

# ***New Technology for Semi-Volatile Analysis***

**Improve Productivity**

**Reduce Maintenance**



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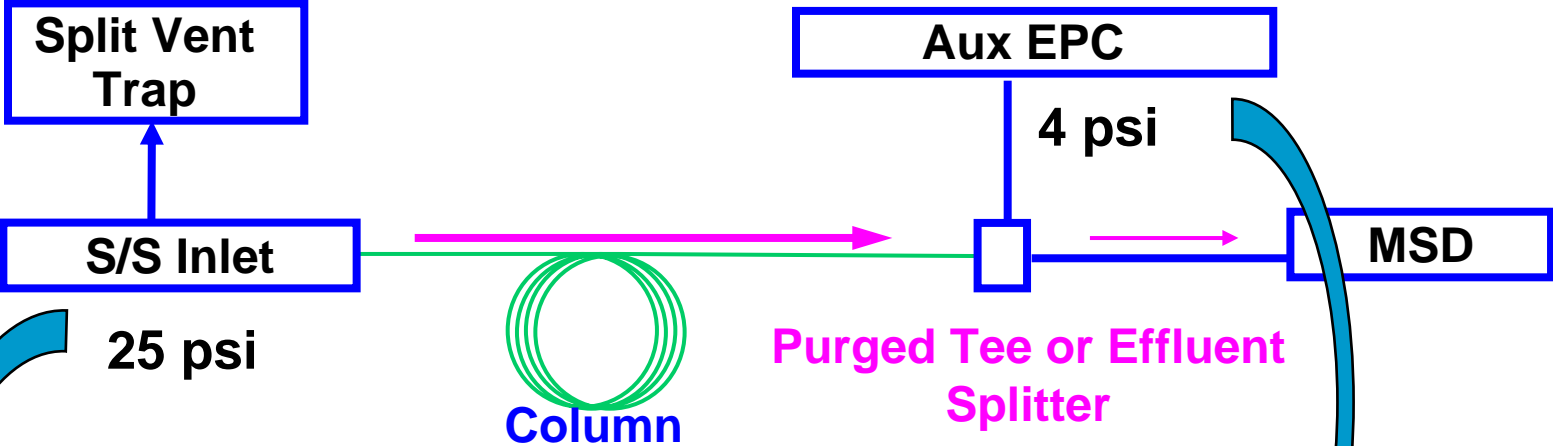
# New Technology

- Backflushing using programmable pressure devices
  - AUX EPC
  - Capillary Flow Technology “CFT” Devices
- Low Thermal Mass “LTM” GC
  - Fast ramps
  - Fast Cool down
- Multi Mode Inlet “MMI”
  - Temperature programmable
  - Solvent Vent for large volume injections “LVI”
- Deans Switch
  - Multidimensional GC

