WAX Column Technology Update

Mark Sinnott
August 14, 2018

WAX Column Update

- What is a WAX column?
- Traditional WAX Phases
  - DB-WAX
  - HP-INNOWAX
  - VF-WAX MS
  - CP-WAX 52/57 CB
  - DB/HP-FFAP (acid modified)
  - CAM (base modified)
- NEW(er) Wax phases
  - INNOWax
  - CP-WAX 52 CB
  - DB-WAX UI
  - DB-FATWAX UI
  - DB-HeavyWAX
- Applications
  - Food/Flavors
  - Organic Acids
  - FAME’s

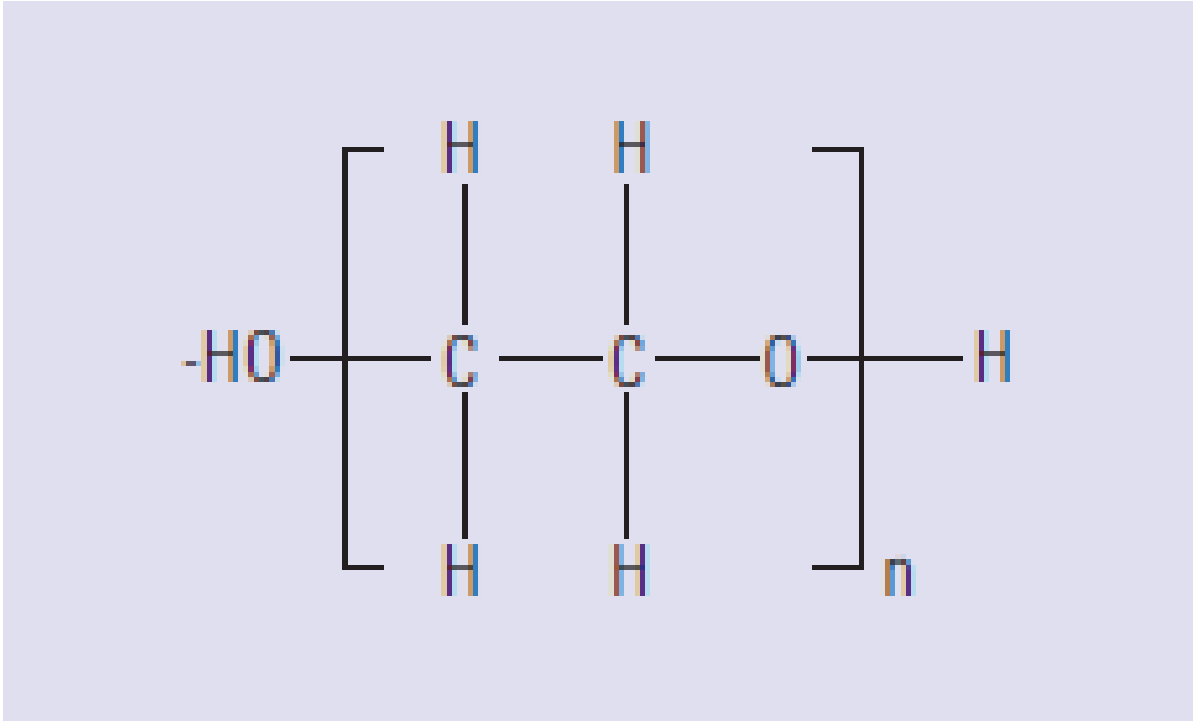
JW Column Portfolio- DB, HP, CP, VF

Low Polarity			Mid Polarity			High Polarity		
CP-Sil 2	DB & HP-1MS UI	DB & HP-5MS UI	DB-XLB	DB-225MS	DB-ALC1	HP-88	DB-WAX	CP-TCEP
DB-MTBE	DB & HP1-MS	DB & HP5-MS	VF-XMS	DB-225	DB-Dioxin	CP-Sil 88	DB-WAX ETR	
CP-Select CB MTBE	VF-1MS	VF-5MS	DB-35MS UI	CP-Sil 43 CB	DB-200	DB-23	HP-INNOWax	
	DB & HP-1	DB & HP-5	DB & VF-35MS	VF-1701 MS	VF-200MS	VF-23 MS	VF-WAX MS	
	CP-Sil 5 CB	CP-Sil 8 CB	DB & HP-35	DB-1701	DB-210		CP-WAX 57 CB	
	Ultra 1	Ultra 2	DB & VF-17MS	CP-Sil 19 CB	DX-4		DB & HP-FFAP	
	DB-1HT	VF-DA	DB-17	HP-Blood Alcohol			DB-WAX FF	
	DB-2887	DB-5.625	HP-50+	DB-ALC2			CP-FFAP CB	
	DB-Petro/PONA	DB & VF-5HT	DB-17HT	DX-1			CP-WAX 58 FFAP CB	
	CP-Sil PONA CB	CP-Sil PAH CB	DB-608				CP-WAX 52 CB	
	DB-HT SimDis	Select Biodiesel	DB-TPH				CP-WAX 51	
	CP-SimDis	SE-54	DB-502.2				CP-Carbowax 400	
	CP-Volamine		HP-VOC				Carbowax 20M	
	Select Mineral Oil		DB-VRX				HP-20M	
	HP-101		DB-624				CAM	
	SE-30		VF-624MS					
			CP-Select 624 CB					
			DB-1301					
			VF-1301MS					
			CP-Sil 13 CB					

Agilent J&W has over 50 different stationary phase offerings

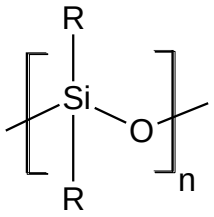
WAX Columns – Structure and Uses

- Polymer Structure is Polyethylene Glycol (PEG)
- Represents the far end of the scale in terms of polarity
- Used primarily to analyze polar compounds
  - Alcohols
  - Glycols
  - FAME's
  - Food and Flavors
  - Petro – Aromatics Analysis / Xylenes



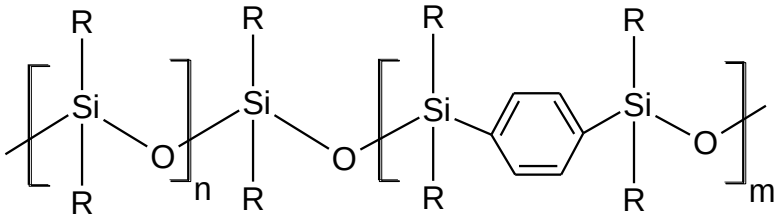
Structure of Polyethylene Glycol (PEG)

Stationary Phase Polymers

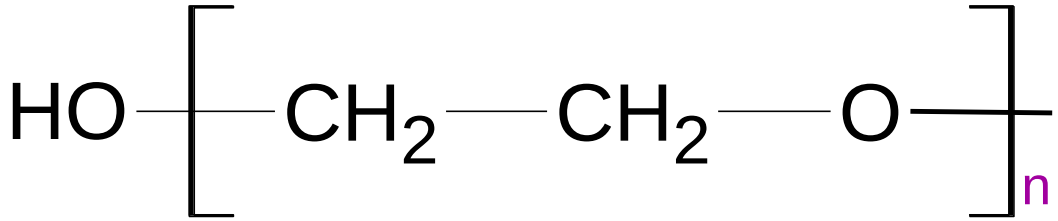


Siloxane

R=methyl, phenyl, cyanopropyl, trifluoropropyl



Siarylene backbone



Polyethylene Glycol

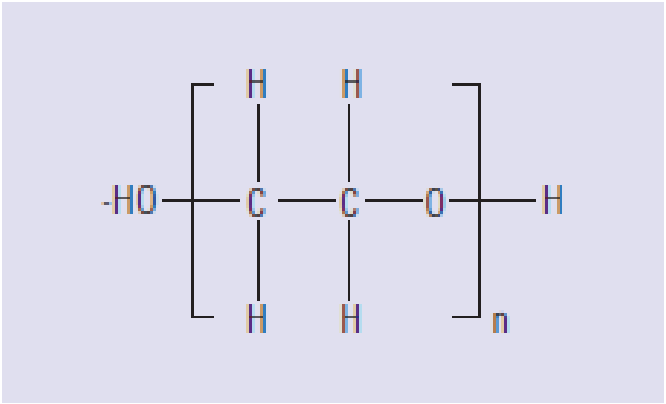
WAX

Most common:

R = 100% methyl:	DB-1
R = 5% phenyl:	DB-5
R = 6% Cyanolpropylphenyl:	DB-624

WAX Columns

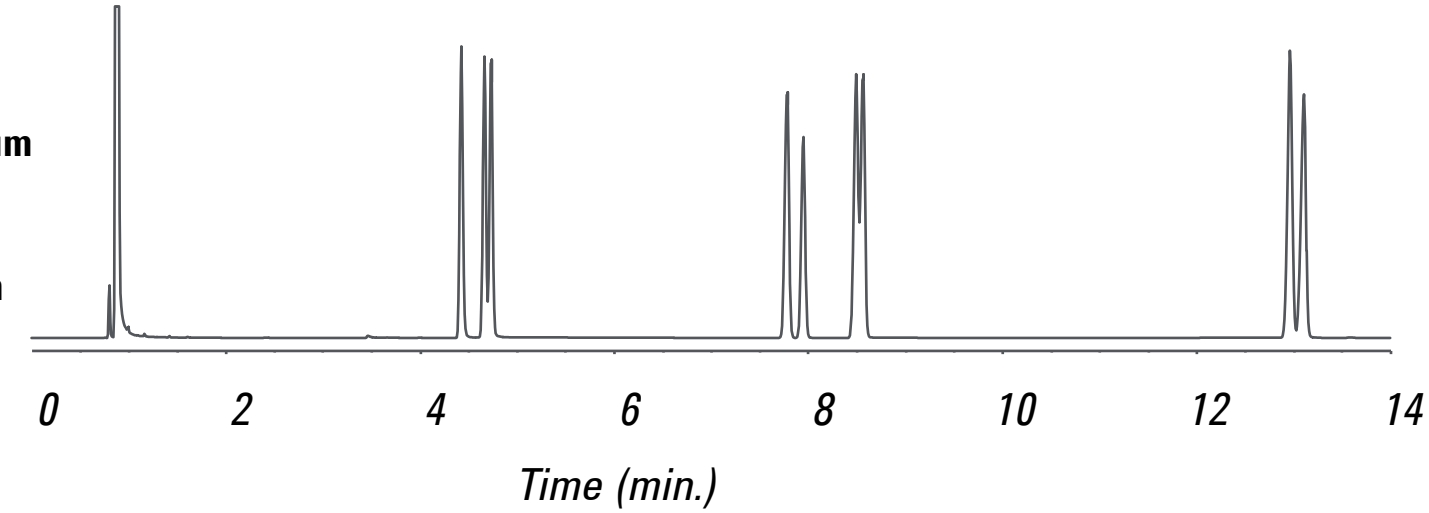
- Some limitations compared to non-polar columns
  - When selecting a column typically choose the most non-polar phase you can
    - Non-Polar columns are generally more stable (look at column temperature limits as an indicator)
  - WAX columns have typical Maximum Operating Temperatures of 250°C isothermal and 260°C programmed
    - Decreased Thermal Stability compared to non-polar phases can result in:
      - Retention Times Shifting
      - Increased Column Bleed
      - Changes in column selectivity
  - More vulnerable to oxygen
  - Limits the max oven temp for dual column instruments



Structure of Polyethylene Glycol (PEG)

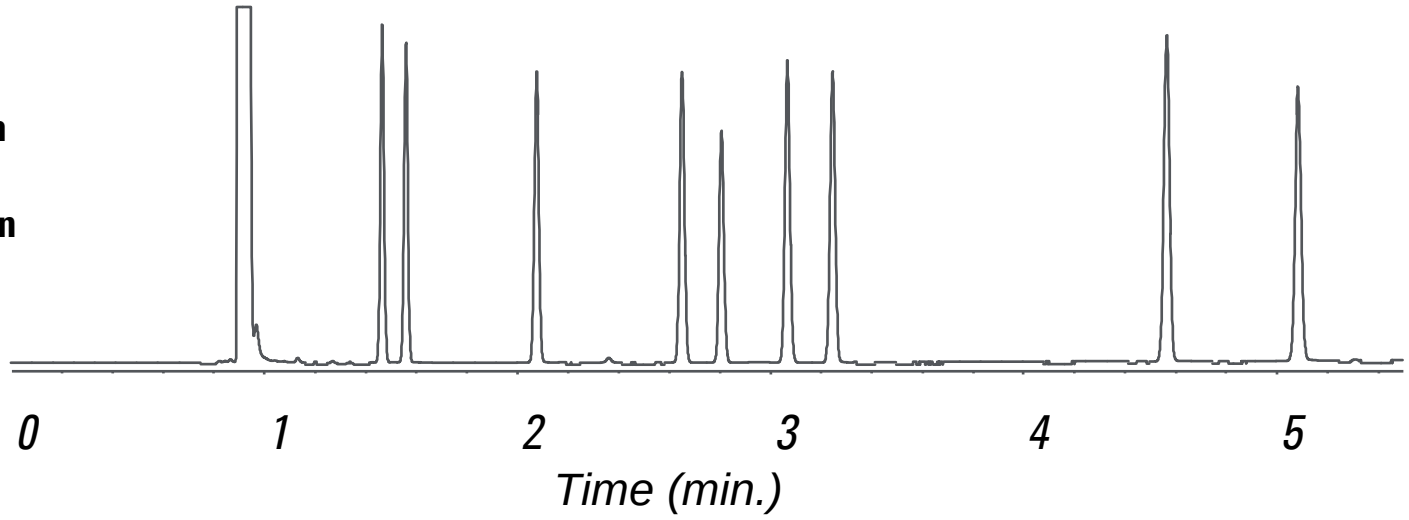
The power of Selectivity: Using the Right Phase

DB-1
15m x 0.32mm, 0.25µm
Oven:
40°C for 2 min
40-120°C at 5°C/min



"Like dissolves like"

DB-Wax
15m, 0.32mm, 0.25µm
Oven:
80-190°C at 20°C/min



The New Wax Columns

HP-INNOWax	New part numbers, same selectivity
CP-Wax 52 CB	New part numbers, same selectivity
DB-WAX Ultra Inert	Released early 2016
DB-FATWAX Ultra Inert	FAME’s and Free Acids
DB-HeavyWAX	The latest and the greatest; Highest temperature wax column available

HP-INNOWax and CP-Wax 52 CB

implemented Fall of 2016:

Improved inertness and peak shapes for diols, amines, acids and ethyl maltol

Exceptional column-to-column reproducibility

Improved inertness longevity and

Extended inertness lifetime that withstands repeated cycling to the upper temperature limits of the column

Simply add the letter “i” to end of the original part #’s (“inert” or “improved”)

Agilent CrossLab
From Insight to Outcome

DB-WAX Ultra Inert

Better peak shape and reproducibility for challenging polar compounds

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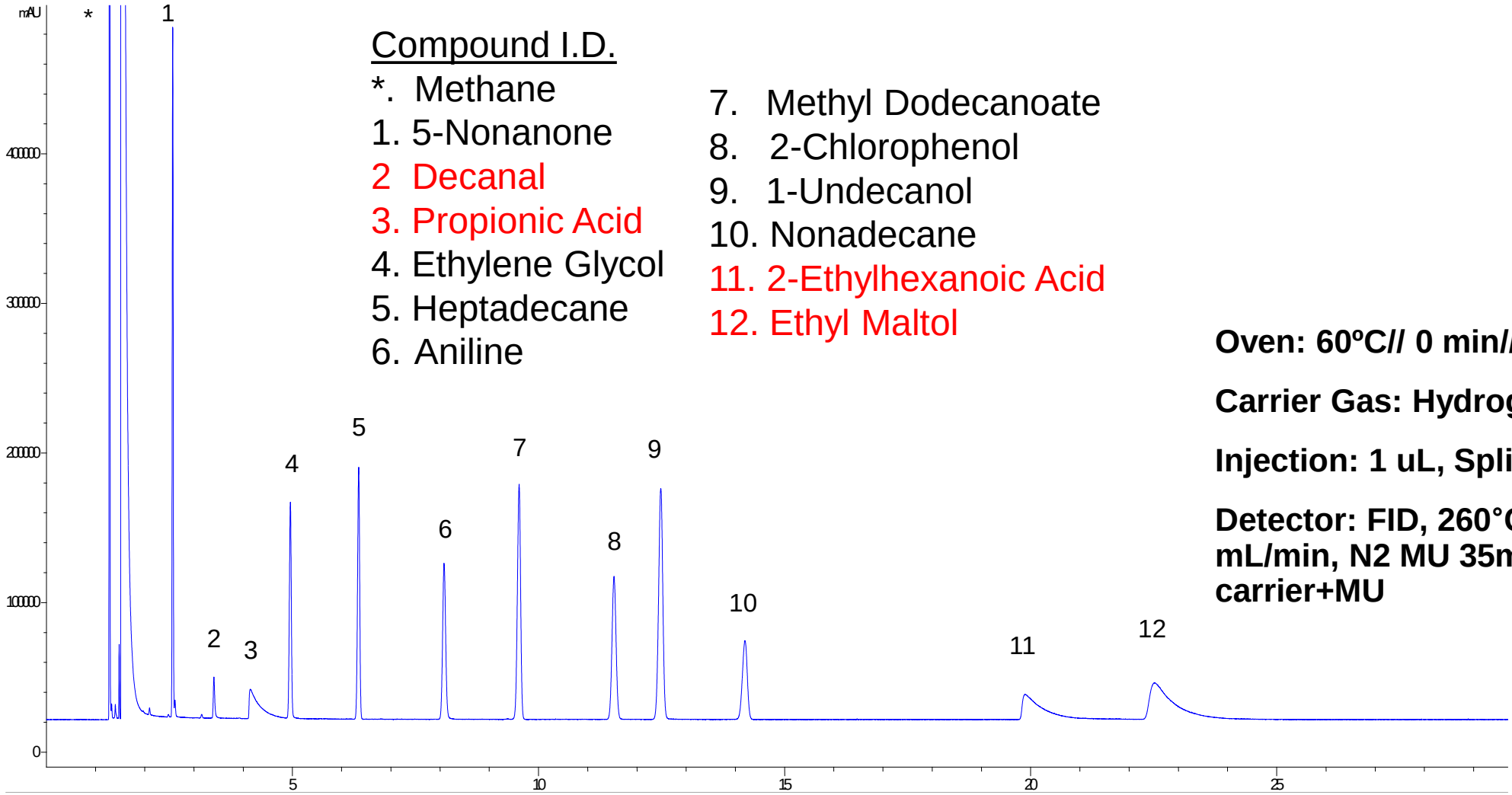
Modified DB-WAX UI mix on Traditional WAX
30 m x 0.25 mm I.D., 0.25 um film



Compound I.D.

