Organic Composition of Carbonaceous Aerosols in an Aged Prescribed Fire Plume

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Supplementary Material

Table S1. Ambient concentrations of organic compounds in $PM_{2.5}$ quantified with GC/MS (unit: $ng.m^{-3}$).

Compound	Before_Fire	Event	After_Fire
Heptadecane	0.660	0.487	0.695
Octadecane	0.631	0.000	0.952
Nonadecane	0.711	0.669	0.778
Eicosane	0.998	0.854	0.654
Heneicosane	1.153	1.525	0.579
Docosane	1.205	1.744	0.537
Tricosane	1.398	2.877	0.615
Tetracosane	1.169	2.065	0.549
Pentacosane	1.273	2.959	0.650
Hexacosane	1.014	1.553	0.355
Heptacosane	0.689	4.812	0.668
Octacosane	0.601	1.725	0.230
Nonacosane	1.054	8.485	0.819
Triacontane	0.000	1.077	0.000
Hentriacontane	0.949	7.060	0.655
Dotriacontane	0.000	0.697	0.000
Tritriacontane	0.268	1.526	0.258
Tetratriacontane	0.000	0.000	0.000
Pentatriacontane	0.000	0.000	0.000
Hexatriacontane	0.000	0.000	0.000
Sum of alkanes	13.775	40.113	8.991
iso-Nonacosane	0.000	0.000	0.000
anteiso-Triacontane	0.000	0.000	0.000
iso-Hentriacontane	0.000	0.000	0.000
Sum of Branch-alkanes	0.000	0.000	0.000
17α(H)-21β(H)-29-Norhopane	0.403	0.455	0.237
17α(H)-21β(H)-Hopane	0.383	0.422	0.227
22,29,30-Trisnorneohopane	0.145	0.197	0.035
22,29,30-Trisnorhopane	0.098	0.000	0.035
22S,17α(H),21β(H)-Homohopane	0.198	0.265	0.116
22R,17α(H),21β(H)-Homohopane	0.160	0.204	0.072
22S,17α(H),21β(H)-Bishomohopane	0.099	0.121	0.059
22R,17α(H),21β(H)-Bishomohopane	0.068	0.045	0.035
22S,17α(H),21β(H)-Trishomohopane	0.000	0.000	0.025
22R,17α(H),21β(H)-Trishomohopane	0.028	0.000	0.000
Sum of hopanes	1.581	1.710	0.840
20S,R-5α(H),14β(H),17β(H)-Cholestanes	0.000	0.000	0.000
20R-5α(H),14α(H),17α(H)-Cholestane	0.000	0.000	0.121
20S,R-5α(H),14β(H),17β(H)-Ergostanes	0.000	0.000	0.000
20S,R-5α(H),14β(H),17β(H)-Sitostanes	0.140	0.000	0.058
Sum of steranes	0.140	0.000	0.179

Table S1. (Continued)

Compound	Before_Fire	Event	After_Fire
Fluoranthene	0.212	0.195	0.146
Acephenanthrylene	0.019	0.041	0.005
Pyrene	0.172	0.159	0.078
Retene	0.059	0.738	0.112
Methyl substituted MW 202 PAH	0.209	0.239	0.090
Benzo(ghi)fluoranthene	0.130	0.176	0.000
Cyclopenta(cd)pyrene	0.046	0.045	0.012
Benz(a)anthracene	0.140	0.154	0.033
Chrysene/Triphenylene	0.237	0.409	0.099
Methyl substituted MW 228 PAH	0.131	0.291	0.088
Methyl substituted MW 226 PAH	nd	nd	nd
Benzo(b)fluoranthene	0.178	0.282	0.082
Benzo(k)fluoranthene	0.124	0.192	0.058
Benzo(j)fluoranthene	0.016	0.027	0.000
Benzo(e)pyrene	0.147	0.242	0.068
Benzo(a)pyrene	0.134	0.148	0.044
Perylene	0.029	0.026	0.000
Indeno(1,2,3-cd)fluoranthene	0.055	0.113	0.029
Indeno(1,2,3-cd)pyrene	0.176	0.244	0.069
Picene	nd	nd	nd
Benzo(ghi)perylene	0.318	0.382	0.098
Coronene	0.261	0.356	0.085
Sum of PAHs	2.792	4.459	1.197
8,15-Pimaredienoic acid	nd	nd	nd
Pimaric acid	0.105	0.549	0.313
Sandaracopimaric acid	0.328	1.661	1.566
Isopimaric acid	nd	nd	nd
Dehydroabietic acid	4.647	41.519	35.977
Abietic acid	0.168	0.437	0.301
Abieta-6,8,11,13,15-pentae-18-oic acid	0.040	0.251	0.070
Abieta-8,11,13,15-tetraen-18-oic acid	0.059	0.687	0.216
7-Oxodehydroabietic acid	0.790	18.516	6.105
Sum of Resin acids	6.136	63.619	44.547
1,2-Benzenedicarboxylic acid	0.702	3.530	0.543
1,4-Benzenedicarboxylic acid	1.036	2.078	1.076
1,3-Benzenedicarboxylic acid	0.447	1.130	0.198
Sum of Aromatic acids	2.186	6.738	1.818
Tetradecanoic acid	0.707	2.477	0.788
Pentadecanoic acid	0.510	1.368	0.459
Hexadecanoic acid	6.580	13.224	4.324
Heptadecanoic acid	0.285	0.780	0.191
Octadecanoic acid	3.226	6.432	1.655
Nonadecanoic acid	0.106	0.732	0.100
Eicosanoic acid	0.447	4.648	0.551
Heneicosanoic acid	0.157	1.923	0.225

