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

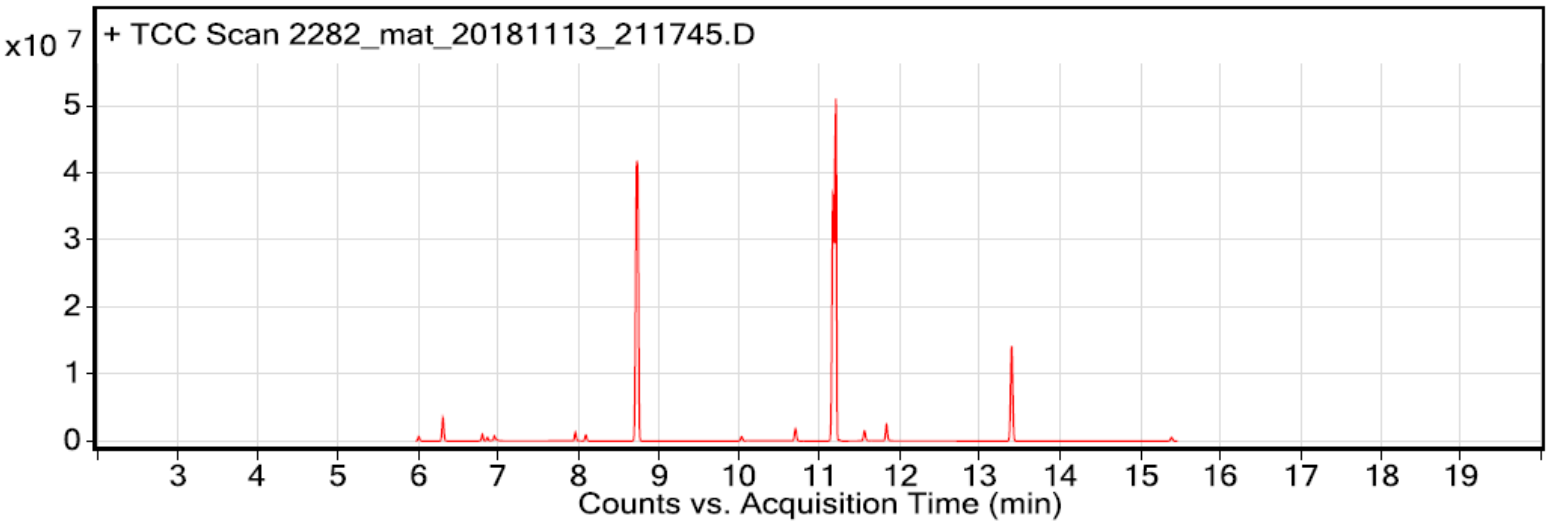
Alkynes – can become reactive when exposed to heat or UV light

Sample: Alpharag Artcare Museum, M8634 white board

Date collected: 11/13/2018

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 crotrapped for 2 min at -15°C; GC ramped from 40°C to 225 °C at 10°C/min. Data analyzed in masshunter Qualitative. 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



Library results

RT	Score	Formula	MW	Area	CAS #	Name
6.310	96.0	C8H24O4Si4	296.1	5611467	556-67-2	Cyclotetrasiloxane, octamethyl-
6.800	96.4	C10H16	136.1	1503764	138-86-3	dl-Limonene
6.950	97.3	C5H9NO	99.1	1479936	872-50-4	2-Pyrrolidinone, 1-methyl-
7.960	97.7	C9H18O	142.1	1889942	124-19-6	Nonanal
8.730	96.7	C10H30O5Si5	370.1	98269995	541-02-6	Cyclopentasiloxane, decamethyl-
10.030	96.7	C12H36O4Si5	384.1	1107933	141-63-9	Pentasiloxane, dodecamethyl-
11.170	96.2	C12H36O6Si6	444.1	95128136	540-97-6	Cyclohexasiloxane, dodecamethyl-
11.210	87.4	C12H36O6Si6	444.1	23425892	540-97-6	Cyclohexasiloxane, dodecamethyl-
11.560	89.9	C12H24O3	216.2	2629022	74367-33-2	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester
11.840	93.6	C12H24O3	216.2	4136046	74367-34-3	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester
13.400	82.6	C14H42O7Si7	518.1	26727251	107-50-6	Cycloheptasiloxane, tetradecamethyl-
15.390	88.9	C16H48O8Si8	592.2	997618	556-68-3	Cyclooctasiloxane, hexadecamethyl-