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

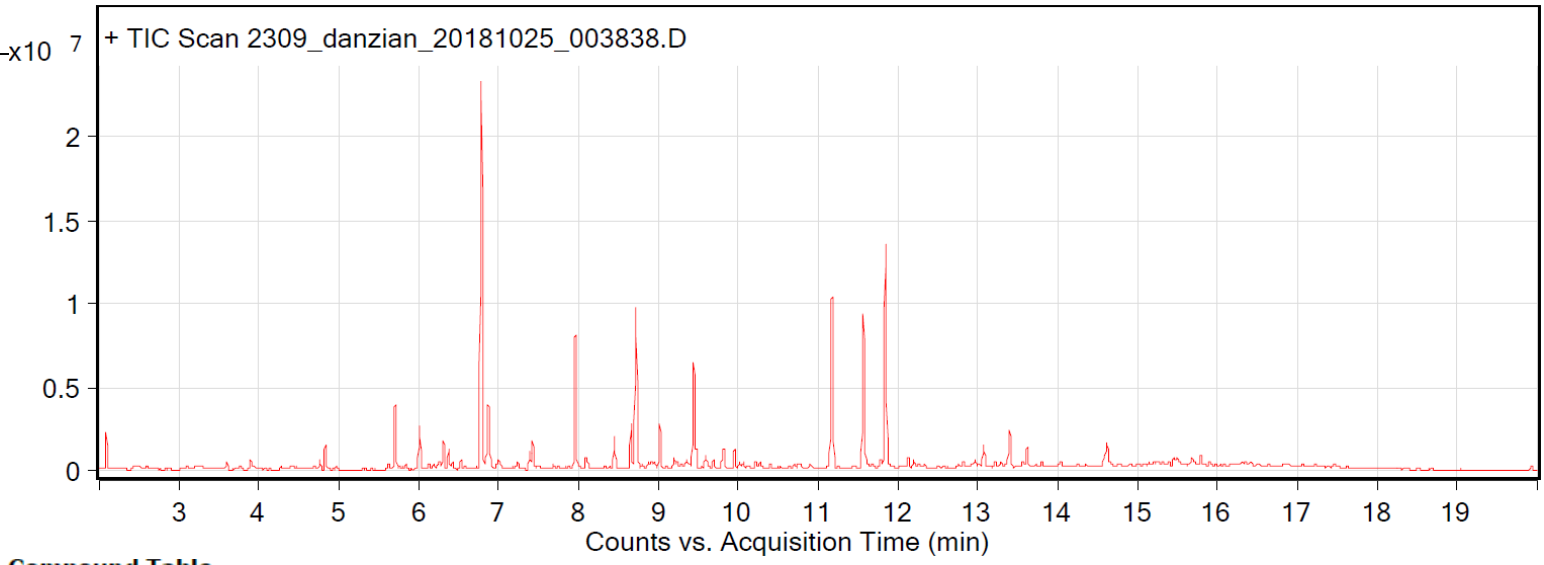
Halogenated compounds – can become reactive with exposure to heat and UV light

