

Gas Chromatographic Analysis of Volatile Organic Compounds Using a Unique Stationary Phase

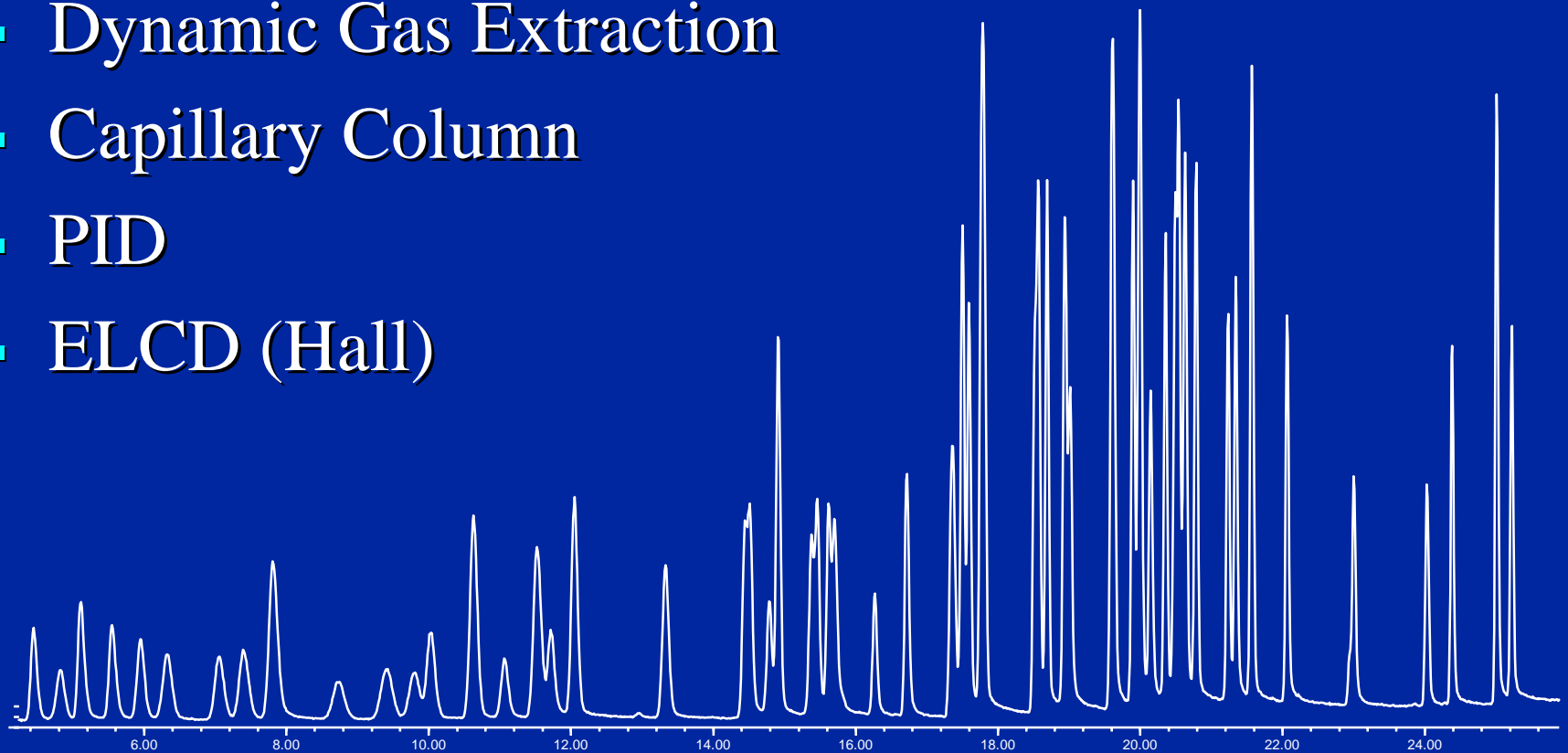
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CHROMATOGRAPHY
RESTEK resolutions

GC Volatiles Analysis EPA Methodology

- Dynamic Gas Extraction
- Capillary Column
- PID
- ELCD (Hall)

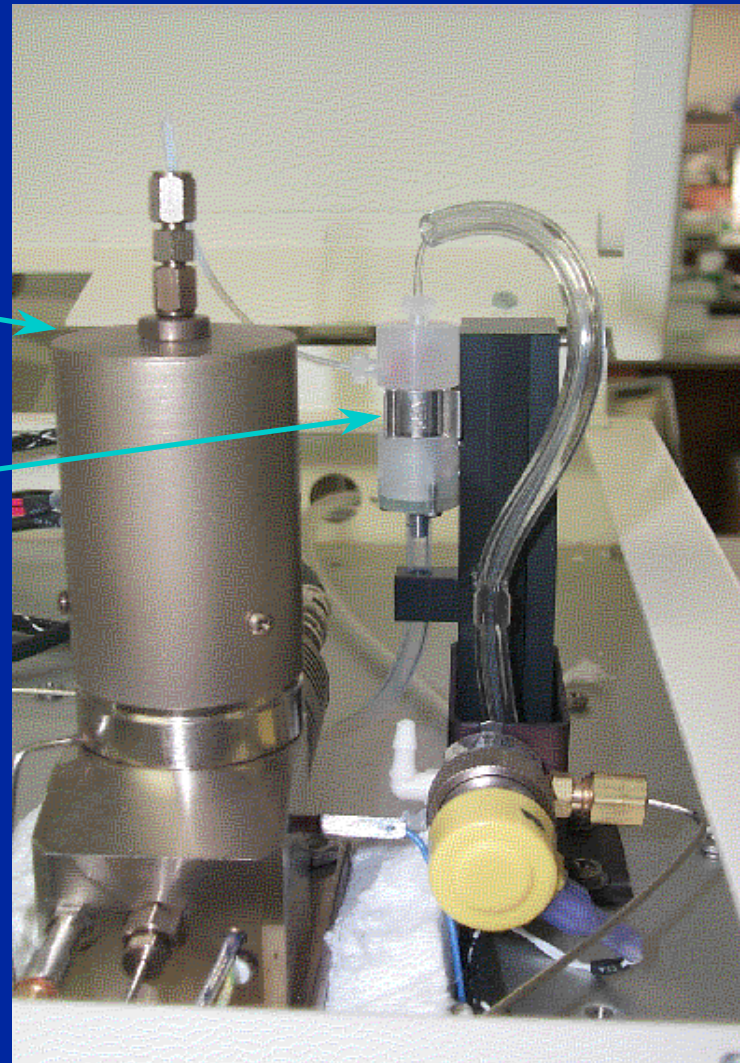


ELCD Detector




Reactor

Conductivity
Cell



Target List 8021A



Benzene
Bromobenzene
Bromochloromethane
Bromodichloromethane
Bromoform
Bromomethane
n-butylbenzene
sec-butylbenzene
tert-butylbenzene
Carbontetrachloride
Chlorobenzene
Chloroethane
Chloroform
Chloromethane
2-Chlorotoluene
4-Chlorotoluene
Dibromochloromethane
1,2-Dibromo-3-chloropropane
1,2-Dibromoethane
Dibromoethane
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
Dichlorodifluoromethane
1,1-Dichloroethane
1,2-Dichloroethane
1,1,-Dichloroethene
cis-1,2-dichloroethene
trans-1,2-dichloroethene
1,2-Dichloropropane
1,3-Dichloropropane
2,2-Dichloropropane
1,1-Dichloropropene
cis-1,3-dichloropropene
trans-1,3-dichloropropene
Ethylbenzene
Hexachlorobutadiene
Isopropylbenzene
4-Isopropyltoluene
Methylene chloride
Naphthalene
Propylbenzene
Styrene
1,1,1,2-Tetrachloroethane
1,1,2,2-Tetrachloroethane
Tetrachloroethene
Toluene
1,2,3-Trichlorobenzene
1,2,4-Trichlorobenzene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethene
Trichlorofluoromethane
1,2,3-Trichloropropane
1,2,4-Trimethylbenzene
1,3,5-Trimethylbenzene
Vinyl Chloride
o-Xylene
m-Xylene
p-Xylene
Fluorobenzene
2-Bromo-1-chloropropane
4-Bromo-1-Chlorobenzene
1-Chloro-2-fluorobenzene
1,4-Dichlorobutane
Freon-113
Methyl-tert-butyl-ether
Tert-Butanol
Choroethylvinylether