*. Methane
1. 5-Nonanone
2 Decanal
3. Propionic Acid
4. Ethylene Glycol
5. Heptadecane
6. Aniline
7. Methyl Dodecanoate
8. 2-Chlorophenol
9. 1-Undecanol
10. Nonadecane
11. 2-Ethylhexanoic Acid
12. Ethyl Maltol

Oven: 60ºC// 0 min//3º/min//200ºC//0 min

Carrier Gas: Hydrogen, @ 42 cm/s

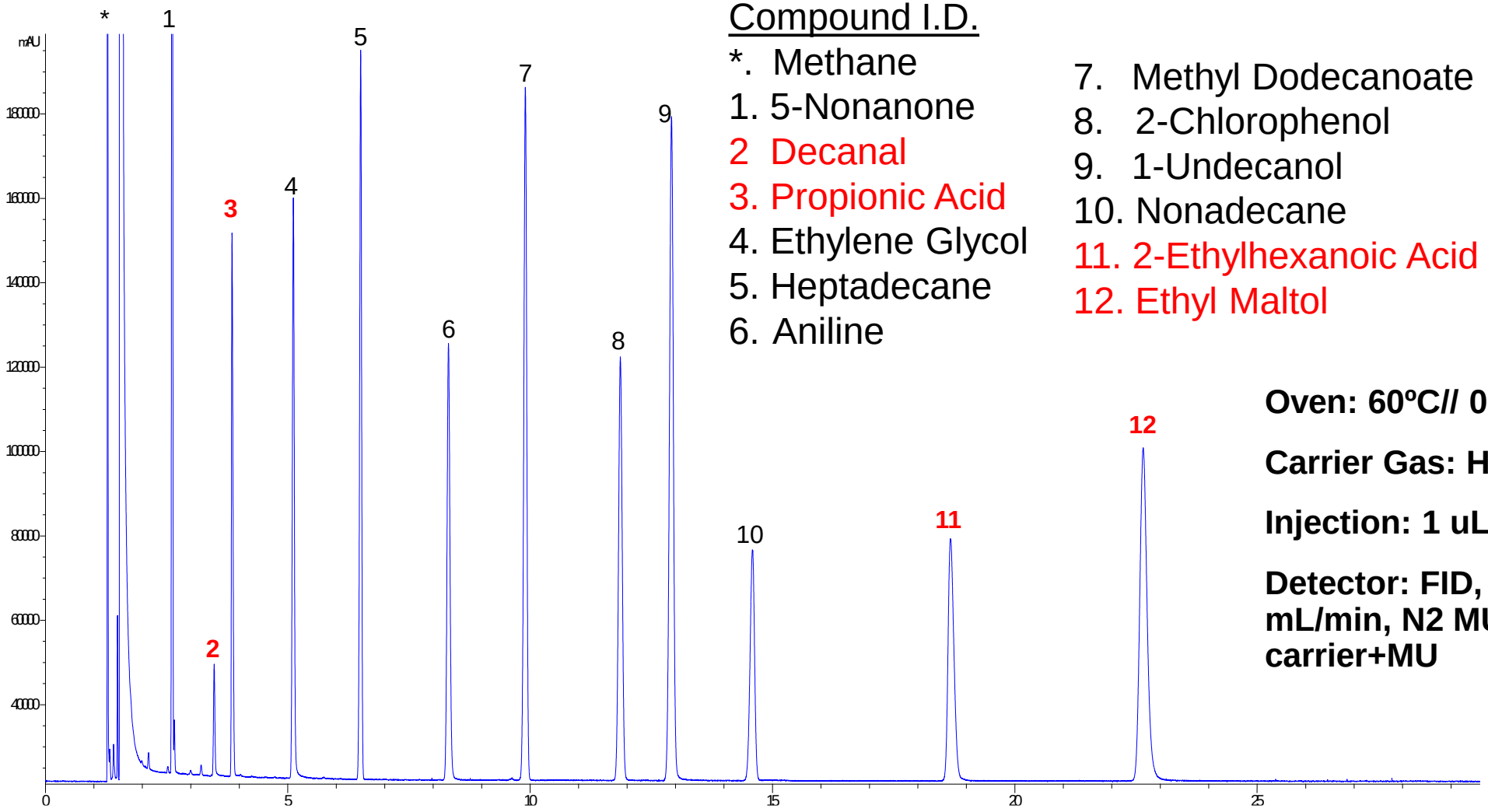
Injection: 1 uL, Split @ 250°C

Detector: FID, 260°C, H2 30 ml/min, Air 300 mL/min, N2 MU 35mL/min constant carrier+MU

Modified DB-WAX UI mix on DB-WAX UI, 122-7032UI 30 m x 0.25 mm I.D., 0.25 um film

Column Serial number: USF081192M

***Every column is tested individually**



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10. Nonadecane
11. 2-Ethylhexanoic Acid
12. Ethyl Maltol

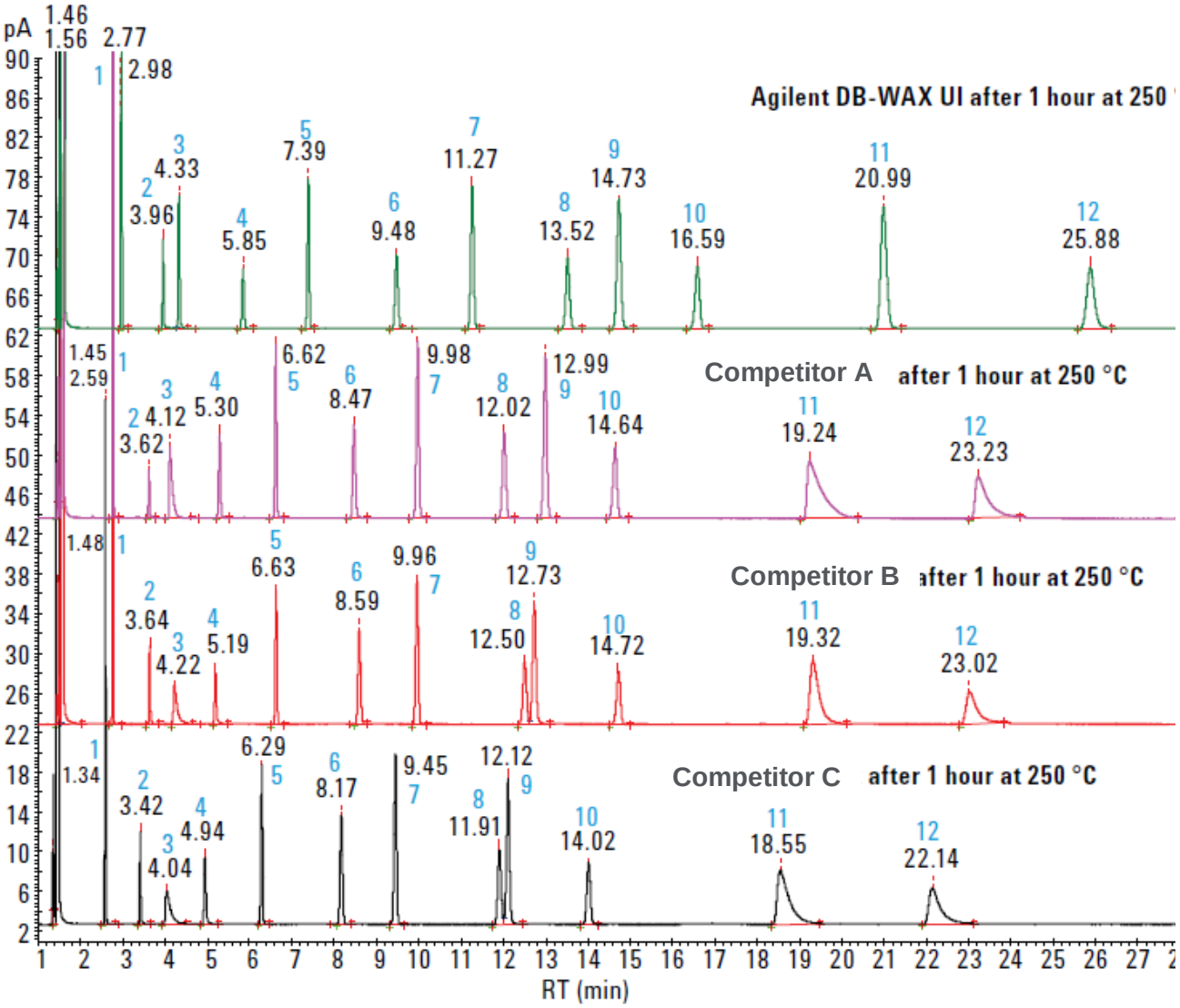
Oven: 60ºC// 0 min//3º/min//200ºC//0 min

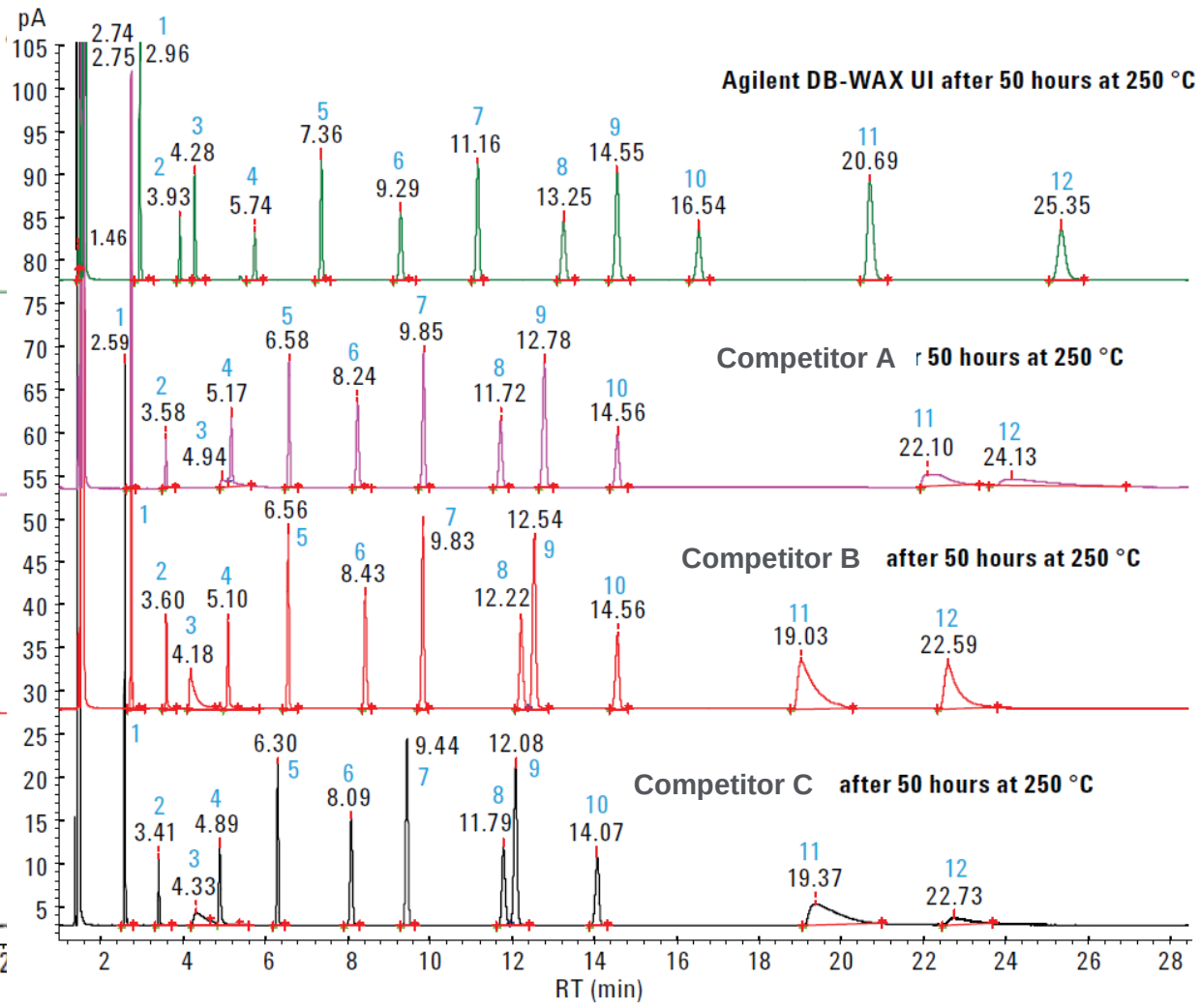
Carrier Gas: Hydrogen, @ 42 cm/s

Injection: 1 uL, Split @ 250°C

Detector: FID, 260°C, H2 30 ml/min, Air 300 mL/min, N2 MU 35mL/min constant carrier+MU

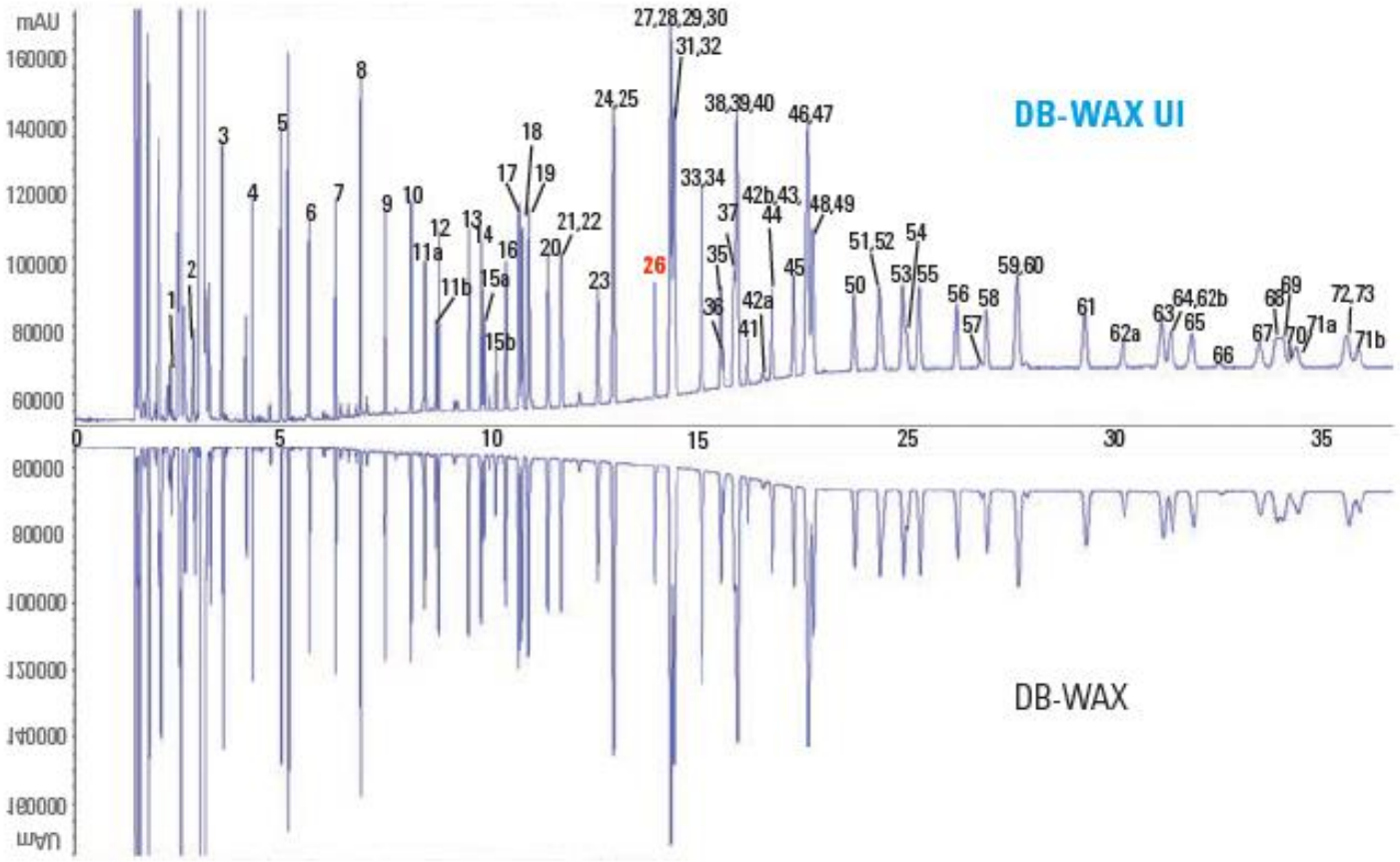
DB-WAX UI After 50 Hours at 250 C





Same Selectivity as Standard DB-WAX

Extended FAMEs mix: 72 compounds, retention time locked for Methyl Stearate (nC18:0)

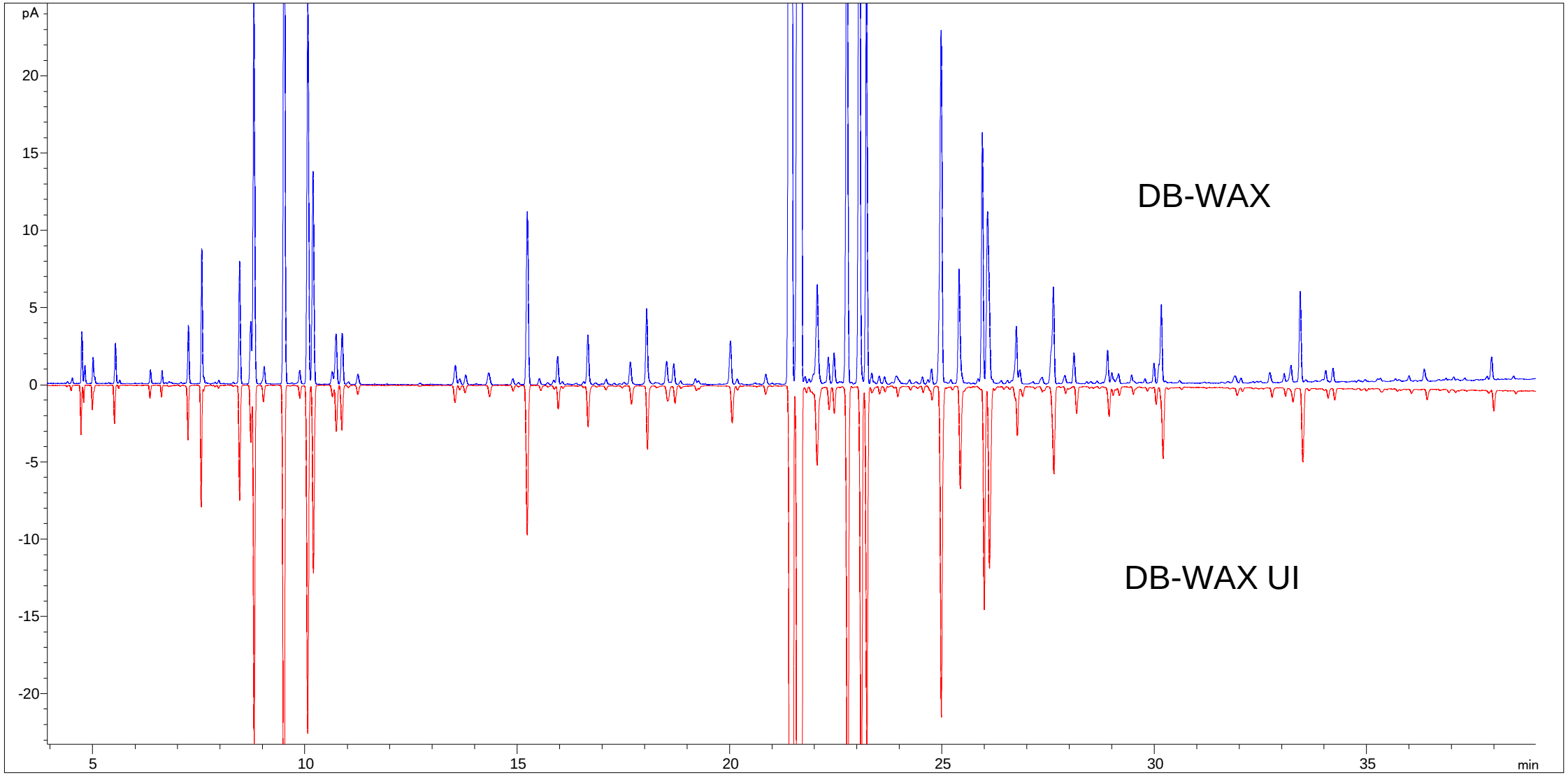


DB-WAX Ultra Inert has the same selectivity as DB-WAX as demonstrated with this separation of 72 FAME compounds.

