

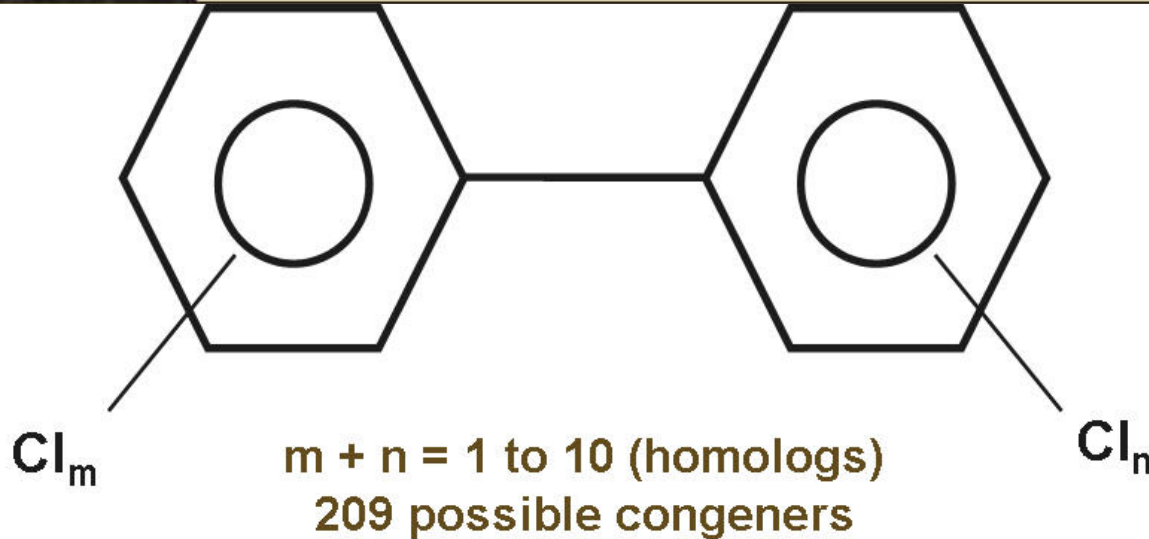


Congener-Specific and  
Aroclor PCB Analysis on the  
HT8-PCB GC Column

David M. Schwope, Caleb K. Nienow,  
William J. Mills

Environmental & Occupational Health Sciences  
And UIC Forensic Sciences Program

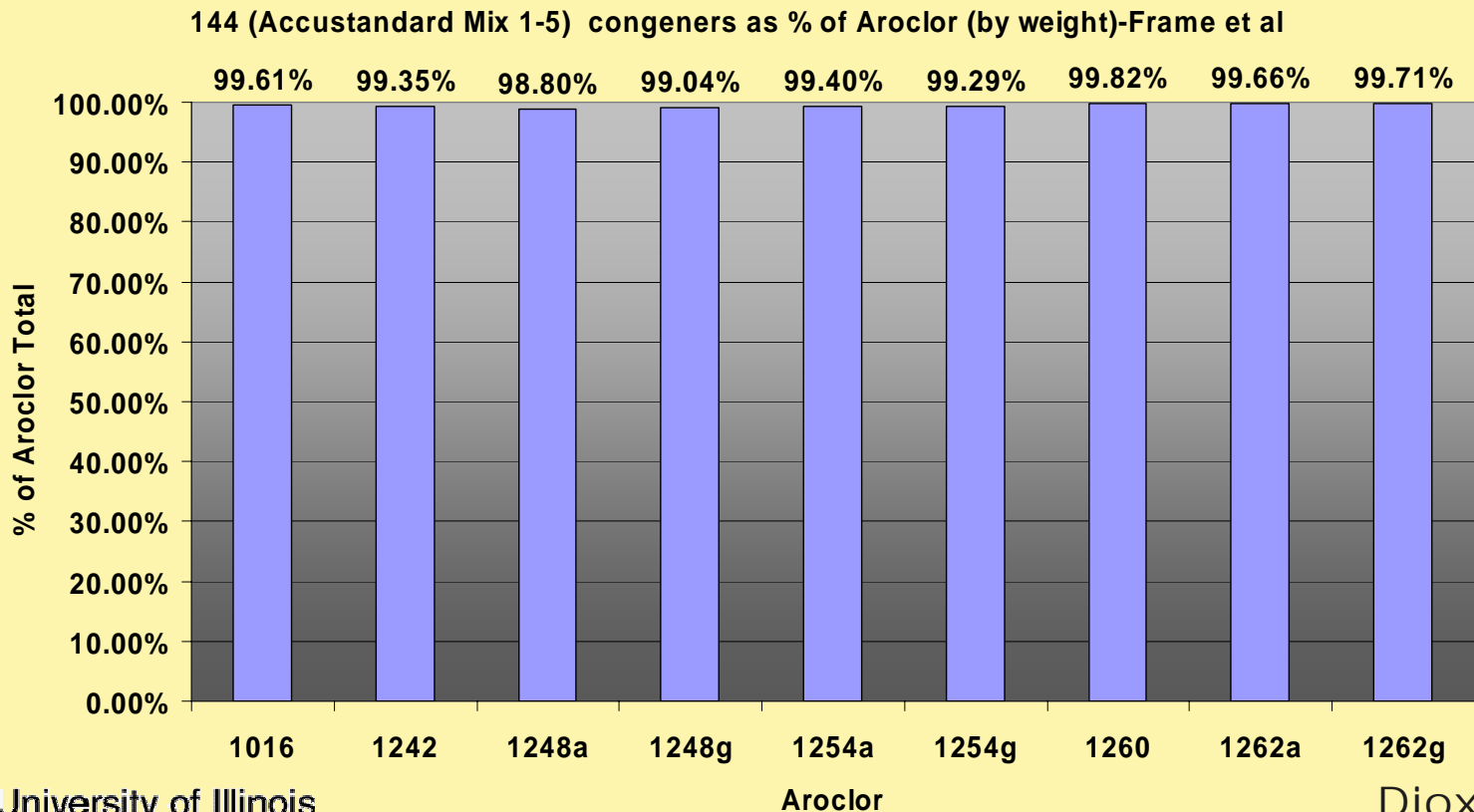
# PCB Structure Review



No. of Cl	No. of Homologs
1	3
2	12
3	24
4	42
5	46
6	42
7	24
8	12
9	3
10	1

# 144 vs. 209 Congeners

- In North America commercial product was Aroclor™, based on % Cl by weight
- Accustandard produces Mix1-9 to give all 209 Congeners. Mix 1-5 contains major PCB Congeners in Aroclors

