Metropolitan Museum of Art
Gas Chromatography- Mass Spectrometry (GC-MS) Results from Material Analysis

This document includes (1) a mass spectrum and (2) the volatile organic compounds (VOCs) emitted from samples using GC-MS analysis. The data is not interpreted; however, several classes of chemicals are highlighted because they are potential risks for artwork in an enclosed environment. A basic key, provided below, indicates those classes. The amount of each chemical identified has not been determined; similarly, it is not known how much of each chemical is necessary to do damage to art. Finally, peaks may be present that are the result of the sample adsorbing chemicals from the air and reemitting them during testing rather than being inherent to the sample. Research is ongoing to determine specifically which chemicals and amounts are required to negatively affect artifacts.

Highlighted data:

Pink – chemicals currently known to be hazardous to art

Green – amines; can raise the pH, are suspected to react with acids and may form crystals in an enclosed environment

Yellow – chemicals of the following type, which *may* be hazardous to art:

Acids – lower the pH, corrosive to metals, degrade organic materials

Aldehydes – can convert to acids with heat or exposure to UV light

Esters – can hydrolyze into acids with heat and humidity

Sulfur-containing compounds – known to tarnish and corrode some metals

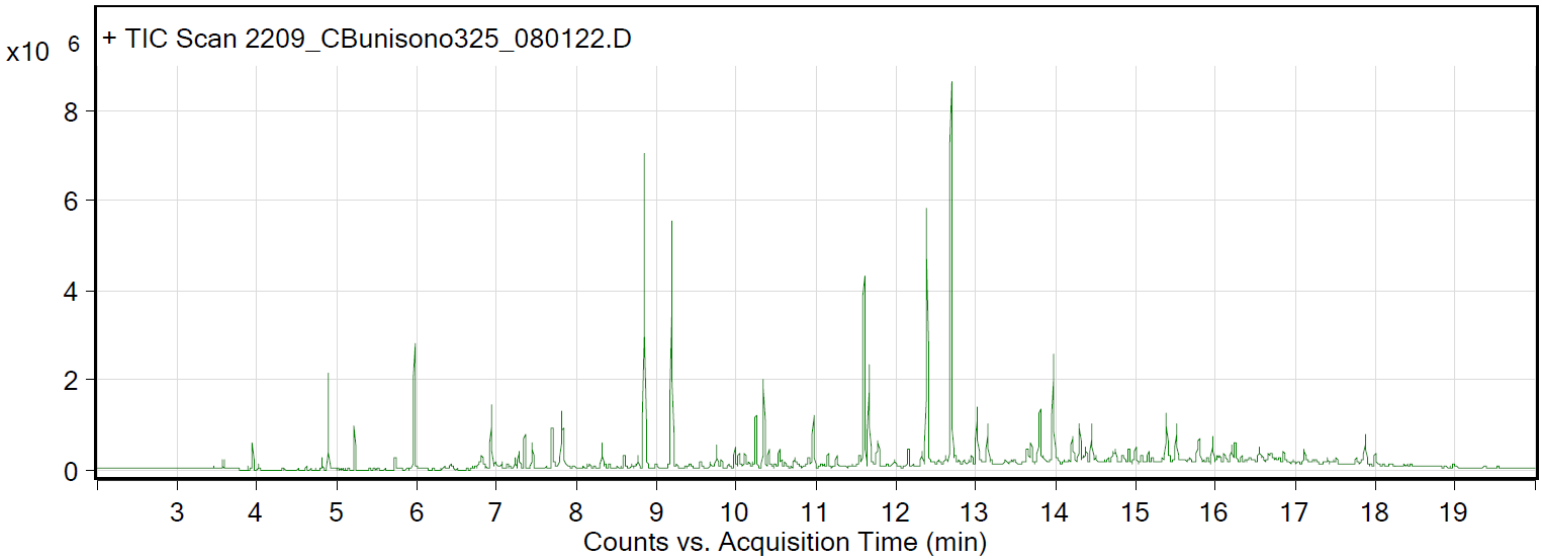
Halogenated compounds – can become reactive with exposure to heat and UV light

Nitrogen-containing, not amine – can react with other off-gassed chemicals

Alkynes – can become reactive when exposed to heat or UV light

Sample: Creation Baumann Unisono 0325
Oddy test result: Unsuitable
Date collected: 6/20/2018
Technique used: SPME with a PDMS/DVB fiber; Agilent 7890B GC and 5977B MS fitted with a GL Sciences OPTIC-4 multimode inlet and LEAP PAL RTC autosampler; Pre-heated at 60°C for 20 minutes; fiber exposure at 60°C for 20 minutes; sample injected into 220°C inlet and cryo-trapped for 2 min at -15°C; GC ramped from 35°C to 250 °C at 10°C/min. Data analyzed in Masshunter Qualitative Analysis. Deconvoluted data with > 85% match with a NIST 17.0 or Wiley 9 library are reported.