Test conditions:

Column:	DB-WAX UI 30 m x 0.25 mm id, 0.25 µm (p/n 122-7032UI)
Inlet:	Split/splitless @ 250 °C (p/n G3970A), split ratio 50:1
Injection volume:	1 µL
Carrier gas:	Hydrogen
Head pressure:	Methyl Stearate is retention time locked at 14.000 min. Carrier gas pressure set to constant pressure mode, velocity approximately 36 cm/s at 50 °C and 53 kPa
Oven program:	50 °C, 1 min, 25 °C/min to 200 °C, 3 min to 230 °C, 18 min hold
Detector:	FID @ 280 °C, H_2 40 mL/min, Air: 450 mL/min, He make-up gas: 30 mL/min
Flow path supplies:	• Ultra Inert Low Pressure drop liner (p/n 5190-2295) • Ultra Inert gold seal (p/n 5190-6144) • Self Tightening Column Nut (p/n 5190-6194) • Graphite-vespel ferrules (p/n 5181-3323) 10 pk • Long-life septa (p/n 5183-4761)

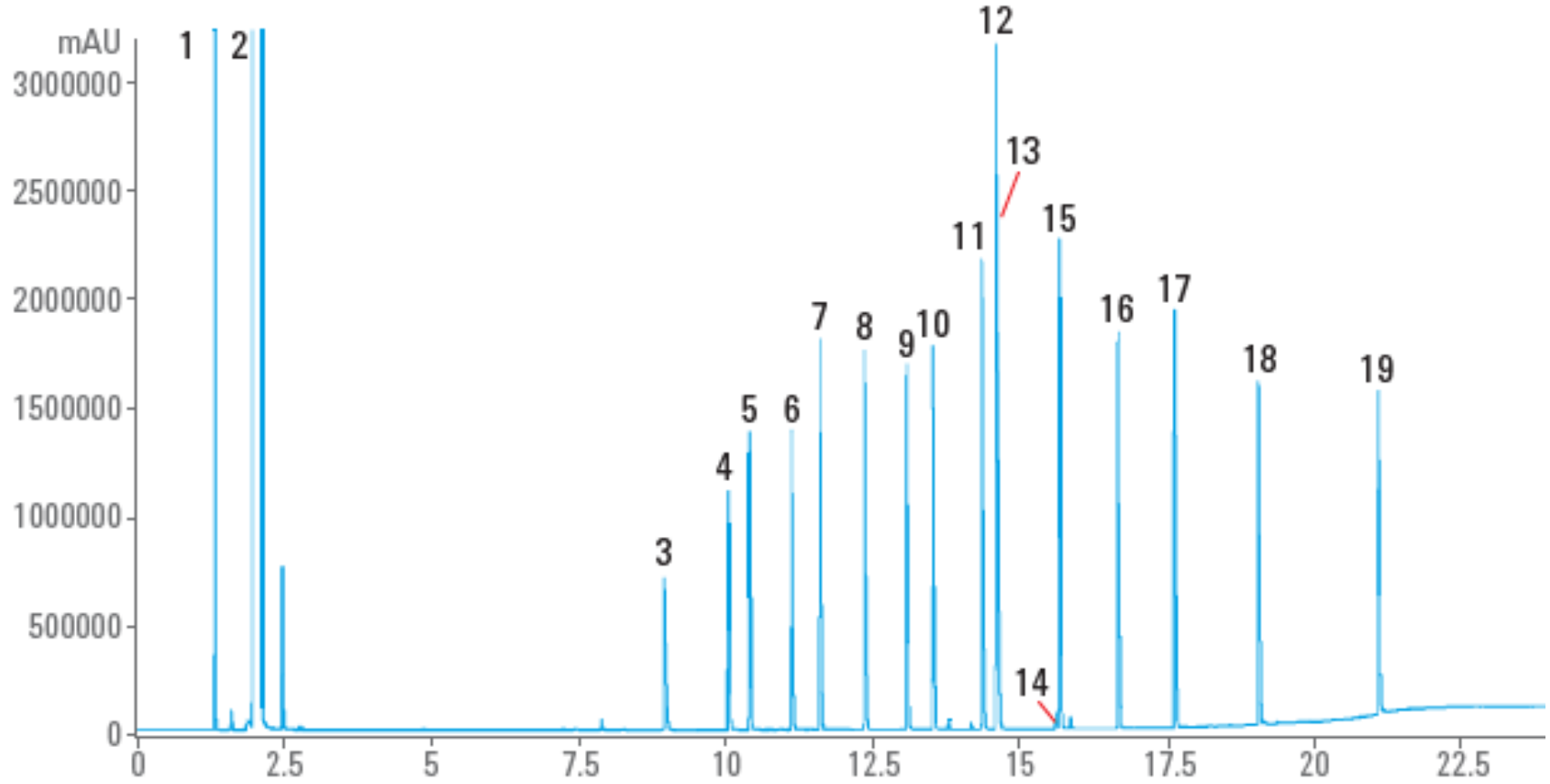
GC/FID Chromatogram of Lavender oil sample (5991-6635EN)



DB-WAX Ultra Inert - Free Acids

Great alternative to FFAP (acid modified) column for free acids

DB-WAX Ultra Inert GC column
30 m x 0.25 mm id, 0.25 µm (p/n 122-7032UI)



Peak identification:

1. Methane
2. Acetone (solvent)
3. Acetic Acid
4. Propionic Acid
5. Isobutyric Acid
6. Butyric Acid
7. Isovaleric Acid
8. Valeric Acid
9. 4-Methylvaleric Acid
10. Hexanoic Acid
11. 4-Methylhexanoic Acid
12. 2-Ethylhexanoic Acid
13. Heptanoic Acid
14. Pyruvic Acid
15. Octanoic Acid
16. Nonanoic Acid
17. Decanoic Acid
18. Undecylenic Acid
19. Myristic Acid (Tetradecanoic)

Test conditions:

Carrier gas:	Hydrogen @ 41.37 cm/s
Injection volume:	1 µL
Inlet:	Split @ 250 °C
Oven program:	130 °C Isothermal
Detector:	FID @ 260 °C, H_2 30 mL/min, Air 300 mL/min, N_2 make-up gas 35 mL/min

DB-WAX Ultra Inert – Available dimensions

Ultra Inert DB-WAX GC columns

ID (mm)	Length (m)	Film (µm)	Part No.
DB-WAX Ultra Inert			
0.18	20	0.18	121-7022UI
		0.30	121-7023UI
0.20	25	0.20	128-7022UI
0.25	15	0.25	122-7012UI
	30	0.25	122-7032UI
		0.50	122-7033UI
	60	0.25	122-7062UI
		0.50	122-7063UI
0.32	15	0.25	123-7012UI
	30	0.25	123-7032UI
		0.50	123-7033UI
	60	0.25	123-7062UI
		0.50	123-7063UI
0.53	15	1.00	125-7012UI
	30	0.25	125-7031UI
		0.50	125-7037UI
		1.00	125-7032UI
	60	1.00	125-7062UI

```
121-7022-INT          JW  DB-WAX 20m, 0.18mm, 0.18um, Intuvo
121-7022UI-INT        JW  DB-WAX UI 20m, 0.18mm, 0.18um, Intuvo
122-7012UI-INT        JW  DB-WAX UI, 15m, 0.25mm,  0.25um, Intuvo
122-7032UI-INT        JW  DB-WAX UI 30m, 0.25mm, 0.25um,Intuvo
122-7033UI-INT        JW  DB-WAX UI 30m, 0.25mm, 0.50um,Intuvo
122-7062UI-INT        JW  DB-WAX UI 60m, 0.25mm, 0.25um,Intuvo
123-7032UI-INT        JW  DB-WAX UI 30m, 0.32mm, 0.25um,Intuvo
123-7033UI-INT        JW  DB-WAX UI 30m, 0.32mm, 0.50um,Intuvo
123-7063UI-INT        JW  DB-WAX UI 60m, 0.32mm, 0.50um, Intuvo
```

Agilent CrossLab
From Insight to Outcome

DB-FATWAX Ultra Inert

For the analysis of:

- FAMEs including Omega 3 and Omega 6
- Small organic acids and free fatty acids
- Applications in fish oil and animal fat analysis

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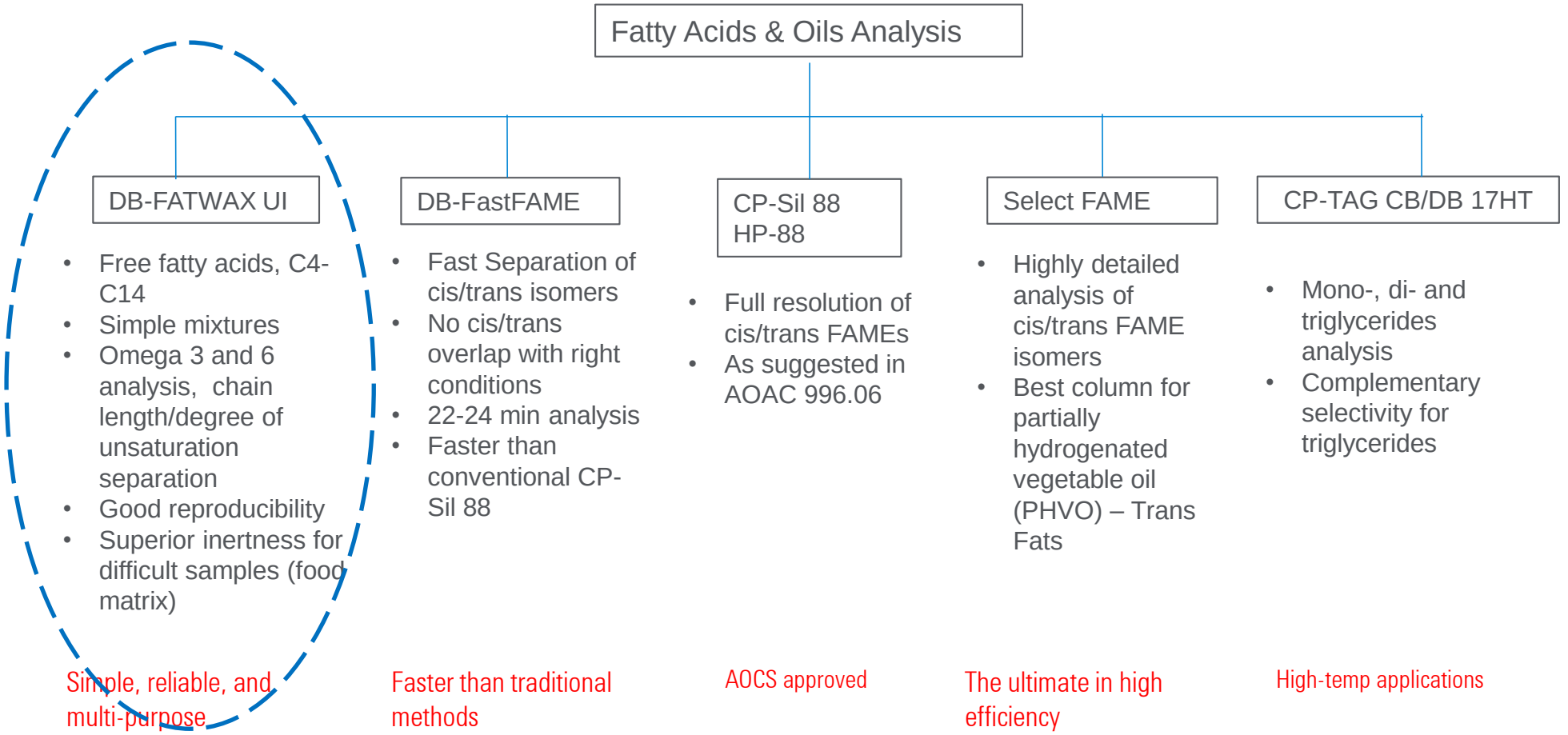
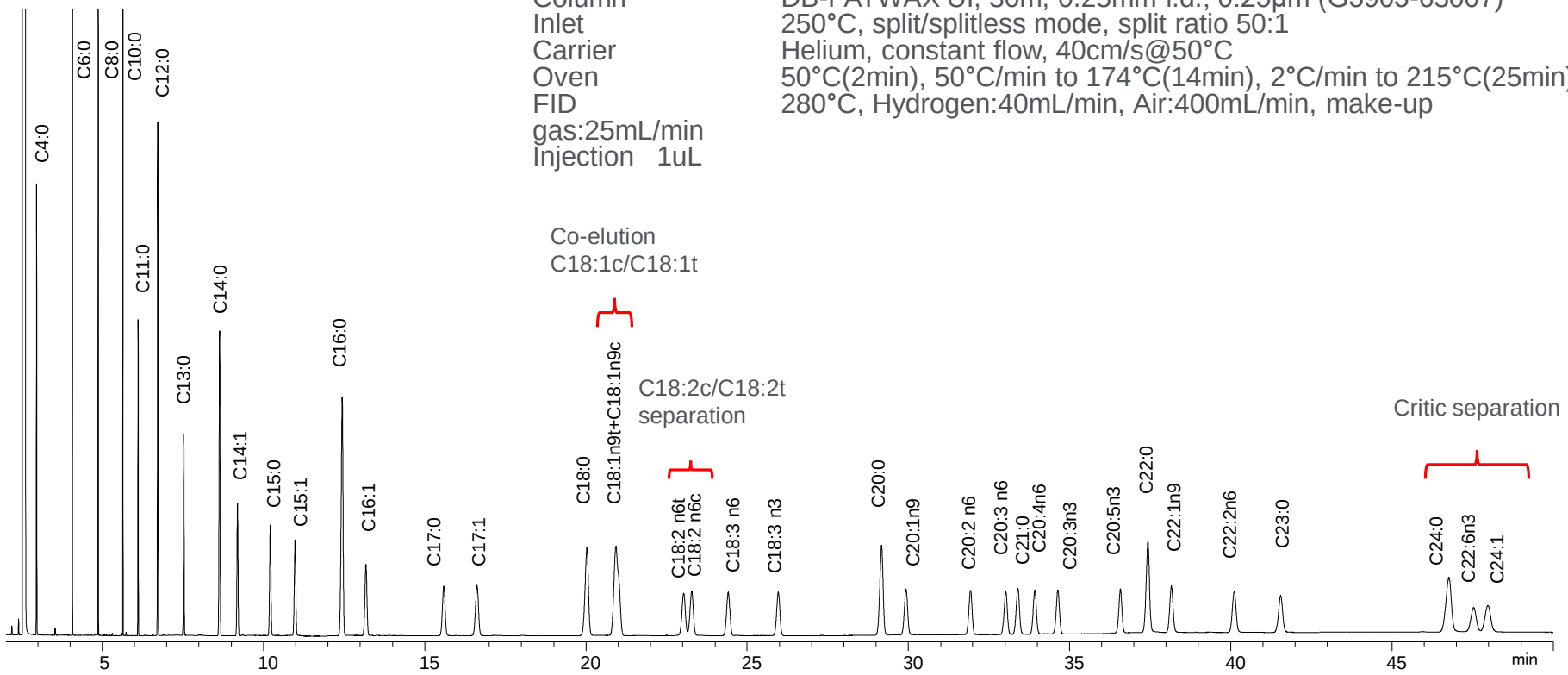
Agilent Portfolio for Fatty Acids, FAMEs & Oils Analysis - Column Positioning -