Table S1. (Continued)

Compound	Before_Fire	Event	After_Fire
Docosanoic acid	0.711	9.762	1.050
Tricosanoic acid	0.237	3.697	0.389
Tetracosanoic acid	1.087	14.297	1.797
Pentacosanoic acid	0.102	1.266	0.171
Hexacosanoic acid	0.454	7.639	0.903
Heptacosanoic acid	0.021	0.433	0.067
Octacosanoic acid	0.143	2.603	0.241
Nonacosanoic acid	0.000	0.516	0.036
Triacontanoic acid	0.136	2.808	0.233
9-Hexadecenoic acid	nd	nd	nd
9,12-Octadecanedienoic acid	0.360	0.341	0.103
9-Octadecenoic acid	1.034	0.346	0.384
Pinonic acid	2.909	4.991	4.362
Pinic acid	1.163	3.108	2.733
sum of Fatty acids	20.374	83.390	20.759
Propanedioic acid	nd	nd	nd
Methylpropanedioic acid	nd	nd	nd
Butanedioic acid	2.705	21.812	3.445
Methylbutanedioic acid	0.377	4.472	0.613
Pentanedioic acid	0.512	3.371	0.749
Hexanedioic acid	0.481	2.587	0.408
Heptanedioic acid	nd	nd	nd
Octanedioic acid	0.350	3.898	0.409
Nonanedioic acid	0.877	8.002	0.957
Sum of dicarboxylic diacids	5.301	44.143	6.583
Nonanal	0.559	0.859	0.282
Sinapyl aldehyde	nd	nd	nd
Acetonylsyringol	0.413	1.799	0.202
Coniferyl aldehyde	nd	nd	nd
Propionylsyringol	nd	nd	nd
Benz(de)anthracen-7-one	0.146	0.233	0.081
3,5-Dimethoxy-4-hydroxyacetophenone	0.000	0.657	0.000
Levoglucosan	114.4	1209.7	144.9
Cholesterol	0.582	0.429	0.421
2-Methylthreitol	0.000	0.243	0.000
2-Methylerythritol	0.000	0.510	0.000
Sum of Other compounds	116.148	1214.414	145.865
Organic Carbon (ug/m3)	3.52	17.69	3.11
Element Carbon (ug/m3)	1.70	2.25	0.74
EC/OC	0.483	0.127	0.238

[a] 'nd', not detected.

Table S2. Source contributions to organic carbons in $PM_{2.5}$ (unit: $\mu g.m^{-3}$).