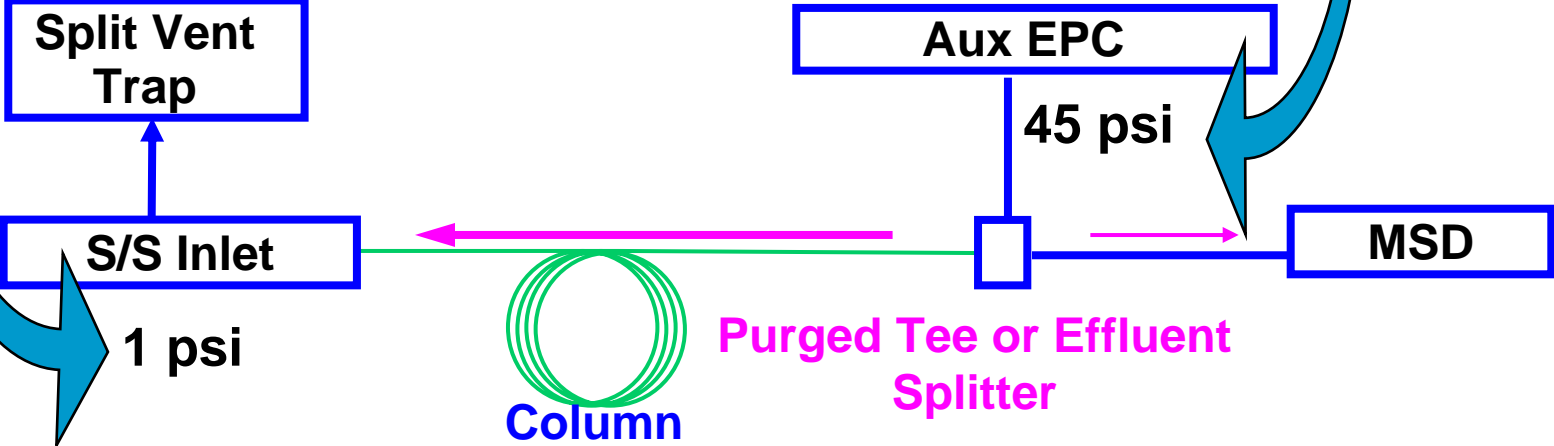


# Post-column Backflush

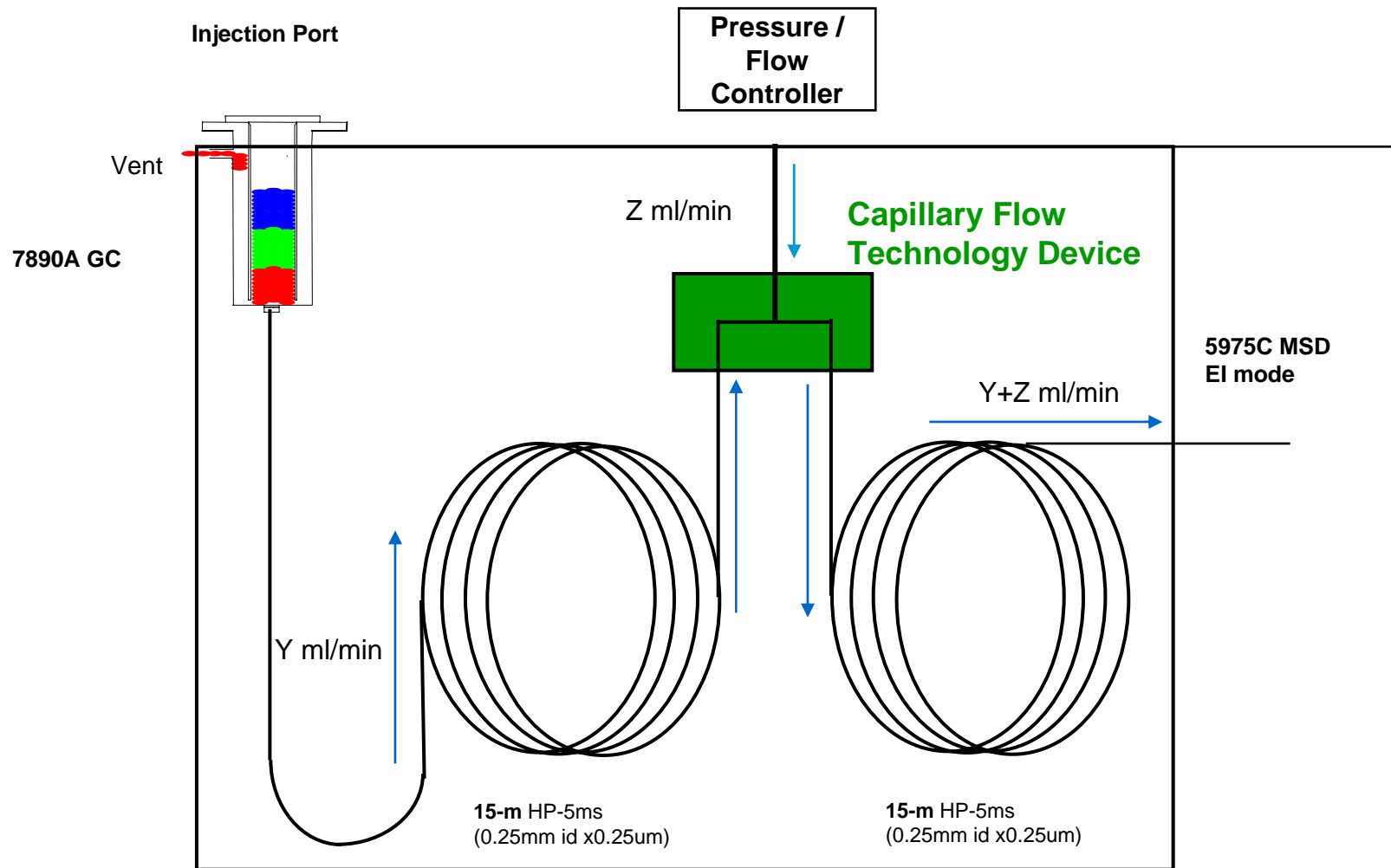
## During GC Run



## After GC Run

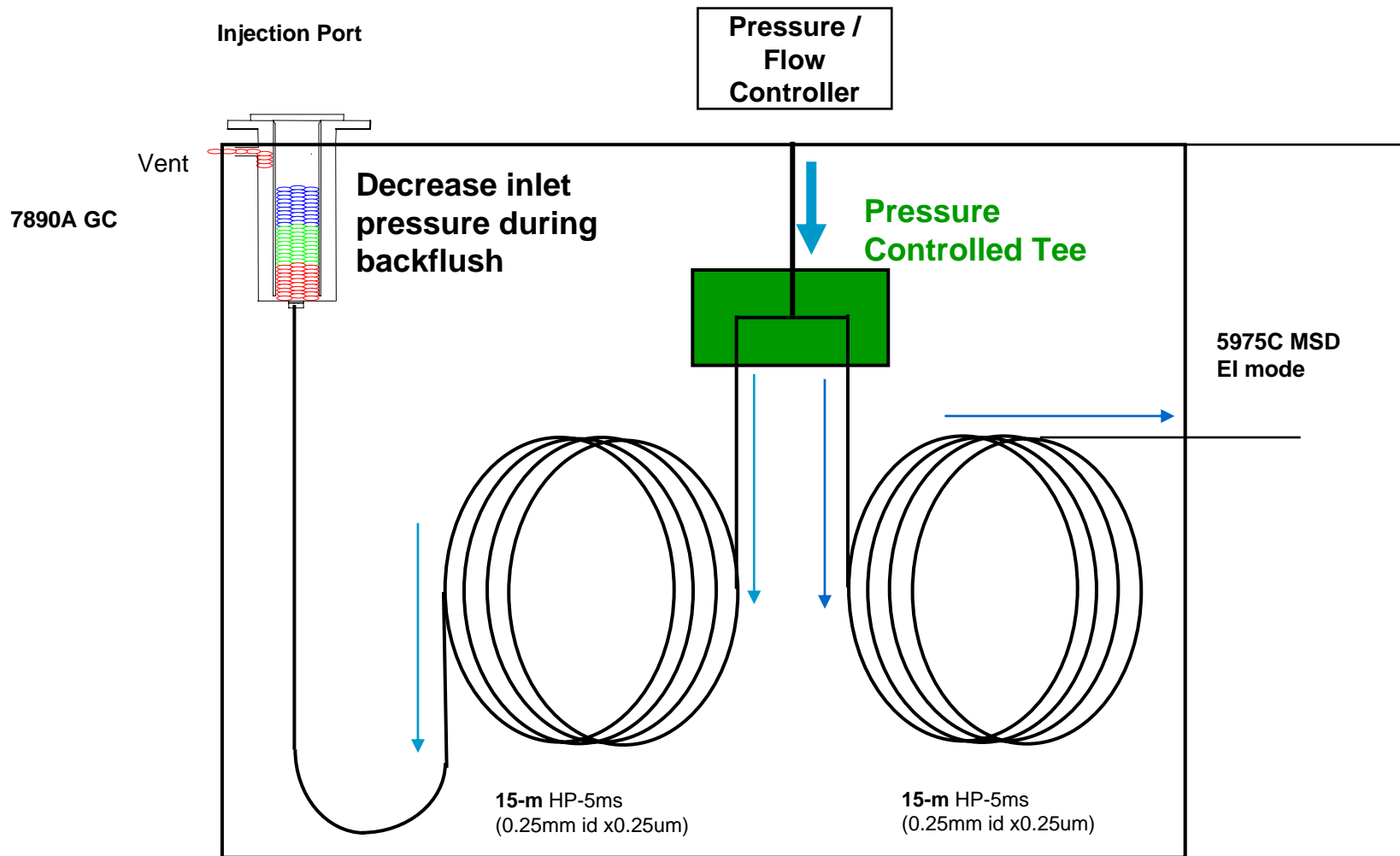


# Backflush – Mid-Column (Analysis Mode)

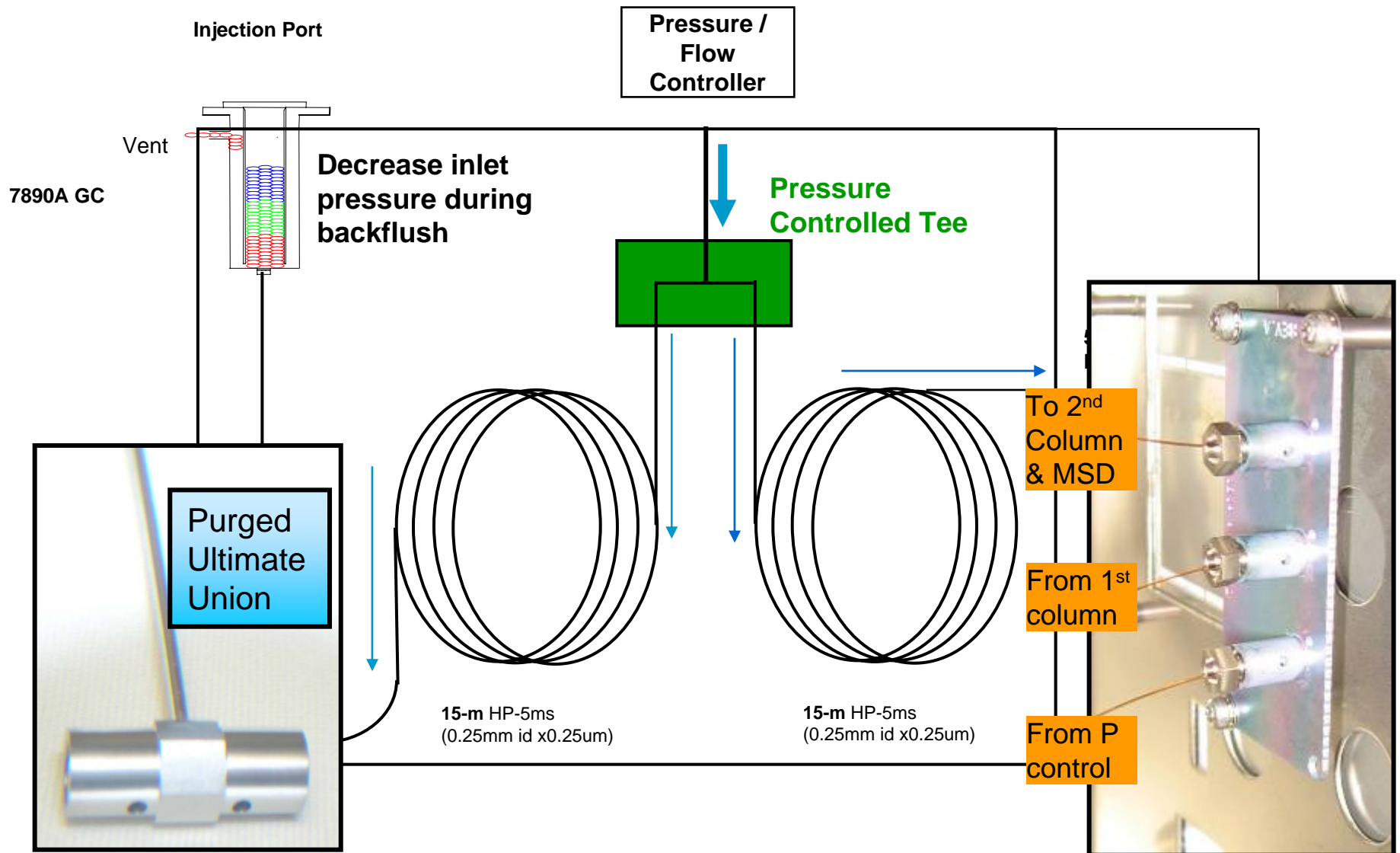


Column 1 and 2 could be different phases and different dimensions

# Backflush – Mid-Column (Backflush Mode)

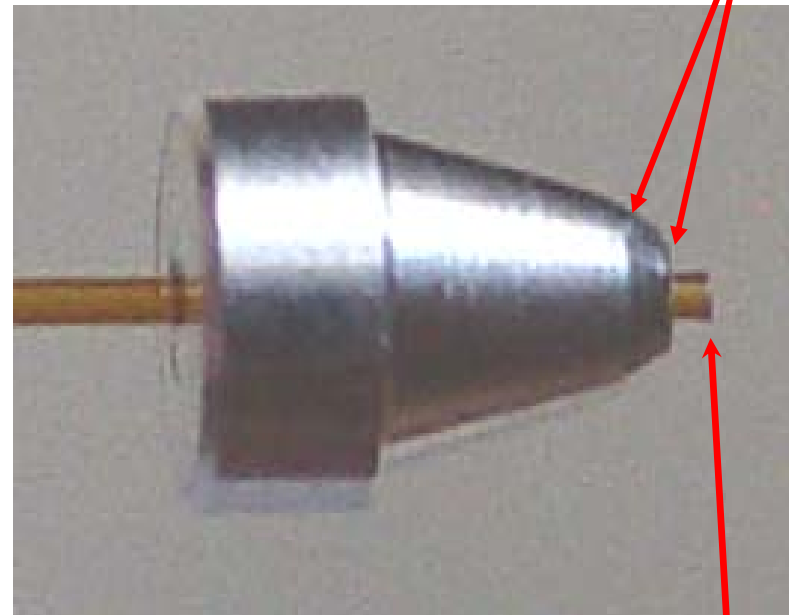
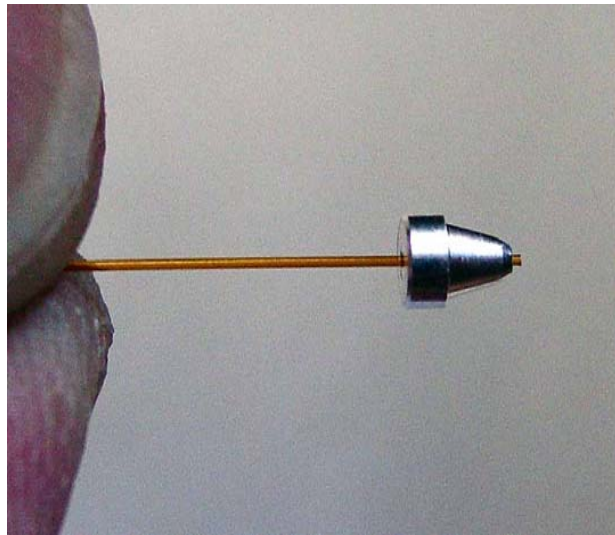


# Backflush – Mid-Column (Backflush Mode)



# The Metal Ferrule

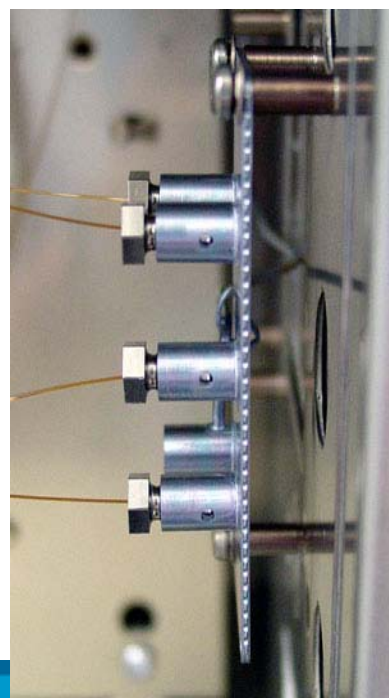
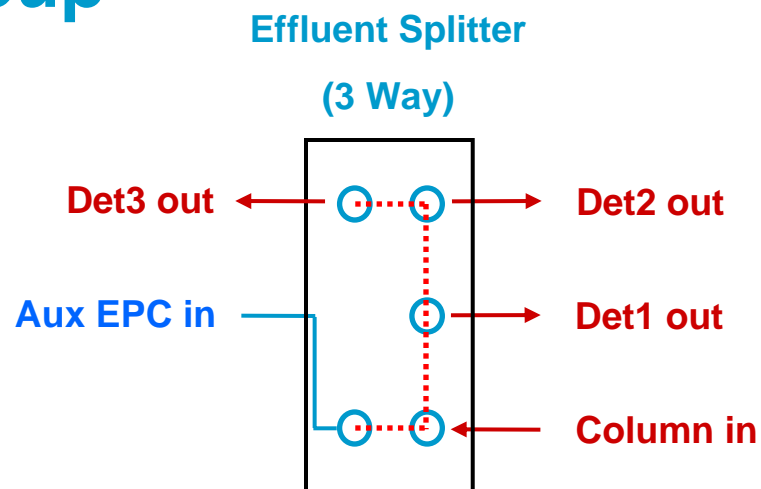
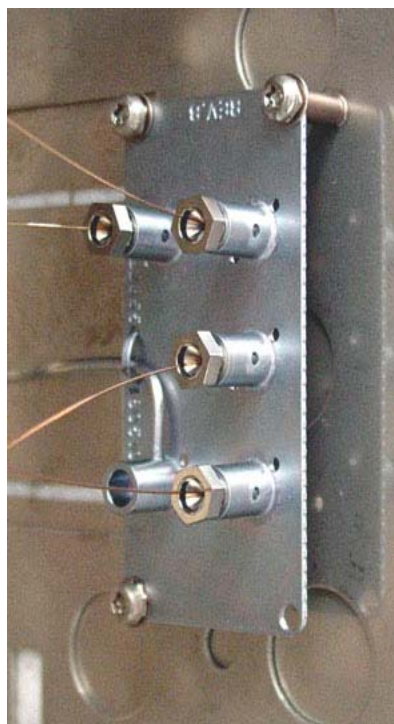
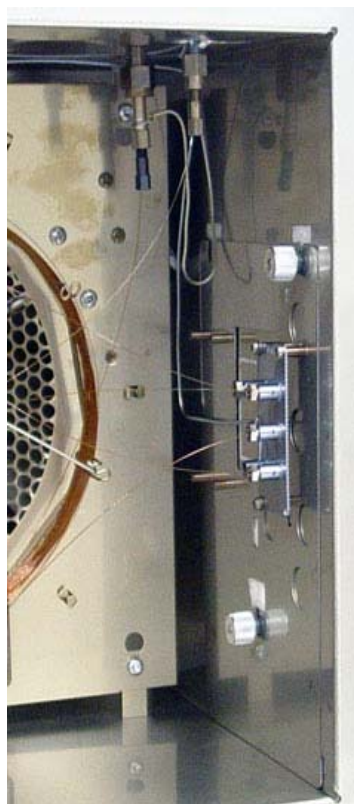
Does not loosen (leak) even with thousands of runs to 350C