37-FAME mix analysis with DB-FATWAX Ultra Inert

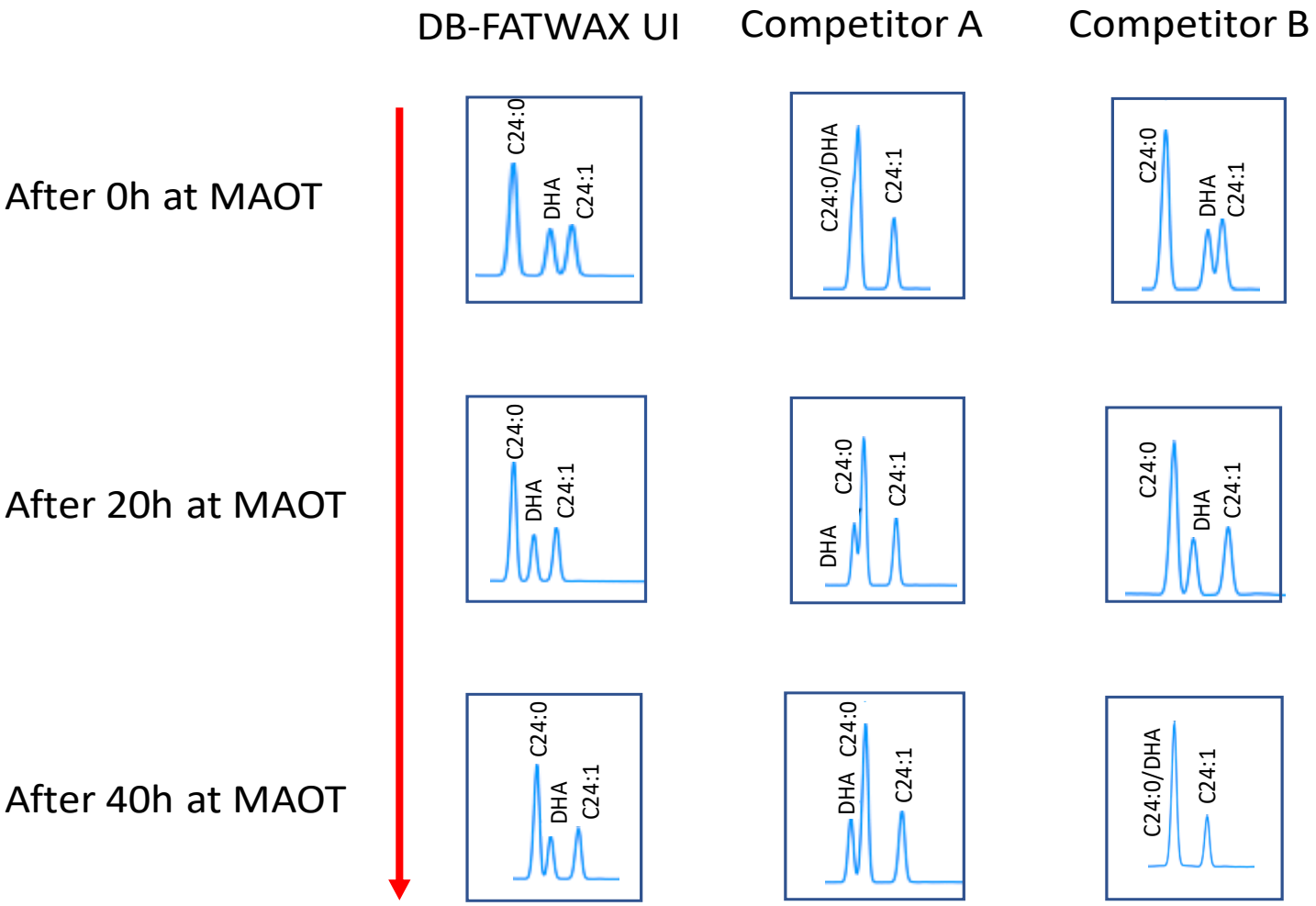
- Best option for saturated and polyunsaturated FAMEs, including Omega 3 and Omega 6
- WAX-type selectivity not ideal for cis/trans separation

GC System	Agilent 7890B
Column	DB-FATWAX UI, 30m, 0.25mm i.d., 0.25µm (G3903-63007)
Inlet	250°C, split/splitless mode, split ratio 50:1
Carrier	Helium, constant flow, 40cm/s@50°C
Oven	50°C(2min), 50°C/min to 174°C(14min), 2°C/min to 215°C(25min)
FID	280°C, Hydrogen:40mL/min, Air:400mL/min, make-up
gas:25mL/min	
Injection	1uL



Comparison study of the C24:0/C22:6n3 (DHA) critical pair

- DB-FATWAX UI fully resolves the C24:0/DHA critical pair
- It remains stable with no change in selectivity or retention time even after 40 h at MAOT.

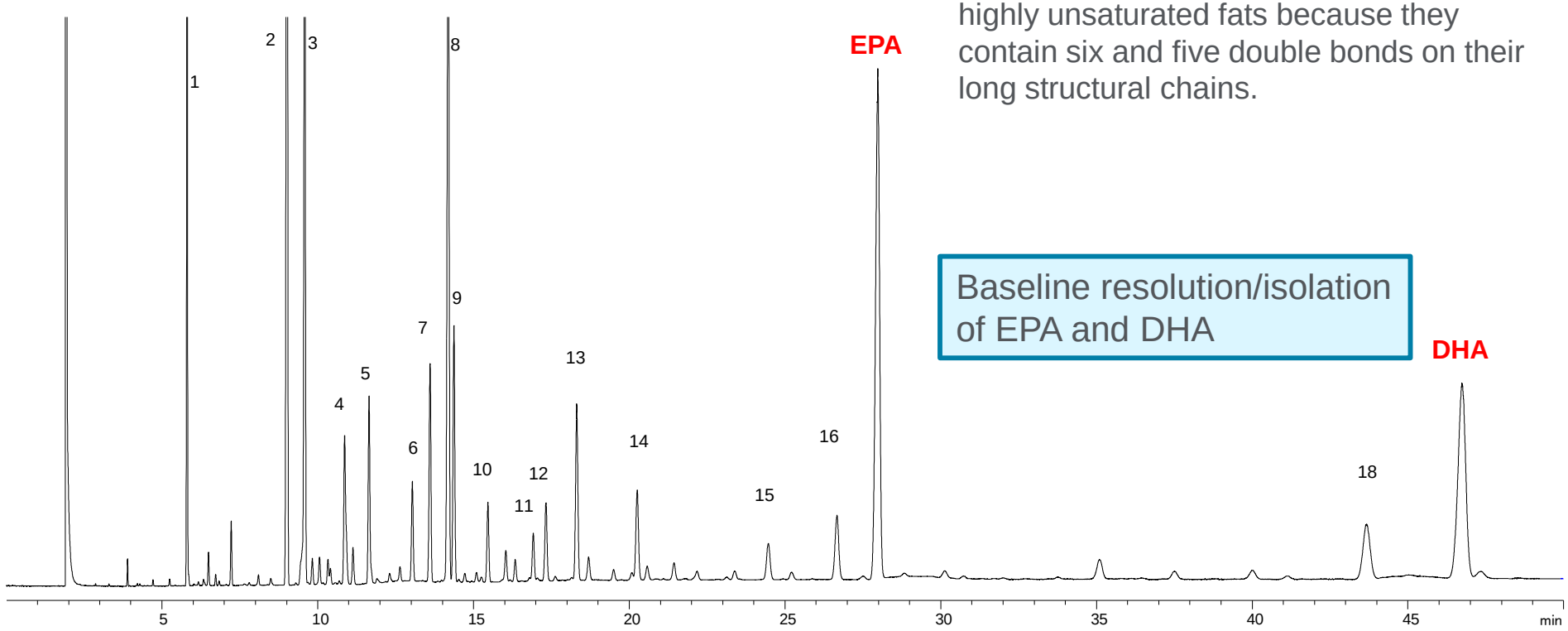


*MAOT: maximum allowable operating temperature

Analysis of real samples

Column	DB-FATWAX UI, **30m, 0.25mm i.d., 0.25µm** (G3903-63007)
Inlet	250°C, split/splitless mode, split ratio 100:1
Carrier	Helium, constant flow, 30cm/s@180°C
Oven	180°C(2min), 2°C/min to 210°C(35min)
FID	280°C, Hydrogen:40mL/min, Air:400mL/min, make-up gas:25mL/min
Injection	1uL
Sample	PUFA No.3 (diluted)

Menhaden Oil analysis following AOAC method



EPA and DHA are eicosapentaenoic acid and docosahexaenoic acid respectively. These fatty acids are omega-3 fats, which are found in cold water fish. **EPA DHA** are highly unsaturated fats because they contain six and five double bonds on their long structural chains.

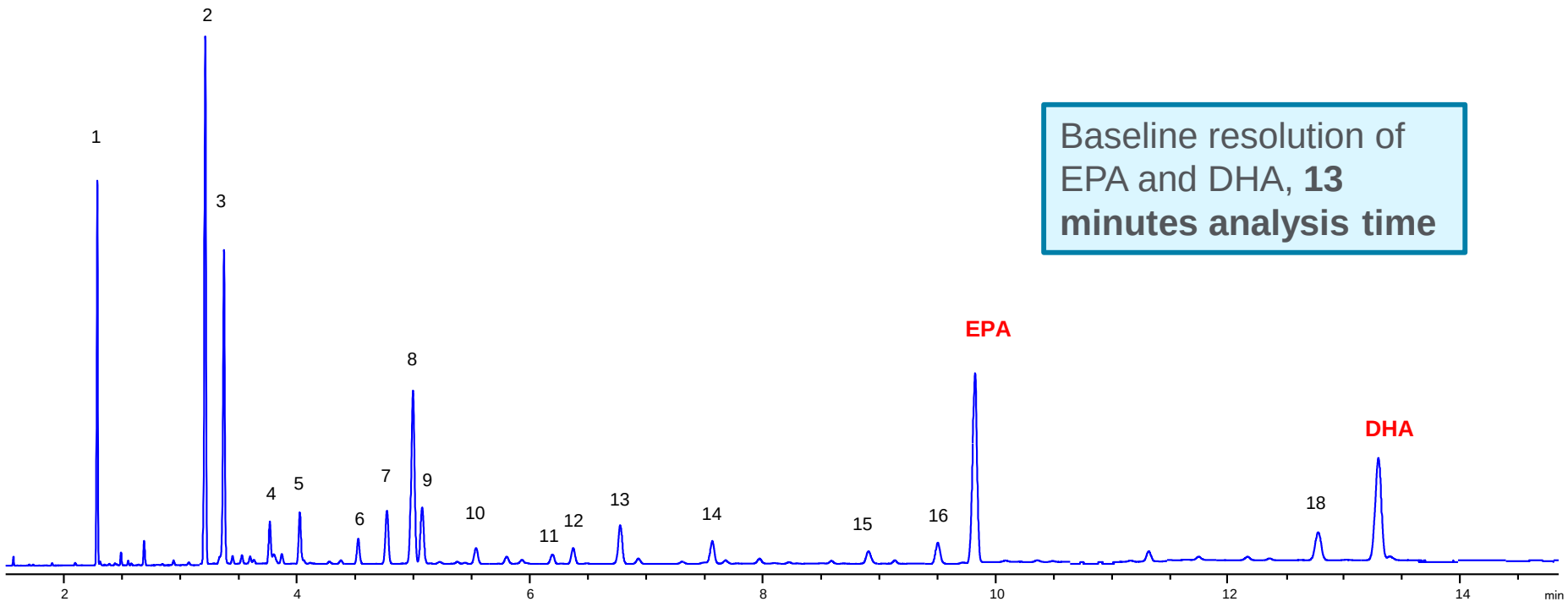
Baseline resolution/isolation of EPA and DHA

1. C14:0
2. C16:0
3. C16:1n7
4. C16:2n4
5. C16:3n4
6. C16:4n1
7. C18:0
8. C18:1n9
9. C18:1n7
10. C18:2n6
11. C18:3n3
12. C18:3n4
13. C18:4n3
14. C20:1n9
15. C20:4n6
16. C20:4n3
17. C20:5n3 (EPA)
18. C22:5n3
19. C22:6n3 (DHA)

Analysis of real samples

Column	DB-FATWAX UI, **20m*0.18mm I.D, 0.18um**
Inlet	250°C, split/splitless mode, split ratio 100:1
Carrier	Hydrogen, constant flow, 2mL/min
Oven	140°C,20°C/min to 190°C(3min), 5°C/min to 220°C(15min)
FID	250°C, Hydrogen:40mL/min, Air:400mL/min, make-up gas:25mL/min
Injection	1uL

Optimize separation of Menhaden Oil using a fast GC method



Baseline resolution of EPA and DHA, **13 minutes analysis time**

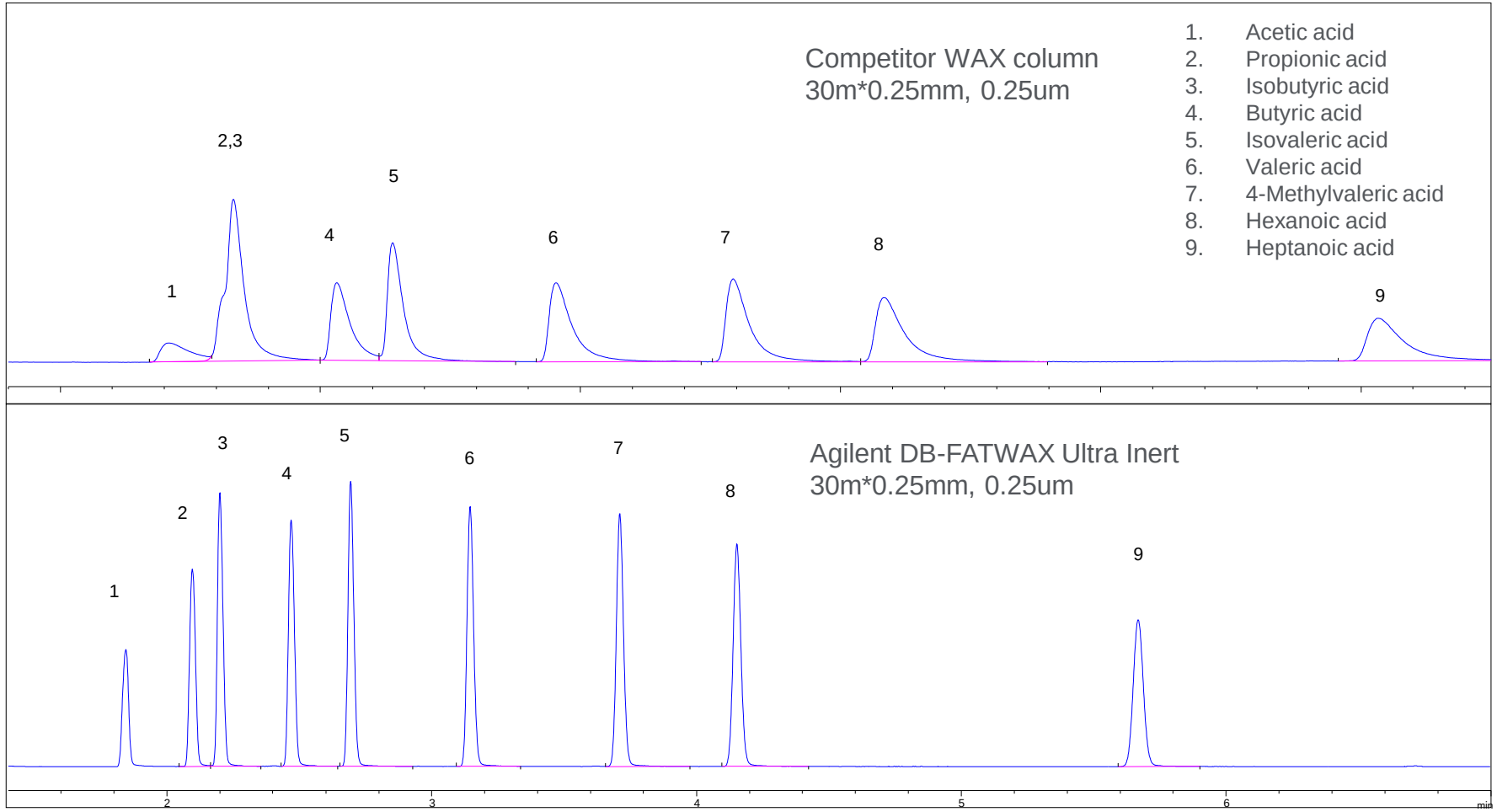
1. C14:0
2. C16:0
3. C16:1n7
4. C16:2n4
5. C16:3n4
6. C16:4n1
7. C18:0
8. C18:1n9
9. C18:1n7
10. C18:2n6
11. C18:3n3
12. C18:3n4
13. C18:4n3
14. C20:1n9
15. C20:4n6
16. C20:4n3
17. C20:5n3
18. C22:5n3
19. C22:6n3

DB-FATWAX UI provides the desire inertness and thermal stability to separate challenge organic acids and fatty acids

- Great need in the food, forensic and cosmetic industries to monitor the content of free and natural occurring fatty acids.
- Analysis of underivatized organic acids and free acids is desirable to eliminate the problems associated with derivatization, extraction, and cleanup procedures
- Volatile organic acids and fatty acids are difficult to quantify accurately by standard WAX columns. These acids often elute as tailing or poorly resolved peaks. For some acids, adsorption can become irreversible.
- Normally:
  - Fatty acids are derivatized to the methyl ester (FAME)
  - Free fatty acids are analyzed using acid-deactivated wax columns (FFAP). The acid modifier, nitroterephthalic acid, however, reduces thermal stability, operating temperature and reacts with humidity, reducing column life time

Separation of Short-chain volatile organic acids in water using a competitor WAX column and DB-FATWAX Ultra Inert