Samples	Diesel Vehicle Exhaust	Gasoline Vehicle Exhaust	Vegetative Detritus	Meat Cooking	Road Dust	Nature Gas Combustion	Prescribed Wood Burning	Others
Before_Fire	0.691 ± 0.105	0.202 ± 0.055	0.013 ± 0.006	0.467 ± 0.225	0.004 ± 0.004	0.008 ± 0.003	1.137 ± 0.331	0.996
Event	0.808 ± 0.186	0.209 ± 0.117	0.090 ± 0.044	0.373 ± 0.194	N/A [a]	N/A	8.676 ± 1.851	7.530
After_Fire	0.247 ± 0.068	0.107 ± 0.029	0.011 ± 0.005	0.297 ± 0.146	0.003 ± 0.002	0.001 ± 0.002	0.952 ± 0.228	1.490

[a] 'N/A' indicates that this source was not identified in the ambient sample.

Table S3. Detection limits (MDL) of organic compounds quantified with GC/MS (unit: ng m^{-3}).

Resin Acids	**MDL**	**Hopane and Sterane**	**MDL**
Isopimaric acid	0.038	17α(H)-21β(H)-Hopane	0.010
Dehydroabietic acid	0.028	22,29,30-Trisnorhopane	0.010
Abietic acid	0.032	20S,R-5α(H),14β(H),17β(H)-Cholestanes	0.008
1,2-benzenedicarboxylic acid	0.008	20R-5α(H),14α(H),17α(H)-Cholestane	0.006
1,4-benzenedicarboxylic acid	0.005	20S,R-5α(H),14β(H),17β(H)-Ergostanes	0.008
1,3-benzenedicarboxylic acid	0.008	20S,R-5α(H),14β(H),17β(H)-Sitostanes	0.019
Fatty Acids		**PAHs**	
Tetradecanoic acid	0.010	Fluoranthene	0.012
Hexadecanoic acid	0.014	Pyrene	0.005
Octadecanoic acid	0.007	Benz(a)anthracene	0.005
Eicosanoic acid	0.022	Chrysene/Triphenylene	0.006
Docosanoic acid	0.022	Benzo(b)fluoranthene	0.029
Tetracosanoic acid	0.030	Benzo(k)fluoranthene	0.018
Octacosanoic acid	0.086	Benzo(a)pyrene	0.010
Triacontanoic acid	0.049	Indeno(cd)pyrene	0.007
9-Hexadecenoic acid	0.032	Benzo(ghi)perylene	0.011
9,12-Octadecanedienoic acid	0.031	Coronene	0.007
9-Octadecenoic acid	0.024		
Alkanedioic Acids		***n*-alkanes**	
Propanedioic acid	0.025	Heptadecane	0.008
Butanedioic acid	0.006	Octadecane	0.012
Pentanedioic acid	0.039	Eicosane	0.016
Hexanedioic acid	0.014	Tetracosane	0.031
Heptanedioic acid	0.014	Octacosane	0.024
Octanedioic acid	0.014	Triacontane	0.046
Nonanedioic acid	0.013	Dotriacontane	0.035
Others			
2-Methyltetrols	0.090		
Pinonic acid	0.040		
Pinic acid	0.070		

Table S4. Source composition profiles from the aged plume on the event and the previous prescribed burning emission (ng/μg OC)