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

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

Sample: Danzian: poly silk white polyester 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: VOCs not highlighted are because they were also observed in blanks: (1) 4.8 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
1.5	97.48	779702	Acetic acid	C2H4O2
1.72	94.6	9011866	4-Ethynylcyclopentene	C7H8
2.09	93.71	1888148	Silanediol, dimethyl-	C2H8O2Si
2.46	86.27	1415389	Hexanal	C6H12O
3.6	94.16	576664	Cyclotrisiloxane, hexamethyl-	C6H18O3Si3
3.89	96.74	726420	2-Pentanone, 4-hydroxy-4-methyl-	C6H12O2
3.93	92.43	1127106	unidentified C2-benzene	C8H10
4.69	93.11	561545	2-Propenoic acid, butyl ester	C7H12O2
4.76	86.71	579827	Oxime-, methoxy-phenyl-_	C8H9NO2
4.83	96.97	1893616	Ethanol, 2-butoxy-	C6H14O2
5.7	97.97	5470154	Benzaldehyde	C7H6O
6.01	85.42	3307824	Phenol	C6H6O
6.13	93.48	500238	6-Methyl-5-hepten-2-one	C8H14O
6.24	93.45	452097	unidentified C3-benzene	C9H12
6.31	96.01	2314439	Cyclotetrasiloxane, octamethyl-	C8H24O4Si4
6.37	96.44	1734543	Octanal	C8H16O
6.53	97.16	698650	Benzene, 1,4-dichloro-	C6H4Cl2
6.58	96.78	425636	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN	C7H16O3
6.79	95.19	38949001	1-Hexanol, 2-ethyl-	C8H18O
6.79	91.33	1873275	dl-Limonene	C10H16
6.85	96.99	989574	Butanedioic acid, dimethyl ester	C6H10O4
6.87	95.56	4418856	Benzyl Alcohol	C7H8O
6.89	87.82	1888507	(S)-3-Ethyl-4-methylpentanol	C8H18O
6.97	92.81	503255	2-Pyrrolidinone, 1-methyl-	C5H9NO
7	91.57	842512	(S)-(+)-5-Methyl-1-heptanol	C8H18O
7.39	98.31	1532092	Ethanone, 1-phenyl-	C8H8O
7.43	96.75	2311862	1-Octanol	C8H18O
7.96	97.91	12092732	Nonanal	C9H18O
8.11	89.01	594210	Benzeneethanol	C8H10O
8.45	97.3	2803006	Pentanedioic acid, dimethyl ester	C7H12O4
8.65	96.19	3914824	Acetic acid, 2-ethylhexyl ester	C10H20O2

8.72	94.52	14958340	Cyclopentasiloxane, decamethyl-	C10H30O5Si5
8.75	88.11	536876	Cyclohexanone, 5-methyl-2-(1-methylethyl)-, cis-	C10H18O
8.8	92.41	418962	2-Nonenal, (E)-	C9H16O
8.95	88.48	669722	1-Nonanol	C9H20O
9.02	97.69	4286858	Cyclohexanol, 5-methyl-2-(1-methylethyl)-, (1.alpha.,2.beta.,5.alpha.)-(.+/-.)-	C10H20O
9.2	87.29	916515	Azulene	C10H8
9.23	94.3	754771	Ethanol, 2-(2-butoxyethoxy)-	C8H18O3
9.35	92.17	734474	Methyl salicylate	C8H8O3
9.44	85.58	10004272	1,3-Dimethyl-4,5-imidazolidinedione	C5H8N2O2
9.47	88.41	1397833	Decanal	C10H20O
9.59	86.62	1302823	Cyclohexanol, 4-(1,1-dimethylethyl)-, trans-	C10H20O
9.69	91.97	729876	Ethanol, 2-phenoxy-	C8H10O2
9.82	94.58	1832453	2-Ethylhexyl acrylate	C11H20O2
9.95	90.87	1637608	2-Ethyl-1-hexyl propionate	C11H22O2
10.01	88.84	538315	Hexanedioic acid, dimethyl ester	C8H14O4
10.4	96.46	527304	1-Decanol	C10H22O
11.14	91.17	830747	Nonane, 2,2,4,4,6,8,8-heptamethyl-	C16H34
11.17	95.8	16828795	Cyclohexasiloxane, dodecamethyl-	C12H36O6Si6
11.56	91.34	15812644	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester	C12H24O3
11.78	88.66	728782	3-PHENYL-1-PROPANOL ACETATE	C11H14O2
11.84	93.37	21766601	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester	C12H24O3
12.13	94.79	906356	Tetradecane	C14H30
12.19	92.4	638856	Diphenylmethane	C13H12
12.26	89.92	427823	Dodecanal	C12H24O
13.62	95.63	1603251	Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl-	C15H24O
13.8	96.06	482887	Lilial	C14H20O
14.62	89.33	2868693	PENTAN-1,3-DIOLDIISOBUTYRATE, 2,2,4-TRIMETHYL-	C16H30O4
15.32	86.42	460633	Octane, 1,1'-oxybis-	C16H34O
15.39	85.17	401623	Cyclooctasiloxane, hexadecamethyl-	C16H48O8Si8
15.45	85.6	884453	1-(4-ISOPROPYLPHENYL)-2-METHYLPROPYL ACETATE	C15H22O2