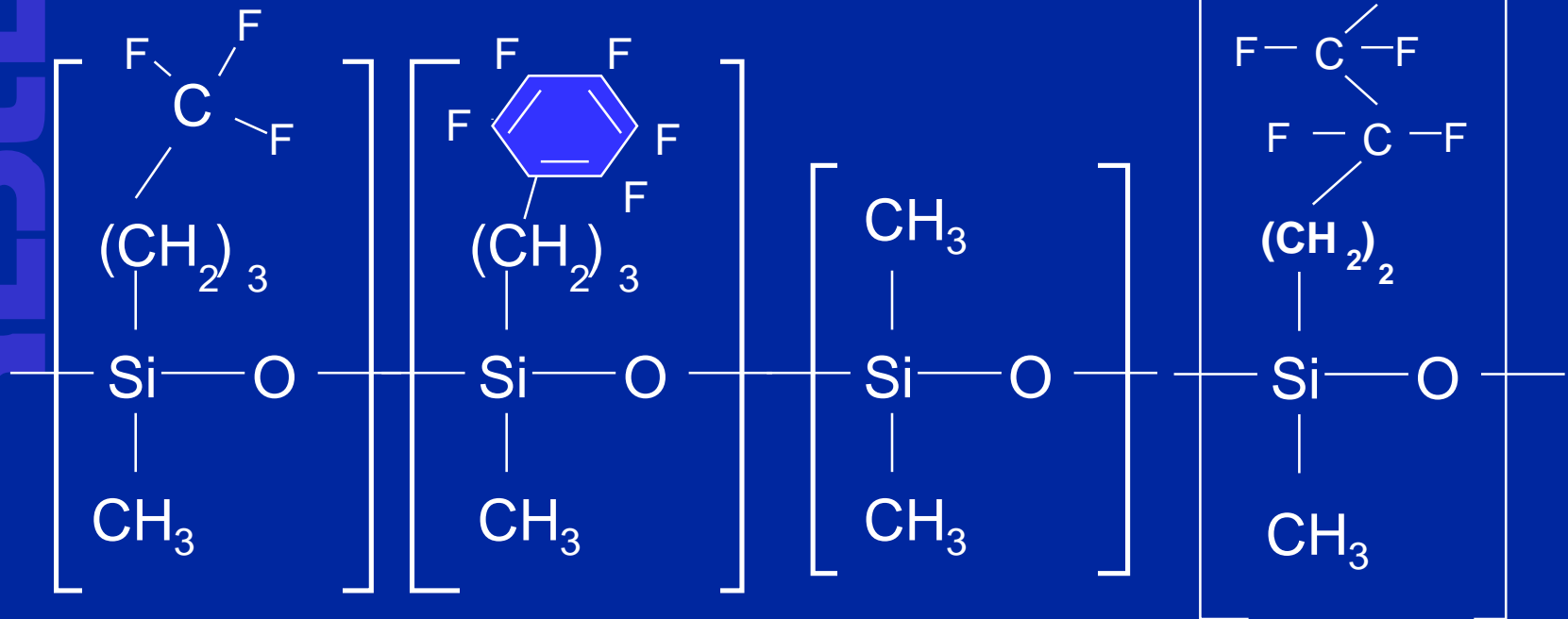
Design Criteria

- Column length
- Analysis Time
- Low Bleed
- Critical Resolution
- No Cryofocusing
- PID ELCD

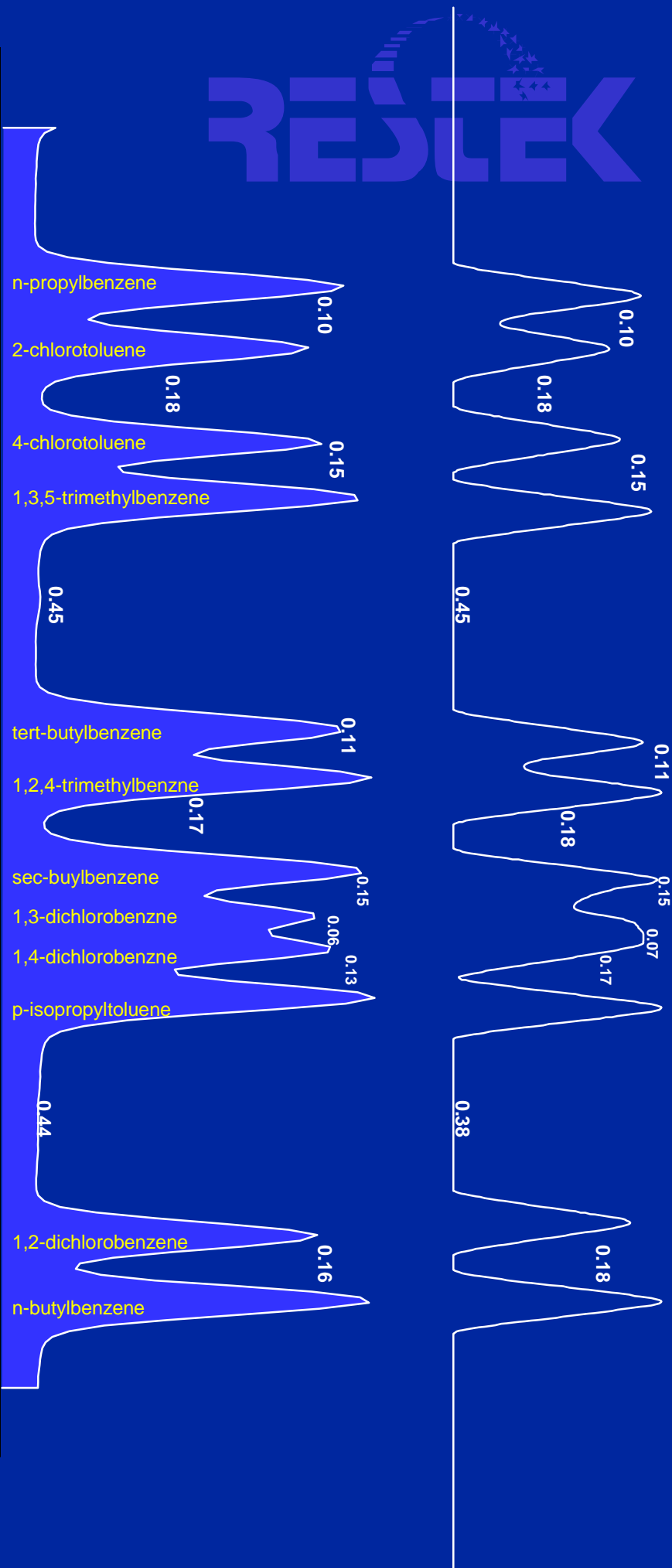


Experimental Fluorinated Phase

Bonded Polymer Examined for GC Applications.