Compound	Aged Plume [a]	POC_{fc} [b]	Lee's [c]	Compound	Aged Plume [a]	POC_{fc} [b]	Lee's [c]
	Fraction [d] ± std [e]	Fraction ± std	Fraction ± std		Fraction ± std	Fraction ± std	Fraction ± std
***n*-alkanes**							
Tetracosane	0.0632 ± 0.0338	0.1128 ± 0.0609	0.1388 ± 0.0705	Triacontane	0.0759 ± 0.0161	0.1357 ± 0.0305	0.1939 ± 0.0937
Pentacosane	0.1189 ± 0.0463	0.2124 ± 0.0840	0.2500 ± 0.1276	Hentriacontane	0.4313 ± 0.1054	0.7703 ± 0.1962	0.2883 ± 0.1375
Hexacosane	0.0380 ± 0.0263	0.0679 ± 0.0472	0.2281 ± 0.1250	Dotriacontane	0.0492 ± 0.0104	0.0879 ± 0.0197	0.0000 ± 0.0001
Heptacosane	0.2910 ± 0.0719	0.5196 ± 0.1336	0.2498 ± 0.1639	Tritriacontane	0.0887 ± 0.0228	0.1584 ± 0.0423	0.0900 ± 0.0723
Octacosane	0.0792 ± 0.0264	0.1415 ± 0.0482	0.1155 ± 0.0538	Tetratriacontane	0.0000 ± 0.0001	0.0000 ± 0.0001	0.0000 ± 0.0001
Nonacosane	0.5245 ± 0.1267	0.9367 ± 0.2360	0.8067 ± 0.3847				
Branch-alkanes							
iso-Nonacosane	0.0000 ± 0.0001	0.0000 ± 0.0001	0.0000 ± 0.0001	iso-Hentriacontane	0.0000 ± 0.0001	0.0000 ± 0.0001	0.0000 ± 0.0001
anteiso-Triacontane	0.0000 ± 0.0001	0.0000 ± 0.0001	0.0000 ± 0.0001				
Hopanes							
17α(H)-21β(H)-29-Norhopane	0.0037 ± 0.0085	0.0066 ± 0.0153	0.0000 ± 0.0001	22R,17α(H),21β(H)-Homohopane	0.0031 ± 0.0036	0.0055 ± 0.0065	0.0000 ± 0.0001
17α(H)-21β(H)-Hopane	0.0027 ± 0.0080	0.0048 ± 0.0143	0.0000 ± 0.0001	22S,17α(H),21β(H)-Bishomohopane	0.0015 ± 0.0022	0.0028 ± 0.0039	0.0000 ± 0.0001
22,29,30-Trisnorneohopane	0.0037 ± 0.0034	0.0066 ± 0.0062	0.0000 ± 0.0001	22R,17α(H),21β(H)-Bishomohopane	0.0000 ± 0.0001	0.0000 ± 0.0001	0.0000 ± 0.0001
22,29,30-Trisnorhopane	0.0000 ± 0.0001	0.0000 ± 0.0001	0.0000 ± 0.0001	22S,17α(H),21β(H)-Trishomohopane	0.0000 ± 0.0001	0.0000 ± 0.0001	0.0000 ± 0.0001
22S,17α(H),21β(H)-Homohopane	0.0047 ± 0.0046	0.0084 ± 0.0083	0.0000 ± 0.0001	22R,17α(H),21β(H)-Trishomohopane	0.0000 ± 0.0001	0.0000 ± 0.0001	0.0000 ± 0.0001
Steranes							
20S,R-5α(H),14β(H),17β(H)-Cholestanes	0.0000 ± 0.0001	0.0000 ± 0.0001	0.0000 ± 0.0001	20S,R-5α(H),14β(H),17β(H)-Ergostanes	0.0000 ± 0.0001	0.0000 ± 0.0001	0.0000 ± 0.0001
20R-5α(H),14α(H),17α(H)-Cholestane	0.0000 ± 0.0001	0.0000 ± 0.0001	0.0000 ± 0.0001	20S,R-5α(H),14β(H),17β(H)-Sitostanes	0.0000 ± 0.0001	0.0000 ± 0.0001	0.0000 ± 0.0001
PAHs							
Fluoranthene	0.0000 ± 0.0001	0.0000 ± 0.0001	0.0895 ± 0.0390	Benzo(j)fluoranthene	0.0007 ± 0.0004	0.0013 ± 0.0008	0.0128 ± 0.0067
Acephenanthrylene	0.0015 ± 0.0006	0.0028 ± 0.0011	0.0280 ± 0.0140	Benzo(e)pyrene	0.0066 ± 0.0040	0.0119 ± 0.0072	0.0499 ± 0.0208
Pyrene	0.0000 ± 0.0001	0.0000 ± 0.0001	0.1068 ± 0.0450	Benzo(a)pyrene	0.0010 ± 0.0028	0.0018 ± 0.0050	0.0298 ± 0.0124
Retene	0.0479 ± 0.0110	0.0856 ± 0.0206	0.3490 ± 0.1645	Perylene	0.0000 ± 0.0001	0.0000 ± 0.0001	0.0039 ± 0.0022
Benzo(ghi)fluoranthene	0.0031 ± 0.0030	0.0057 ± 0.0055	0.0972 ± 0.0778	Indeno(1,2,3-cd)fluoranthene	0.0041 ± 0.0018	0.0073 ± 0.0032	0.0000 ± 0.0001
Cyclopenta(cd)pyrene	0.0000 ± 0.0001	0.0000 ± 0.0001	0.2888 ± 0.1381	Indeno(1,2,3-cd)pyrene	0.0048 ± 0.0042	0.0085 ± 0.0076	0.0737 ± 0.0342
Benz(a)anthracene	0.0010 ± 0.0029	0.0018 ± 0.0052	0.0800 ± 0.0329	Picene	0.0000 ± 0.0001	0.0000 ± 0.0001	0.0000 ± 0.0001
Chrysene/Triphenylene	0.0121 ± 0.0067	0.0216 ± 0.0121	0.0978 ± 0.0411	Benzo(ghi)perylene	0.0045 ± 0.0070	0.0080 ± 0.0125	0.0358 ± 0.0149