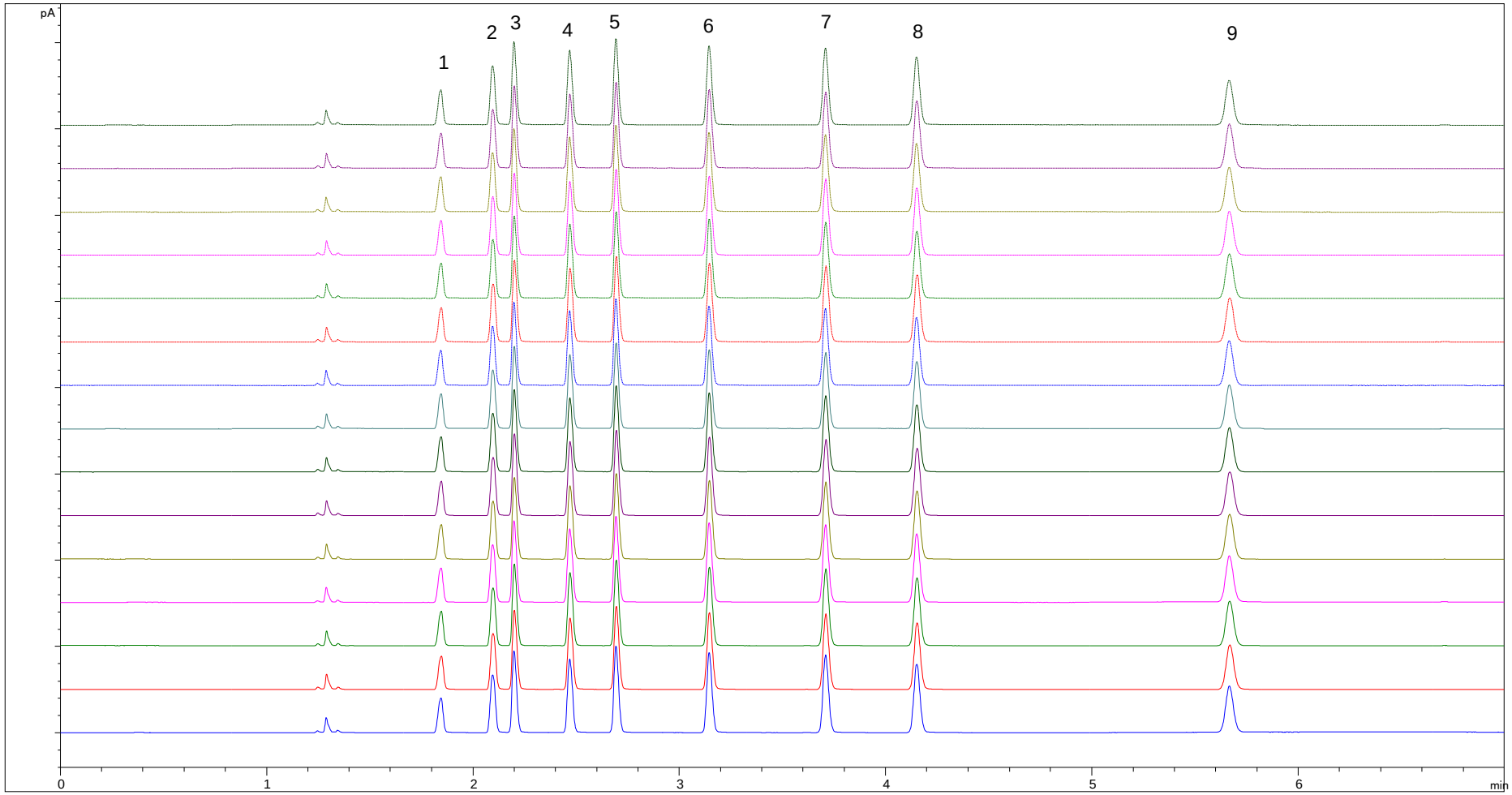
- Standard WAX columns don't have the inertness to separate most organic acids



Proven robustness for aqueous sample – Volatile Organic Acids in Water

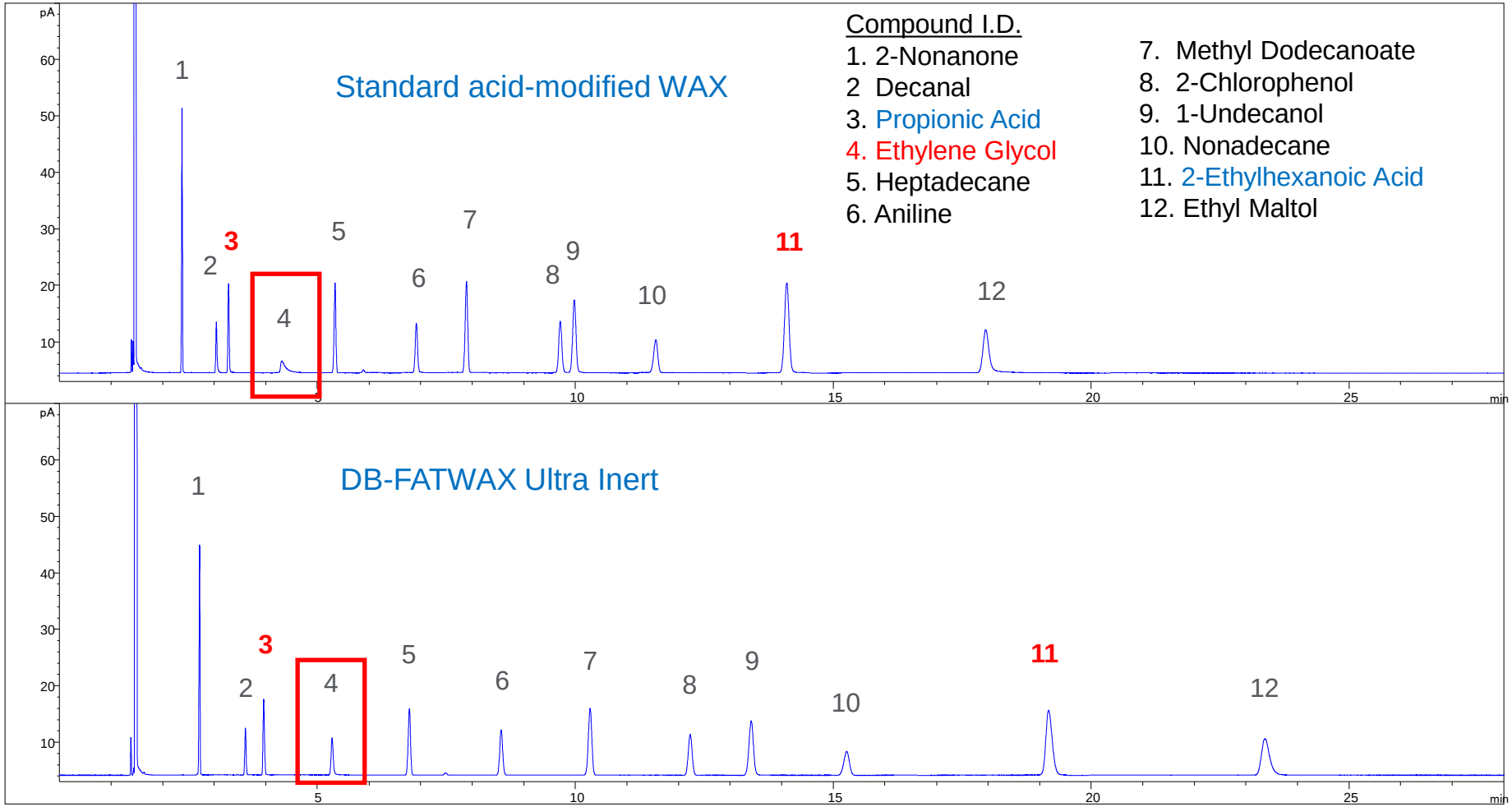
RT RSD = 0.03%
Peak Area RSD = 2.1%

Consistent retention times and peak shapes



Comparison between acid-modified WAX and DB-FATWAX UI after 50h at 250 ºC

DB-FATWAX Ultra Inert shows superior inertness and thermal stability than acid-modified WAX

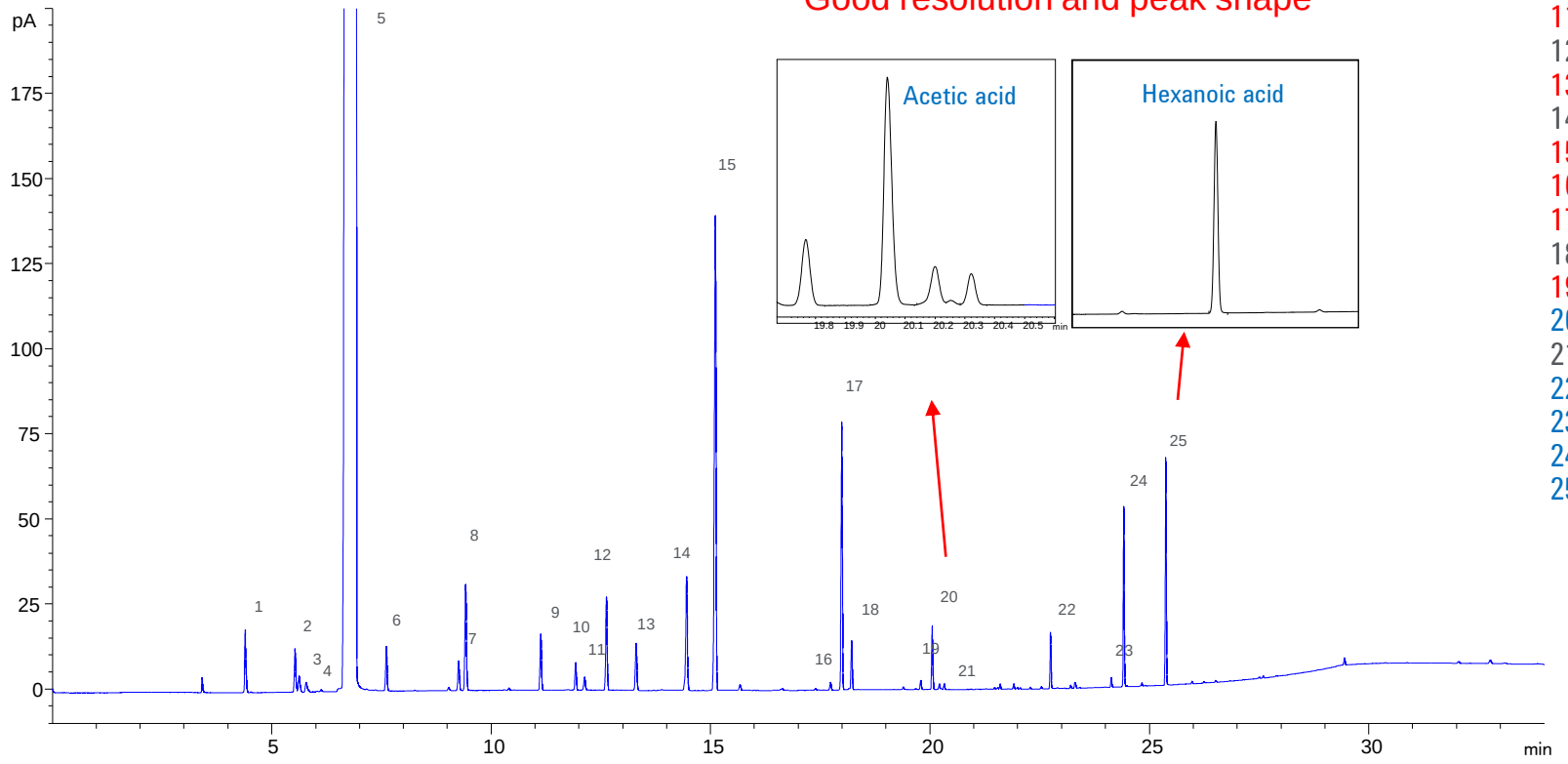


Analysis of real samples

Column	DB-FATWAX UI, 30m*0.25mm I.D, 0.25um
Inlet	250°C, split/splitless mode, split ratio 30:1
Carrier	Nitrogen, constant flow, 0.7mL/min
Oven	40°C (4min), 5°C/min to 100°C(5min), 10°C/min to 230°C(5min)
FID	260°C, Hydrogen:40mL/min, Air:400mL/min, make-up gas:25mL/min
Injection	1uL, 38% (v/v) Chinese distilled liquor sample

FA and naturally ocurring FAEEs analysis in alcoholic beverages

Good resolution and peak shape



1. Acetone
2. Ethyl acetate
3. Acetal
4. Methanol
5. Ethanol
6. 2-Pentanone
7. Ethyl butyrate
8. n-propanol
9. iso-Butanol
10. 2-Pentanol
11. Ethyl valerate
12. 1-Butanol
13. Amyl acetate
14. Isoamyl alcohol
15. Ethyl hexanoate
16. Ethyl heptanoate
17. Ethyl lactate
18. 1-Hexanol
19. Ethyl octanoate
20. Acetic acid
21. Furfural
22. Butyric acid
23. Valeric acid
24. 2-Ethylbutyric acid
25. Hexanoic acid

Red: FAEE
Blue: FA

DB-FATWAX Ultra Inert – Available dimensions

G3903-63007	JW	DB-FATWAX UI	20m,	0.18mm,	0.18um	
G3903-63008	JW	DB-FATWAX UI	30m,	0.25mm,	0.25um	
G3903-63009	JW	DB-FATWAX UI	30m,	0.32mm,	0.25um	
G3909-63002	JW	DB-FATWAX UI	20m,	0.18mm,	0.18um,	Intuvo
G3909-63003	JW	DB-FATWAX UI	30m,	0.25mm,	0.25um,	Intuvo
G3909-63004	JW	DB-FATWAX UI	30m,	0.32mm,	0.25um,	Intuvo

Agilent CrossLab
From Insight to Outcome

DB-HeavyWAX

For the analysis of:

- High temp applications for polar analyites
- Essential oils and flavor & fragrances
- Other high temp. requirements (GCxGC)

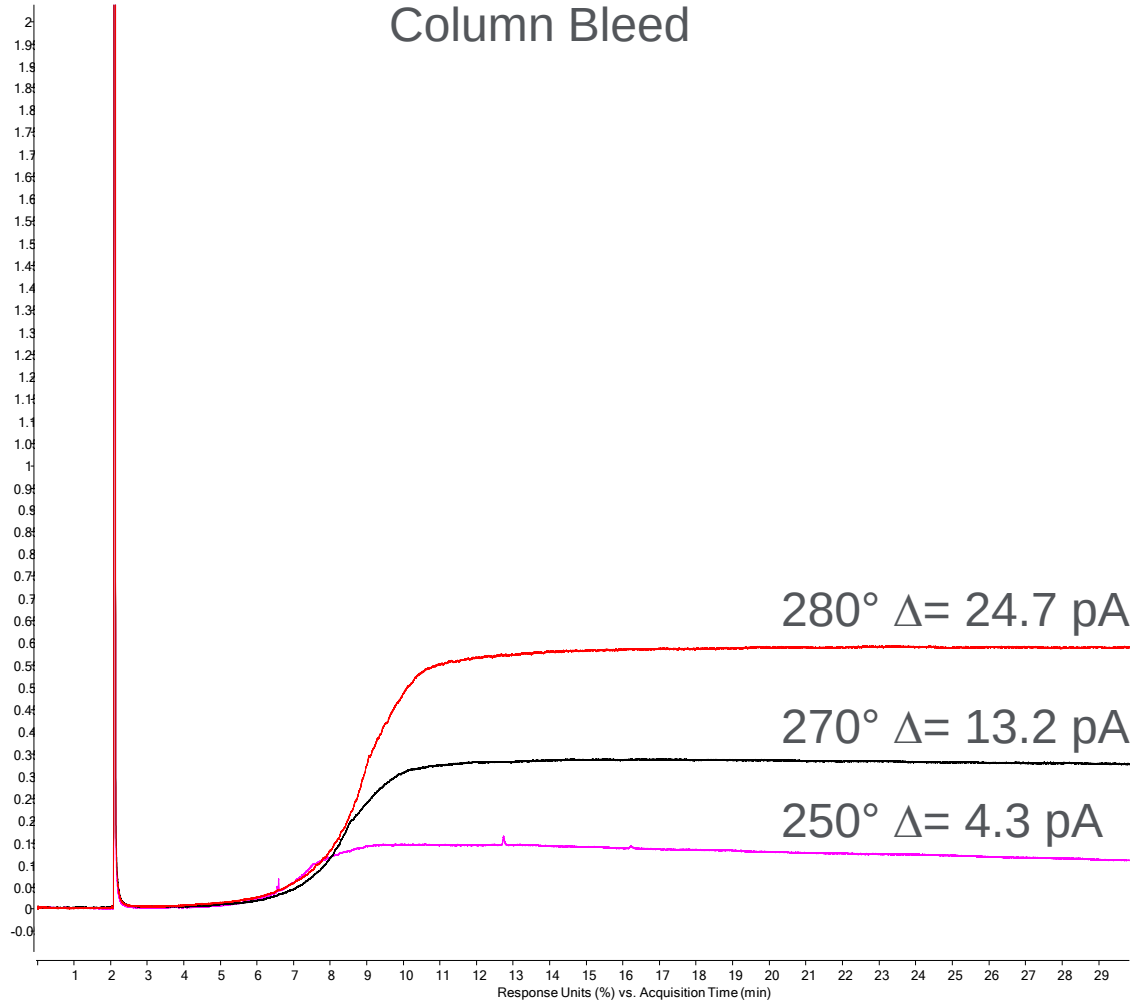
Agilent

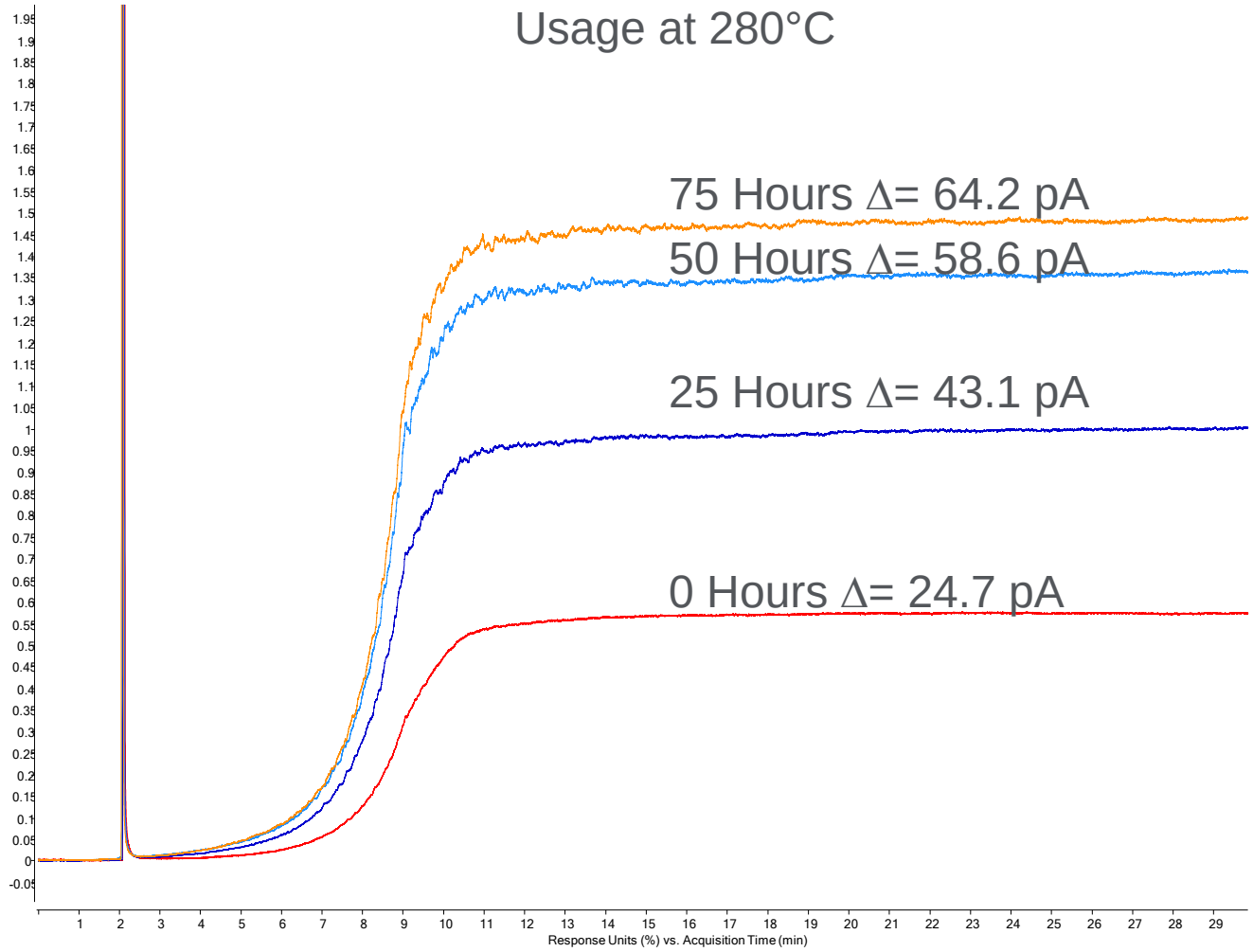
Introducing DB-HeavyWAX

- WAX column with increased MAOT compared to existing columns on the market
  - 280°C isothermal and 290°C programmed
- Provides increased thermal stability
- Has a low bleed level
- Advantages