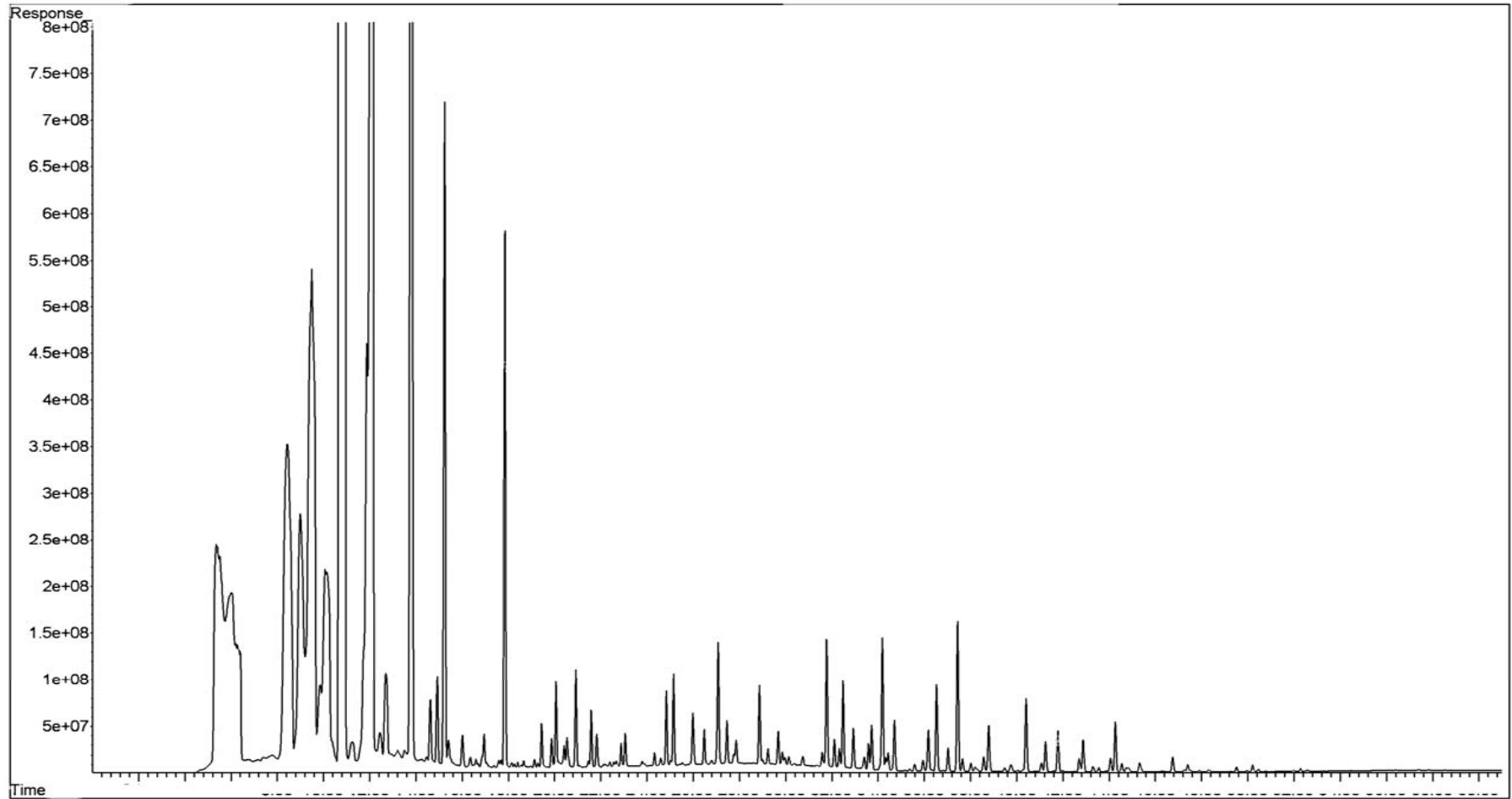


# Background

- Obtaining air samples from vicinity of operating transformers containing PCBs
- Analyze samples for concentration and PCB congener profile