Predicted vs. Actual 4 Dimensional Phase



Application #1 US EPA METHOD 502.2/8021

Column #1: Rtx-VGC 75m x 0.45mm x 2.55df

Column #2: Rtx-VRX 75m x 0.45mm x 2.55df

GC Program: 35°(4) 3/75 (2) 21/175 (0) 35/205 (5)

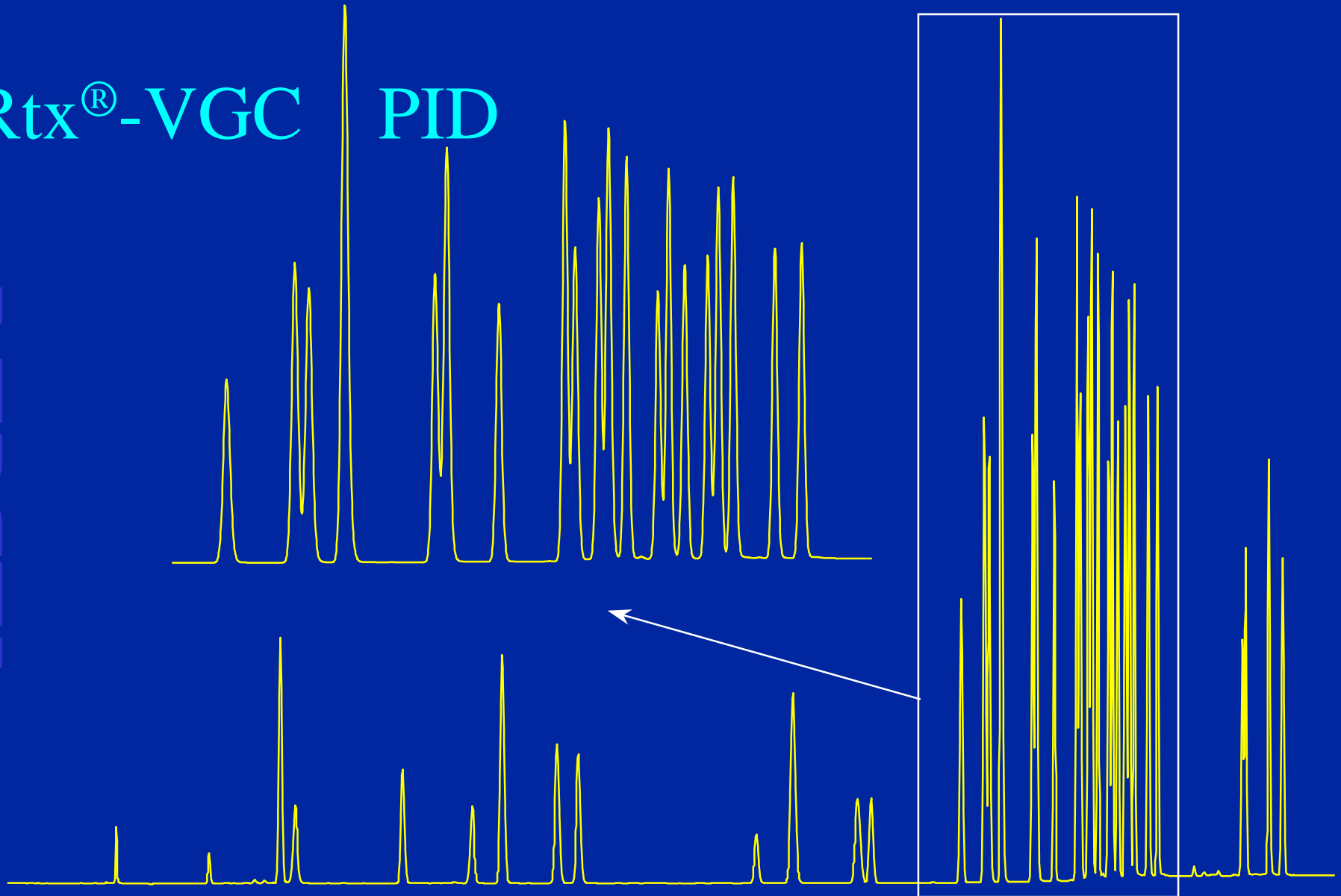
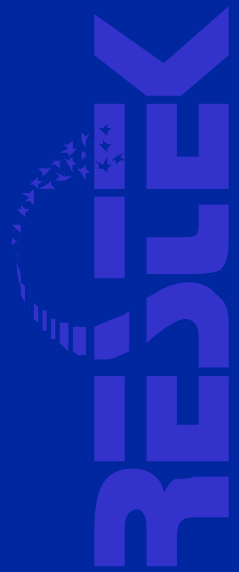
He Flow: ~11 ml/min (Adjust Cl₂F₂me to 2.24 min. @ 35°C)

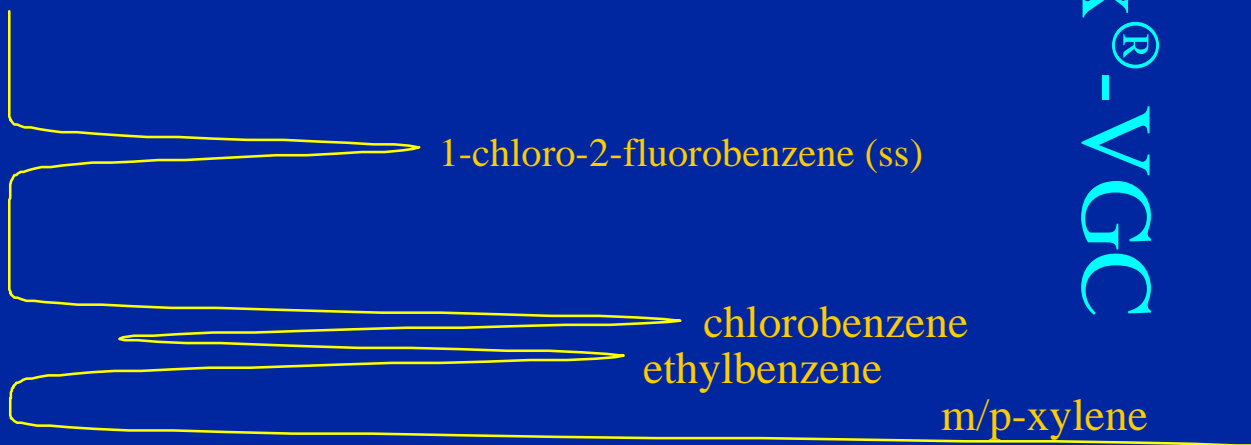
Total Runtime: 29 minutes

Added Cmpds: Freon®113, MTBE

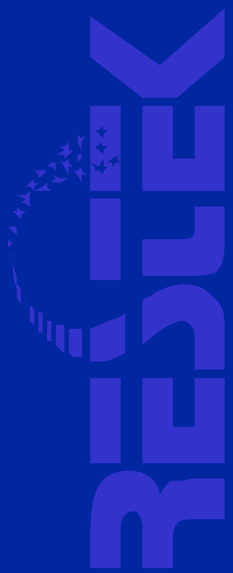
Surrogates: fluorobenzene, 1-bromo-2-chloroethane,
1-chloro-3-fluorobenzene