VOCs not highlighted are because they were also observed in blanks: (1) 5.7 min: methoxyphenyl oxime; (2) 12.4 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxyl-1-methylethyl) propyl ester propanoic acid; (3) 12.7 min: 2-methyl-, 3-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid



Compound Table

RT	Score (Lib)	Area	Name	Formula
3.59	98.02	170209	Acetic acid	C2H4O2
3.94	95.1	454261	Silanediol, dimethyl-	C2H8O2Si
4.82	96.86	235681	Hexanal	C6H12O
4.89	92.49	1560504	Cyclotrisiloxane, hexamethyl-	C6H18O3Si3
5.22	95.86	948129	2-Pentanone, 4-hydroxy-4-methyl-	C6H12O2
5.73	85.86	266472	Oxime-, methoxy-phenyl-_	C8H9NO2
5.97	96.93	2871916	Ethanol, 2-butoxy-	C6H14O2
6.82	98.34	269672	Benzaldehyde	C7H6O
6.84	96.25	124645	1-Heptanol	C7H16O
6.92	93.95	322490	Phenol	C6H6O
6.94	96.56	1405663	Cyclotetrasiloxane, octamethyl-	C8H24O4Si4
7.07	87.31	150282	6-Methyl-5-hepten-2-one	C8H14O
7.23	91.26	270411	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN	C7H16O3
7.28	91.05	534019	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN	C7H16O3
7.35	97.63	852581	Octanal	C8H16O
7.44	95.49	820924	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN	C7H16O3
7.69	96.7	1235668	1-Hexanol, 2-ethyl-	C8H18O
7.81	95.41	1539344	Benzyl Alcohol	C7H8O
7.83	92.3	902450	1,2-Hexanediol	C6H14O2
8.85	97.87	8680930	Nonanal	C9H18O
9.19	94.49	6507875	Cyclopentasiloxane, decamethyl-	C10H30O5Si5
9.55	89.49	200215	1,3-Pentanediol, 2,2,4-trimethyl-	C8H18O2
9.75	90.31	560724	Tetrahydrofurfuryl acrylate	C8H12O3
9.98	97.77	655274	Cyclohexanol, 5-methyl-2-(1-methylethyl)-	C10H20O
10.03	94.86	405121	Ethanol, 2-(2-butoxyethoxy)-	C8H18O3

10.15	94.6	171358	Azulene	C10H8
10.2	96.57	165803	Methyl salicylate	C8H8O3
10.24	94.61	1495676	Dodecane	C12H26
10.34	97.31	2515822	Decanal	C10H20O
10.53	93.1	539188	Ethanol, 2-phenoxy-	C8H10O2
10.91	89.55	268145	1-Phenoxypropan-2-ol	C9H12O2
10.97	94.97	1500613	Hexanoic acid, 2-ethyl-, 2-methylpropyl ester	C12H24O2
11.15	93.35	392757	2-Decenal, (E)-	C10H18O
11.26	96.25	368663	1-Decanol	C10H22O
11.53	87.97	159575	Phenol, 3-(1,1-dimethylethyl)-	C10H14O
11.6	95.47	5473526	Cyclohexasiloxane, dodecamethyl-	C12H36O6Si6
11.66	94.62	3317767	Tridecane	C13H28
11.76	96.27	419341	Benzaldehyde, 2,4,5-trimethyl-	C10H12O
11.78	96.86	718620	Undecanal	C11H22O
11.98	89.95	257337	Undecane, 3,6-dimethyl-	C13H28
12.15	94.23	525474	Triacetin	C9H14O6
12.38	90.49	7775761	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester	C12H24O3
12.69	94.1	11586057	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester	C12H24O3
12.74	88.2	185819	Hexasiloxane, tetradecamethyl-	C14H42O5Si6
12.95	93.46	194093	Phenol, 4-(1,1-dimethylpropyl)-	C11H16O
13.01	94.93	1915931	Tetradecane	C14H30
13.15	97.56	1227188	Dodecanal	C12H24O
13.69	91.29	629813	Cyclopentane, nonyl-	C14H28
13.97	96.89	3348609	1-Dodecanol	C12H26O
14.2	93.71	796951	1-Pentadecene	C15H30
14.29	92.82	1236389	pentadecane	C15H32
14.45	97.95	1137224	Tridecanal	C13H26O
14.75	87.37	388164	Heptasiloxane, hexadecamethyl-	C16H48O6Si7
14.92	86.28	416809	Sulfurous acid, hexyl tetradecyl ester	C20H42O3S
15	93.3	512168	n-Nonylcyclohexane	C15H30
15.16	90.86	307194	Pentadecane, 3-methyl-	C16H34
15.21	85.15	188144	Decanedioic acid, didecyl ester	C30H58O4

15.33	85.21	135298	2,3,4-trimethyl-1-pentanol	C8H18O
15.51	90.2	1202183	2,6,10-Trimethyltridecane	C16H34
15.68	87.71	197040	Pentadecanal-	C15H30O
15.77	90.2	500851	Cyclooctasiloxane, hexadecamethyl-	C16H48O8Si8
15.79	87.44	591748	Dodecanoic acid, 1-methylethyl ester	C15H30O2
15.96	97.59	757203	Methanone, diphenyl-	C13H10O
16.2	88.66	534582	Cyclopentane, undecyl-	C16H32
16.24	91.14	596431	Octane, 1,1'-oxybis-	C16H34O
17.51	95.06	190372	Benzyl benzoate	C14H12O2
17.87	97.41	988266	Benzene, 1,1'-[1,2-ethanediylbis(oxy)]bis-	C14H14O2
18	92.83	364844	Isopropyl myristate	C17H34O2