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

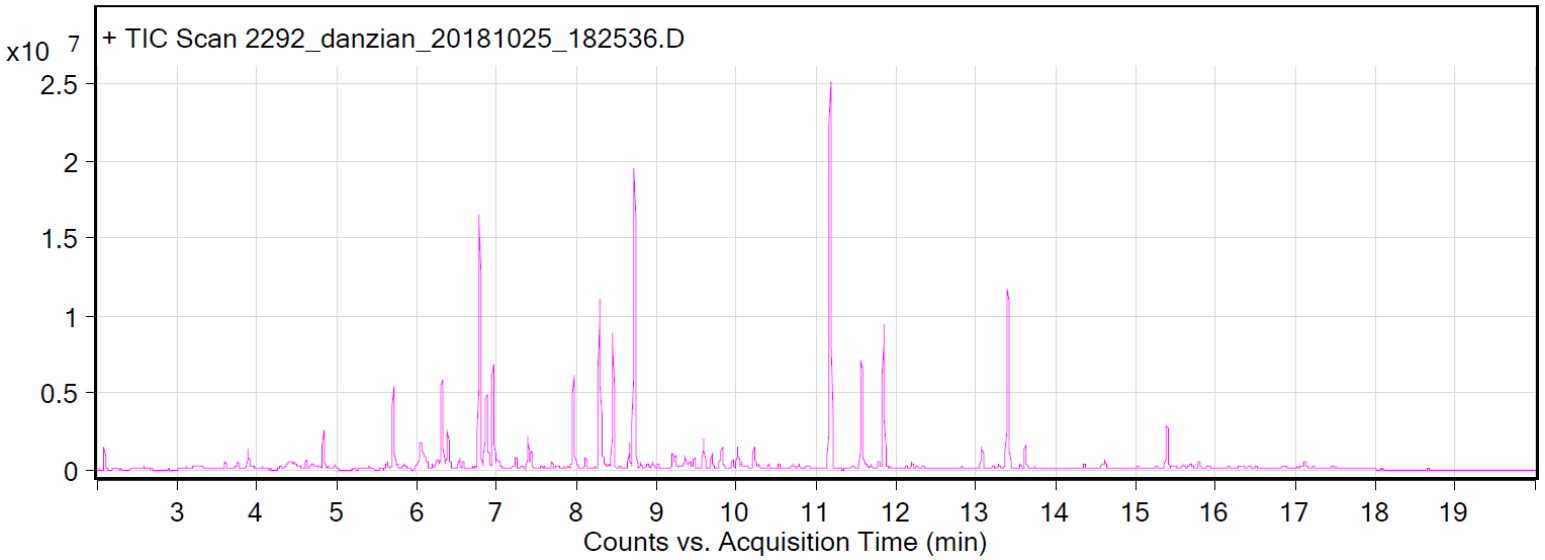
Halogenated compounds – can become reactive with exposure to heat and UV light

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

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

Sample: Danzian: Celtic Cloth gray polyester fabric
Oddy test result: Temporary
Date collected: 10/24/2018
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) 11.6 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxyl-1-methylethyl) propyl ester propanoic acid; (2) 11.8 min: 2-methyl-, 3-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid



