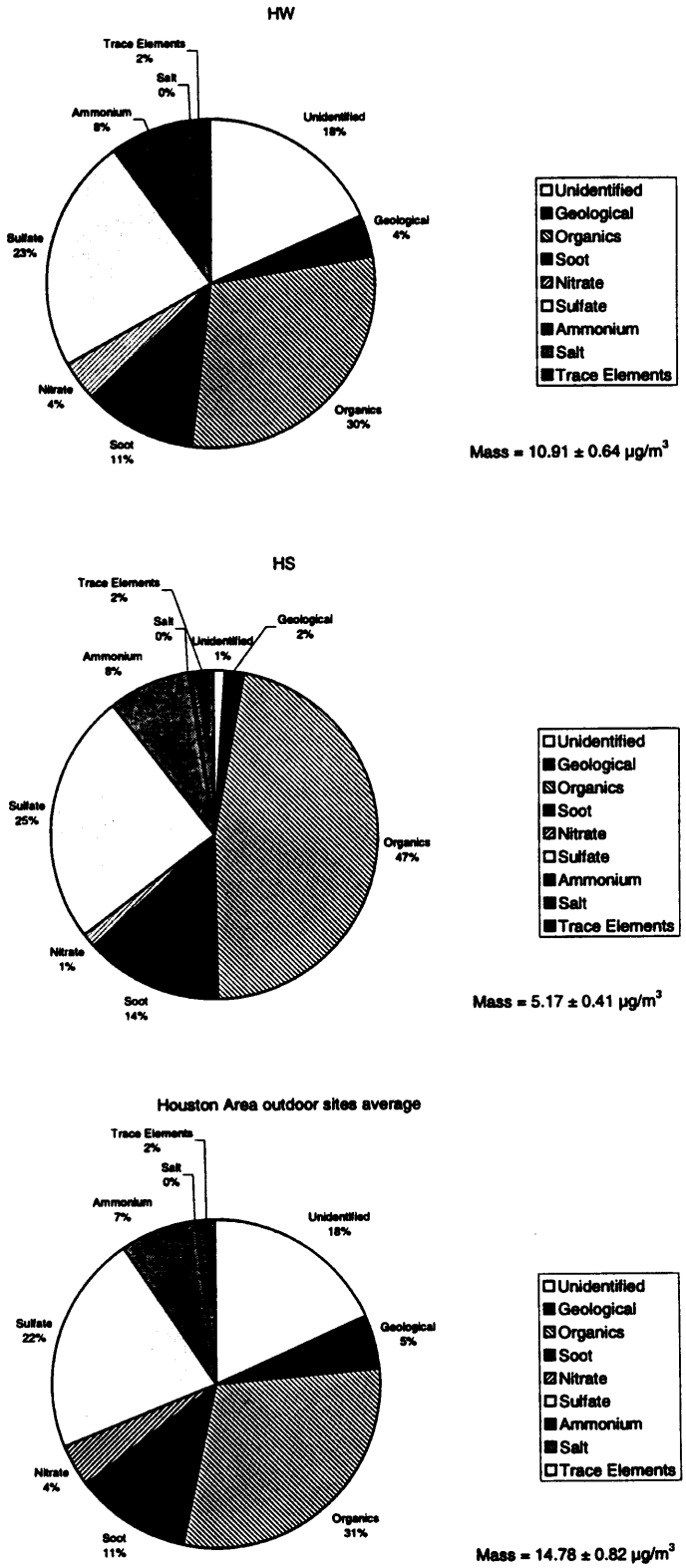


Figure 4-19. Material balance of major $PM_{2.5}$ chemical compositions at the HW and HS sites, and average of all outdoor sites, during the Texas $PM_{2.5}$ Sampling and Analysis Study between 09/13/97 and 03/12/98.



sample, or if one has reason to believe that particulate organic carbon is the result of transport and transformation to more oxygenated compounds such as may be the case at a remote location, with few or no major primary sources.

The most dramatic difference between outdoor and indoor air at the Shell Westhollow Technology Center is in the carbonaceous aerosol, with the outdoor site (HW) averaging 27% (2.8 ± 1.7 $\mu g/m^3$ organic carbon and 1.1 ± 0.7 $\mu g/m^3$ elemental carbon) and the indoor site (HS) averaging 61% (2.0 ± 1.0 $\mu g/m^3$ organic carbon and 0.7 ± 0.4 $\mu g/m^3$ elemental carbon). Even with mass concentrations one third of the outside measurements, the indoor samples had comparable carbon concentrations. The higher mass percentage of indoor organic carbon may be the result of lighter gaseous hydrocarbons emitted from indoor materials, such as wallpaper or carpeting or items such as copier machine toner that is adsorbed onto the particulate matter already deposited on the filter. As would be expected, the contribution from geological sources decreases from 0.5 $\mu g/m^3$ (4%) outdoors to 0.1 $\mu g/m^3$ (2%) indoors. Nitrate decreases from 0.4 $\mu g/m^3$ (4%) outdoors to 0.07 $\mu g/m^3$ (1%) indoors. The concentrations (as mass percentages) of ammonium, sulfate, and trace elements are comparable between the indoor and outdoor sites.

The pie chart for the El Paso site (EP) shows a significant fraction of the mass attributed to salt (3%). This fraction is higher than the 1% seen at the coastal sites (CC and HG) where a higher salt content would be expected. The source of the salt (XRF analysis of chlorine) in El Paso is not fully understood. The average soluble sodium concentration from all of the sites was 0.135 ± 0.140 $\mu g/m^3$. Both of the coastal sites, CC and HG, showed higher-than-average soluble sodium concentrations, 0.144 ± 0.150 $\mu g/m^3$ and 0.279 ± 0.310 $\mu g/m^3$, respectively. The El Paso site had an average soluble sodium concentration of 0.081 ± 0.036 $\mu g/m^3$, indicating that the source of chlorine in El Paso is not from salt (NaCl).