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

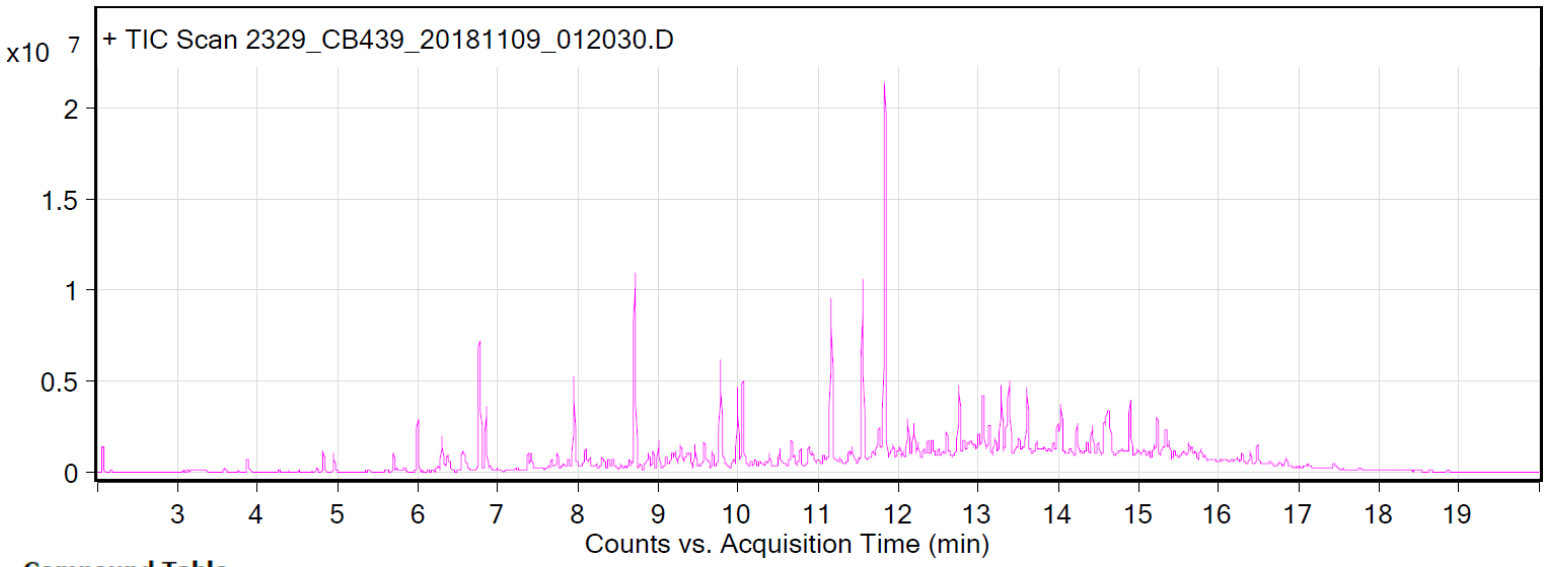
Halogenated compounds – can become reactive with exposure to heat and UV light

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: Ultra V 439 cotton fabric
Oddy test result: Temporary
Date collected: 11/9/2018
Technique used: SPME with a PDMS/Carbon WR 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) 11.5 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxyl-1-methylethyl) propyl ester propanoic acid;



