

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

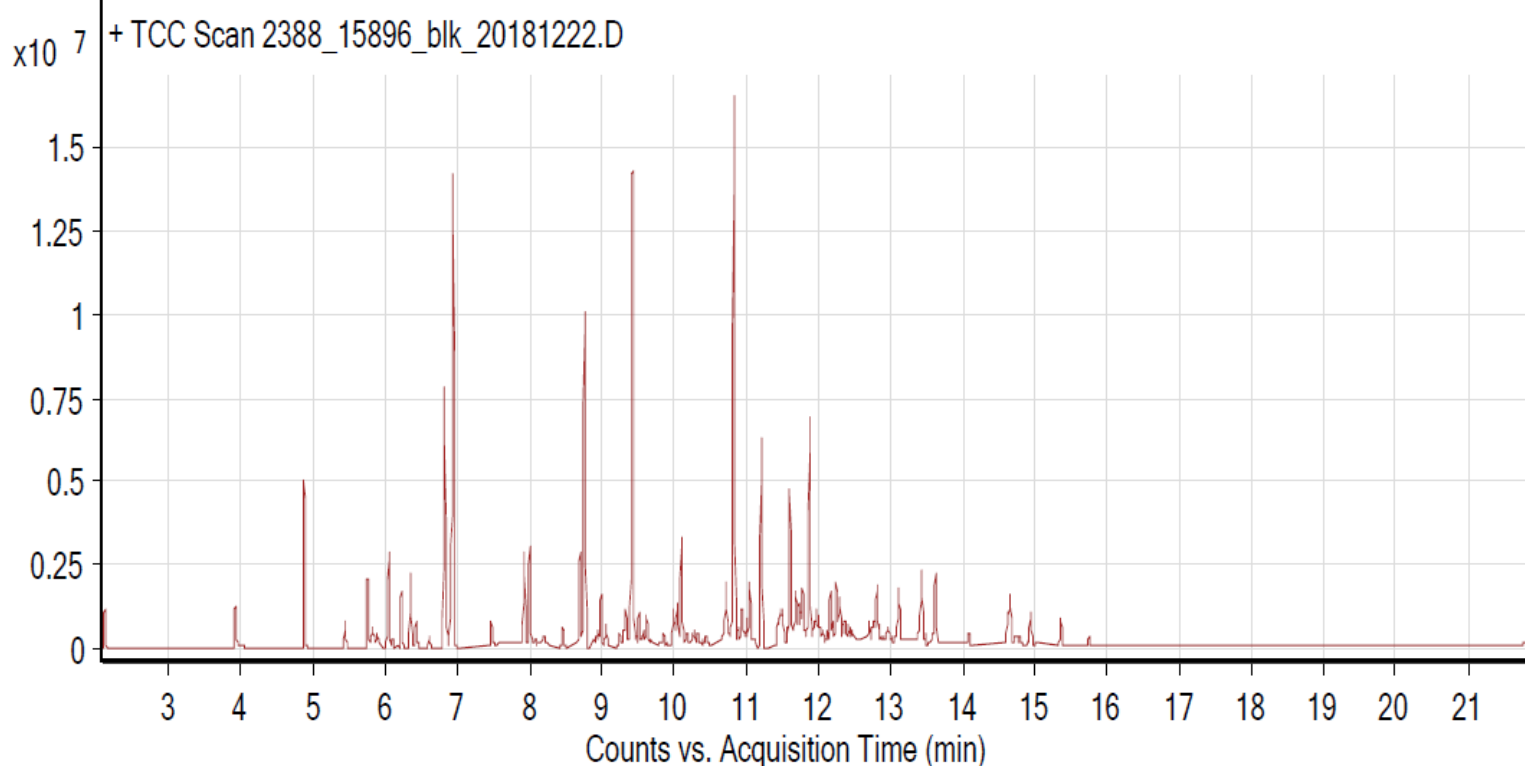
Alkynes – can become reactive when exposed to heat or UV light

Sample: Talas; Museum black board

Date collected: 12/22/2018

Oddy test result: Temporary

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 cotrapped for 2 min at -15°C; GC ramped from 35°C to 225 °C at 7.5°C/min. Data analyzed in masshunter Qualitative. Samples > 90% match with a NIST 17.0 library are reported. VOCs not highlighted are because they were also observed in blanks: (1) 11.8 min: 2-methyl-, 3-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid



Compound Table

RT	Score (Lib)	Area	Name
3.91	93.71	1803592	2-Pentanone, 4-hydroxy-4-methyl-
3.98	91.97	658670	Benzene, 1,3-dimethyl-
4.87	97.38	6626181	Ethanol, 2-butoxy-
5.44	93.94	1123667	2-Propanol, 1-butoxy-
5.75	96.27	3117498	N-benzylidene-dimethylammonium chloride
6.05	95.5	3428660	Phenol
6.22	94.55	2705779	Heptane, 2,2,4,6,6-pentamethyl-
6.35	90.21	3731289	2-methoxy[1]benzothieno[2,3-c]quinolin-6(5H)-one
6.82	97.56	11485777	1-Hexanol, 2-ethyl-
6.9	91.63	2070270	Benzenemethanol
6.93	96.33	19729212	Benzene, 1,3-dichloro-
7.46	93.37	1266465	1-Octanol
7.92	95.15	4410442	Undecane
8	96	4532093	Nonanal
8.69	96.47	4256501	Acetic acid, 2-ethylhexyl ester
8.99	91.05	1306142	Tridecane, 2,5-dimethyl-
9.29	95.54	527172	Ethyl (E)-2',2'-difluorohexadec-13-enoate
9.42	94.83	23311700	Undecane, 4,7-dimethyl-
9.51	95.14	1420133	Decanal
10.83	95.15	13730725	Undecane, 4,7-dimethyl-
11.88	90.8	11678336	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester
12.16	94.61	2535795	Undecane, 4,7-dimethyl-

12.96	92.3	1131559	Undecane, 2,10-dimethyl-
13.42	94.43	2030255	Tricosane
13.62	93.04	1798676	Heptane, 2,2,4,6,6-pentamethyl-
15.36	93.74	1394649	Octane, 1,1'-oxybis-
15.75	92.57	519204	Hexacosane