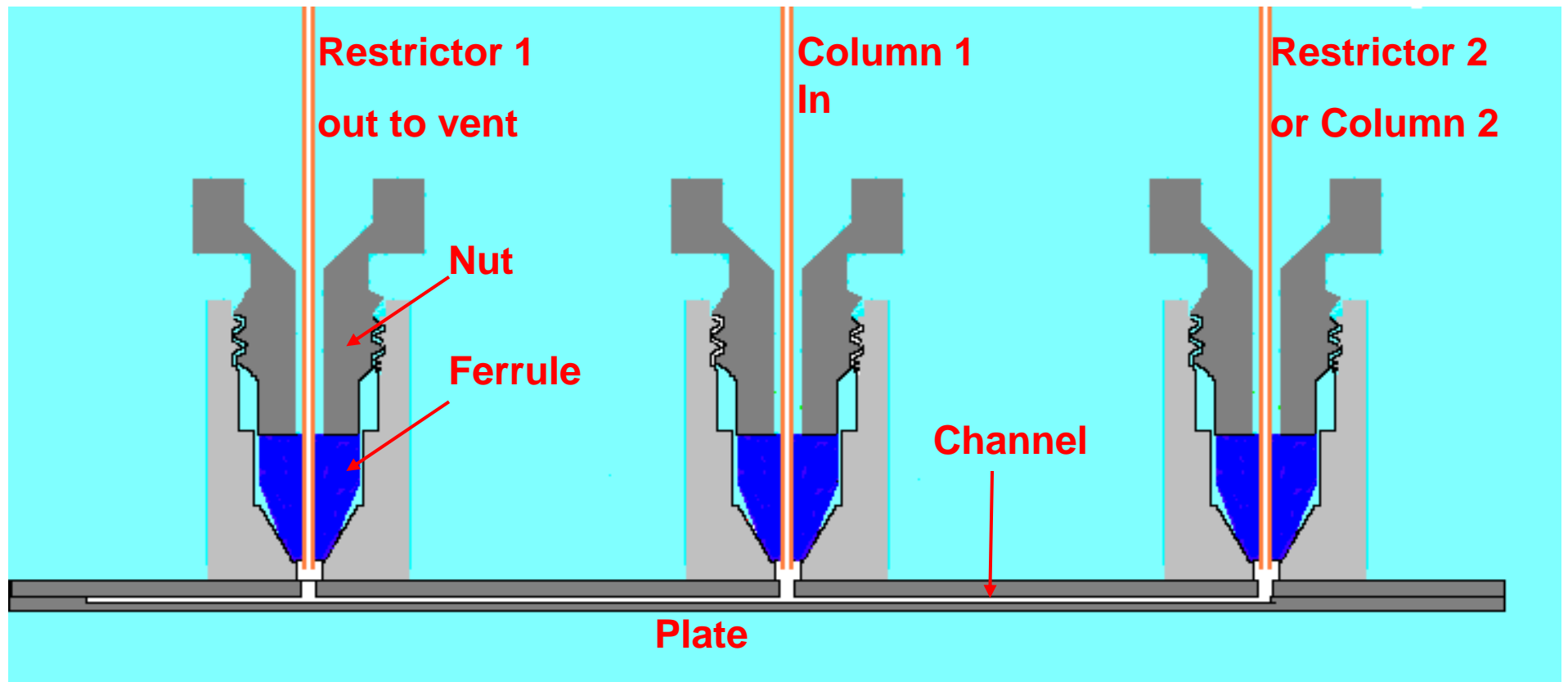
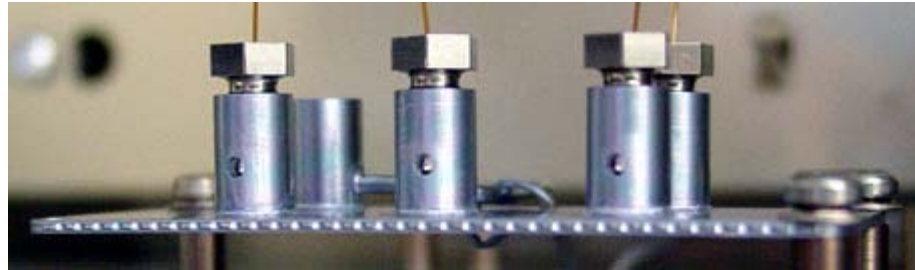
**Seal region**

**Square cut is not critical**

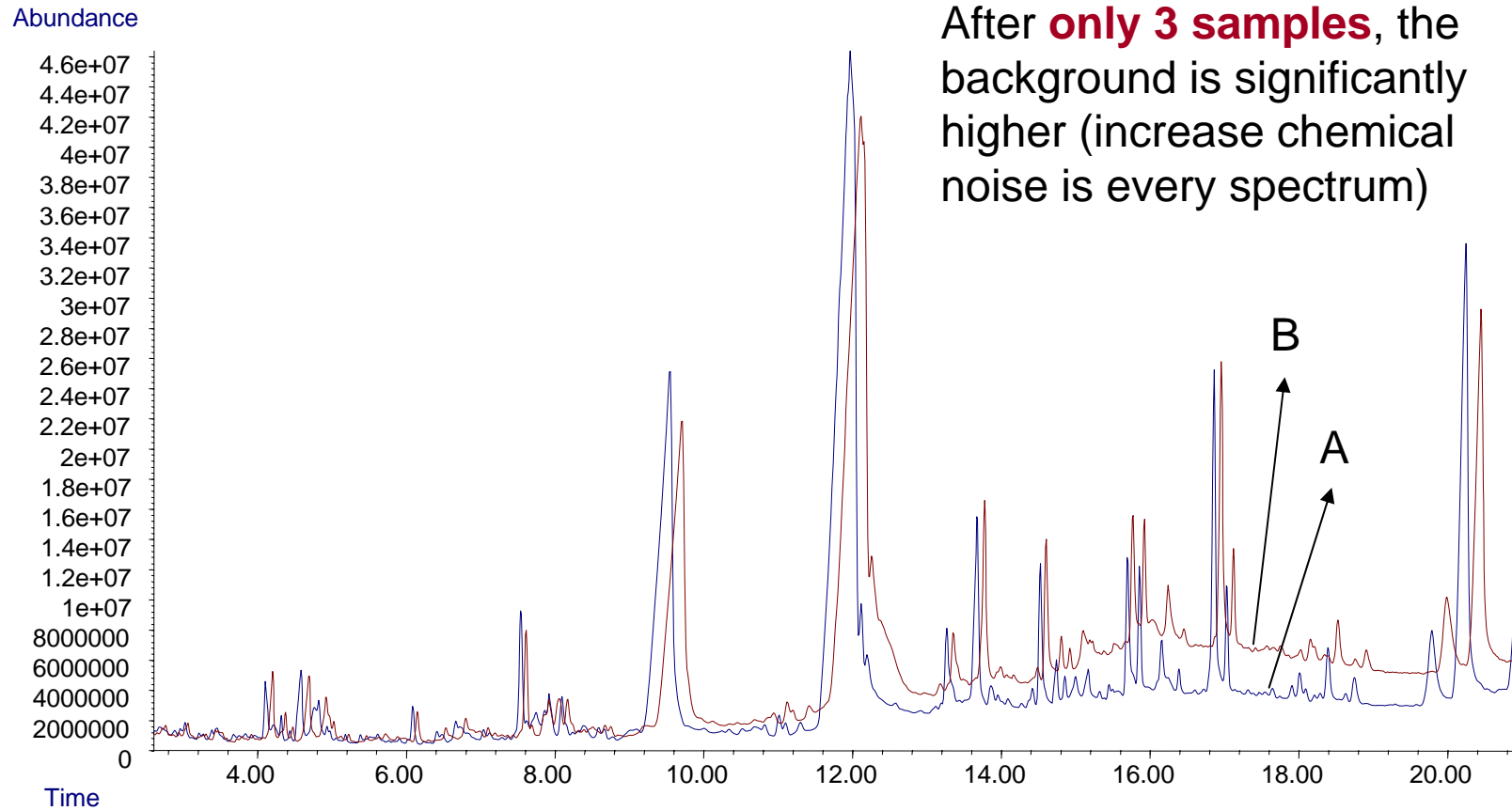
# 3-Way Splitter With Makeup



# Capillary Flow Technology



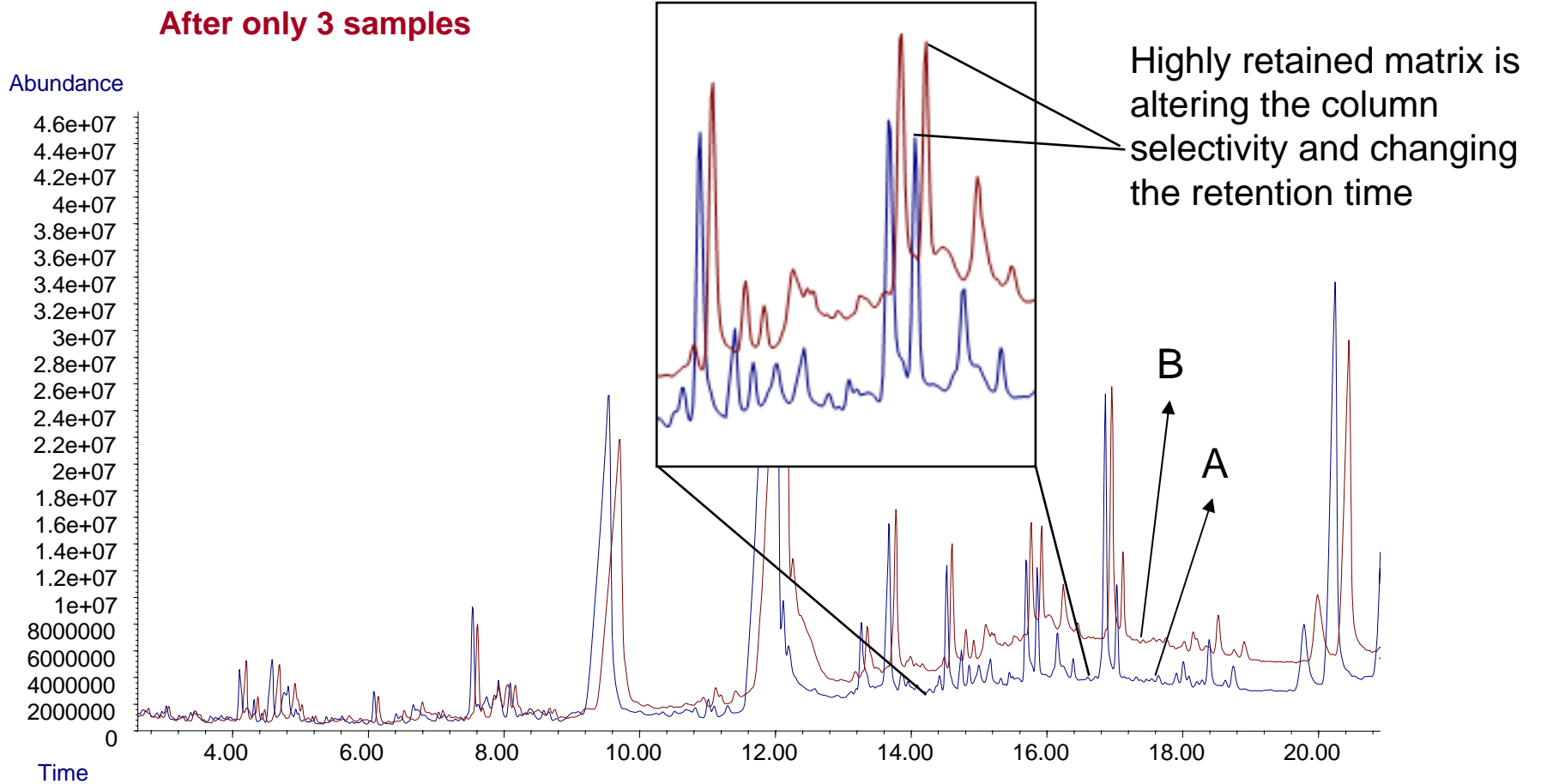
# Without Backflush: A Serious Problem



After **only 3 samples**, the background is significantly higher (increase chemical noise is every spectrum)