Table S4. (Continued)

Compound	Aged Plume [a]	POC_{fc} [b]	Lee's [c]	Compound	Aged Plume [a]	POC_{fc} [b]	Lee's [c]
	Fraction [d] ± std [e]	Fraction ± std	Fraction ± std		Fraction ± std	Fraction ± std	Fraction ± std
PAHs							
Benzo(b)fluoranthene	0.0073 ± 0.0047	0.0131 ± 0.0085	0.0505 ± 0.0210	Coronene	0.0066 ± 0.0062	0.0119 ± 0.0111	0.0074 ± 0.0044
Benzo(k)fluoranthene	0.0048 ± 0.0032	0.0086 ± 0.0058	0.0407 ± 0.0167				
Resin Acids							
8,15-Pimaredienoic acid	0.0000 ± 0.0001	0.0000 ± 0.0001	0.0000 ± 0.0001	Abietic acid	0.0189 ± 0.0067	0.0339 ± 0.0123	0.0000 ± 0.0001
Pimaric acid	0.0312 ± 0.0082	0.0558 ± 0.0152	2.4658 ± 1.0099	Abieta-6,8,11,13,15-pentae-18-oic acid	0.0149 ± 0.0037	0.0266 ± 0.0069	0.0000 ± 0.0001
Sandaracopimaric acid	0.0941 ± 0.0248	0.1680 ± 0.0460	0.0000 ± 0.0001	Abieta-8,11,13,15-tetraen-18-oic acid	0.0443 ± 0.0102	0.0791 ± 0.0191	0.0000 ± 0.0001
Isopimaric acid	0.0000 ± 0.0001	0.0000 ± 0.0001	2.9594 ± 1.2311	7-Oxodehydroabietic acid	1.2512 ± 0.2774	2.2343 ± 0.5204	0.0000 ± 0.0001
Dehydroabietic acid	2.6027 ± 0.6202	4.6477 ± 1.1562	33.316 ± 14.302				
Aromatic Acids							
1,2-Benzenedicarboxylic acid	0.1995 ± 0.0528	0.3563 ± 0.0978	0.0147 ± 0.0088	1,3-Benzenedicarboxylic acid	0.0482 ± 0.0175	0.0861 ± 0.0318	0.0000 ± 0.0001
1,4-Benzenedicarboxylic acid	0.0735 ± 0.0332	0.1312 ± 0.0600	0.0090 ± 0.0071				
Alkanoic Acids							
Tetradecanoic acid	0.1249 ± 0.0375	0.2230 ± 0.0688	2.0065 ± 0.9764	Tricosanoic acid	0.2442 ± 0.0553	0.4361 ± 0.1035	0.6541 ± 0.2863
Pentadecanoic acid	0.0605 ± 0.0210	0.1081 ± 0.0384	0.6371 ± 0.3281	Tetracosanoic acid	0.9325 ± 0.2137	1.6651 ± 0.3998	4.9519 ± 2.2088
Hexadecanoic acid	0.4689 ± 0.2113	0.8374 ± 0.3821	6.7301 ± 2.9428	Pentacosanoic acid	0.0822 ± 0.0189	0.1468 ± 0.0353	0.3831 ± 0.1679
Heptadecanoic acid	0.0349 ± 0.0119	0.0623 ± 0.0218	0.2481 ± 0.1184	Hexacosanoic acid	0.5071 ± 0.1143	0.9056 ± 0.2141	3.6714 ± 1.6200
Octadecanoic acid	0.2262 ± 0.1029	0.4040 ± 0.1860	2.2421 ± 1.0502	Heptacosanoic acid	0.0290 ± 0.0064	0.0518 ± 0.0121	0.1410 ± 0.0652
Nonadecanoic acid	0.0442 ± 0.0109	0.0789 ± 0.0203	0.4882 ± 0.2505	Octacosanoic acid	0.1736 ± 0.0389	0.3100 ± 0.0730	0.9881 ± 0.4472
Eicosanoic acid	0.2965 ± 0.0694	0.5295 ± 0.1296	1.1947 ± 0.5701	Nonacosanoic acid	0.0364 ± 0.0077	0.0650 ± 0.0146	0.1684 ± 0.0868
Heneicosanoic acid	0.1247 ± 0.0287	0.2226 ± 0.0537	0.2886 ± 0.1278	Triacontanoic acid	0.1885 ± 0.0420	0.3367 ± 0.0788	0.8029 ± 0.4244
Docosanoic acid	0.6388 ± 0.1459	1.1408 ± 0.2731	1.7855 ± 0.8199				
Alkenoic Acids							
9-Hexadecenoic acid	0.0000 ± 0.0001	0.0000 ± 0.0001	0.5076 ± 0.3254	9-Octadecenoic acid	0.0000 ± 0.0001	0.0000 ± 0.0001	2.4381 ± 1.1394
9,12-Octadecanedienoic acid	0.0000 ± 0.0001	0.0000 ± 0.0001	2.2530 ± 1.2726				
Alkanedioic Acids							
Propanedioic acid	0.0000 ± 0.0001	0.0000 ± 0.0001	0.0000 ± 0.0001	Hexanedioic acid	0.1486 ± 0.0387	0.2655 ± 0.0717	0.0265 ± 0.0196
Methylpropanedioic acid	0.0000 ± 0.0001	0.0000 ± 0.0001	0.0000 ± 0.0001	Heptanedioic acid	0.0000 ± 0.0001	0.0000 ± 0.0001	0.0300 ± 0.0240
Butanedioic acid	1.3487 ± 0.3258	2.4084 ± 0.6067	0.3964 ± 0.2064	Octanedioic acid	0.2504 ± 0.0582	0.4473 ± 0.1088	0.0595 ± 0.0409