General GC	GC/MS	GC×GC
• Shorter runtimes when late eluters are present • Better S/N ratio, improved detection • Better thermal stability • Faster column bake-out	• Desire for “zero” bleed • Avoid MS contamination by column bleed for longer system uptime and column lifetime • Improve detection limit	• Extended scope of compounds • Can raise / elevate oven temp when paired with a non-polar column in GC x GC

Traditional WAX and Going Above the MAOT

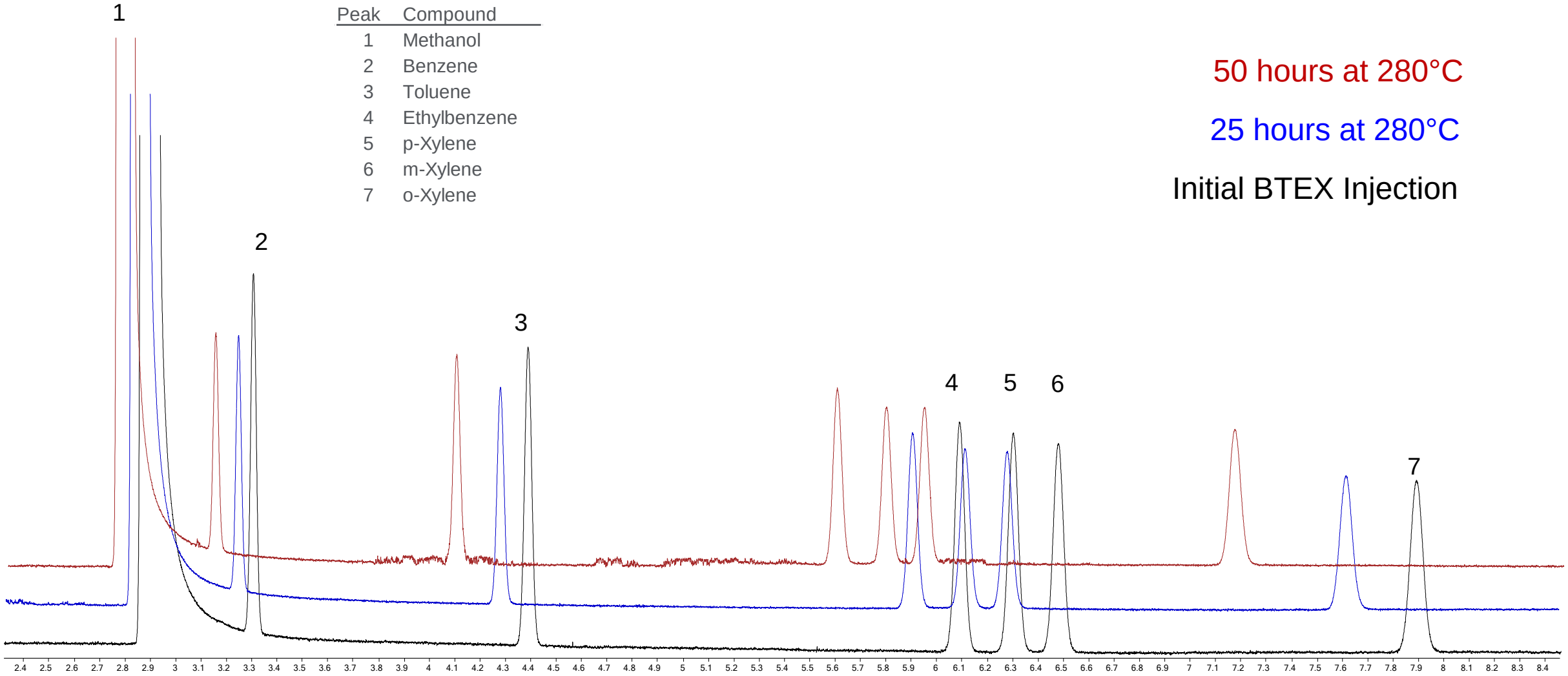




Thermal Stability and Retention Time Shifting

Commercially available traditional WAX column

Peak	Compound
1	Methanol
2	Benzene
3	Toluene
4	Ethylbenzene
5	p-Xylene
6	m-Xylene
7	o-Xylene



50 hours at 280°C

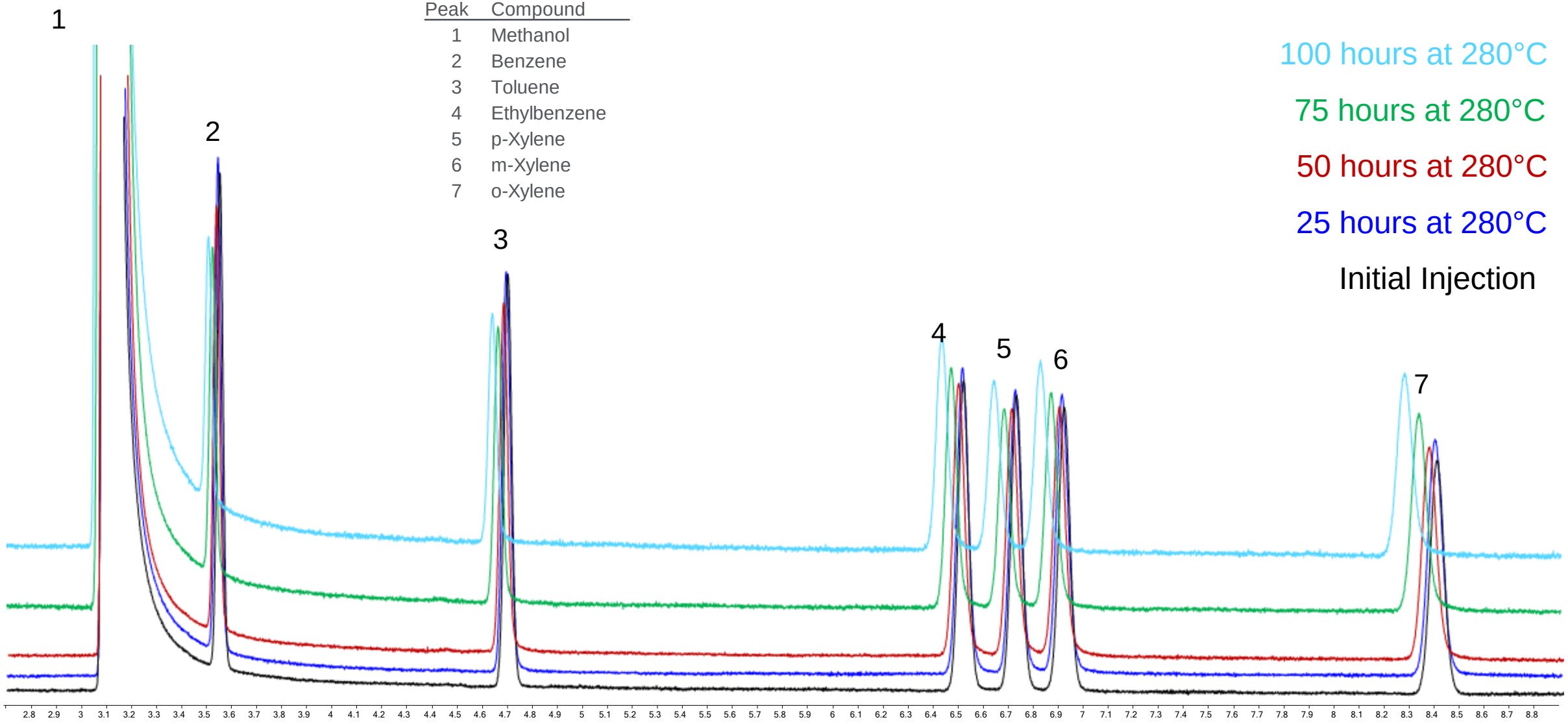
25 hours at 280°C

Initial BTEX Injection

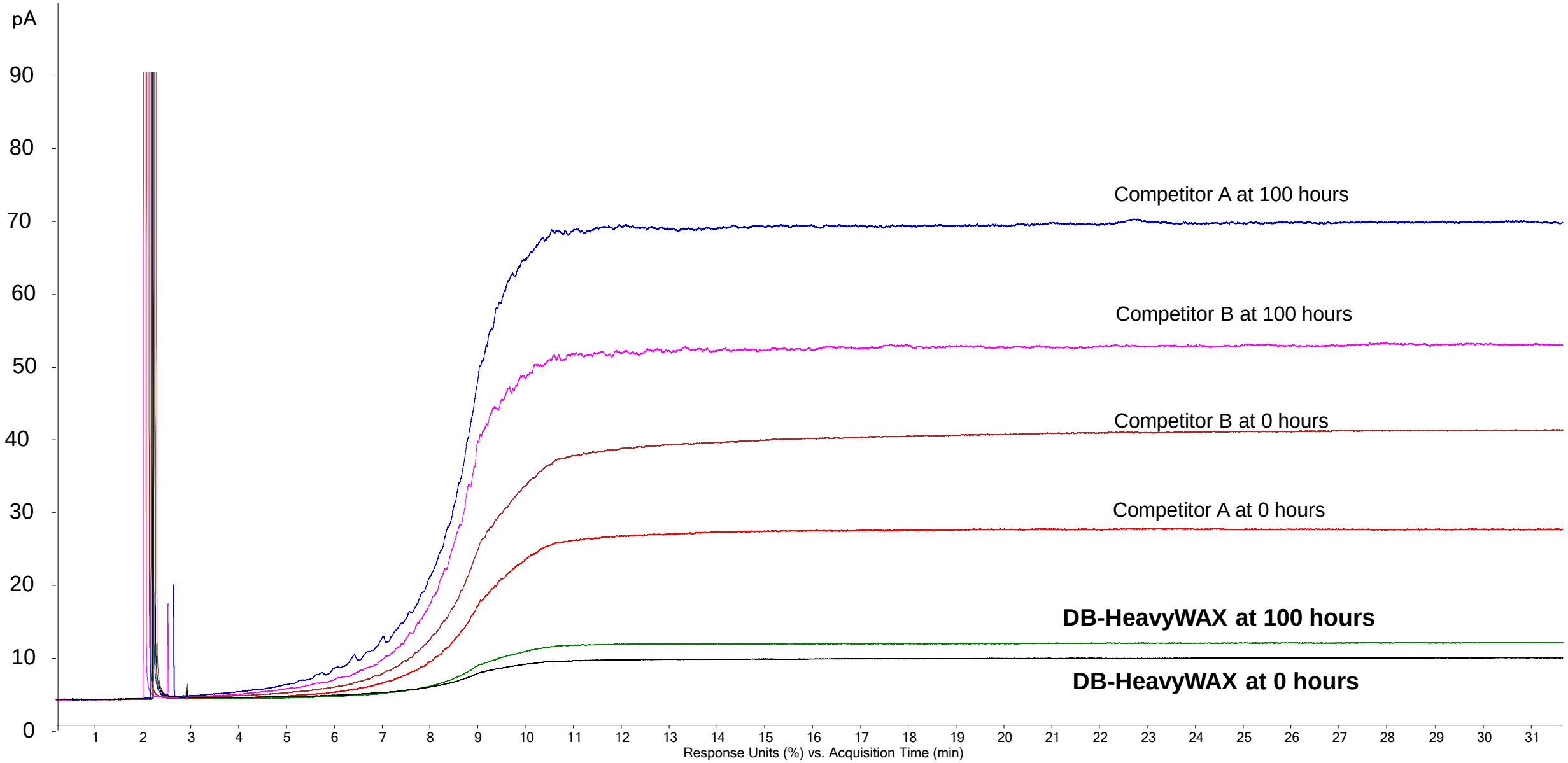
Thermal Stability and Retention Time Shifting

DB-HeavyWAX

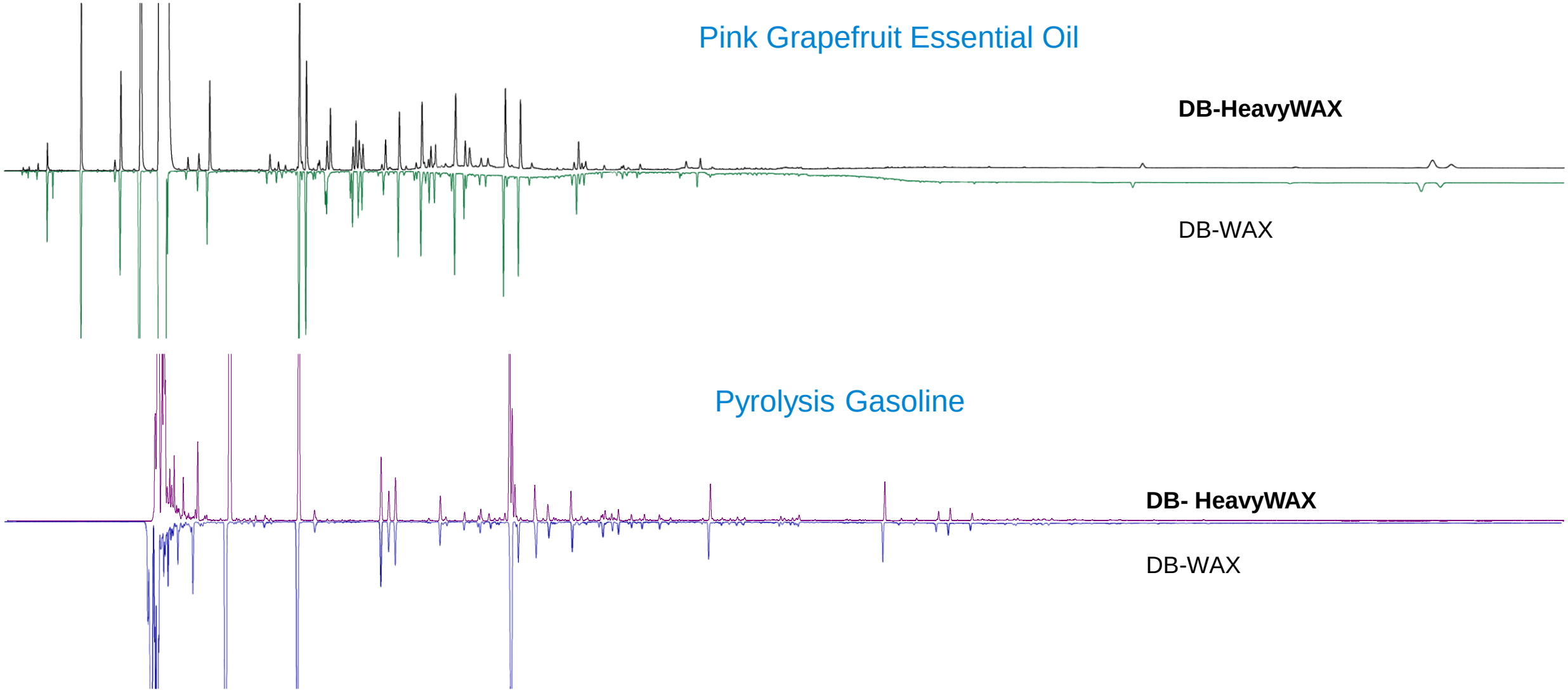
Peak	Compound
1	Methanol
2	Benzene
3	Toluene
4	Ethylbenzene
5	p-Xylene
6	m-Xylene
7	o-Xylene



Bleeding at 280°C after 100 Hours



It Is a WAX!