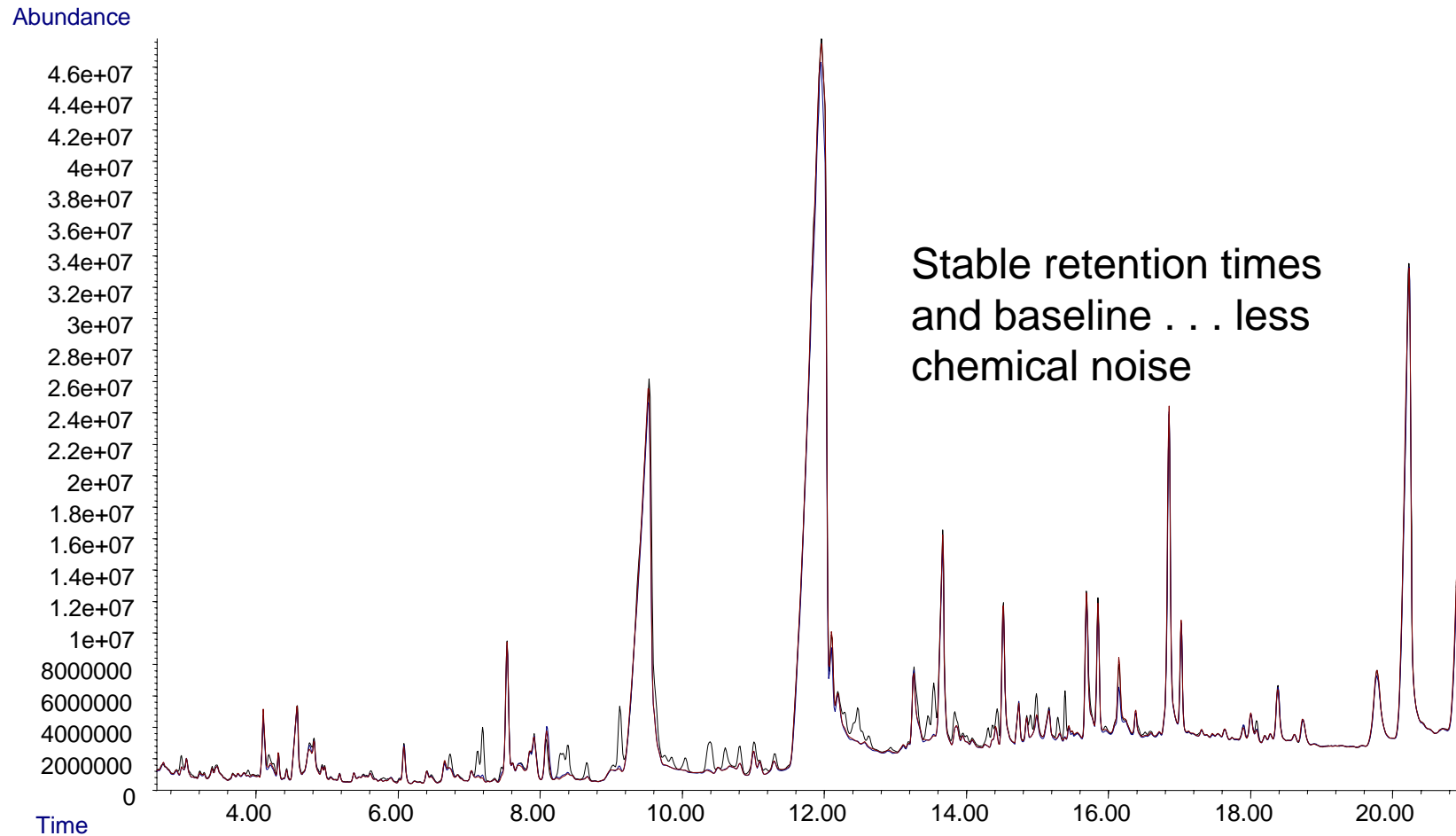
Overlay of two chromatograms of a matrix extract injected BEFORE (A) and AFTER (B) three injections without backflush

# Without Backflush: Changes in Retention Time



Overlay of two chromatograms of a matrix extract injected BEFORE (A) and AFTER (B) three injections without backflush

# With Backflush: Consistent Retention Times and Baselines (No Increase in Spectral Noise)



Overlay of three chromatograms of matrix extract run with 2 min of back flush

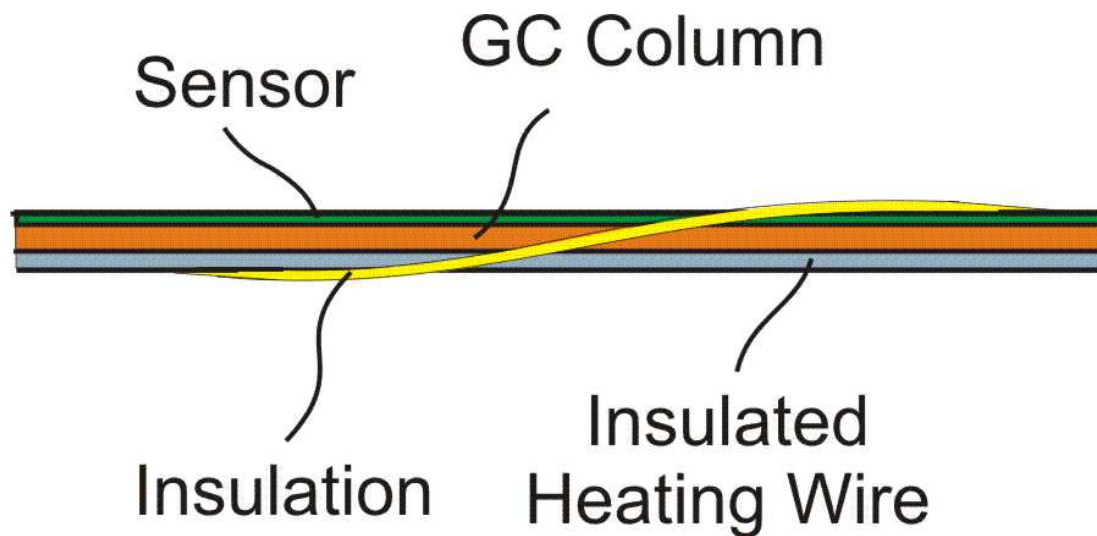
# “LTM” (Low Thermal Mass) Technology

- Why heat the entire oven?
- Why not just directly heat the column?
- Wouldn't that be faster and better?
  - Yes → 400C/min
- Would this help the global warming problem?
  - It is more energy efficient
  - 40 watts vs. 1800 watts



# “LTM” (Low Thermal Mass) Technology

- Direct heating of fused silica GC columns



# Low Thermal Mass Technology for 7890/6890 GC

**Faster Cycle Times**  
**Lower Energy Use**

Independent and simultaneous temperature programming of:  
1-2 column modules (fastest cooldown), or  
1-4 column modules (small format)

LTM Column Modules  
(standard width shown)

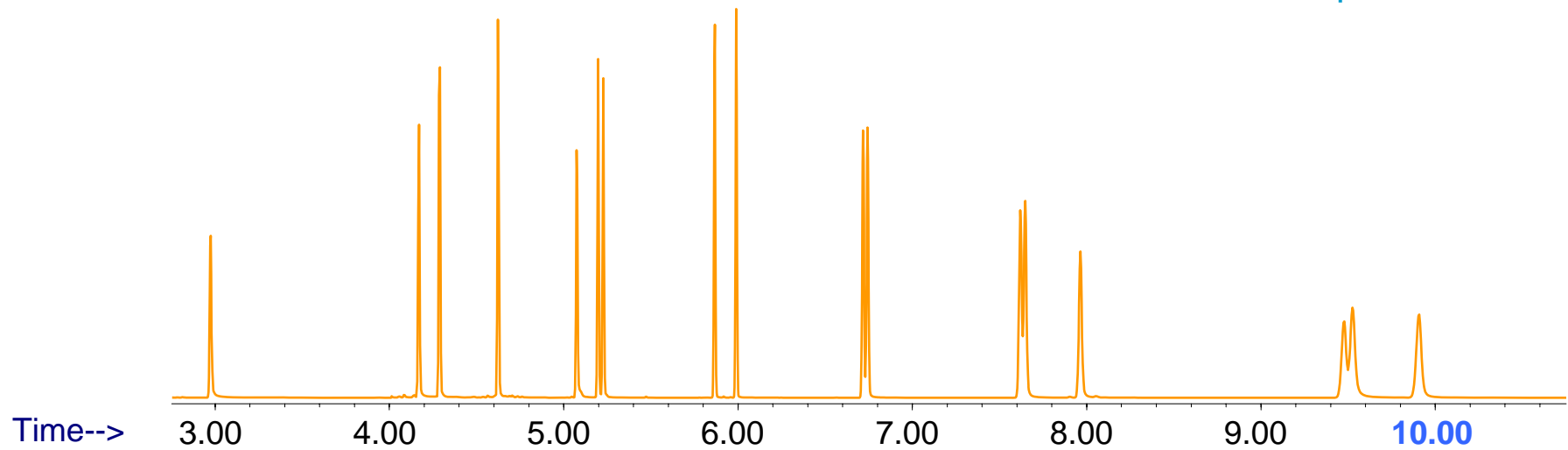
LTM Control System  
w/ Keypad User Interface  
... Agilent LTM Control SW