Table S4. (Continued)

Compound	Aged Plume [a]	POC_{fc} [b]	Lee's [c]	Compound	Aged Plume [a]	POC_{fc} [b]	Lee's [c]
	Fraction [d] ± std [e]	Fraction ± std	Fraction ± std		Fraction ± std	Fraction ± std	Fraction ± std
Alkanedioic Acids							
Methylbutanedioic acid	0.2890 ± 0.0668	0.5162 ± 0.1249	0.0000 ± 0.0001	Nonanedioic acid	0.5029 ± 0.1195	0.8981 ± 0.2229	0.2586 ± 0.1358
Pentanedioic acid	0.2018 ± 0.0503	0.3604 ± 0.0935	0.0813 ± 0.0429				
Others							
Nonanal	0.0211 ± 0.0145	0.0378 ± 0.0261	0.0000 ± 0.0001	Benz(de)anthracen-7-one	0.0061 ± 0.0039	0.0109 ± 0.0070	0.0000 ± 0.0001
Sinapyl aldehyde	0.0000 ± 0.0001	0.0000 ± 0.0001	0.0000 ± 0.0001	3,5-Dimethoxy-4-hydroxyacetophenone	0.0463 ± 0.0098	0.0827 ± 0.0186	0.0000 ± 0.0001
Acetonylsyringol	0.0978 ± 0.0270	0.1747 ± 0.0498	0.0000 ± 0.0001	Levoglucosan	77.311 ± 18.076	138.05 ± 33.752	94.750 ± 40.256
Coniferyl aldehyde	0.0000 ± 0.0001	0.0000 ± 0.0001	0.0000 ± 0.0001	Cholesterol	0.0000 ± 0.0001	0.0000 ± 0.0001	0.0000 ± 0.0001
Propionylsyringol	0.0000 ± 0.0001	0.0000 ± 0.0001	0.0000 ± 0.0001				

[a] source composition profiles where individual organic compounds are normalized to the fire-caused total OC mass on the event day;
[b] source composition profiles where individual organic compounds are normalized to the fire-caused primary OC mass estimated on the event day;
[c] source composition profiles from the prescribed burning emission in Georgia (Lee et al., 2005);
[d] fraction of organic compound in the associated OC mass (ng/μg OC);
[e] standard deviation.