Rtx[®]-VGC PID

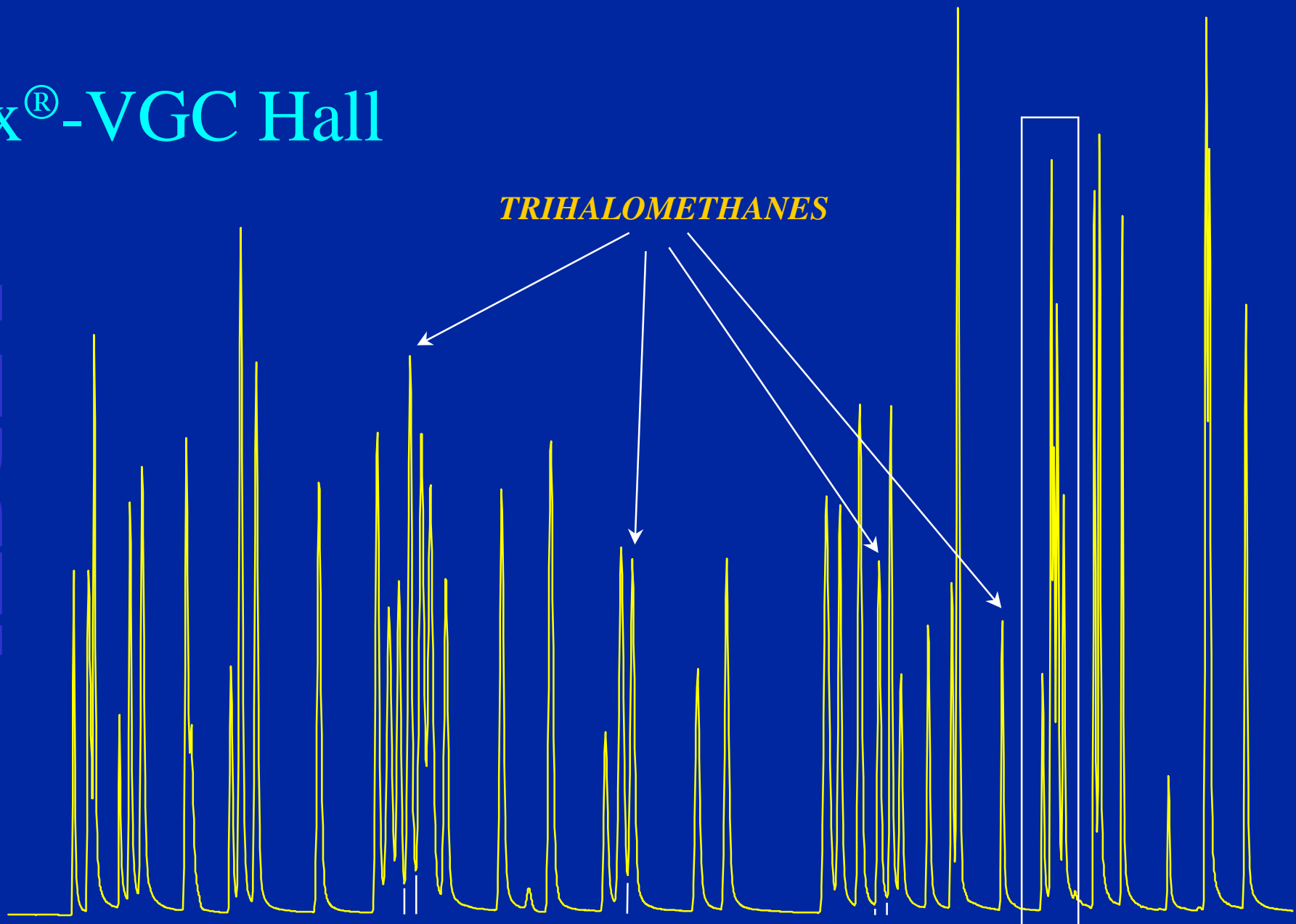




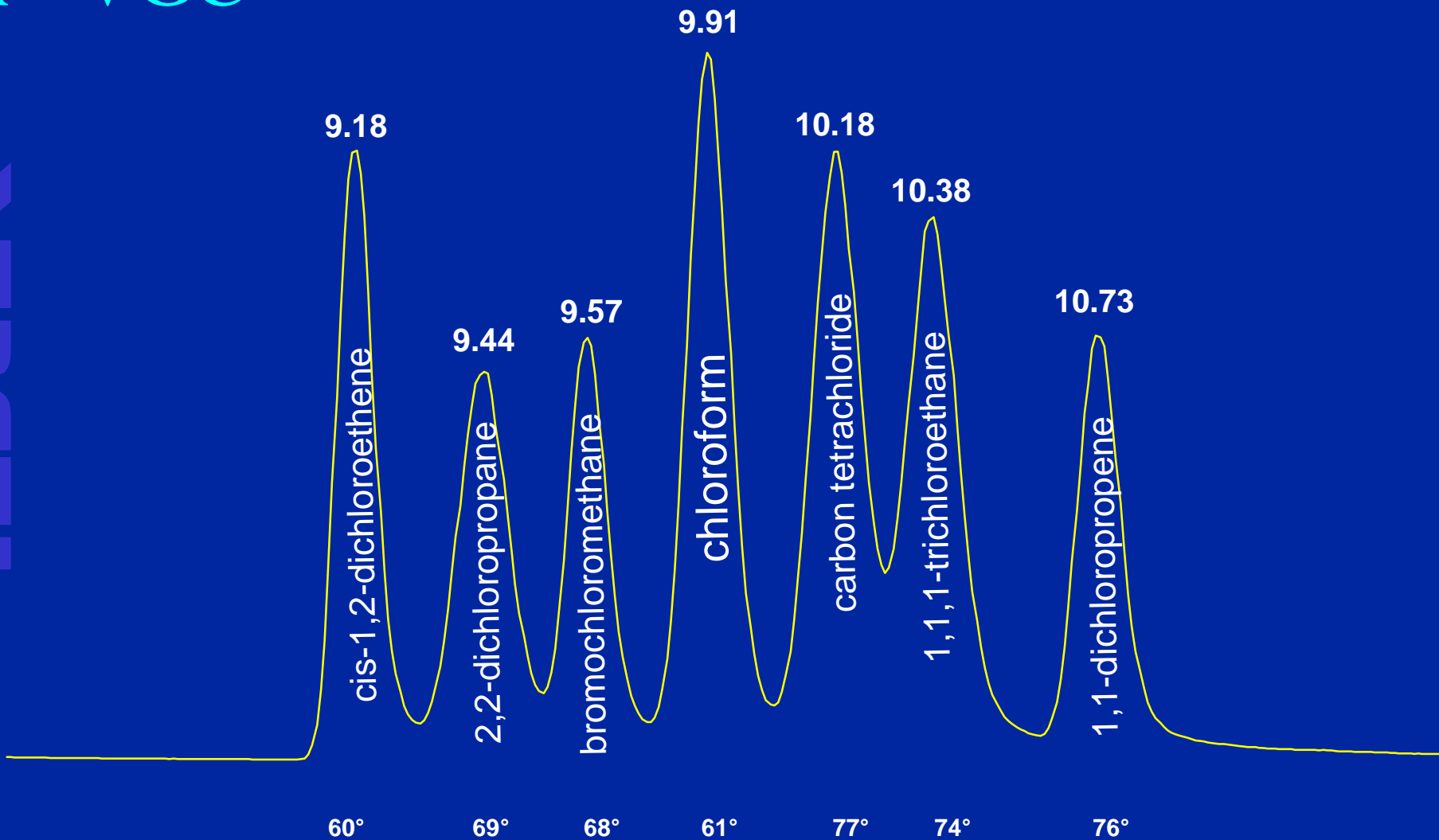
Rtx[®]-VGC Hall



TRIHALOMETHANES

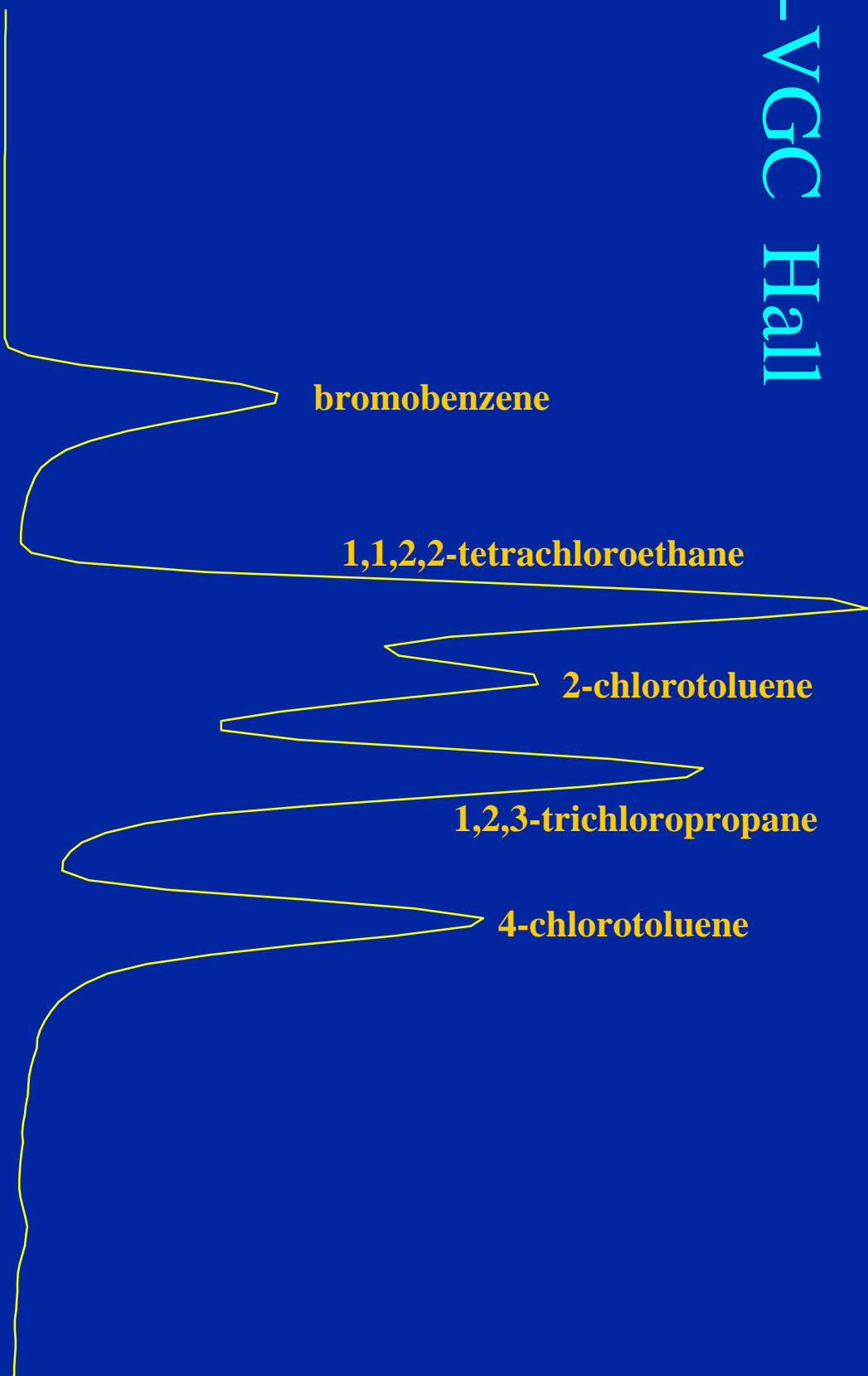


Rtx[®]-VGC





RTX[®]-VGC HaII



Application #2 US EPA METHOD 502.2/8021

Column #1: Rtx-VGC 75m x 0.45mm x 2.55df

Column #2: Rtx-502.2 75m x 0.45mm x 2.55df

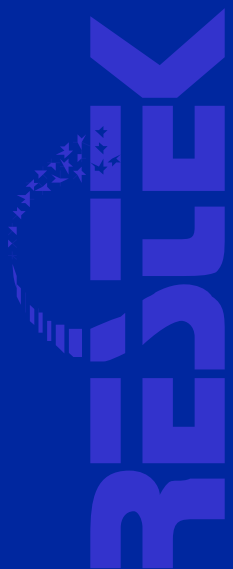
GC Program: 50°(2) 2/70 (0) 9/130 (0) 40/200 (5)

He Flow: 10ml/min (Adjust Cl₂F₂me to 2.28 min. @ 50°C)