# PAH by LTM/GC/MS

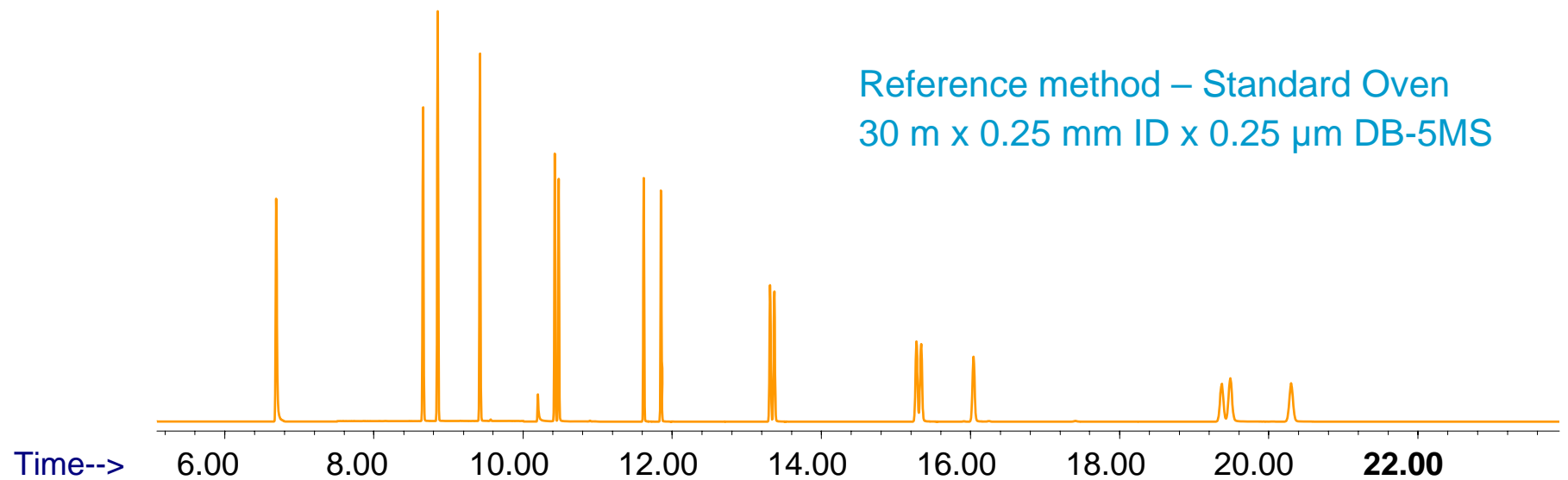
Fast Analysis - LTM

20 m x 0.18 mm ID x 0.18  $\mu$ m DB-5MS



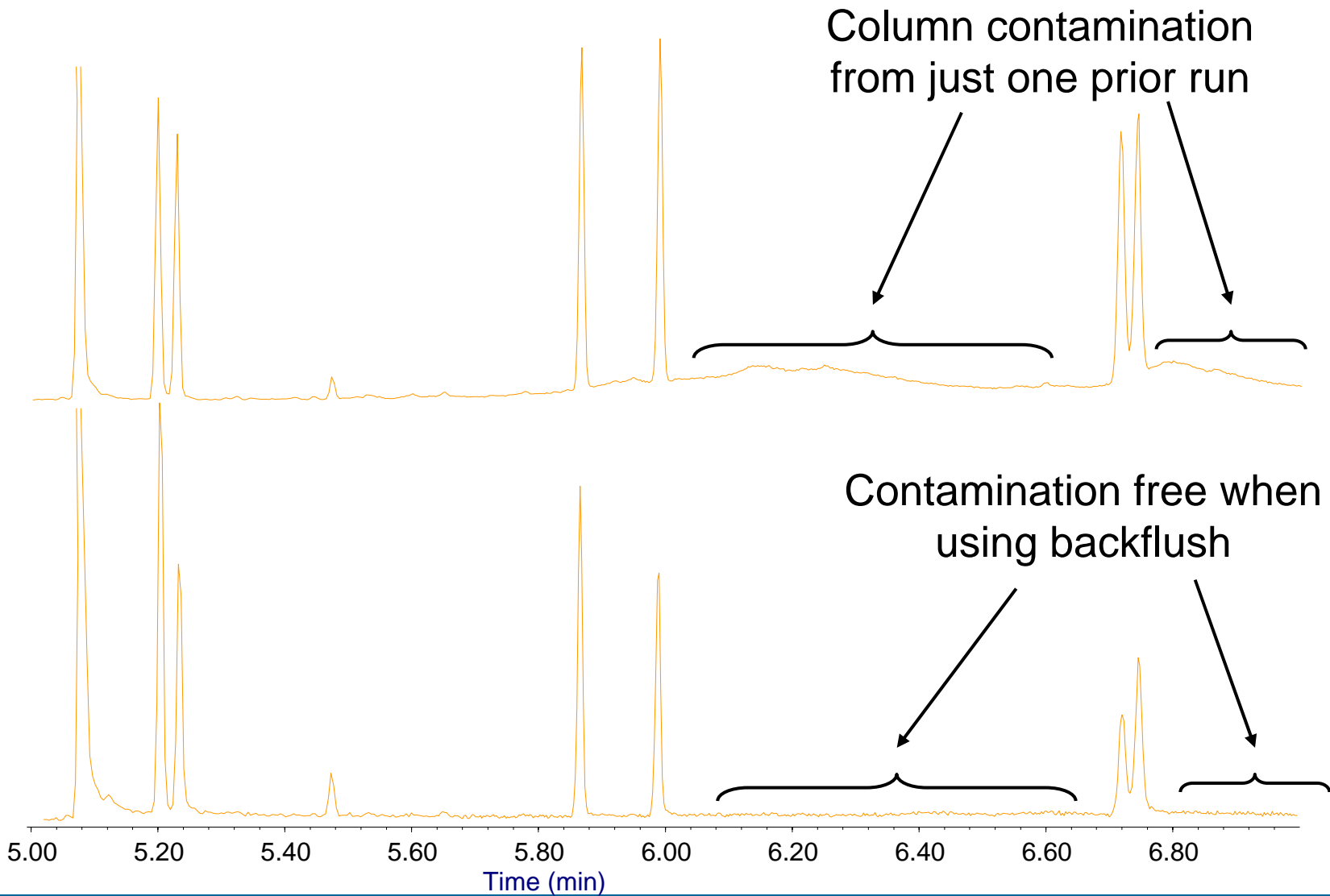
Reference method – Standard Oven

30 m x 0.25 mm ID x 0.25  $\mu$ m DB-5MS



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# PAH by LTM/GC/MS



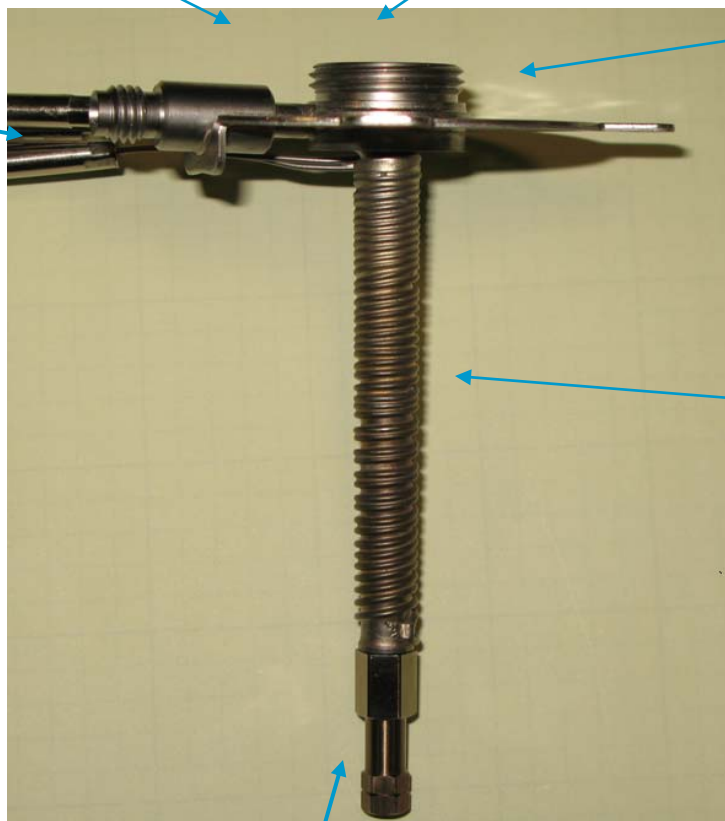
# New Agilent Multimode Inlet

Turn-top easy liner exchange

Standard 11mm septa

Air plus CO<sub>2</sub>, N<sub>2</sub>  
cryogenic  
cooling

No leaks at liner



Standard liner  
dimensions

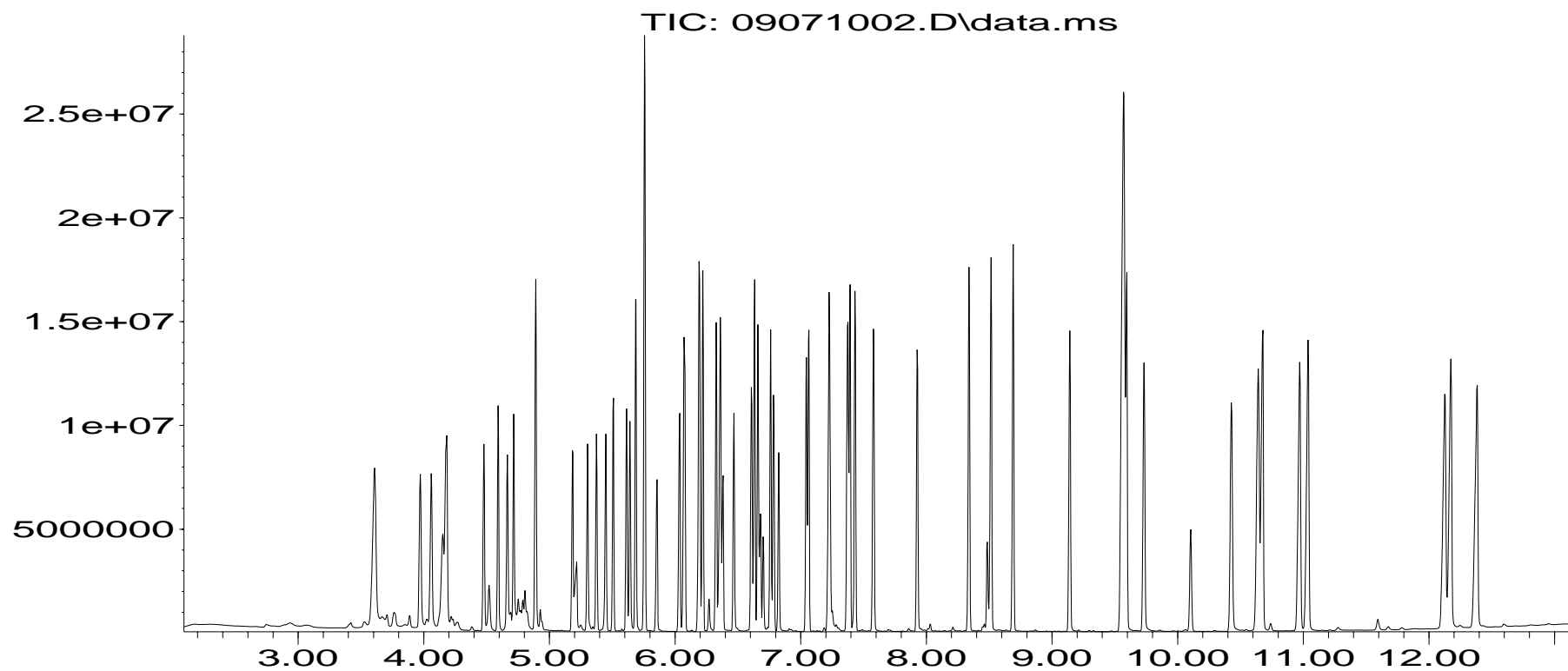
Standard column nut

# Multimode Inlet

- Temperature programmable
  - Cool injection for labile compounds
  - Reduces solvent backflash
  - Improves sample transfer to column by 2-3 times (cold splitless)
- Solvent vent
  - Minimizes solvent on column
  - Allows Large Volume Injection

# Fast 8270 Using 20 ul Injection on MMI

Abundance



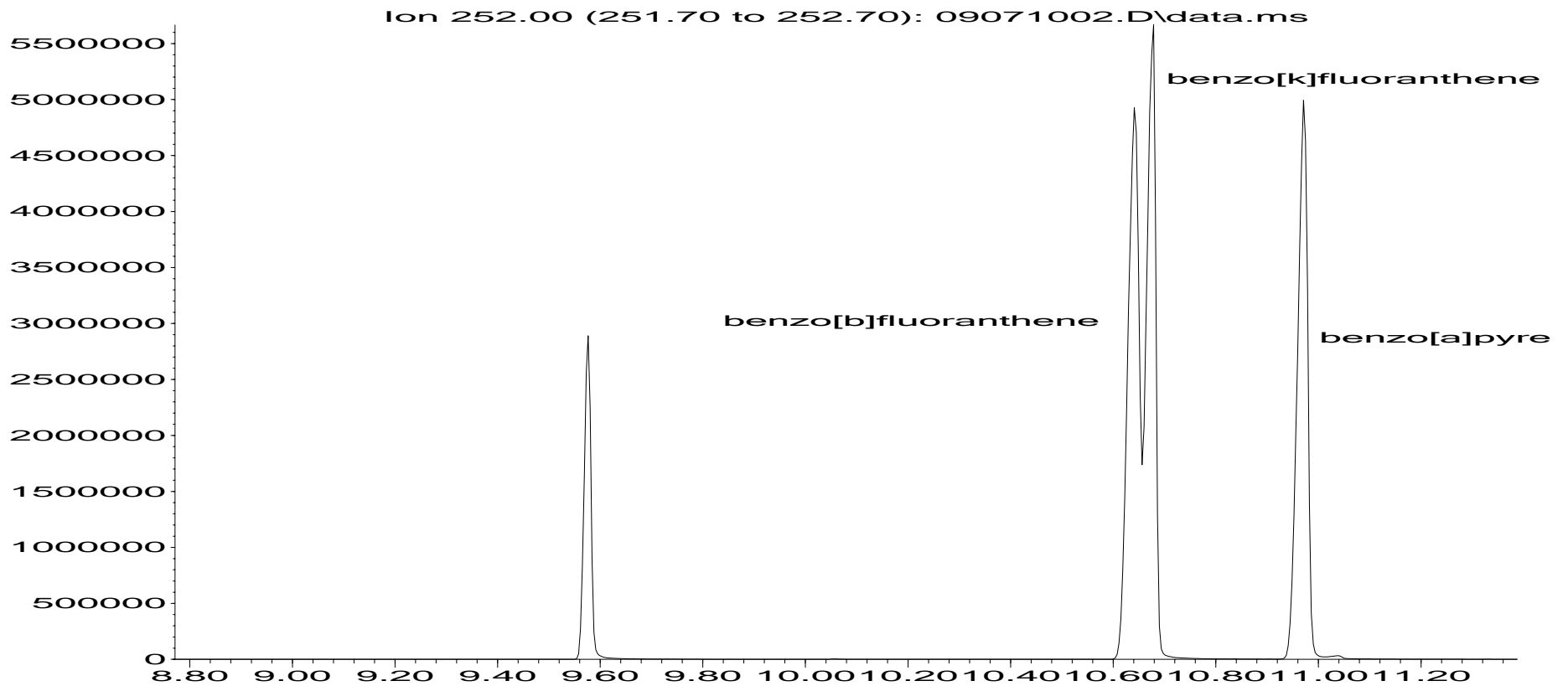
Time-->



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# Fast 8270 Using 20 ul Injection on MMI Benzo(b) & Benzo(k) resolution