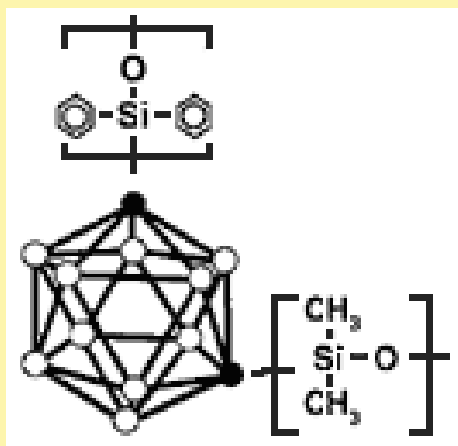
# GC Chromatogram of Air Samples



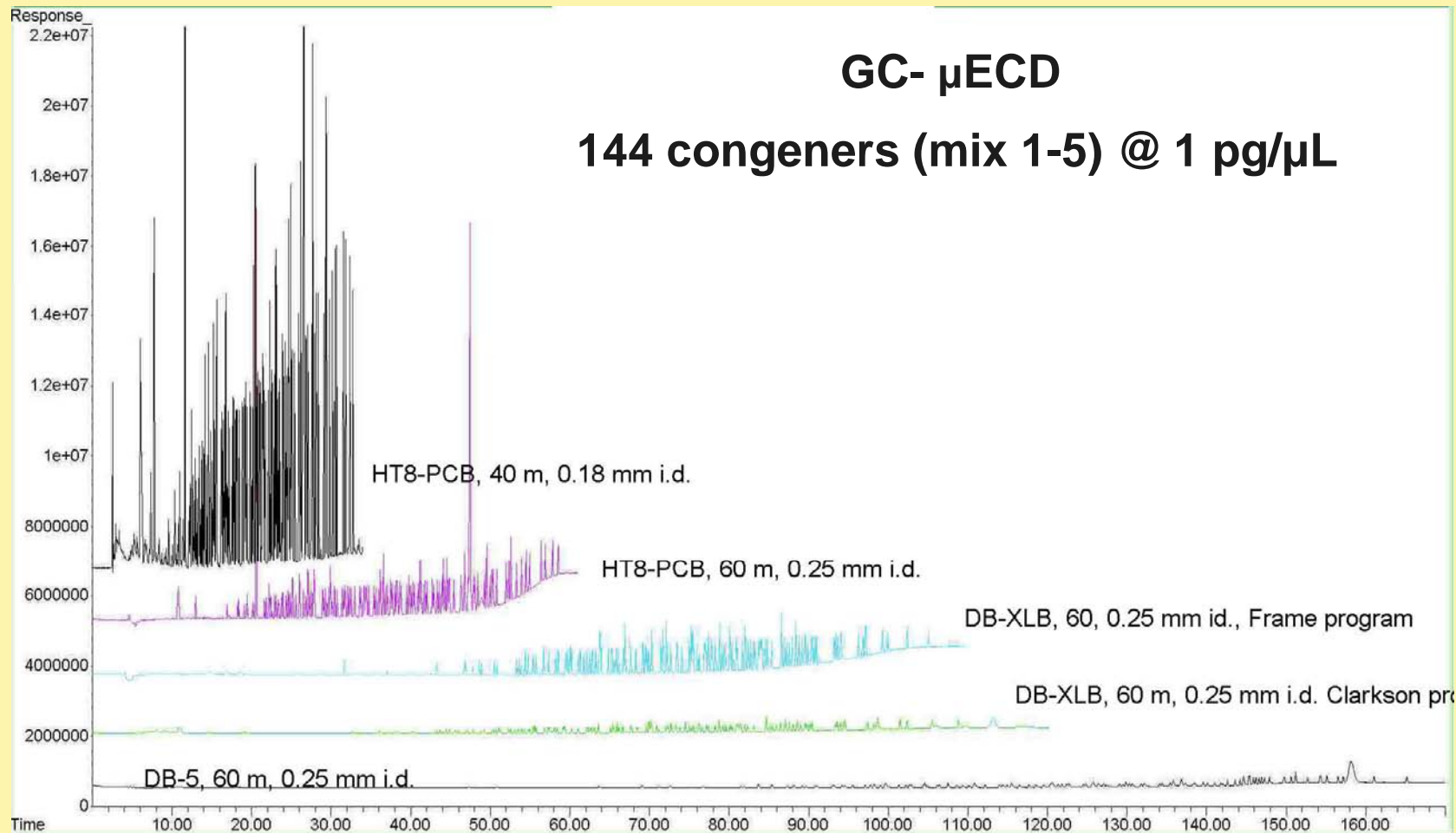
# Columns Compared

Column	Length (m)	i.d. (mm)	film thickness (um)	run time (minutes)	# of Peaks
DB-5	60	0.25	0.25	175	105
DB-XLB	60	0.25	0.25	120/110	120
<a href="#">HT8-PCB</a>	60	0.25	n/a	61	117
<a href="#">SGE PCB40</a>	40	0.18	n/a	34	120 (122)