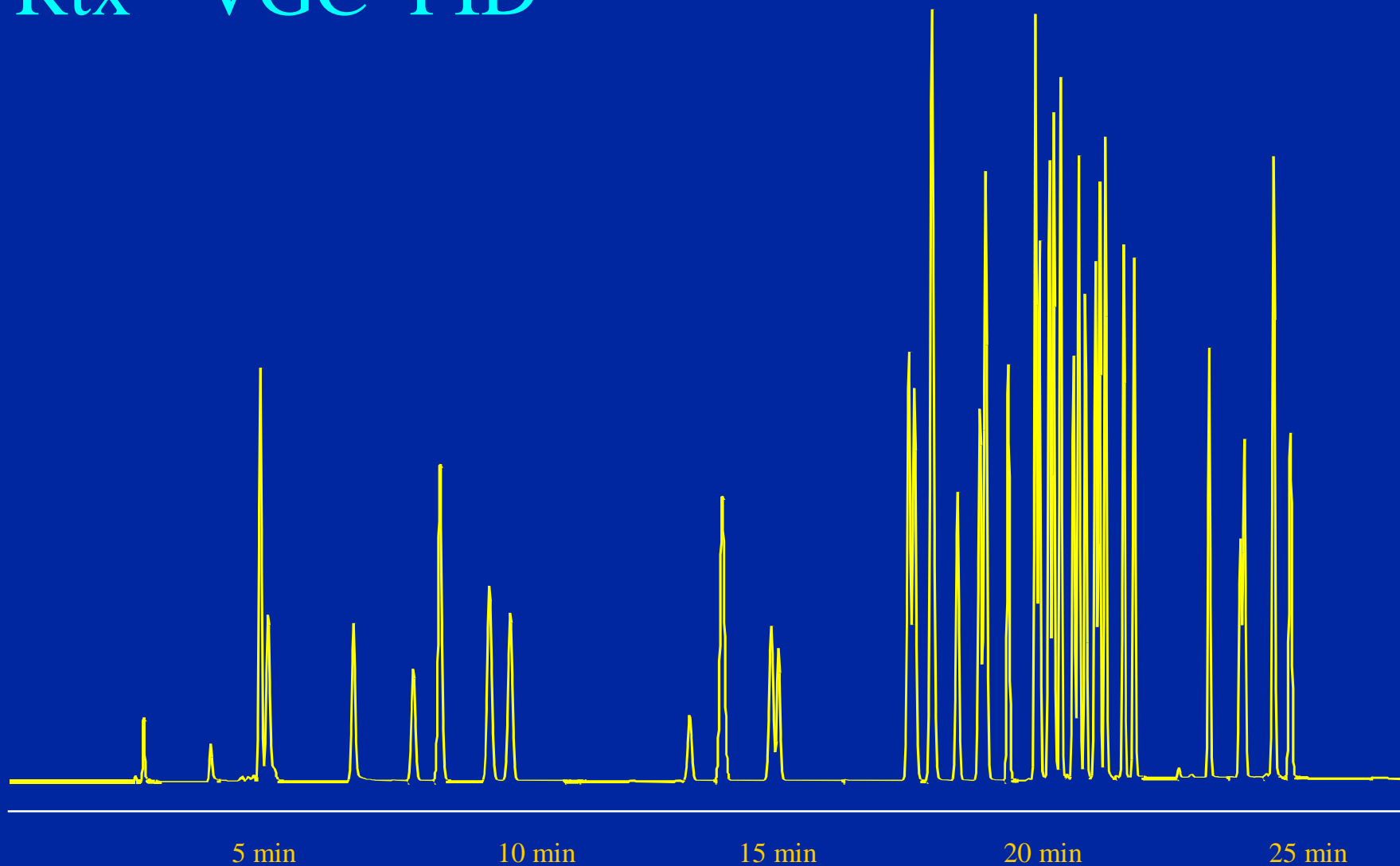
Total Runtime: 25 minutes

Added Cmpds: allyl chloride, MTBE

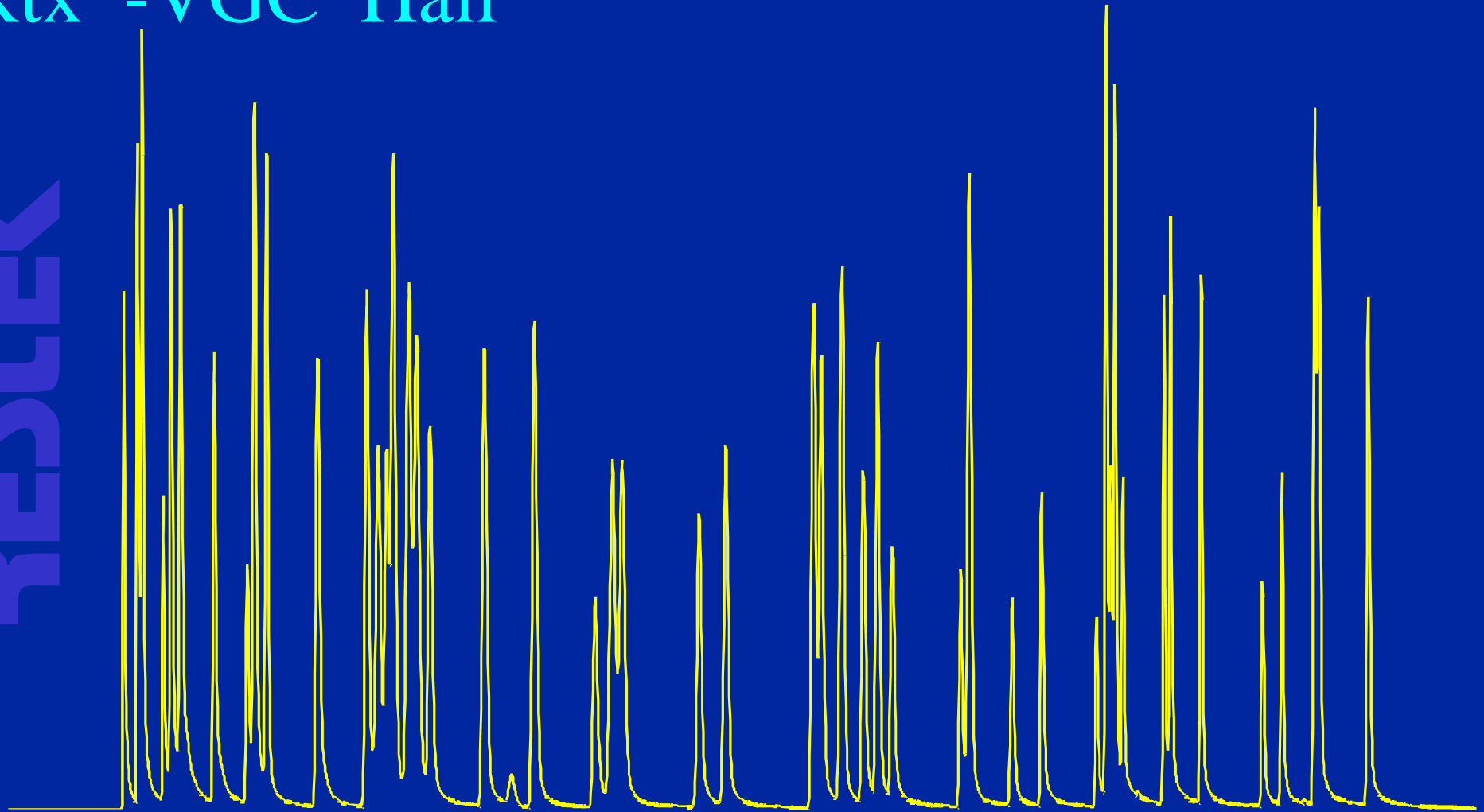
Surrogates: fluorobenzene, 1-bromo-2-chloroethane,
1-chloro-2-fluorobenzene



Rtx[®]-VGC PID



Rtx[®]-VGC Hall



5 min

10 min

15 min

20 min

25 min

Application #3 US EPA METHOD 601/602

Column #1: Rtx-VGC 75m x 0.45mm x 2.55df

Column #2: Rtx-VRX 75m x 0.45mm x 2.55df

GC Program: 40°(2) 4/58 (0) 10/90 (5) 40/220 (5)

He Flow: ~10 ml/min (Adjust Cl₂F₂me to 2.47 min. @ 40°C)