Abundance

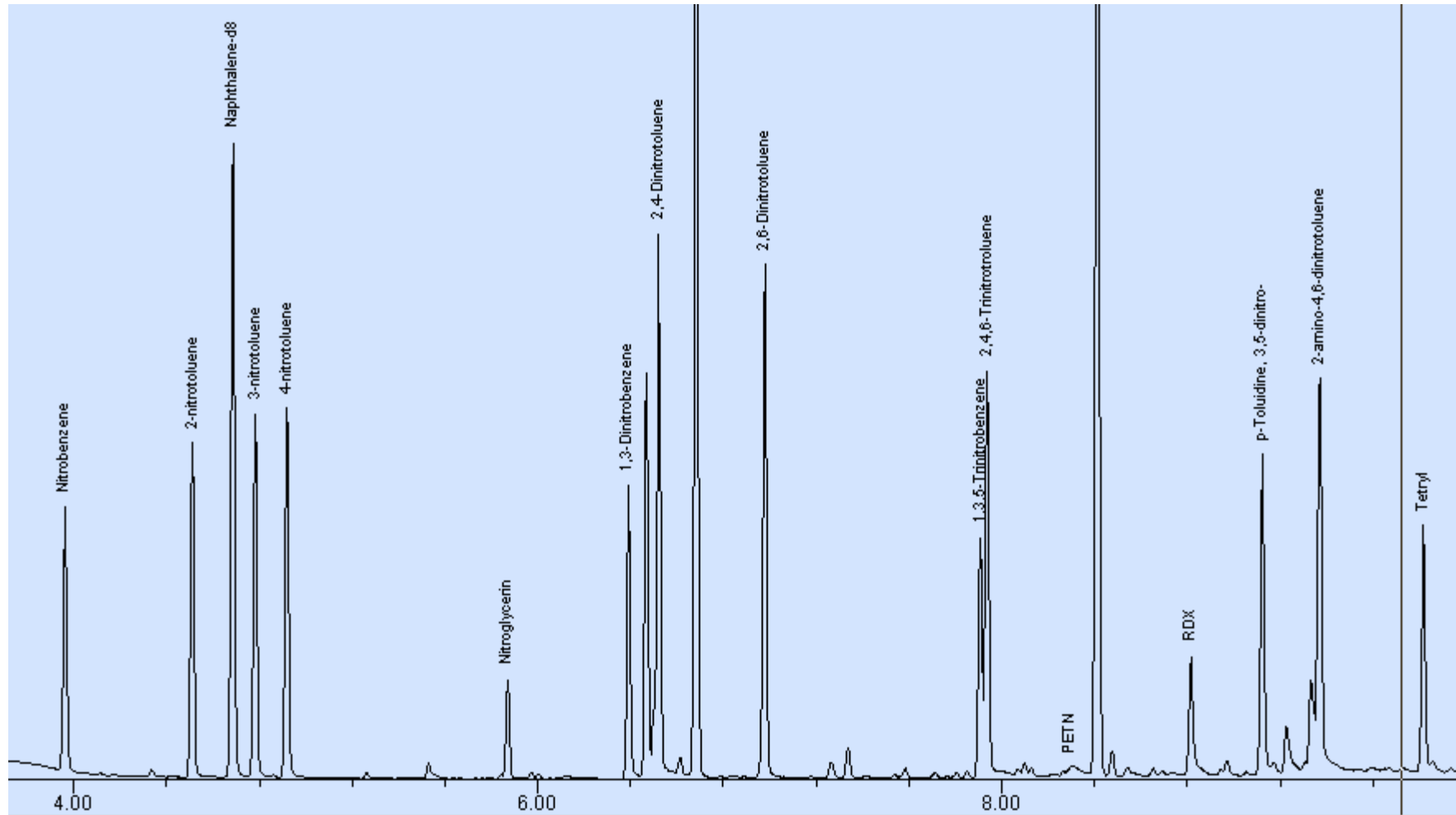


Time-->



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# Explosives Using 50 ul injection on MMI