HT8 column structure

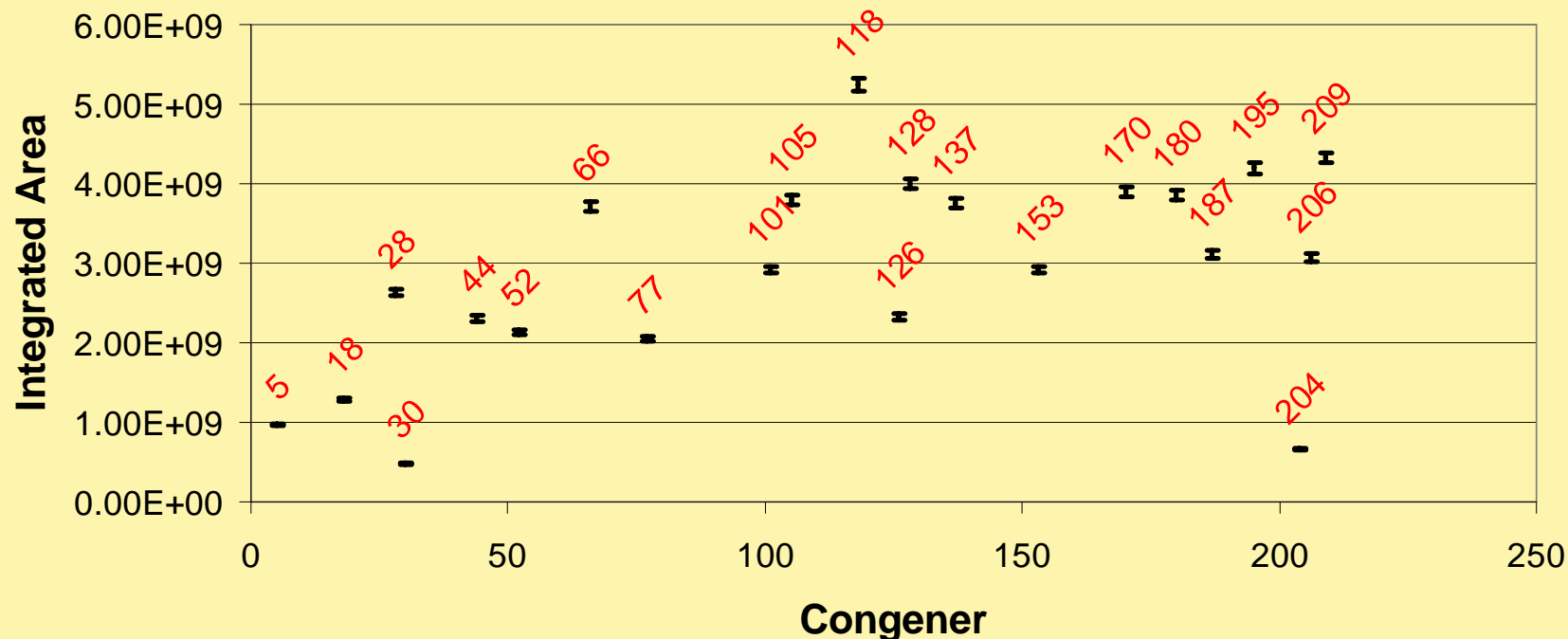


# Comparison Chromatograms



# Precision

**Injection Replicability for 20 Congener Mix with IS PCB 30 and 204  
(19 Injections)**