Pink Grapefruit Essential Oil
DB-HeavyWAX
DB-WAX
Pyrolysis Gasoline
DB- HeavyWAX
DB-WAX

Advantages of applications at high temperatures: Applications

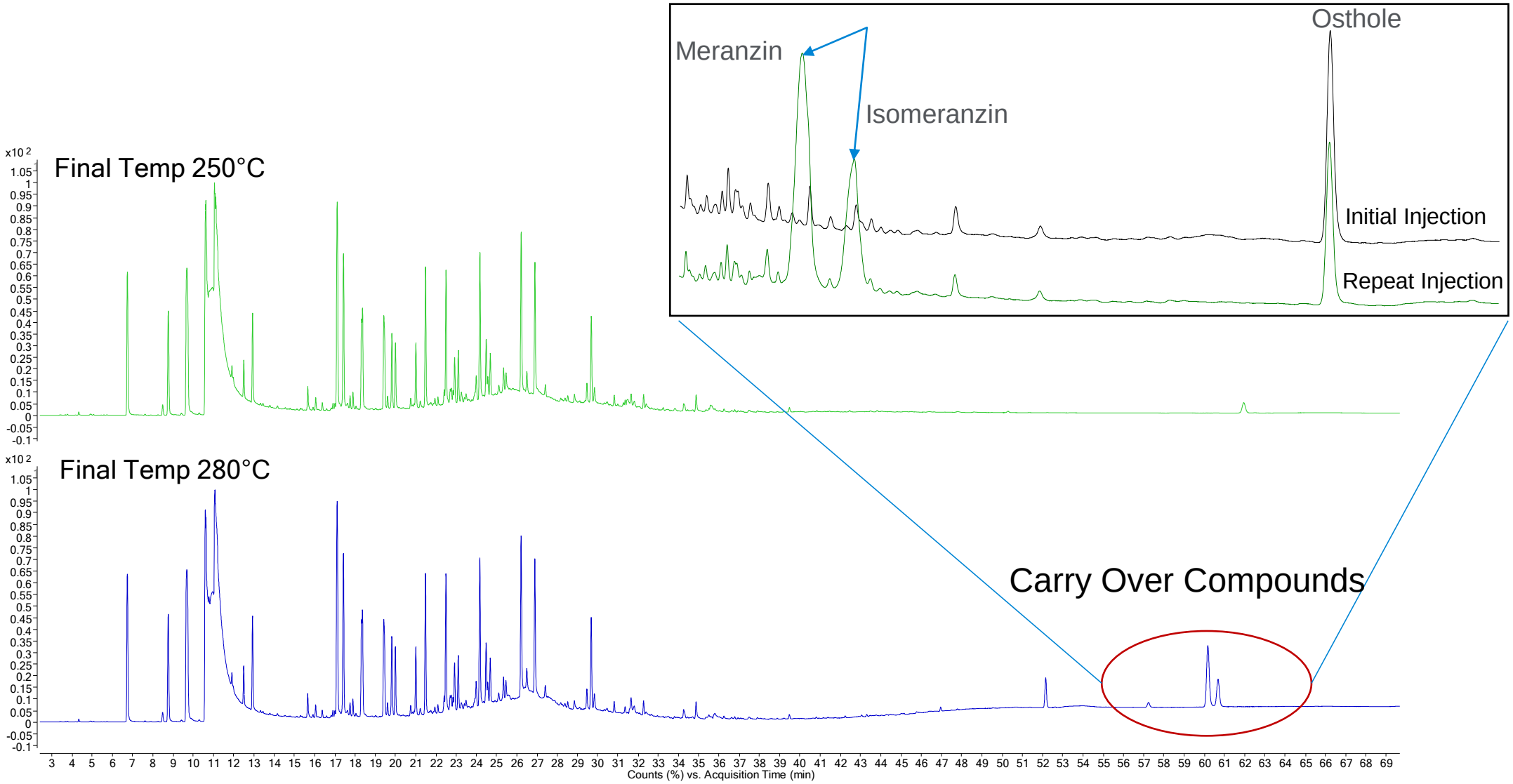
Pinkfruit essential oil

- ‘carry over’ reduction
- Analysis time reduction
- Selectivity is stable after repeated cycling to high temperatures

GC Conditions	
Column	30m x 0.25 mm x 0.25 µm
Carrier	Helium, constant flow, 1.2 mL/min
Oven	60°C (2.0 min),Ramp 5°C/min to 280°C (30 min)

Selectivity similar to traditional WAX phases

Reduce Cary-Over - Pink Grapefruit Essential Oil

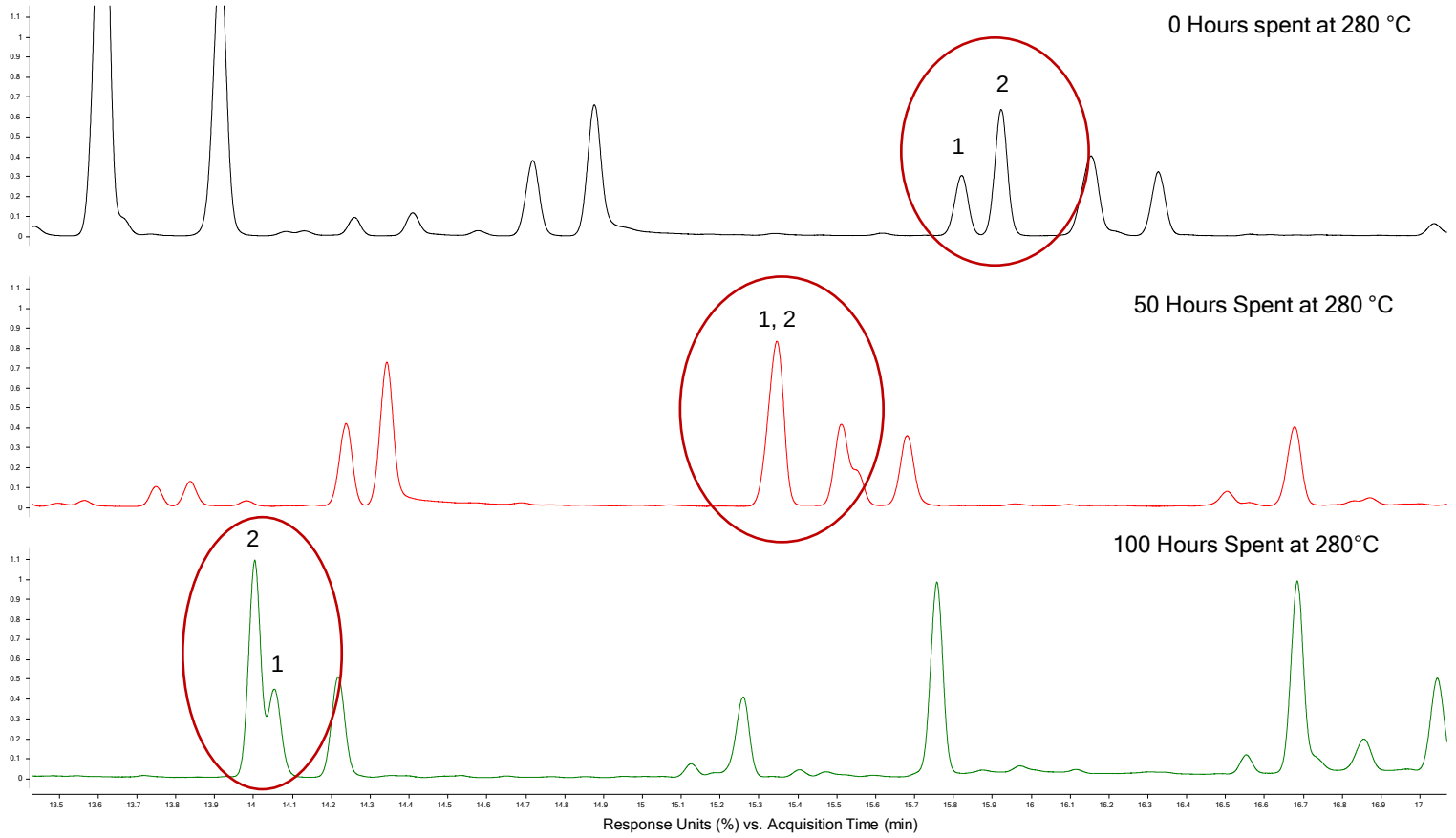


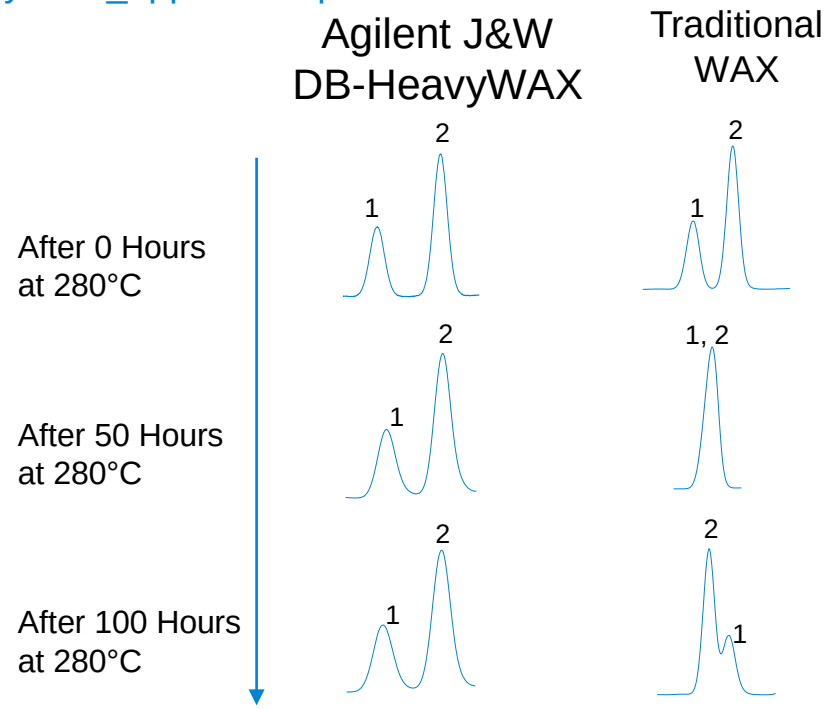
Thermal Stability and Selectivity: In Action (Cold pressed Grapefruit)

5991-9078EN: www.agilent.com/cs/library/applications/5991-9078EN_grapefruit_oil_DB HeavyWAX_application.pdf

Peak	Compound
1	Linalool
2	γ-Amorphene

Traditional WAX





GC Conditions	
Column	30m x 0.25 mm x 0.25 µm
Carrier	Helium, constant flow, 1.2 mL/min
Oven	60°C (2.0 min),Ramp 5°C/min to 280°C (30 min)

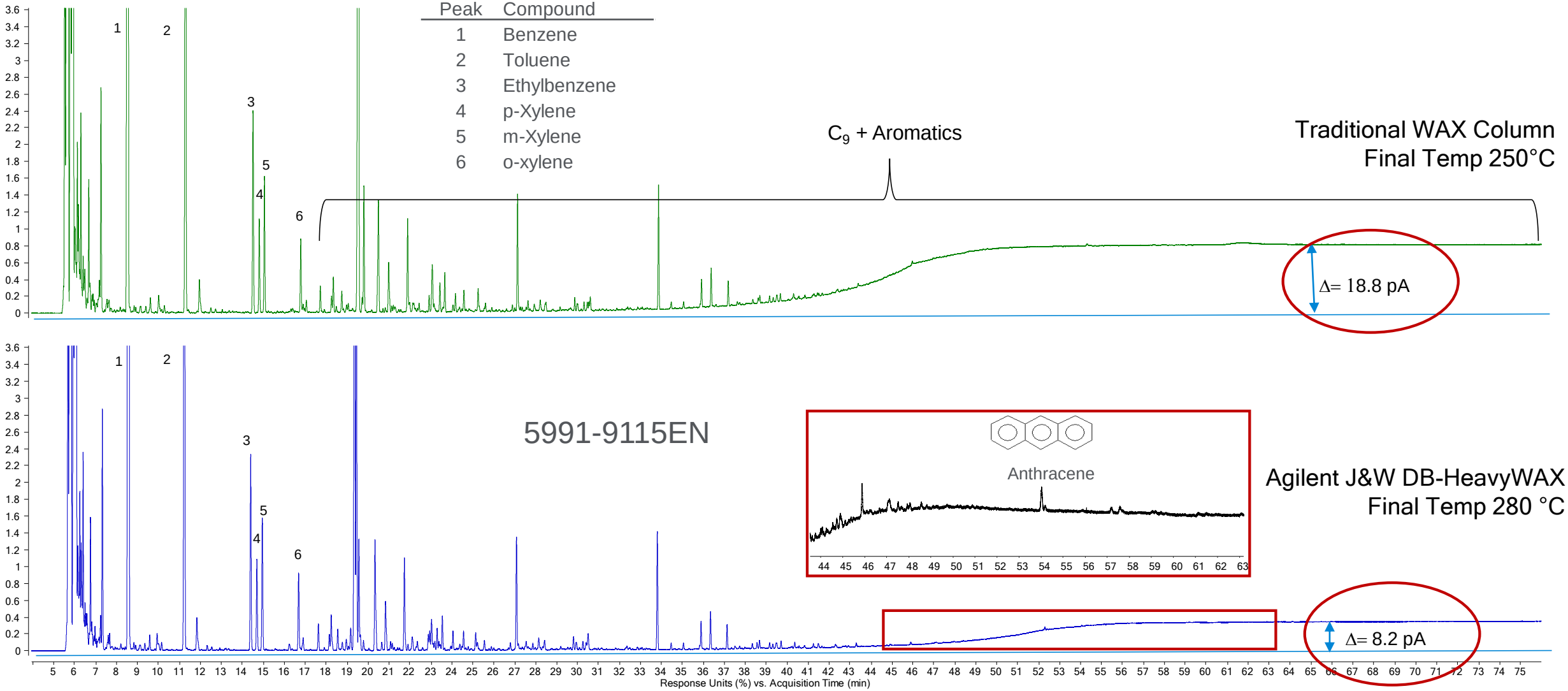
Benefits of Low Bleed - Pyrolysis Gasoline

- Analysis of Pyrolysis Gasoline
  - According to ASTM D6563
- Sample contains heavier aromatic compounds
- Lower bleed at 280°C than traditional WAX at 250°C
  - Increased Sensitivity for Later Eluting Compounds
  - Increased Column Lifetime

GC Conditions	
Column	60m x 0.25 mm x 0.25 μm
Carrier	Helium, constant flow, 1.2 mL/min
Oven	70°C (10.0 min),Ramp 5°C/min to 280°C (30 min)

Benefits of Low Bleed - Pyrolysis Gasoline

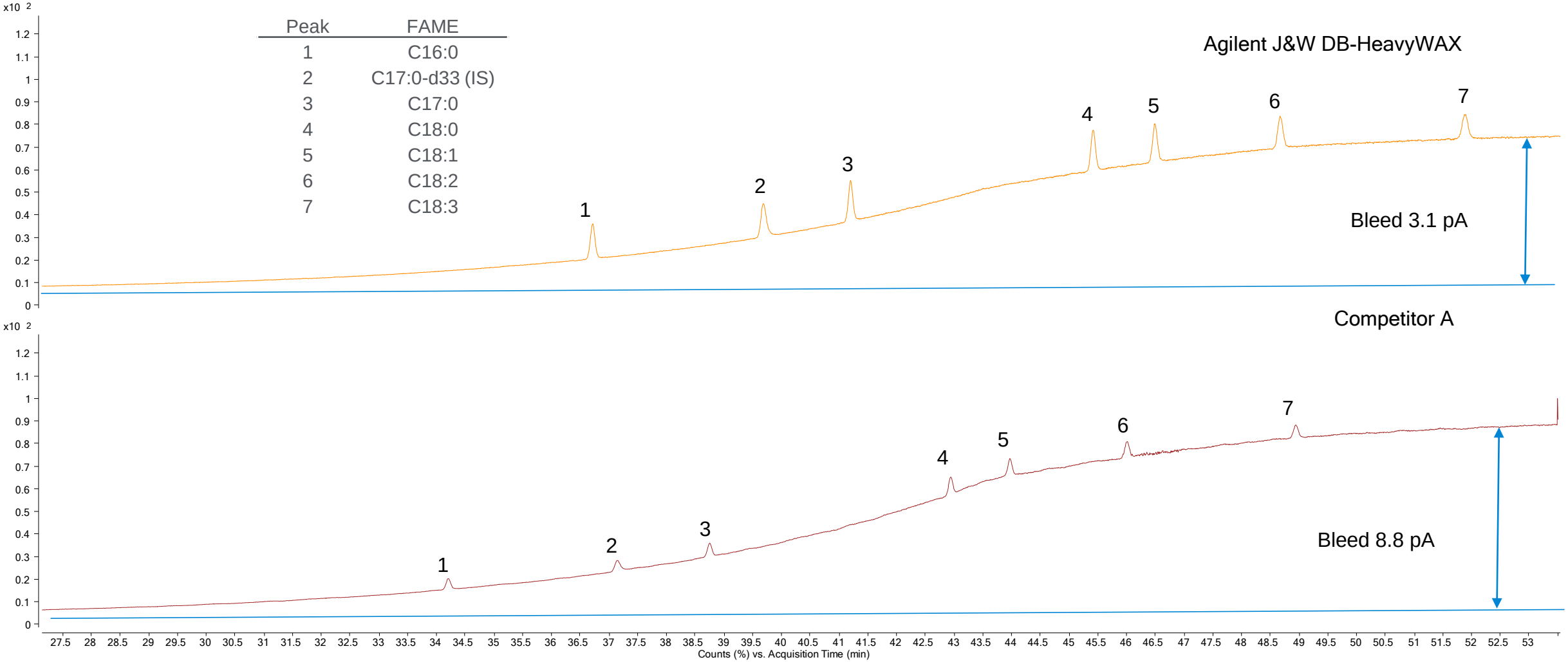
Peak	Compound
1	Benzene
2	Toluene
3	Ethylbenzene
4	p-Xylene
5	m-Xylene
6	o-xylene



5991-9115EN: www.agilent.com/cs/library/applications/5991-9115EN_pyrolysis gasoline_ ASTM D6563_DB HeavyWAX_application.pdf

Lower Bleed for FAMEs in Biodiesel (IP-585) using DB-HeavyWAX, 60m x 0.25mm x 0.50 µm

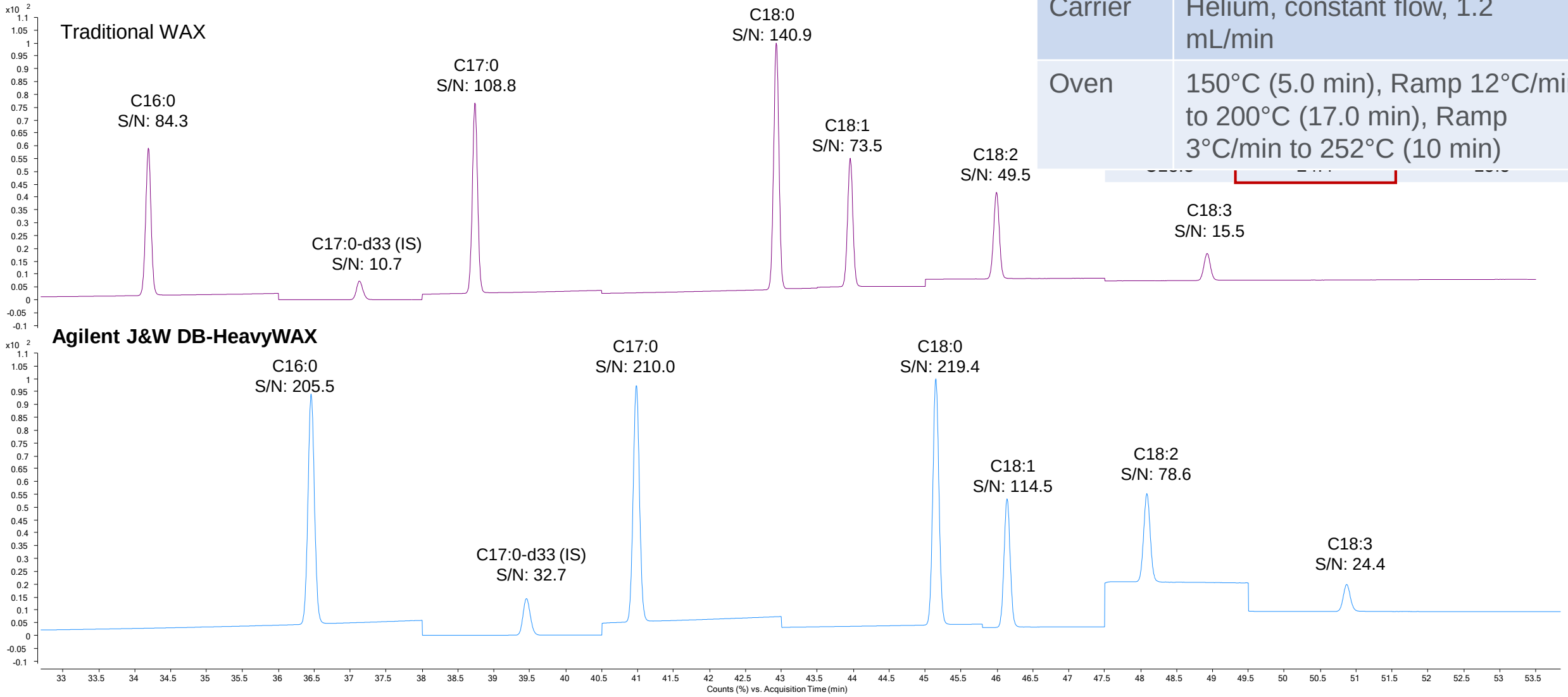
Peak	FAME
1	C16:0
2	C17:0-d33 (IS)
3	C17:0
4	C18:0
5	C18:1
6	C18:2
7	C18:3