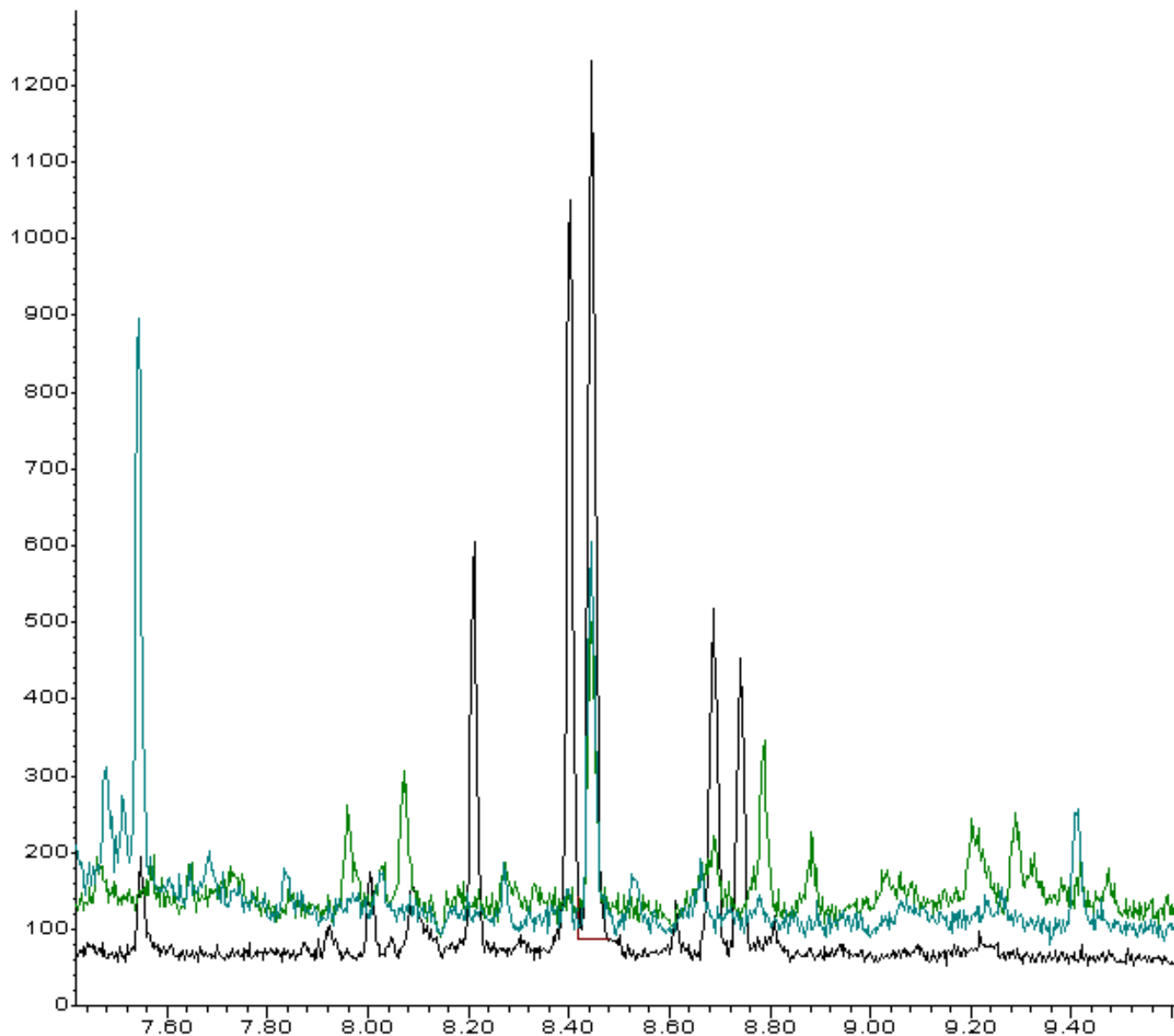


# Deans Switch

## Not in the EPA Methods -- YET

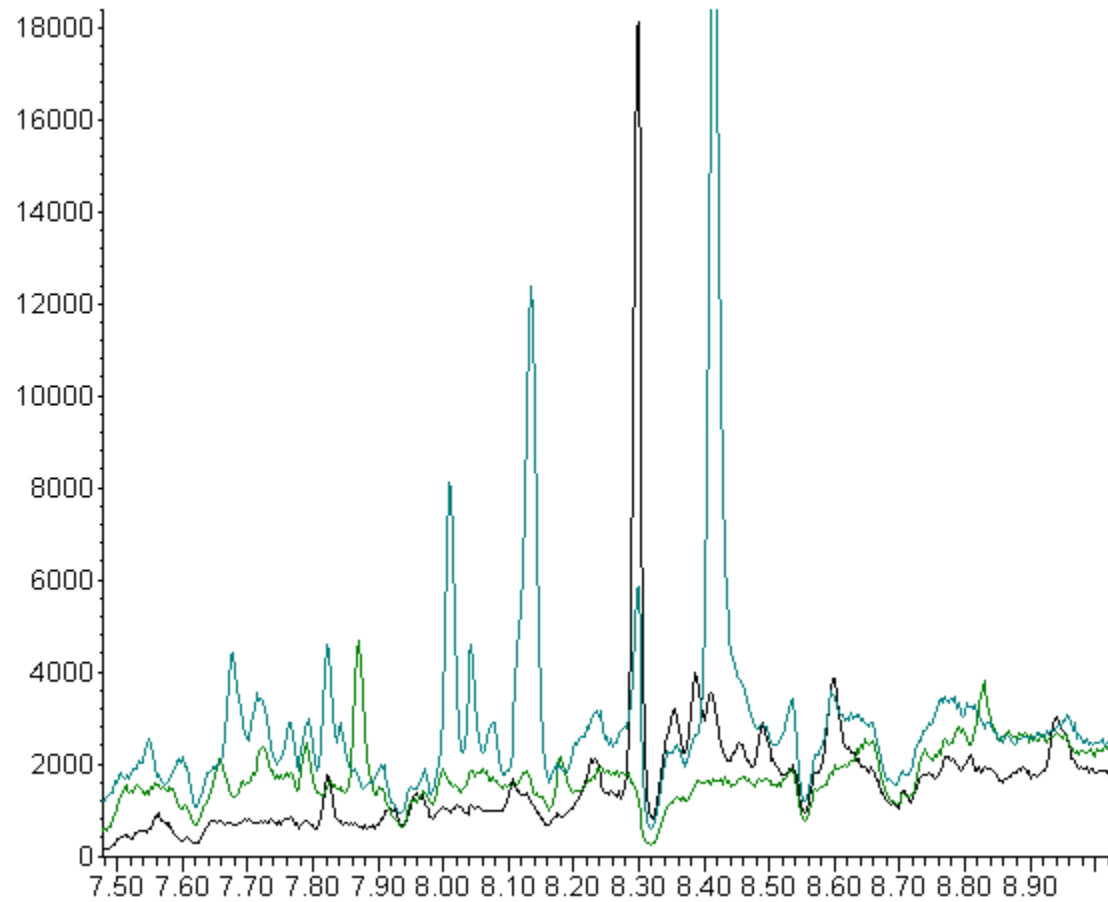
- Multidimensional GC
- 2D GC
- GC-GC

# Ideal Conditions (20 fg clean standard)

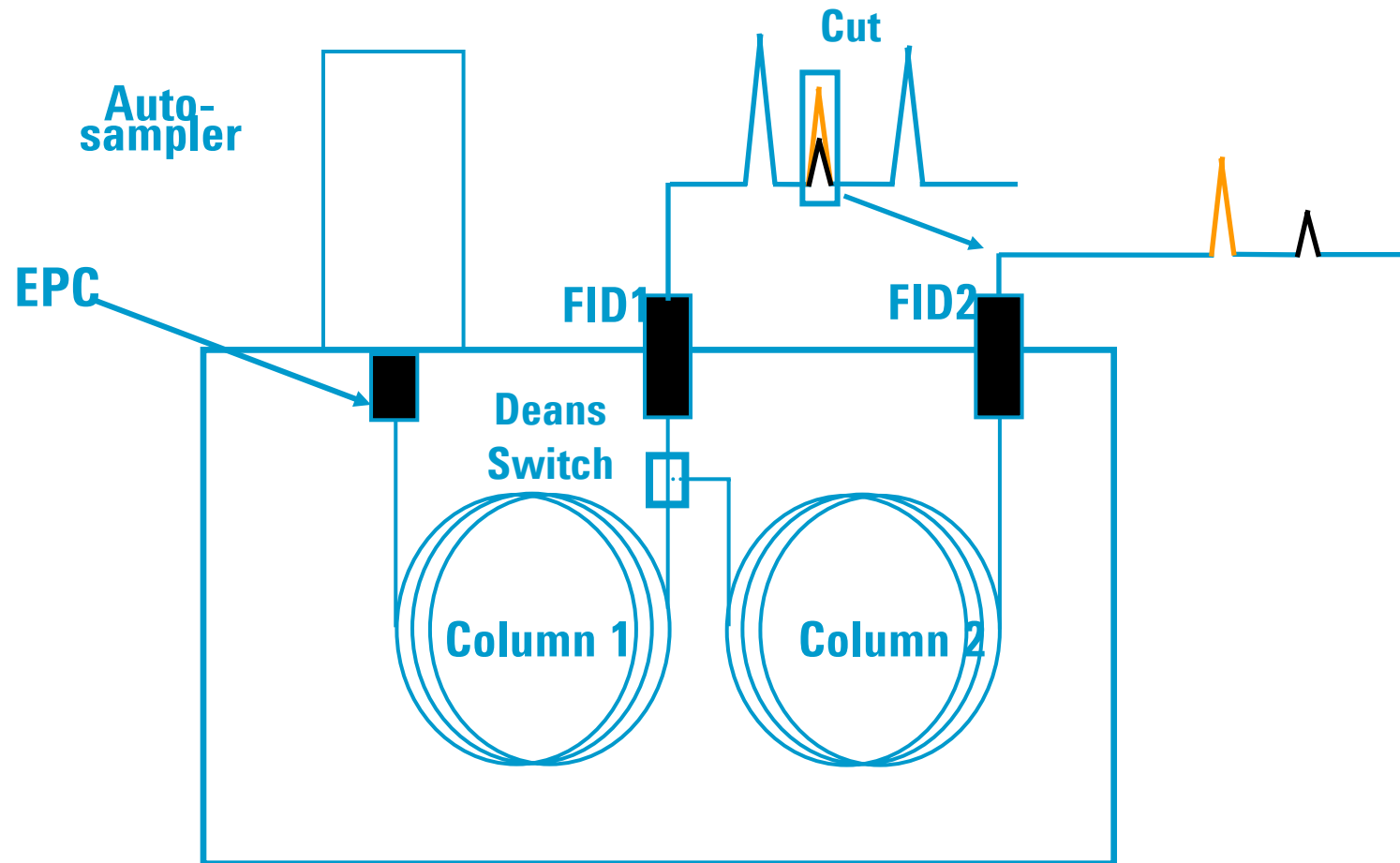


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# Soil Matrix Effect – no peak