95% CI=1.5% FOR IS

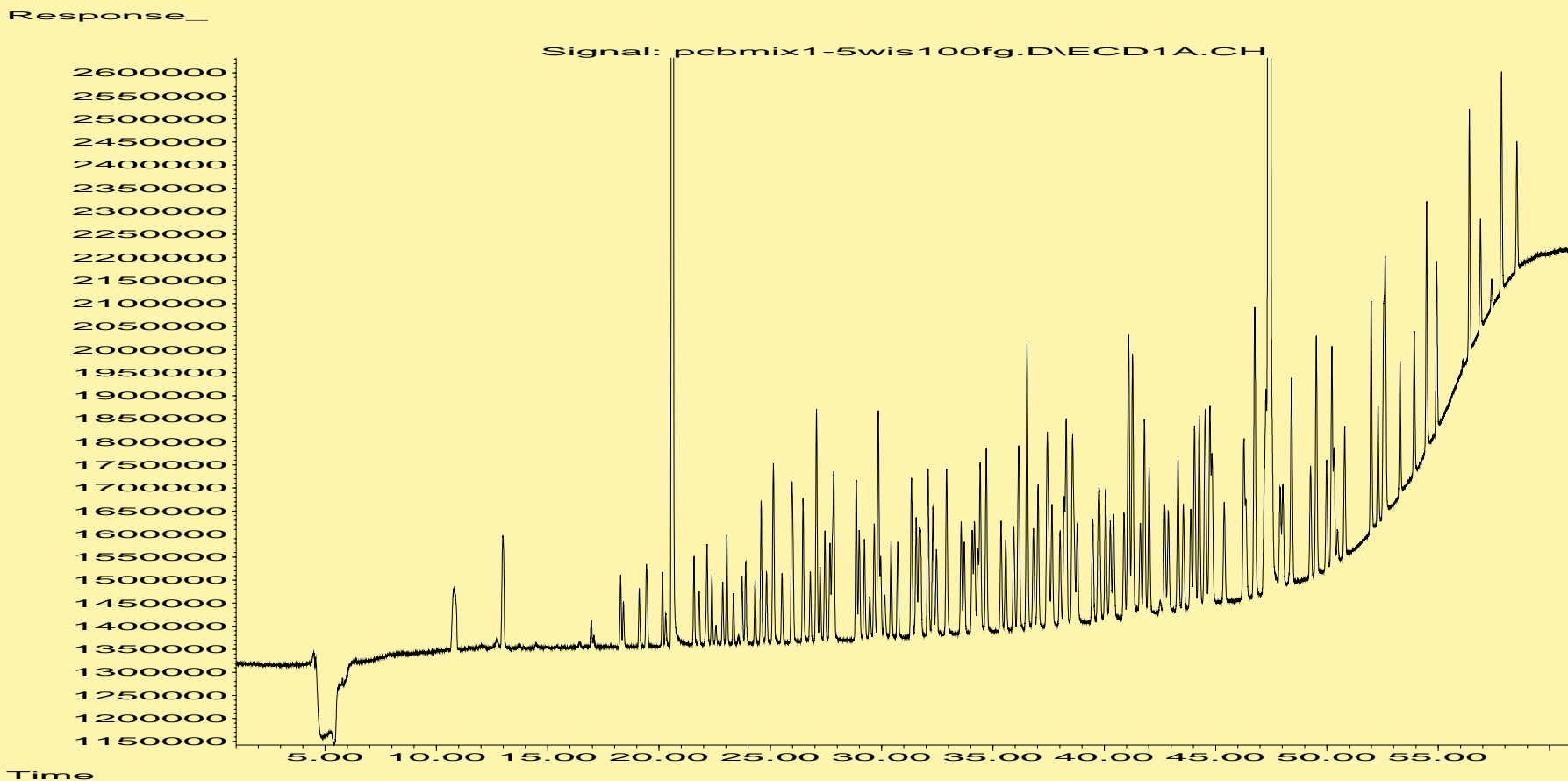
Mean RSD: 3.5%



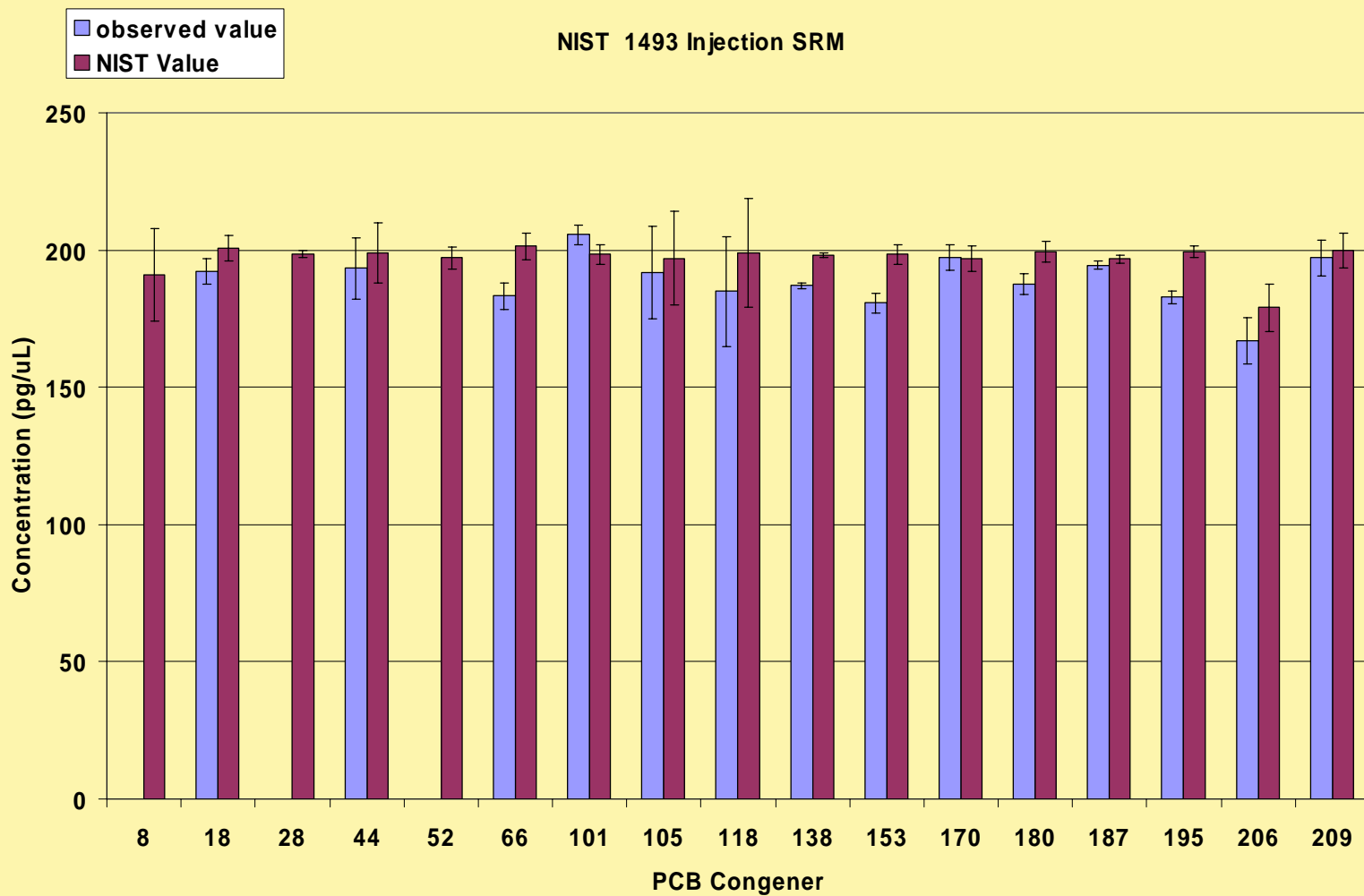


# 6890 GC- $\mu$ ECD Sensitivity

Accustandard PCB Mixes 1-5 at 100 fg injection, 60m HT8-PCB