Compound Table

RT	Score (Lib)	Area	Name	Formula
1.49	97.38	453268	Acetic acid	C2H4O2
1.73	90.69	1359611	Toluene	C7H8
2.09	89.07	1662301	Silanediol, dimethyl-	C2H8O2Si
3.25	87.82	2209374	2-Furancarboxaldehyde	C5H4O2
3.6	93.33	772559	Cyclotrisiloxane, hexamethyl-	C6H18O3Si3
3.88	95.39	1808623	2-Pentanone, 4-hydroxy-4-methyl-	C6H12O2
3.92	94.39	979022	unidentified C2-benzene	C8H10
4.4	91.52	2886797	Styrene	C8H8
4.46	92.89	458753	1-Acetoxy-2-propanol	C5H10O3
4.61	98.14	748168	Styrene	C8H8
4.7	91.91	762059	2-Propenoic acid, butyl ester	C7H12O2
4.77	88.54	488058	Heptanal	C7H14O
4.83	96.89	3277366	Ethanol, 2-butoxy-	C6H14O2
4.97	92.34	489757	2(5H)-Furanone	C4H4O2
5.64	90.58	532095	2-heptenal (Z and E)	C7H12O
5.71	97.65	7720619	Benzaldehyde	C7H6O
6.04	90.4	5049852	Phenol	C6H6O
6.24	92.93	746095	Mesitylene	C9H12
6.26	85.78	794613	1,2-Ethanediol, diacetate	C6H10O4
6.31	95.85	6988570	Cyclotetrasiloxane, octamethyl-	C8H24O4Si4
6.32	96.84	2258721	Decane	C10H22
6.38	95.36	1934021	Octanal	C8H16O
6.39	94.44	3202765	Ethanol, 2-(2-ethoxyethoxy)-	C6H14O3
6.53	97.29	911445	Benzene, 1,3-dichloro-	C6H4Cl2
6.57	98.16	891502	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN	C7H16O3
6.79	96.35	25843441	1-Hexanol, 2-ethyl-	C8H18O
6.8	91.6	1434031	dl-Limonene	C10H16
6.86	99.48	3865291	Butanedioic acid, dimethyl ester	C6H10O4
6.88	95.61	6100924	Benzyl Alcohol	C7H8O
6.9	87.7	843388	(S)-3-Ethyl-4-methylpentanol	C8H18O
6.95	97.38	10177902	2-Pyrrolidinone, 1-methyl-	C5H9NO
7.24	87.42	1111502	Nonane, 4,5-dimethyl-	C11H24

7.39	97.8	2860829	Ethanone, 1-phenyl-	C8H8O
7.43	96.81	1480854	1-Octanol	C8H18O
7.69	85.49	604585	Benzenemethanol, .alpha.,.alpha.-dimethyl-	C9H12O
7.96	97.56	9126917	Nonanal	C9H18O
8.28	98.35	20045512	Phosphoric acid, triethyl ester	C6H15O4P
8.45	97.23	12348519	Pentanedioic acid, dimethyl ester	C7H12O4
8.66	96.06	2500588	Acetic acid, 2-ethylhexyl ester	C10H20O2
8.73	95.59	30962565	Cyclopentasiloxane, decamethyl-	C10H30O5Si5
8.8	93.94	563651	2-Nonenal, (E)-	C9H16O
8.88	87.14	543119	Acetic acid, phenylmethyl ester	C9H10O2
8.96	93.88	700551	1-Nonanol	C9H20O
9.02	85.2	530101	Cyclohexanol, 5-methyl-2-(1-methylethyl)-, (1.alpha.,2.beta.,5.alpha.)-(.+/-.)-	C10H20O
9.2	89.04	1288509	Azulene	C10H8
9.24	95.26	1456681	Ethanol, 2-(2-butoxyethoxy)-	C8H18O3
9.36	94.92	1250753	Methyl salicylate	C8H8O3
9.42	92.29	686505	Cyclohexanol, 4-(1,1-dimethylethyl)-, cis-	C10H20O
9.48	96.51	1137396	Decanal	C10H20O
9.59	94.84	2981852	Cyclohexanol, 4-(1,1-dimethylethyl)-, trans-	C10H20O
9.69	92.86	1326805	Ethanol, 2-phenoxy-	C8H10O2
9.82	93.83	1966401	2-Ethylhexyl acrylate	C11H20O2
9.95	91.48	921561	2-Ethyl-1-hexyl propionate	C11H22O2
10.01	97.04	2197854	Hexanedioic acid, dimethyl ester	C8H14O4
10.22	93.4	2074527	2,3-Diethyl-2,3-dimethylsuccinonitrile	C10H16N2
10.53	86.65	528562	Dodecane, 4,6-dimethyl-	C14H30
11.18	96.58	43887728	Cyclohexasiloxane, dodecamethyl-	C12H36O6Si6
11.57	90.72	11810881	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester	C12H24O3
11.78	90.45	665443	3-PHENYL-1-PROPANOL ACETATE	C11H14O2
11.84	93.16	14758433	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester	C12H24O3
12.2	92.33	610074	Diphenylmethane	C13H12
13.62	96.73	2085045	Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl-	C15H24O
14.58	89.28	461806	1,2-Benzenedicarboxylic acid, diethyl ester	C12H14O4
14.62	89.28	1003635	PENTAN-1,3-DIOLDIISOBUTYRATE, 2,2,4-TRIMETHYL-	C16H30O4
15.39	89.05	4339427	Cyclooctasiloxane, hexadecamethyl-	C16H48O8Si8