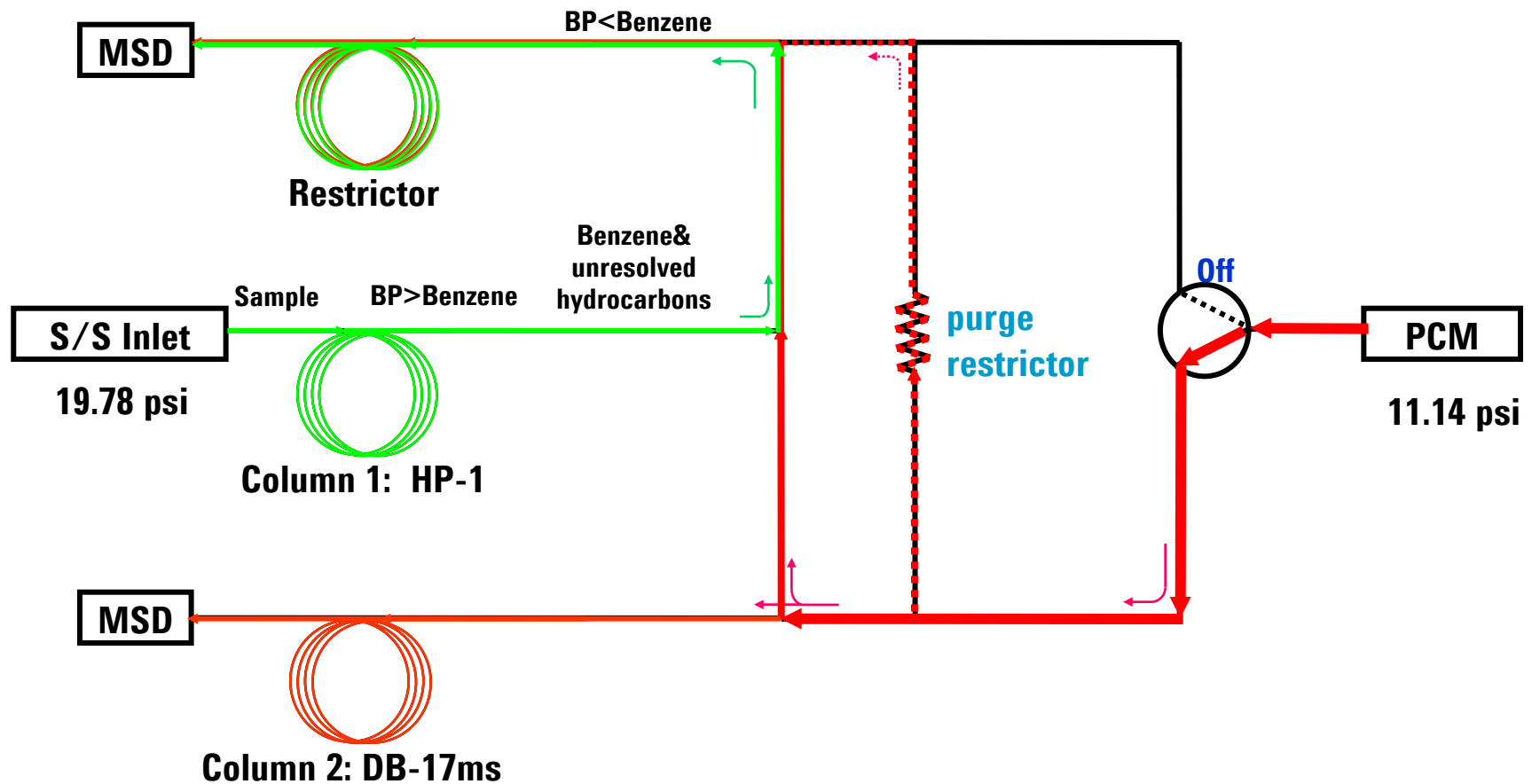


# Heart-Cutting 2-D GC



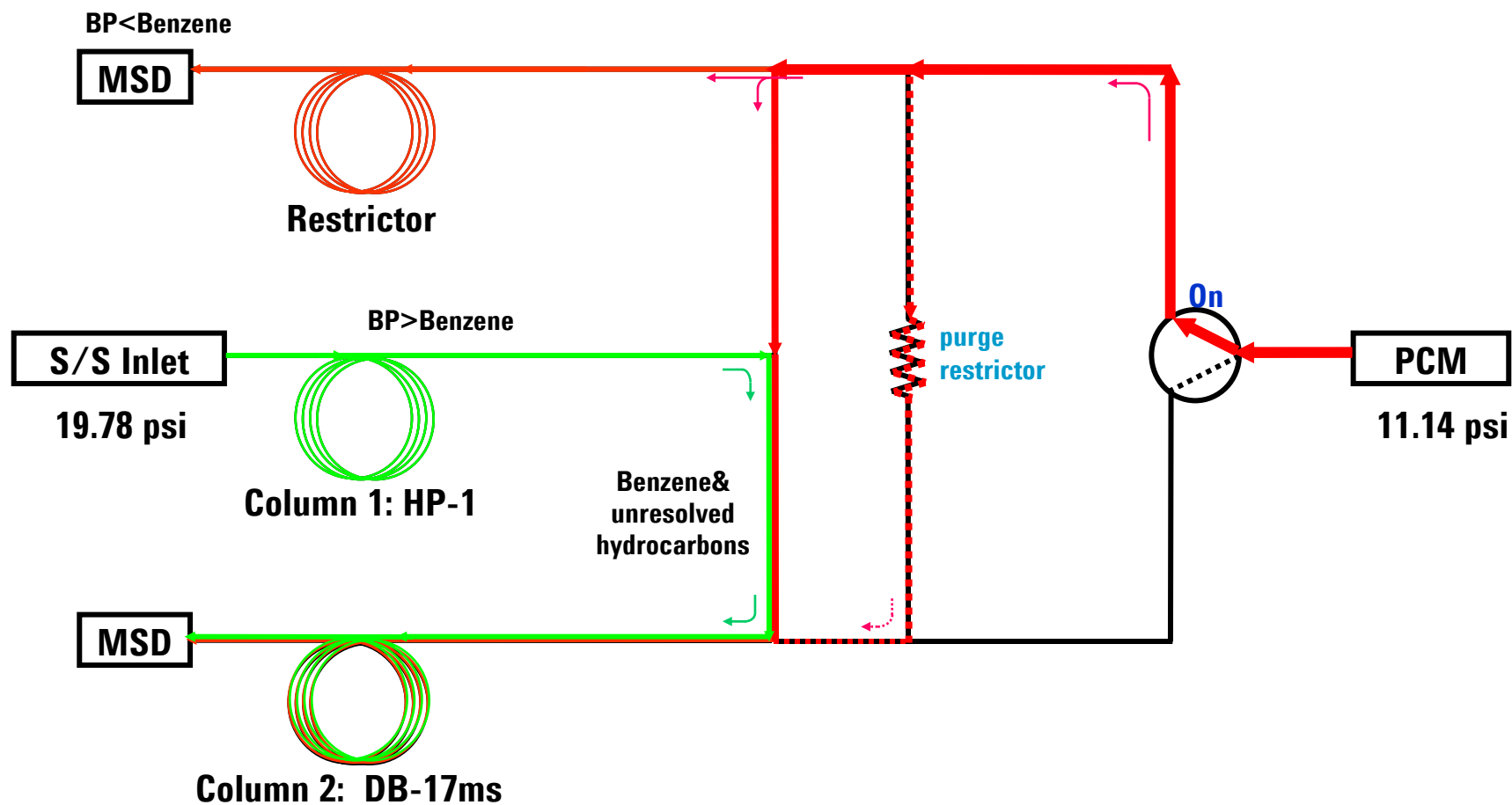
# Heart Cutting 2-D GC – How It Works

Valve off, no heart cutting– inject sample, initial separation on column 1



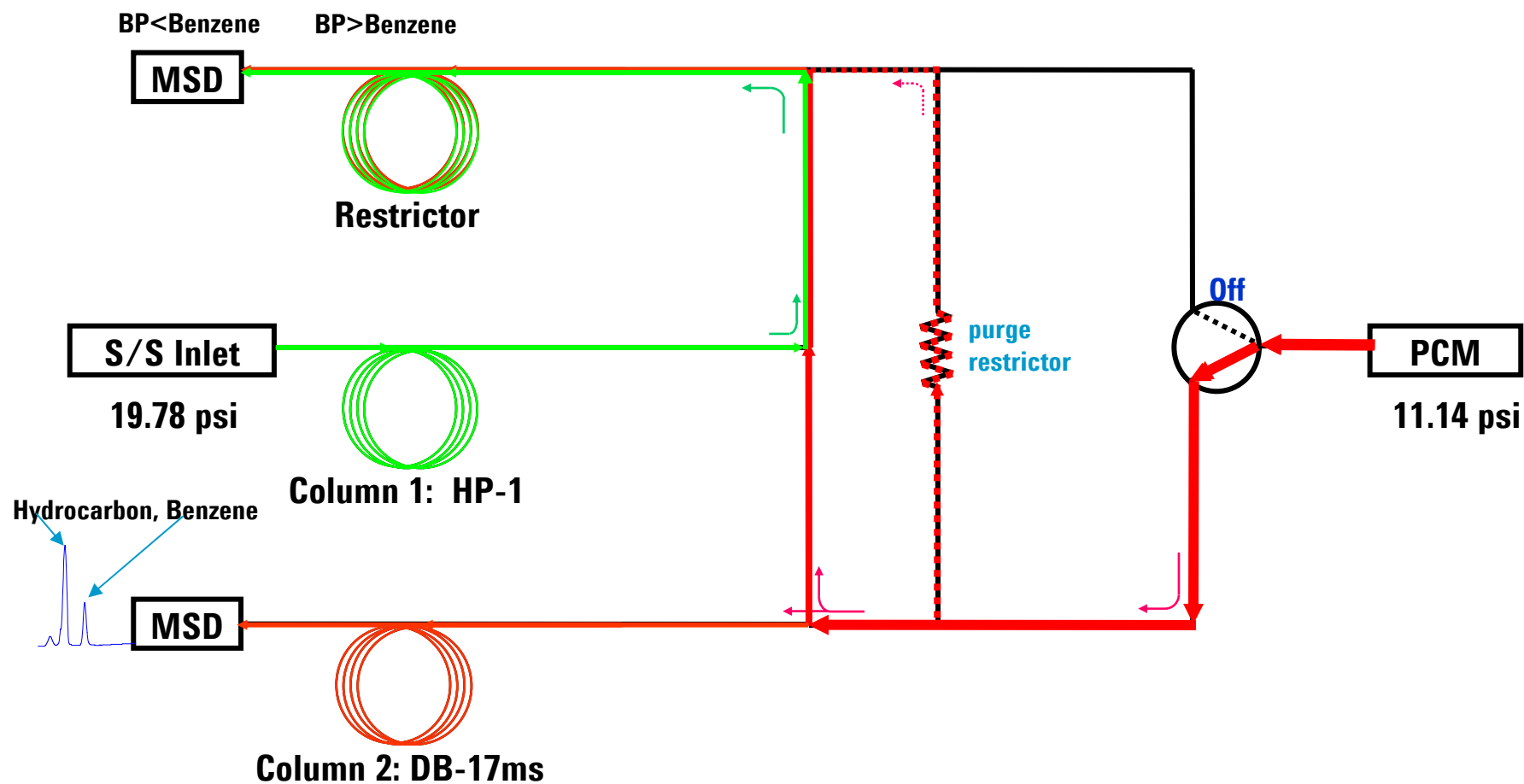
# Heart Cutting 2-D GC – How It Works

Valve on – start heart cut from column 1 to column 2

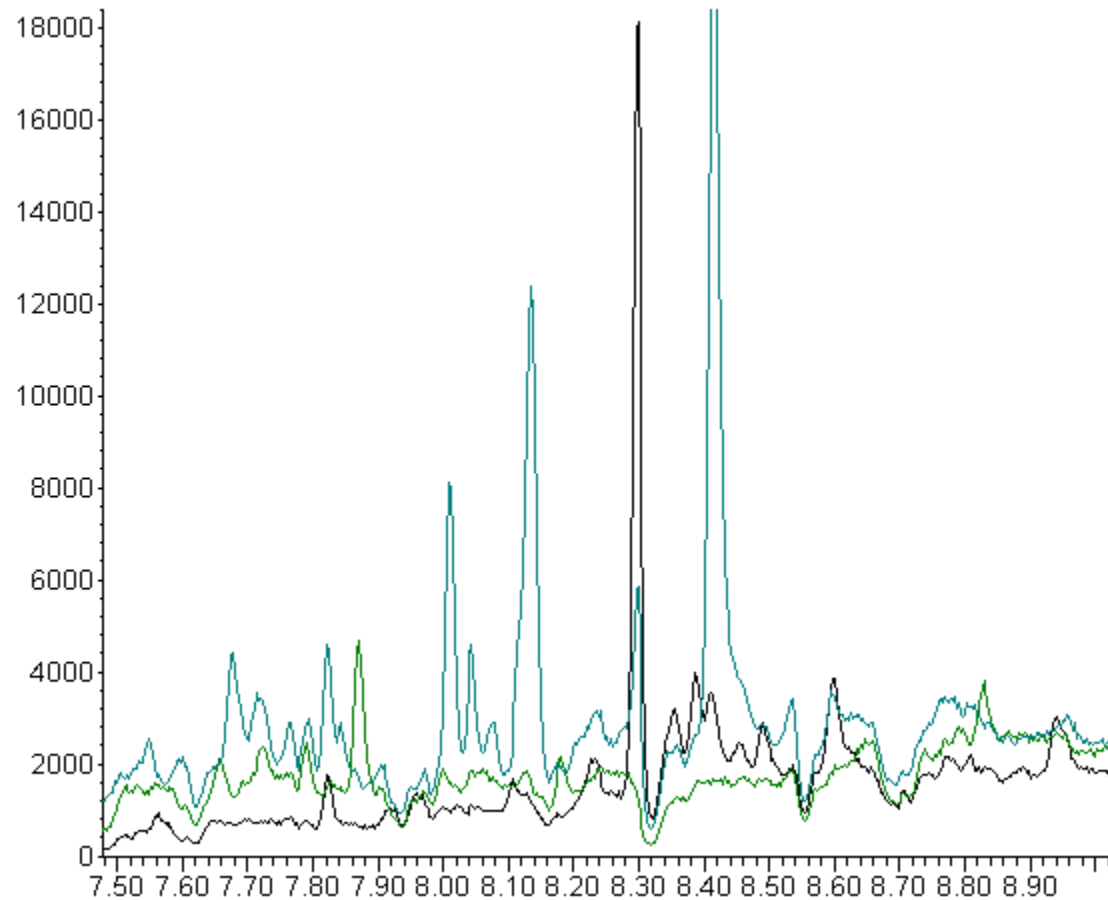


# Heart Cutting 2-D GC – How It Works

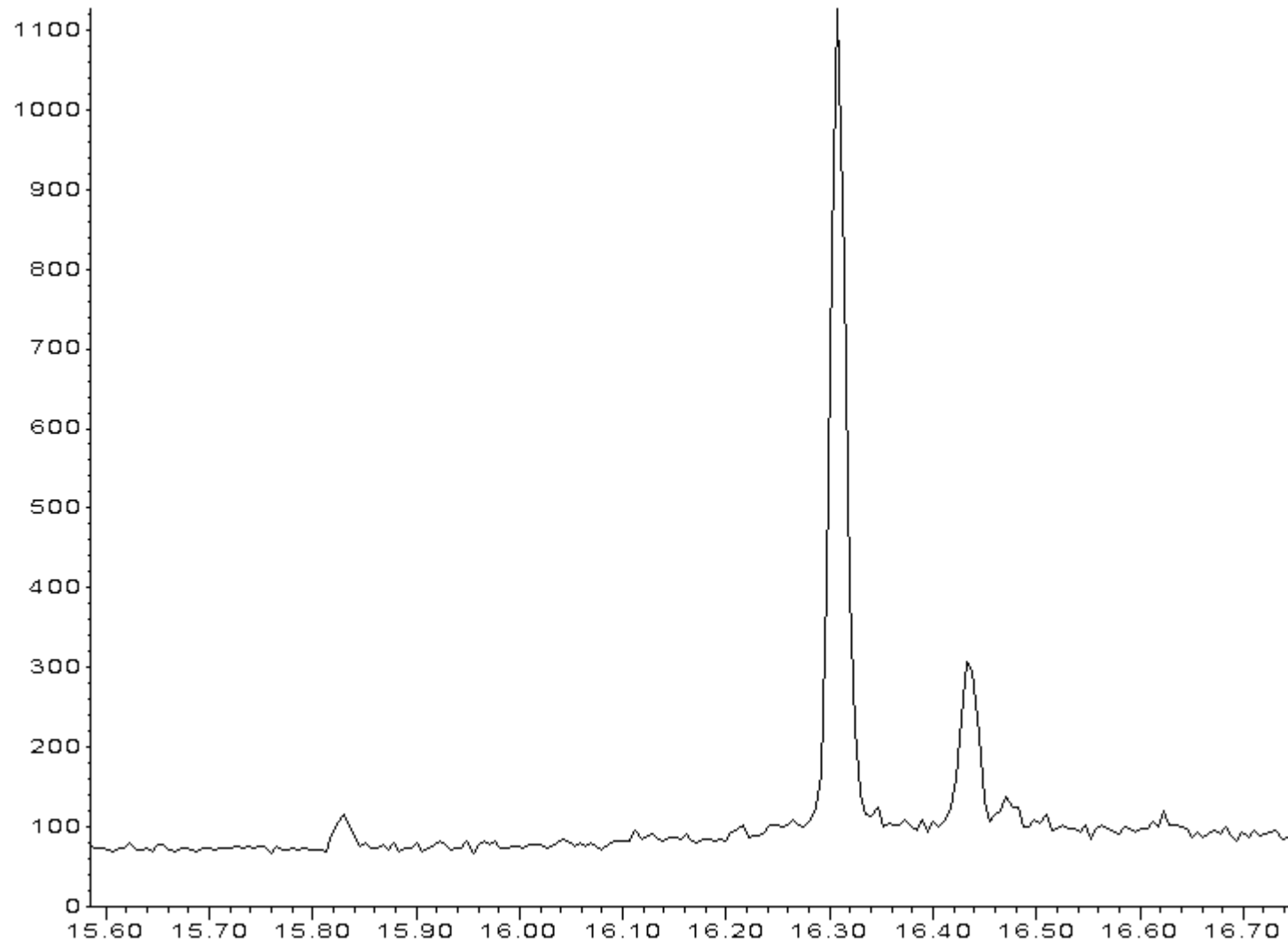
**Valve off – end heart cut, perform 2<sup>nd</sup> separation on column 2**



# Remember the Soil Matrix Effect – no peak



# Results: 20 fg in Soil Extract



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# Summary – improve productivity/reduce maintenance

- Backflushing
  - Uses AUX EPC and CFT (purged splitter or purged union)
- LTM
  - Faster Heating and Cooling – Uses less power
- Multimode inlet
  - Cool injection – LVI reduces sample size for extraction
- Deans switch
  - Allows detection of trace analytes in complex matrices