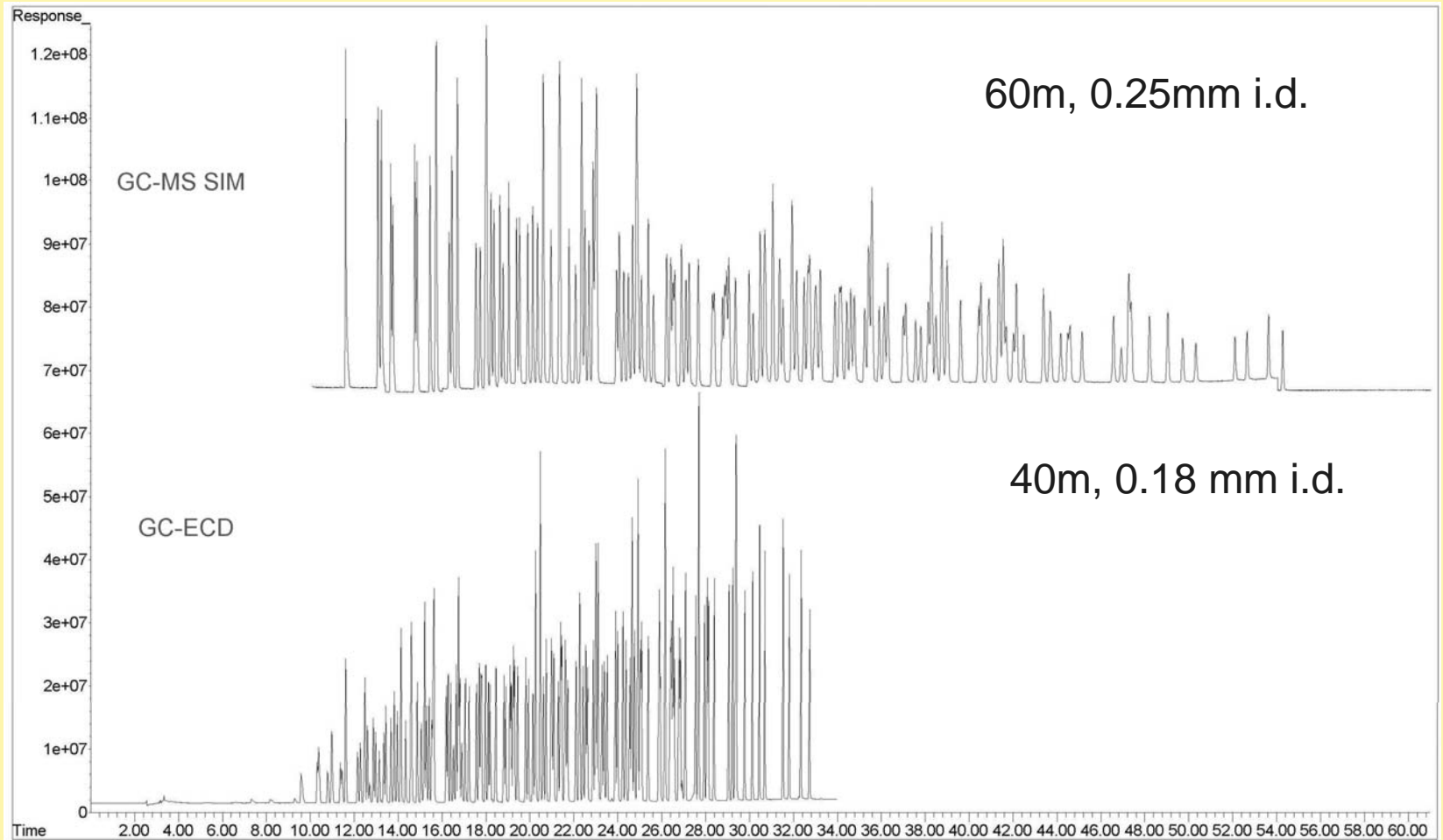


# Accuracy



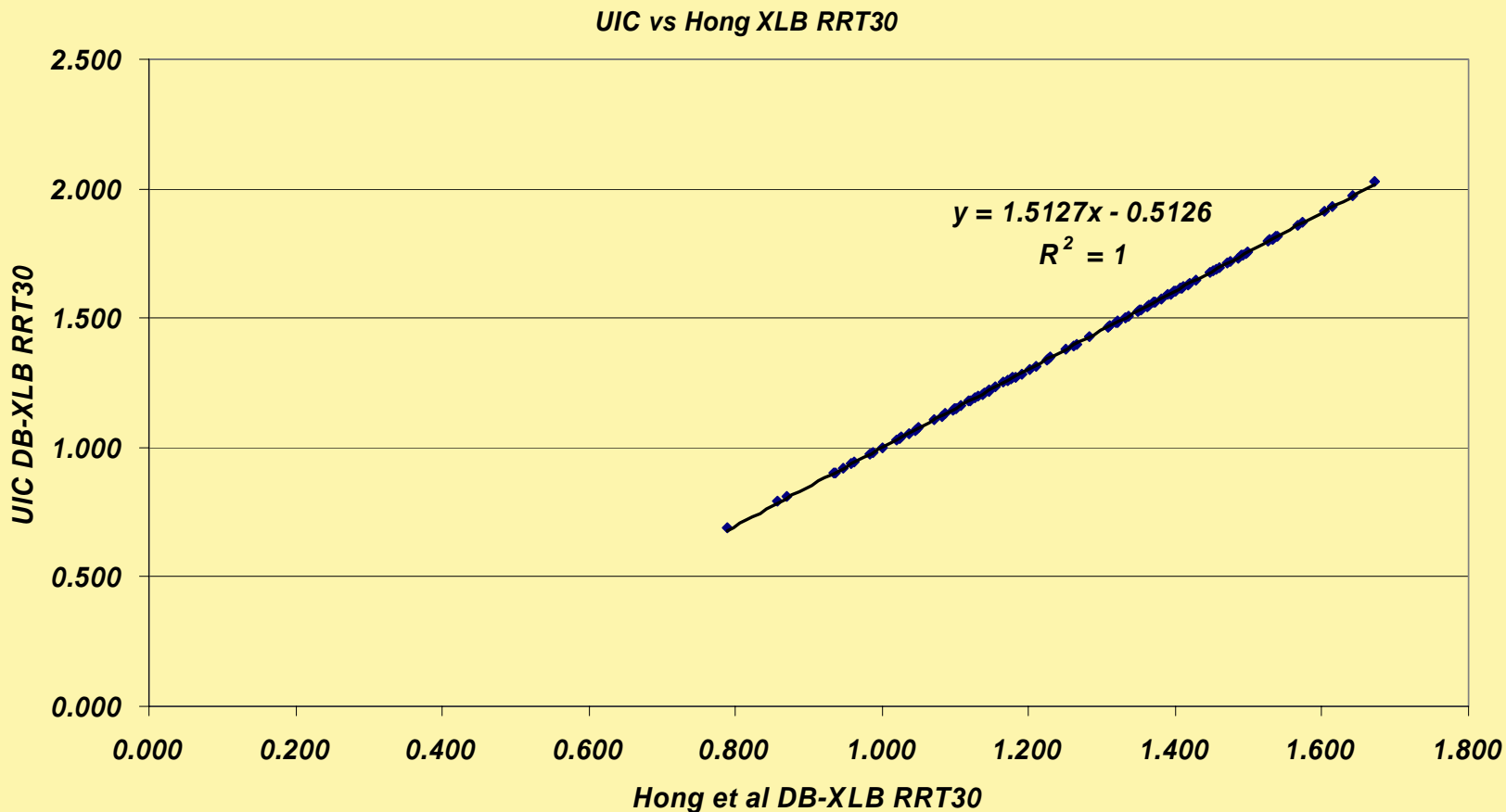


# GC-ECD vs. GC-SIM



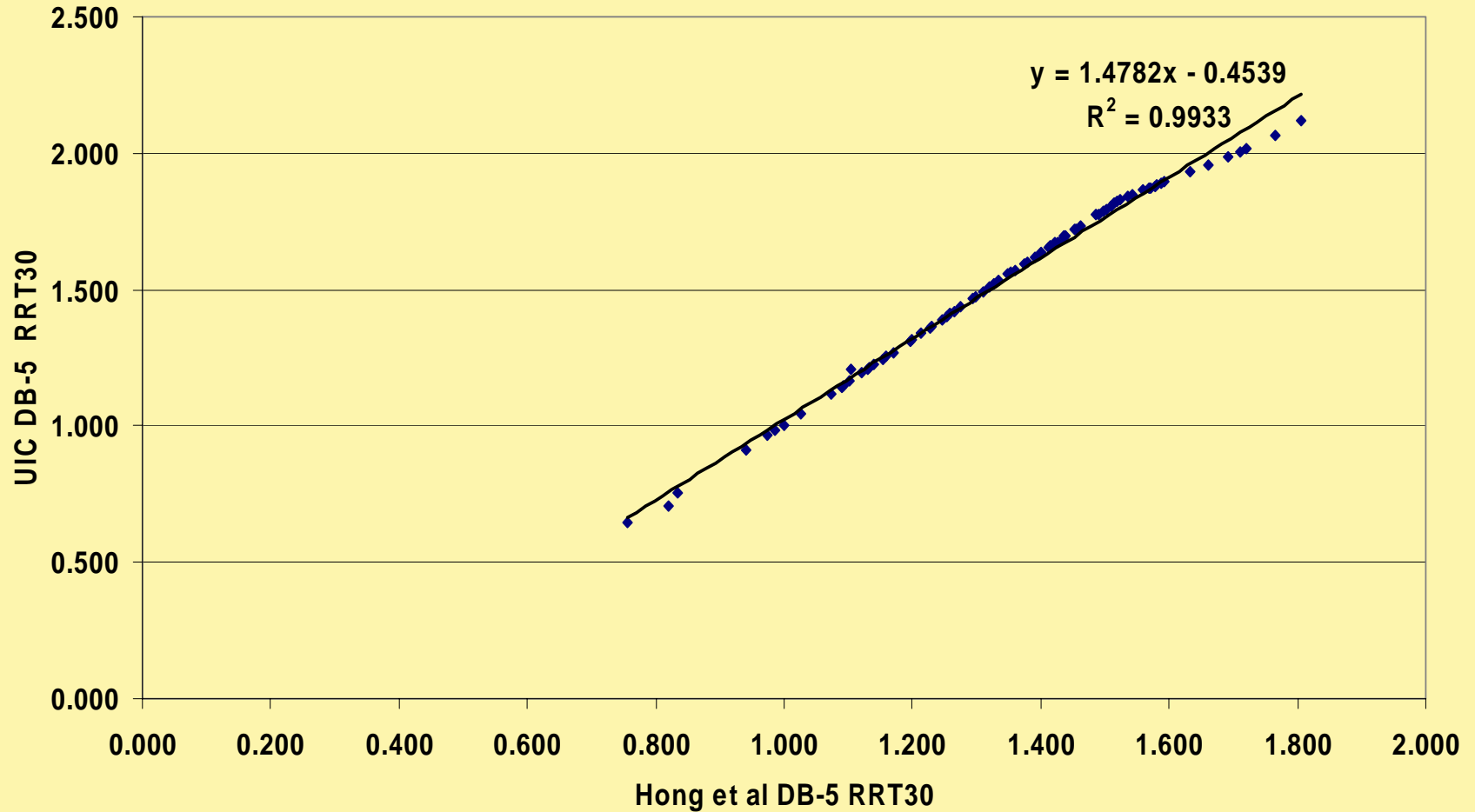
Both columns have same phase ratio ( $\beta$ )