Decrease Bleed → Increase Signal to Noise

FAMEs in Jet Fuel (IP585)

GC Conditions (IP585)	
Column	60m x 0.25 mm x 0.5 μm
Carrier	Helium, constant flow, 1.2 mL/min
Oven	150°C (5.0 min), Ramp 12°C/min to 200°C (17.0 min), Ramp 3°C/min to 252°C (10 min)



Retention time stability on a DB-HeavyWAX

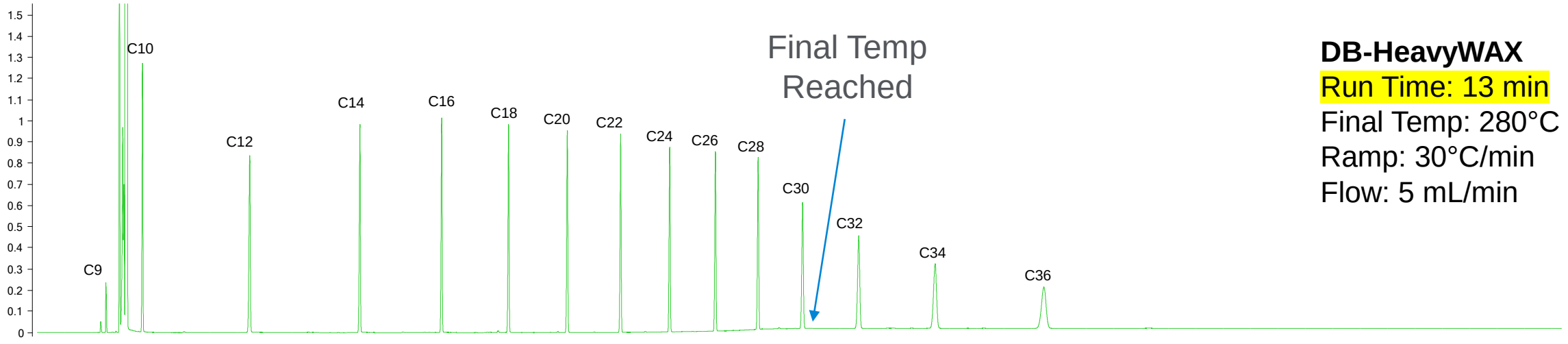
IP-585: FAMEs in aviation fuel

- Less bleeds reduces noise level
- Enhance sensitivity without changing the detector
- Increase thermal stability→ Better stability in the SIM window → Less service time

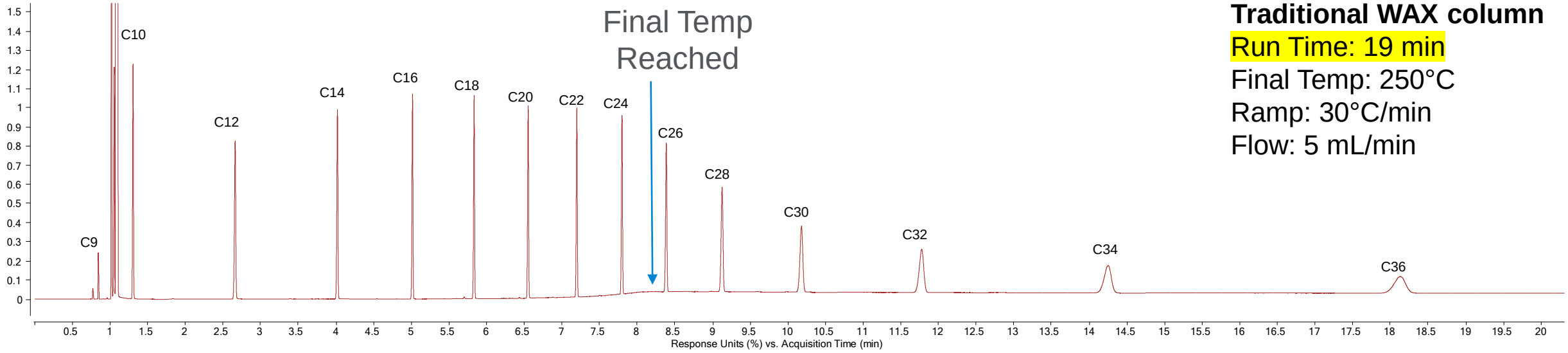
GC Conditions	
Column	60m x 0.25 mm x 0.5 μm
Carrier	Helium, constant flow, 1.2 mL/min
Oven	150°C (5.0 min), Ramp 12°C/min to 200°C (17.0 min), Ramp 3°C/min to 252°C (10 min)

Compound	Operating Hours at 260°C									Average	%RSD
	1	5	7	13	22	39	42	46	49		
C16:0	36.58	36.47	36.45	36.44	36.43	36.43	36.43	36.43	36.42	36.45	0.13%
C17:0 d33 (ISTD)	39.57	39.47	39.45	39.44	39.44	39.44	39.44	39.44	39.44	39.46	0.11%
C17:0	41.09	40.99	40.98	40.96	40.97	40.97	40.97	40.97	40.96	40.98	0.10%
C18:0	45.26	45.16	45.15	45.13	45.14	45.15	45.15	45.15	45.14	45.16	0.08%
C18:1	46.25	46.15	46.14	46.12	46.13	46.13	46.13	46.13	46.13	46.15	0.09%
C18:2	48.20	48.10	48.09	48.07	48.08	48.07	48.08	48.08	48.07	48.09	0.09%
C18:3	51.01	50.89	50.87	50.85	50.84	50.86	50.86	50.87	50.86	50.88	0.10%

Better Peak Shape and Decrease Runtime - Hydrocarbons



DB-HeavyWAX
Run Time: 13 min
Final Temp: 280°C
Ramp: 30°C/min
Flow: 5 mL/min



Traditional WAX column
Run Time: 19 min
Final Temp: 250°C
Ramp: 30°C/min
Flow: 5 mL/min

Limitations of DB-HeavyWAX

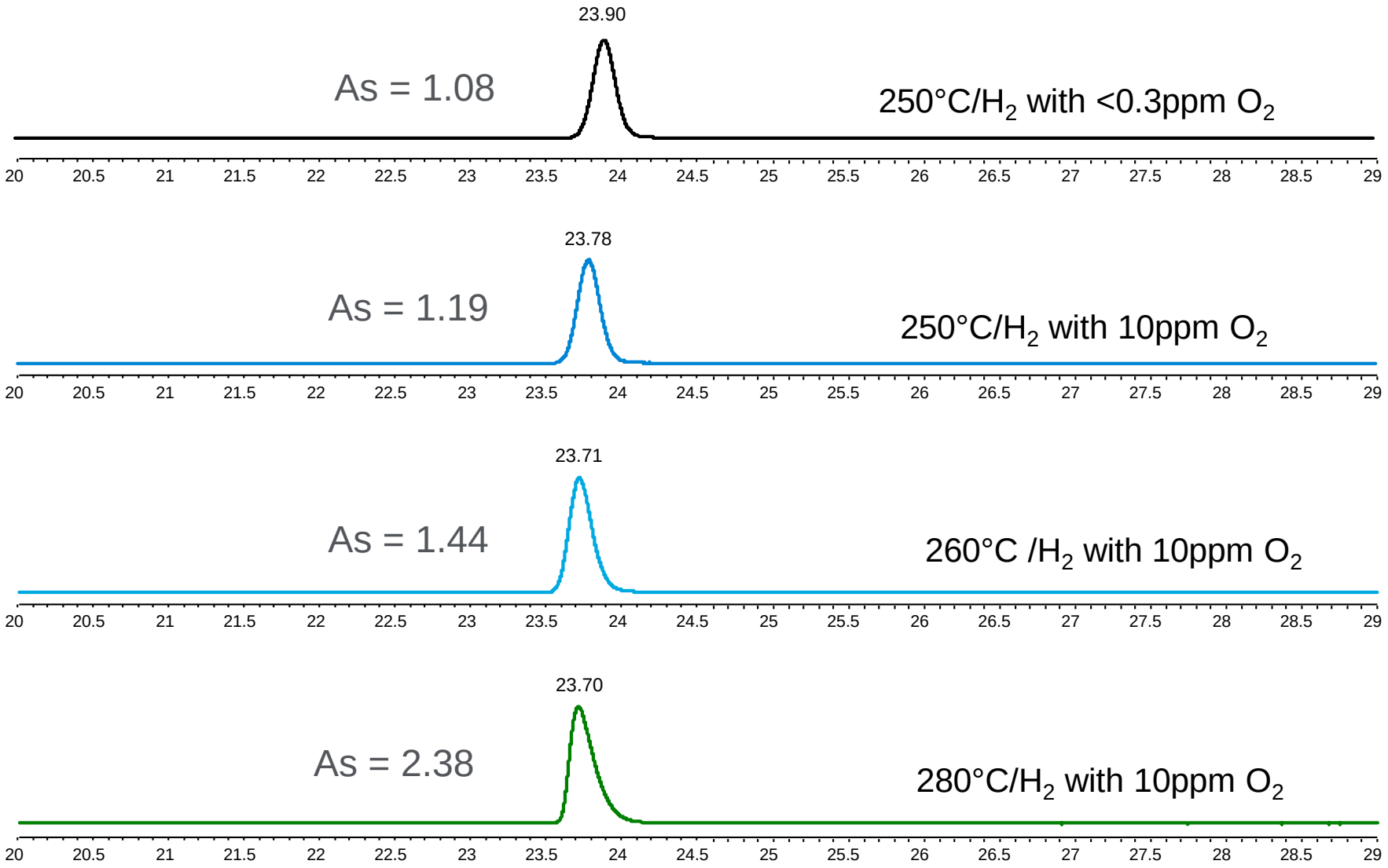
- Cannot be solvent rinsed
- Be extra careful with oxygen levels (see next slide)
- It is not in the Ultra Inert line of columns
  - For *very* active compounds, may be better to use DB-WAX Ultra Inert or DB-FATWAX Ultra Inert
- For acids, better to use DB-Fatwax or DB-WAX UI or FFAP

Self-tightening column nuts

For inlet or GC detector P/N 5190-6194

For MS transfer line P/N 5190-5233

Effect of oxygen on peak shape of 2-ethylhexanoic acid



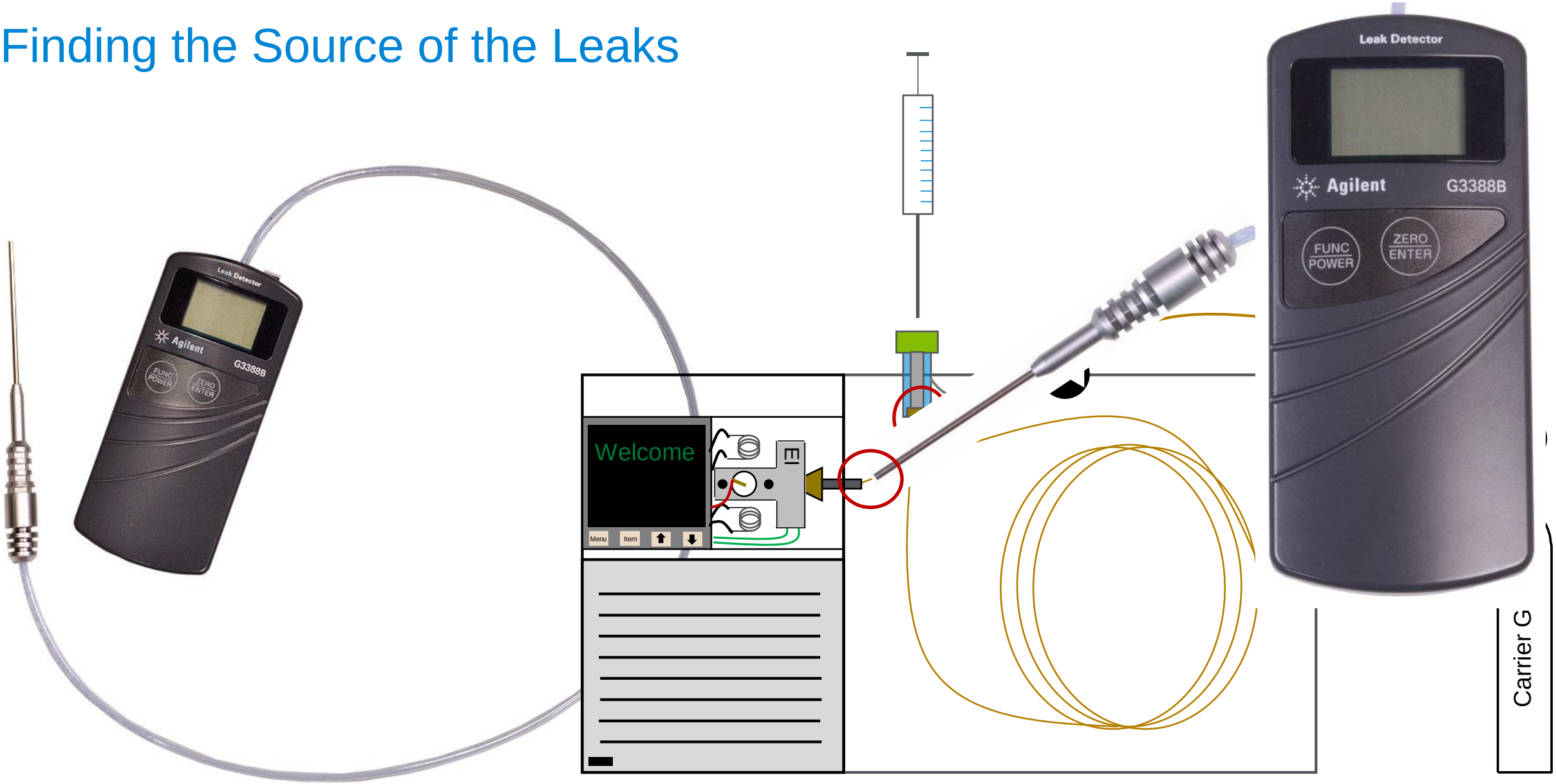
Inlet or GC detector: P/N 5190-6194
MS transfer line: P/N 5190-5233

Gas Clean Filter Indicator and Replacement

P/N CP17973

Remove plugs before installation

Finding the Source of the Leaks



P/N: G3388B

Benefits of Increased Temperature Limits of DB-HeavyWAX

- WAX/PEG selectivity
- Reduced bleed = better signal to noise
- Lower bleed at 280°C compared to traditional WAX columns at 250°C
- Retention time stability when column is used at maximum operating temperature
  - No changes in peak order
- Reduce potential carryover; reduced Re-Runs
- Decrease Runtime by Increasing the Final Temperature Instead of the Final Hold Time
- Better Peak Shape for Heavy/High Boiling Compounds
  - Increase Analyte Range
  - May reduce the need for secondary column
- Safe Bake-outs Without Damaging the Column
  - Extended Periods at 280°C (Isothermal limit)
  - Short Periods of time up to 290°C (Temperature program limit)

Available DB-HeavyWAX configurations

ID (mm)	Length (m)	Film (µm)	Temp Limits (°C)	7 in Cage	Intuvo configuration
0.10	10	0.10	40 to 280/290	127-7112	
0.18	10	0.18	40 to 280/290	121-7112	
	20	0.18	40 to 280/290	121-7122	
0.25	15	0.25	40 to 280/290	122-7112	
	25	0.20	40 to 280/290	122-7127	
	30	0.25	40 to 280/290	122-7132	122-7132-INT
		0.50	40 to 270/280	122-7133	122-7133-INT
	50	0.20	40 to 280/290	122-7157	
	60	0.25	40 to 280/290	122-7162	122-7162-INT
		0.50	40 to 270/280	122-7163	
0.32	15	0.25	40 to 280/290	123-7112	
	30	0.25	40 to 280/290	123-7132	123-7132-INT
		0.50	40 to 270/280	123-7133	123-7133-INT
	50	0.20	40 to 280/290	123-7157	
	60	0.25	40 to 280/290	123-7162	
		0.50	40 to 270/280	123-7163	123-7163-INT

Summary

WAX columns offer unique and sometimes necessary selectivity

INNOWax and CP-WAX 52 CB have been improved
- Add an “i” to existing part #

DB-WAX UI
- Very inert – proven with test mix (every column is tested)
- Can replace FFAP as a more stable alternative than FFAP for free fatty acids

DB-FATWAX UI
- Very inert - proven with test mix (every column is tested)
- Great choice for FAME’s and small organic acids

DB-HeavyWAX
- Highest temperature WAX (280/290 c)
- Reduced analysis time
- Reduced carry-over of high boilers
- Very low bleed – improved signal to noise
- Stable selectivity after temperature cycles

Contact Agilent Chemistries and Supplies Technical Support

We are always here to help!

1-800-227-9770 Option 3, Option 3:

Option 1 for GC/GCMS Columns and Supplies

Option 2 for LC/LCMS Columns and Supplies

Option 3 for Sample Preparation, Filtration and QuEChERS

Option 4 for Spectroscopy Supplies

Available in the USA 8-5 all time zones

gc-column-support@Agilent.com

lc-column-support@agilent.com

spp-support@agilent.com

spectro-supplies-support@agilent.com