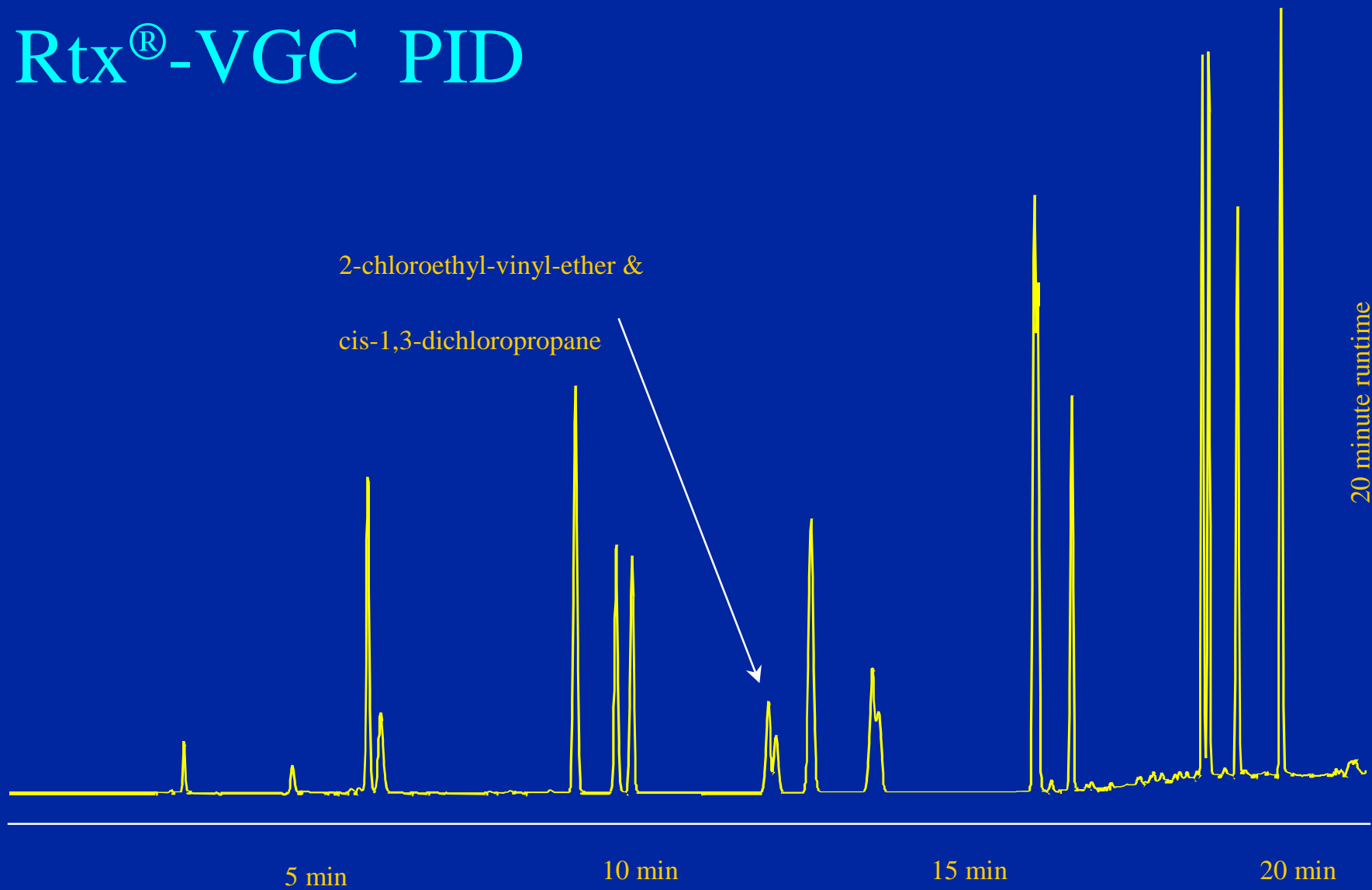
Total Runtime: 20 minutes

Added Cmpds: MTBE, 2-chloroethyl-vinyl-ether

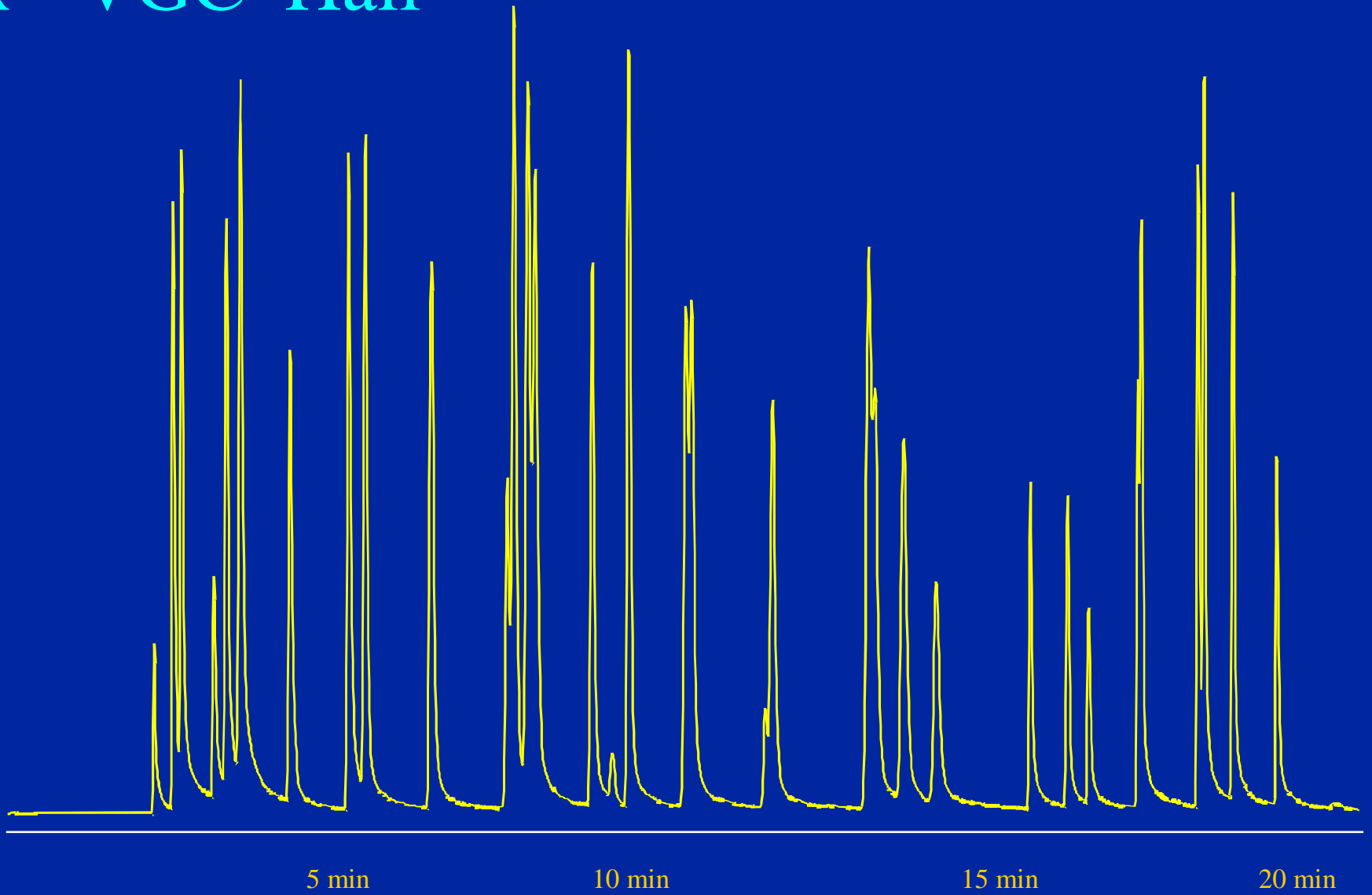
Surrogates: fluorobenzene, 1-chloro-2-fluorobenzene,
4-bromo-1-chlorobenzene, bromochloromethane



Rtx[®]-VGC PID



Rtx[®]-VGC Hall



Application #4 US EPA METHOD 8021B

Column #1: Rtx-VGC 75m x 0.45mm x 2.55df

Column #2: Rtx-502.2 75m x 0.45mm x 2.55df

GC Program: 45°(4) 2/70 (0) 20/210 (10)

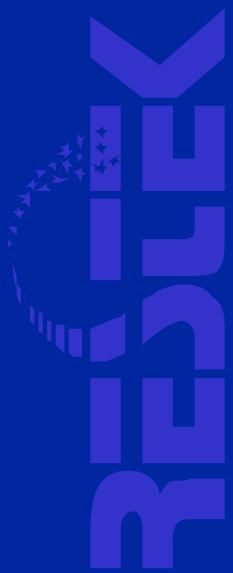
He Flow: ~10 ml/min (Adjust Cl₂F₂me to 2.40 min. @ 45°C)