# Comparison of RRT-30: DB-XLB



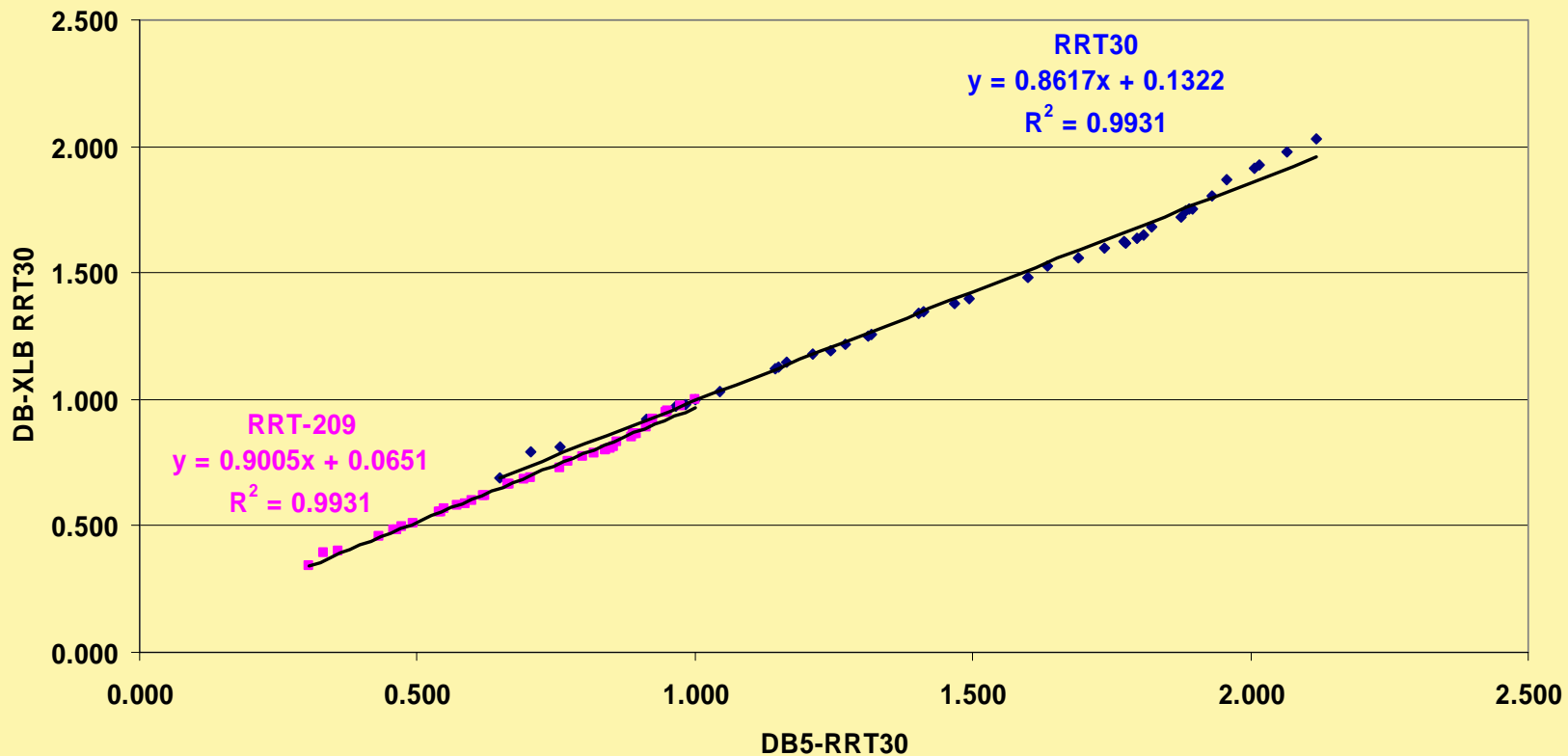
# Comparison of RRT-30: DB-5

DB-5 RRT30 Comparison UIC vs Hong et al



