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

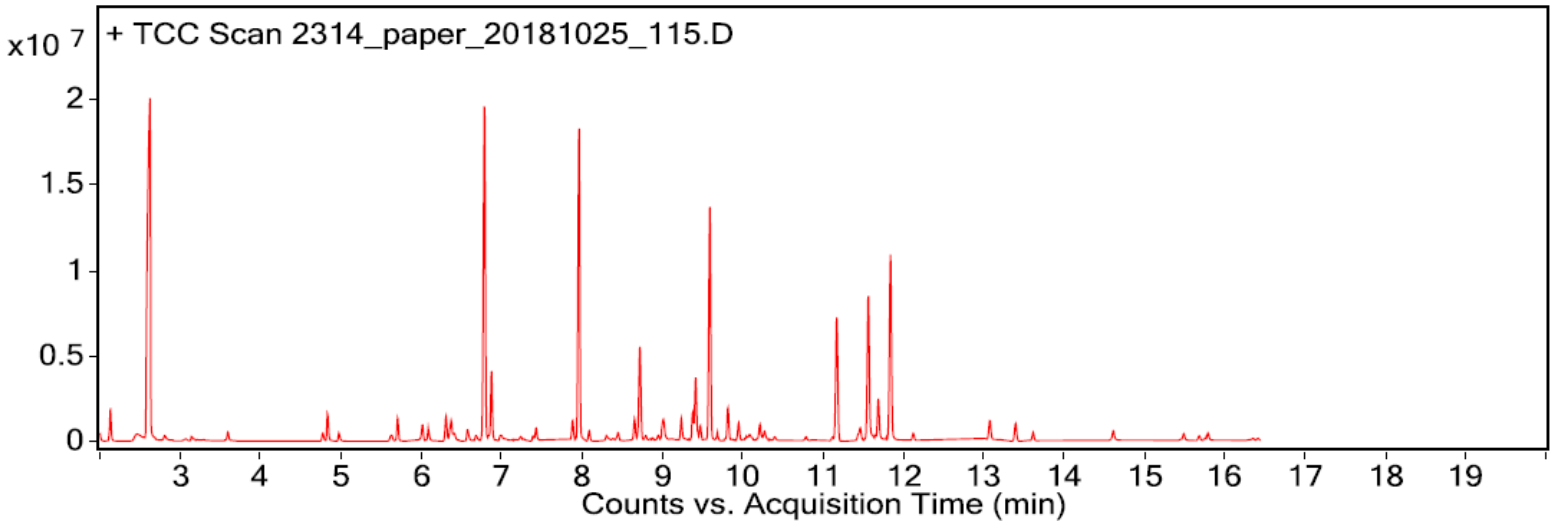
Alkynes – can become reactive when exposed to heat or UV light

Sample: Talas; single sided tape with potato starch gumming

Date collected: 10/25/2018

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 auto-sampler; Pre-heated at 60°C for 20 minutes; fiber exposure at 60°C for 20 minutes; sample injected into 220°C inlet and cryotrapped for 2 min at -15°C; GC ramped from 40°C to 225 °C at 10°C/min. Data analyzed using the Masshunter Qualitative program. Samples > 80% match with a NIST 17.0 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



RT	Mass	Name	DB Formula
1.53		Acetic acid	C2H4O2
2.13		Silanediol, dimethyl-	C2H8O2Si
2.47		Hexanal	C6H12O
2.62		1,2-Propanediol	C3H8O2
3.59		Cyclotrisiloxane, hexamethyl-	C6H18O3Si3
4.83		Ethanol, 2-butoxy-	C6H14O2
4.97		2(5H)-furanone	C4H4O2
5.71		Benzaldehyde	C7H6O
6.31		Cyclotetrasiloxane, octamethyl-	C8H24O4Si4
6.36		O-Ethyl-1,3-dioxolanium	C5H11O2
6.37		Octanal	C8H16O
6.58		dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN	C7H16O3
6.79		1-Hexanol, 2-ethyl-	C8H18O
6.87		Benzyl Alcohol	C7H8O
6.99		2-Pyrrolidinone, 1-methyl-	C5H9NO
7.88		Undecane	C11H24
7.96		Nonanal	C9H18O
8.45		Pentanedioic acid, dimethyl ester	C7H12O4
8.66		Acetic acid, 2-ethylhexyl ester	C10H20O2
8.72		Cyclopentasiloxane, decamethyl-	C10H30O5Si5
9.02		Cyclohexanol, 5-methyl-2-(1-methylethyl)-	C10H20O
9.24		Ethanol, 2-(2-butoxyethoxy)-	C8H18O3
9.38		Dodecane	C12H26
9.42		Cyclohexanol, 4-(1,1-dimethylethyl)-, cis-	C10H20O
9.59		Cyclohexanol, 4-(1,1-dimethylethyl)-, trans-	C10H20O
9.69		Ethanol, 2-phenoxy-	C8H10O2
9.82		2-Ethylhexyl acrylate	C11H20O2
9.95		2-Ethyl-1-hexyl propionate	C11H22O2
10.09		2H-Azepin-2-one, hexahydro-	C6H11NO
10.22		meso-2,3-Diethyl-2,3-dimethylsuccinic acid dinitrile	C10H16N2

11.17		Cyclohexasiloxane, dodecamethyl-	C12H36O6Si6
11.46		1,3-Diacetin	C7H12O5
11.56		Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester	C12H24O3
11.69		Ethanol, 2-(2-butoxyethoxy)-, acetate	C10H20O4
11.84		Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester	C12H24O3
12.12		Tetradecane	C14H30
13.62		Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl-	C15H24O