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

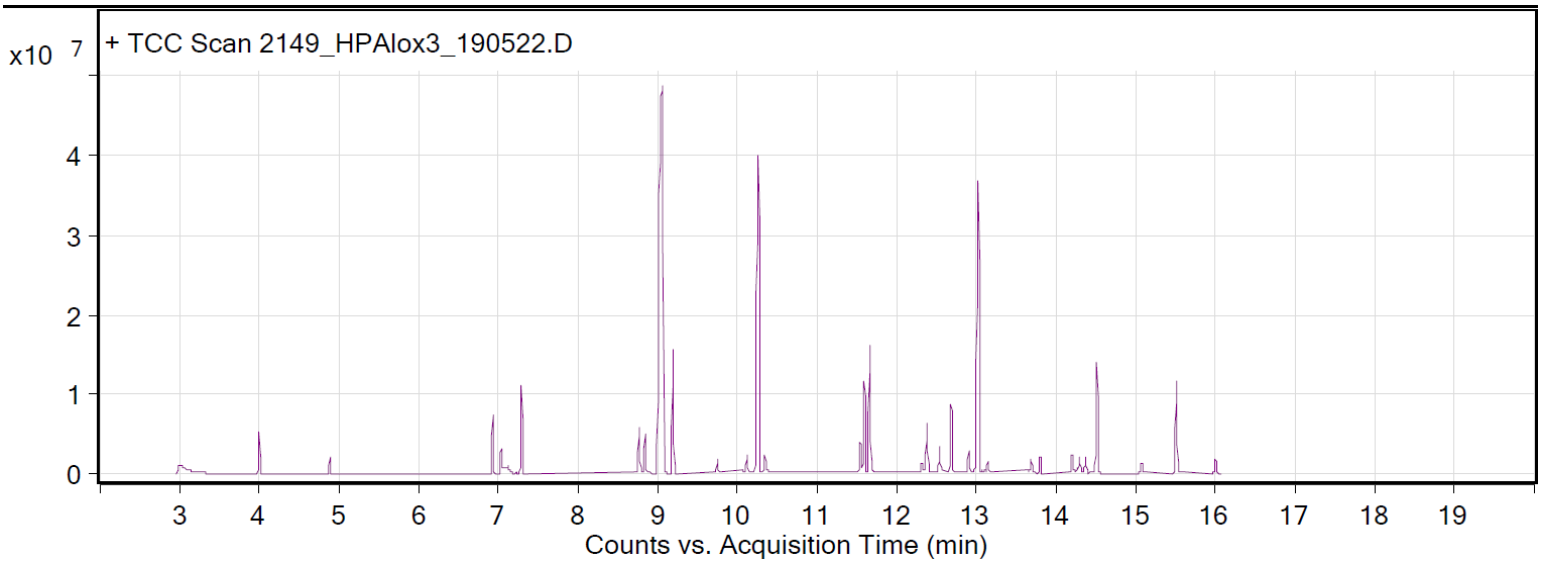
Halogenated compounds – can become reactive with exposure to heat and UV light

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

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

Sample: Heritage Packaging; 48 ga Alox PET/adhesive/2.5 mil LLDPE
Oddy test result: Temporary
Date collected: 4/27/2018
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) 12.4 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxyl-1-methylethyl) propyl ester propanoic acid; (2) 12.7 min: 2-methyl-, 3-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid



Compound Table

RT	Score (Lib)	Area	Name	Formula
3.01	91.1	9679629	Triethylamine	C6H15N
4	95.81	5579015	Triethylamine	C6H15N
4.89	92.5	2130724	Cyclotrisiloxane, hexamethyl-	C6H18O3Si3
6.93	96.19	8720005	Cyclotetrasiloxane, octamethyl-	C8H24O4Si4
7.29	95.91	13552148	Decane	C10H22
8.76	96.9	5587445	Undecane	C11H24
8.84	97.8	6613698	Nonanal	C9H18O
9.06	97.98	179033507	Phosphoric acid, triethyl ester	C6H15O4P
9.19	95.4	20792406	Cyclopentasiloxane, decamethyl-	C10H30O5Si5
9.75	92.56	2438823	Decane, 5-methyl-6-methylene-	C12H24
10.12	95.85	3100755	1-Dodecene	C12H24
10.26	95.75	85394134	Dodecane	C12H26
10.34	97.65	3348157	Decanal	C10H20O
11.54	95.82	5627657	1-Tridecene	C13H26
11.59	95.97	15837580	Cyclohexasiloxane, dodecamethyl-	C12H36O6Si6
11.66	94.93	23824574	Tridecane	C13H28
12.38	90.09	9720911	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester	C12H24O3
12.54	89.06	5481645	2-Butyl-1-decene	C14H28
12.68	93.78	13082992	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester	C12H24O3
12.9	95.85	4156326	1-Tetradecene	C14H28
13.03	95.59	69165620	Tetradecane	C14H30
13.14	95.66	2119094	Dodecanal	C12H24O
13.68	95.13	2497628	Cyclopentane, nonyl-	C14H28
14.2	95.4	3911095	1-Pentadecene	C15H30
14.29	94.38	3169638	pentadecane	C15H32
14.37	92.59	2769455	Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl-	C15H24O
15.08	87.68	2010555	1-Pentadecene, 2-methyl-	C16H32
15.51	93.28	17060271	Hexadecane	C16H34