Compound Table

RT	Score (Lib)	Area	Name	Formula
2.06	93.66	1290294	Silanediol, dimethyl-	C2H8O2Si
3.59	92.38	388309	Cyclotrisiloxane, hexamethyl-	C6H18O3Si3
3.87	95.24	1023270	2-Pentanone, 4-hydroxy-4-methyl-	C6H12O2
4.82	96.65	1582174	Ethanol, 2-butoxy-	C6H14O2
4.95	92.9	1400232	2(5H)-Furanone	C4H4O2
5.7	97.82	1493174	Benzaldehyde	C7H6O
6	88.92	3424226	Phenol	C6H6O
6.25	96.68	467661	1,2-Ethanediol, diacetate	C6H10O4
6.3	95.92	2676792	Cyclotetrasiloxane, octamethyl-	C8H24O4Si4
6.33	93.03	489275	O-Ethyl-1,3-dioxolanium	C5H11O2
6.36	93	1033099	Octanal	C8H16O
6.4	88.88	673289	O-Ethyl-1,3-dioxolanium	C5H11O2
6.77	96.36	10391809	1-Hexanol, 2-ethyl-	C8H18O
6.85	95.48	4696955	Benzyl Alcohol	C7H8O
7.38	97.94	1227353	Ethanone, 1-phenyl-	C8H8O
7.42	95.69	1430855	1-Octanol	C8H18O
7.67	91.37	762602	Benzenemethanol, .alpha.,.alpha.-dimethyl-	C9H12O
7.74	91.65	1290933	2-Butoxyethyl acetate	C8H16O3
7.95	96.87	7884858	Nonanal	C9H18O
8.1	89.35	1186106	Benzeneethanol	C8H10O
8.3	88.25	1352107	Undecane, 3,7-dimethyl-	C13H28
8.38	87.59	796363	2-chloro-1,1,1-trifluoro-2-tridecene	C13H22ClF3
8.44	86.26	520160	Pentanedioic acid, dimethyl ester	C7H12O4
8.71	95.52	16385997	Cyclopentasiloxane, decamethyl-	C10H30O5Si5
8.94	92.38	1380679	Decyl heptyl ether	C17H36O
9.01	96.9	2123784	Cyclohexanol, 5-methyl-2-(1-methylethyl)-, (1.alpha.,2.beta.,5.alpha.)-(.+/-.)-	C10H20O
9.22	93.31	1217155	Ethanol, 1-(2-butoxyethoxy)-	C8H18O3
9.34	94.08	546205	Methyl salicylate	C8H8O3
9.46	96.55	1779024	Decanal	C10H20O

9.68	90.89	1154623	Ethanol, 2-phenoxy-	C8H10O2
9.78	95.07	8164644	Benzothiazole	C7H5NS
9.94	85.39	820082	2-Ethyl-1-hexyl propionate	C11H22O2
9.99	85.22	5878963	2-Propanol, 1,1'-oxybis-	C6H14O3
10.06	88.6	6875280	2-Propanol, 1,1'-oxybis-	C6H14O3
10.39	96.58	1179163	1-Decanol	C10H22O
10.51	86.51	1508226	Benzene, 1,3-bis(1-methylethenyl)-	C12H14
10.67	94.87	2763576	1-Tridecene	C13H26
10.78	86.83	1449075	Tridecane	C13H28
11.16	96.23	14841105	Cyclohexasiloxane, dodecamethyl-	C12H36O6Si6
11.55	89.3	17035262	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester	C12H24O3
11.76	90.92	2603990	Ethanone, 1-(2,3-dihydro-1H-inden-5-yl)-	C11H12O
12.12	94.79	3767080	Tetradecane	C14H30
12.24	93.97	1478450	Dodecanal	C12H24O
12.37	85.28	1759492	1-Nonadecene	C19H38
12.76	87.62	7210290	Cyclopentane, nonyl-	C14H28
13.29	95.03	7225565	1-Pentadecene	C15H30
13.61	97.57	5332209	Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl-	C15H24O
14.03	90.18	4594814	n-Nonylcyclohexane	C15H30
14.34	87.05	491807	Heptasiloxane, hexadecamethyl-	C16H48O6Si7
14.42	86.49	2792284	Cyclopentane, 1,2-dimethyl-3-(1-methylethyl)-	C10H20
14.49	90.24	1735140	1-Tricosene	C23H46
14.6	85.07	5058421	PENTAN-1,3-DIOLDIISOBUTYRATE, 2,2,4-TRIMETHYL-	C16H30O4
15.23	91.63	4217248	Cyclohexadecane	C16H32
15.38	88.13	1437963	Cyclooctasiloxane, hexadecamethyl-	C16H48O8Si8
15.62	92.12	2094948	1-Heptadecene	C17H34
16.39	92.55	1146851	Cyclohexane, undecyl-	C17H34
16.84	92.06	855614	5,5-Diethylpentadecane	C19H40