Total Runtime: 29 minutes

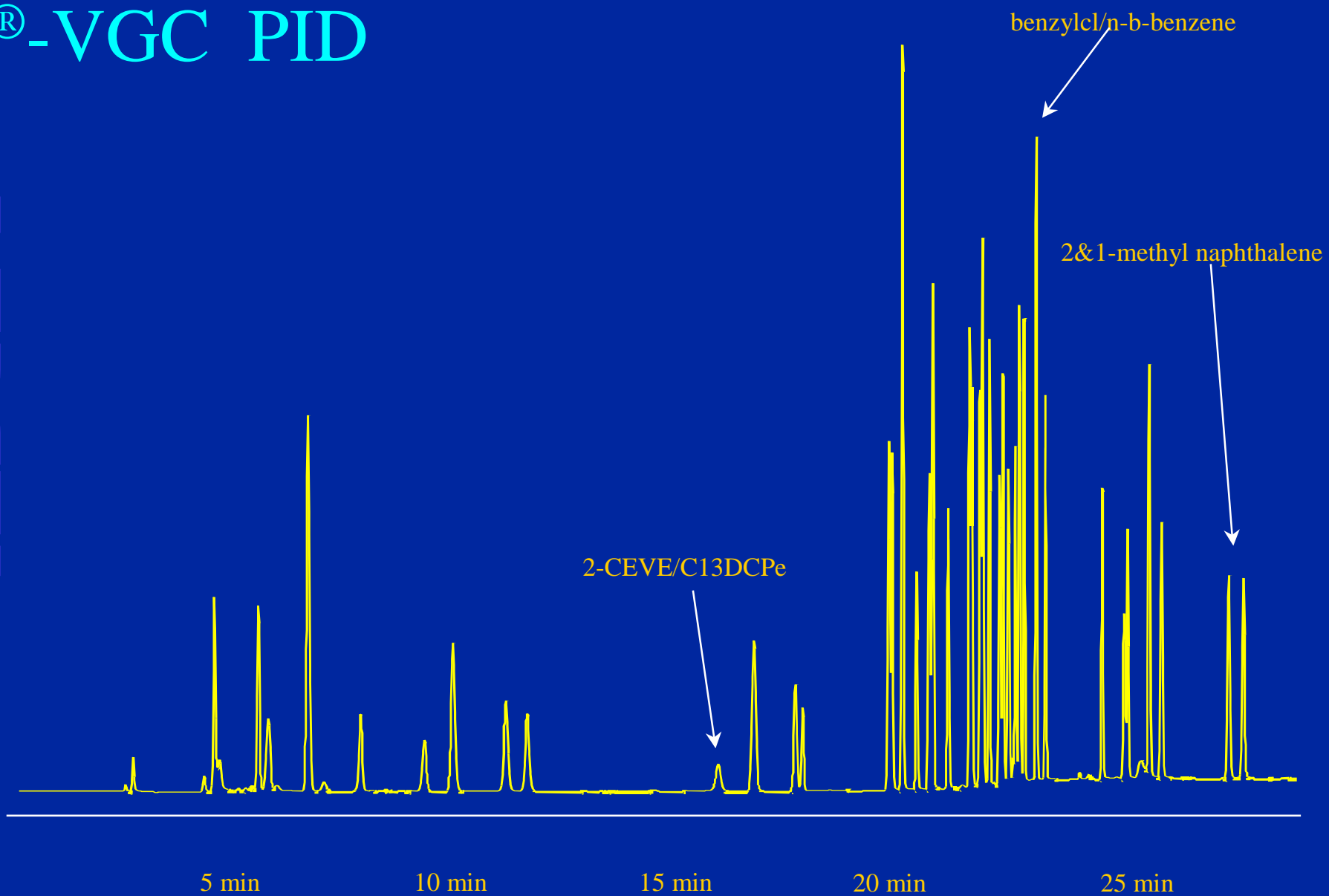
Added Cmpds: MTBE, 2-chloroethyl-vinyl-ether, Freon®113, iodomethane, tert-butyl alcohol, pentachloroethane, 1&2-methylnaphthalene.

Missing Cmpds: bis(2-chloroisopropyl)ether, bromoacetone, 2-chloroethanol, 1,3-dichloro-2-propanol, epichlorhydrin

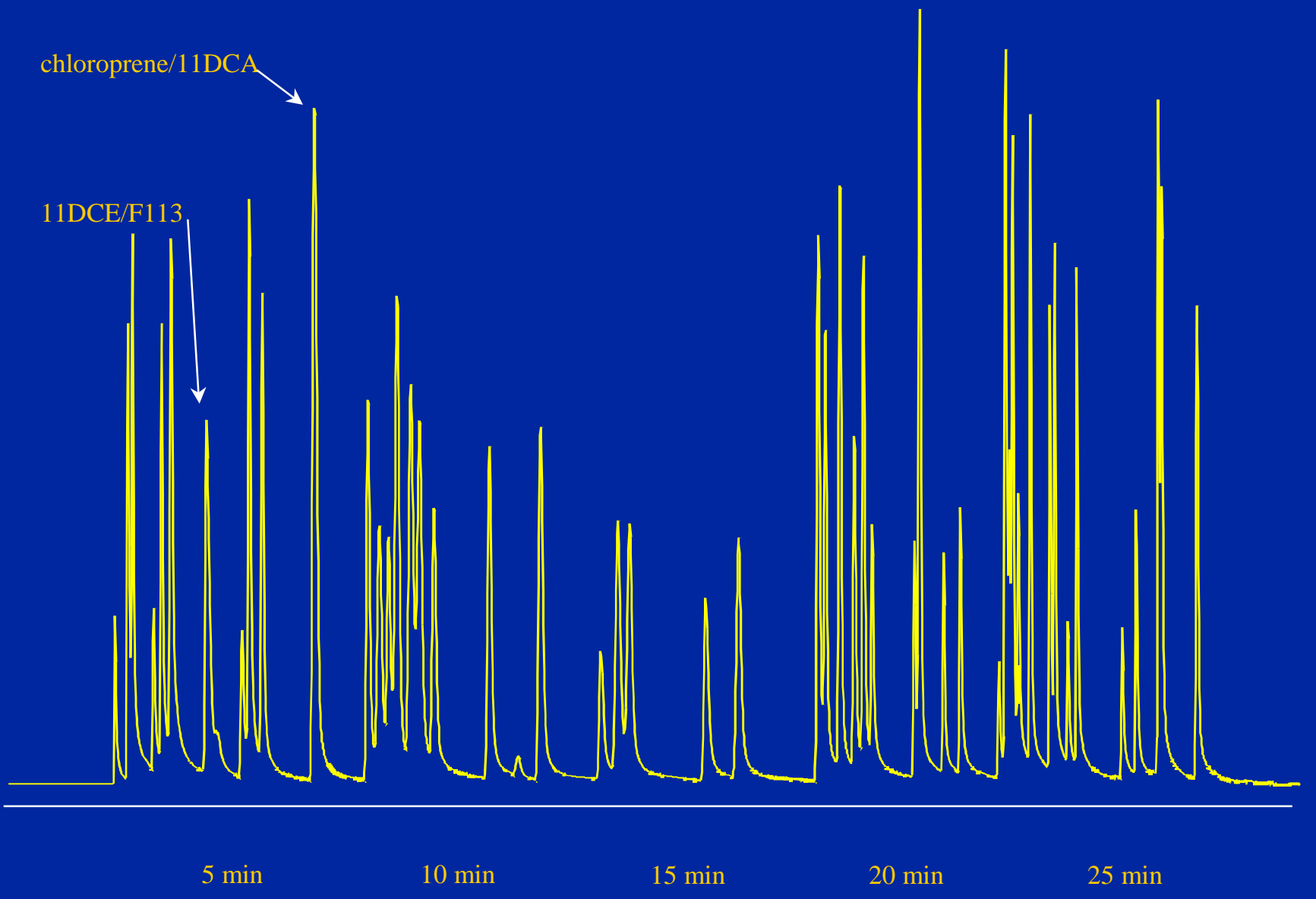
Surrogates: fluorobenzene, 1-bromo-2-chloroethane, 1-chloro-2-fluorobenzene, 2-bromo-1-chlorobenzene



Rtx[®]-VGC PID

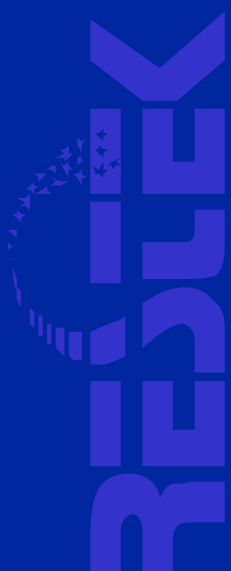


Rtx[®]-VGC Hall



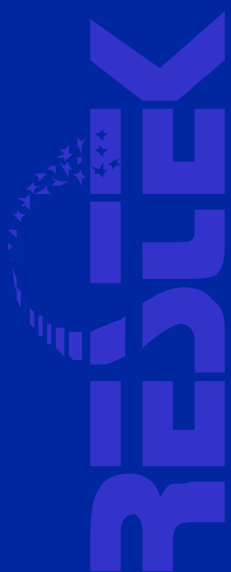
Rtx[®]-VGC Column

- Excellent gas resolution
- 25 minute run time
- 40°C starting temperature possible
- Separates all compounds in US EPA Methods 502.2 & 8021



Finnigan 9001 GC

Instrument Courtesy of Thermoquest



Conclusions

- Application-specific column
- Computer modeling
- Resolution of critical compounds



For More Information...

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