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

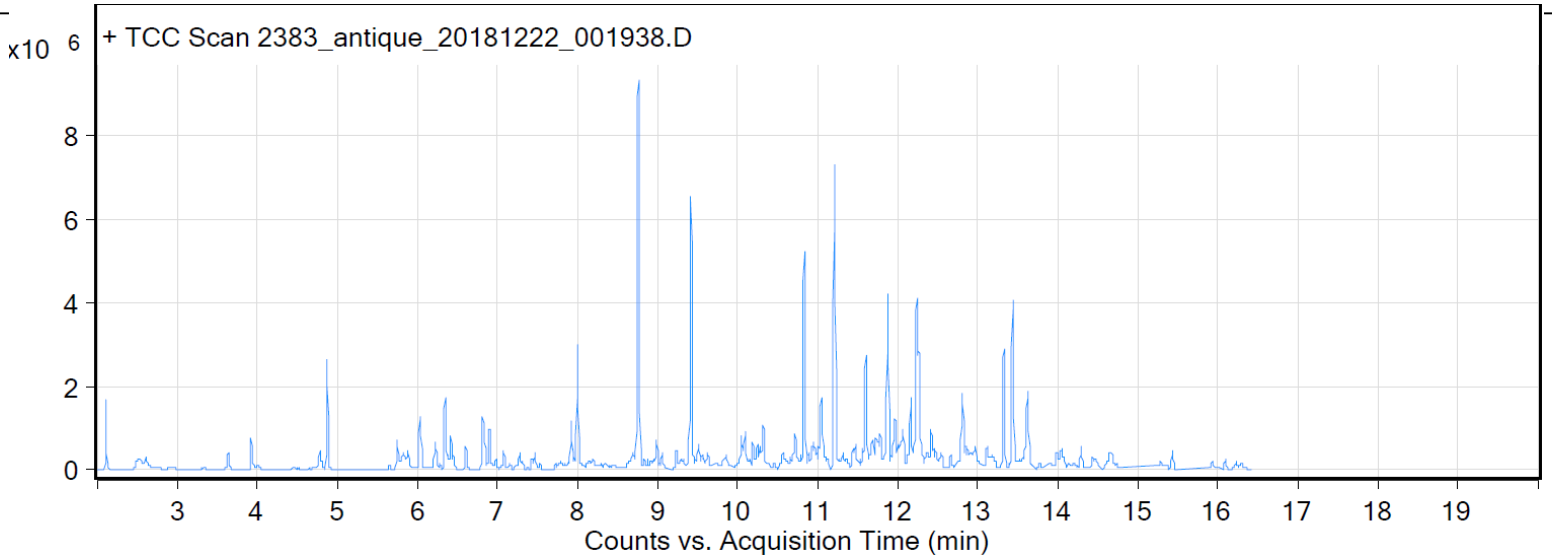
Sample: Talas; Museum board Antique white board

Oddy test result: temporary

Date collected: 12/22/2018

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) 4.8 min: methoxyphenyl oxime; (2) 11.6 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxyl-1-methylethyl) propyl ester propanoic acid; (3) 11.9 min: 2-methyl-, 3-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid



Compound Table

RT	Score (Lib)	Area	Name	Formula
2.1	93.64	1401112	Silanediol, dimethyl-	C2H8O2Si
2.51	90.9	1802089	Hexanal	C6H12O
2.6	85.88	183979	(S)-(+)-1,2-Propanediol	C3H8O2
3.63	92.47	550381	Cyclotrisiloxane, hexamethyl-	C6H18O3Si3
3.92	97.29	974560	2-Pentanone, 4-hydroxy-4-methyl-	C6H12O2
4.78	85.79	566700	Oxime-, methoxy-phenyl-_	C8H9NO2
4.81	91.43	433415	Heptanal	C7H14O
4.87	97.34	3492985	Ethanol, 2-butoxy-	C6H14O2
5.75	96.78	717397	N-benzylidene-dimethylammonium chloride	C9H12ClN
6.22	93.67	1025363	Heptane, 2,2,4,6,6-pentamethyl-	C12H26
6.24	91.51	318816	Furan, 2-pentyl-	C9H14O
6.28	95.69	165602	unidentified C3-benzene	C9H12
6.34	95.98	2611206	Cyclotetrasiloxane, octamethyl-	C8H24O4Si4
6.38	92.82	311949	O-Ethyl-1,3-dioxolanium	C5H11O2
6.41	96.11	996378	Octanal	C8H16O
6.44	91.51	490589	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN	C7H16O3
6.6	96.4	955876	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN	C7H16O3
6.81	96.48	1884537	1-Hexanol, 2-ethyl-	C8H18O
6.84	96.11	778606	dl-Limonene	C10H16
6.9	96.52	690151	Benzyl Alcohol	C7H8O
7.07	85.01	617078	Hexane, 1-nitro-	C6H13NO2
7.43	98.94	296657	Ethanone, 1-phenyl-	C8H8O
7.46	92.13	531862	1-Octanol	C8H18O
7.54	86.88	184259	Cyclotrisiloxane, hexamethyl-	C6H18O3Si3
7.92	95.45	1688335	Undecane	C11H24
8	98.45	4390287	Nonanal	C9H18O
8.76	95.41	16419913	Cyclopentasiloxane, decamethyl-	C10H30O5Si5
8.83	87.97	287148	2-Nonenal, (E)-	C9H16O
8.98	92.15	551402	Undecane, 3-methyl-	C12H26

9.06	96.1	479812	Cyclohexanol, 5-methyl-2-(1-methylethyl)-, (1.alpha.,2.beta.,5.alpha.)-(.+/-.)-	C10H20O
9.23	87.47	376248	Pentasiloxane, dodecamethyl-	C12H36O4Si5
9.42	96.08	10245447	Dodecane	C12H26
9.51	97.67	761360	Decanal	C10H20O
9.85	90.94	471499	2-Ethylhexyl acrylate	C11H20O2
10.32	88.02	904221	Ethylene diacrylate	C8H10O4
10.46	88.92	224838	n-Propyl benzoate	C10H12O2
10.56	87.44	453744	Undecane, 3,8-dimethyl-	C13H28
10.72	93.95	1632312	1-Tridecene	C13H26
10.83	95.56	7926641	Tridecane	C13H28
11.04	86.84	1202654	Heptane, 2,2,4,6,6-pentamethyl-	C12H26
11.21	96.05	13264921	Cyclohexasiloxane, dodecamethyl-	C12H36O6Si6
11.32	87.98	396807	Heptadecane, 7-methyl-	C18H38
11.6	89.49	4317181	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester	C12H24O3
11.78	91.83	1186940	Tridecane, 3-methyl-	C14H30
11.87	93.51	6968801	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester	C12H24O3
11.96	96.1	1241124	1,1'-Biphenyl	C12H10
12.16	93.94	1576330	Tetradecane	C14H30
12.24	85.79	5756220	1,1'-Biphenyl, 2-methyl-	C13H12
12.26	94.97	3970903	Benzene, 1,1'-oxybis-	C12H10O
12.54	89.98	273510	2,2'-Dimethylbiphenyl	C14H14
12.66	90.08	507520	Diphenylmethane	C13H12
12.81	87.68	1885798	Nonyl tetradecyl ether	C23H48O
12.96	85.19	603185	Tetradecane, 4-methyl-	C15H32
13.32	94.91	4632023	1,1'-Biphenyl, 4-methyl-	C13H12
13.62	89.58	1518081	Tetradecane, 2,2-dimethyl-	C16H34
13.77	90.85	240204	Benzene, 1,1'-(1,2-ethanediyl)bis-	C14H14
14.19	85.13	184230	Pentadecane, 2-methyl-	C16H34
14.43	85.45	343815	1-METHYL-2-(PROPENYLOXY)-ETHYL ESTER OF BENZOIC ACID	C13H16O3
14.59	93.59	208421	4,4'-Dimethylbiphenyl	C14H14
14.65	90.48	685994	PENTAN-1,3-DIOLDIISOBUTYRATE, 2,2,4-TRIMETHYL-	C16H30O4
15.43	88.07	858722	Cyclooctasiloxane, hexadecamethyl-	C16H48O8Si8