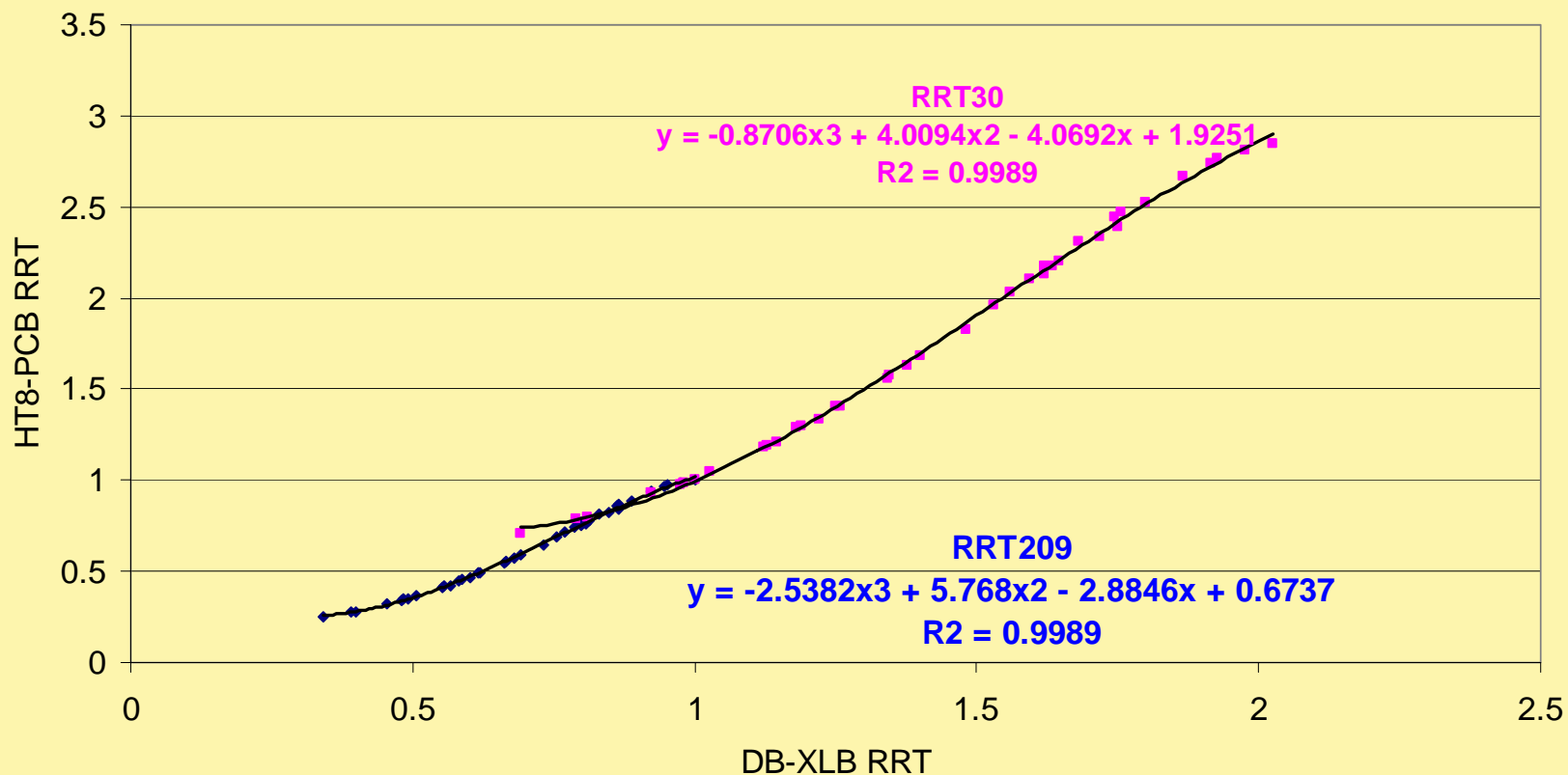
# DB-5 vs XLB RRTs

DB-XLB vs DB-5 RRTs



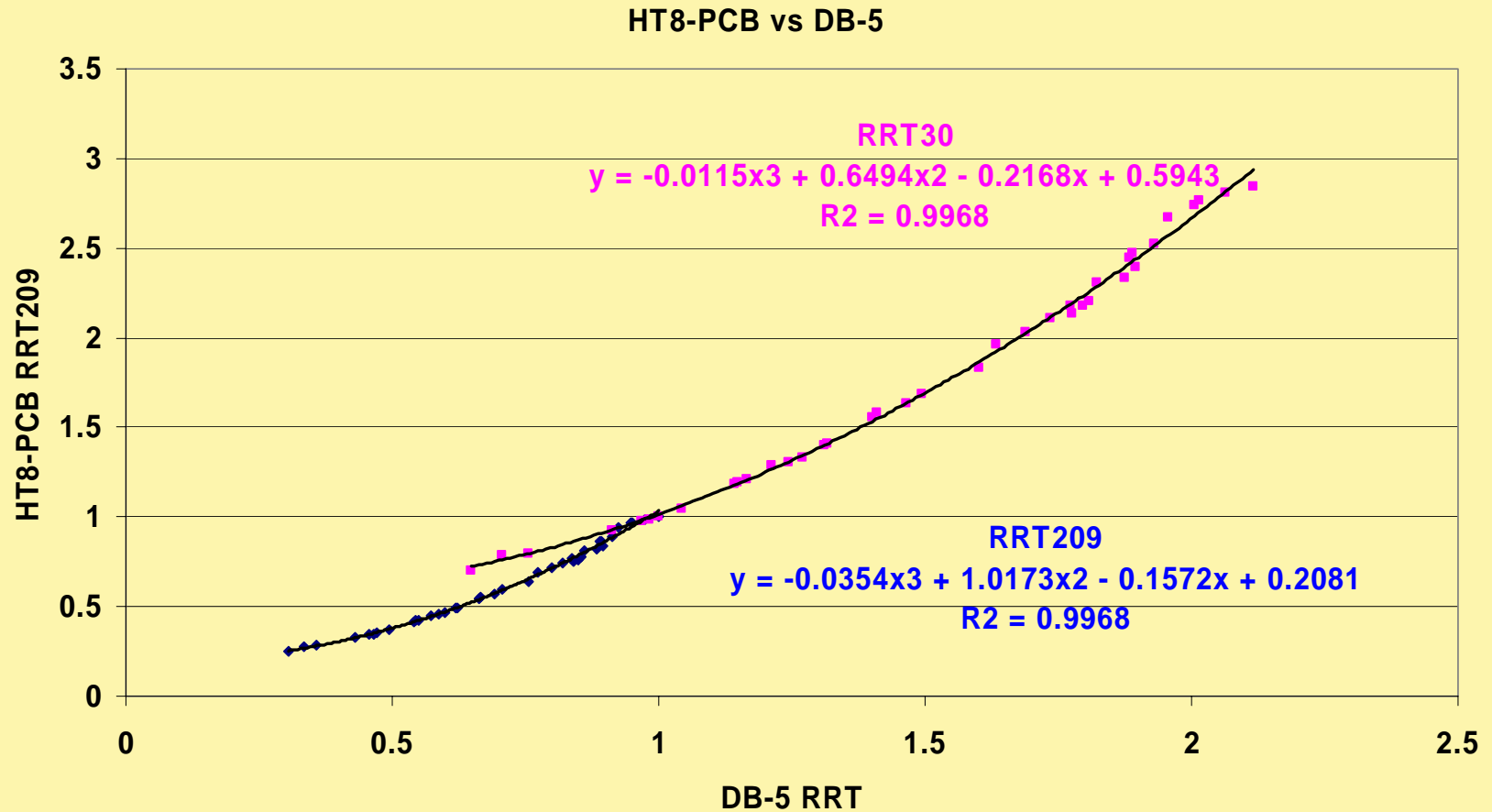
# HT8-PCB vs XLB

HT8-PCB vs XLB





# HT8-PCB vs DB-5





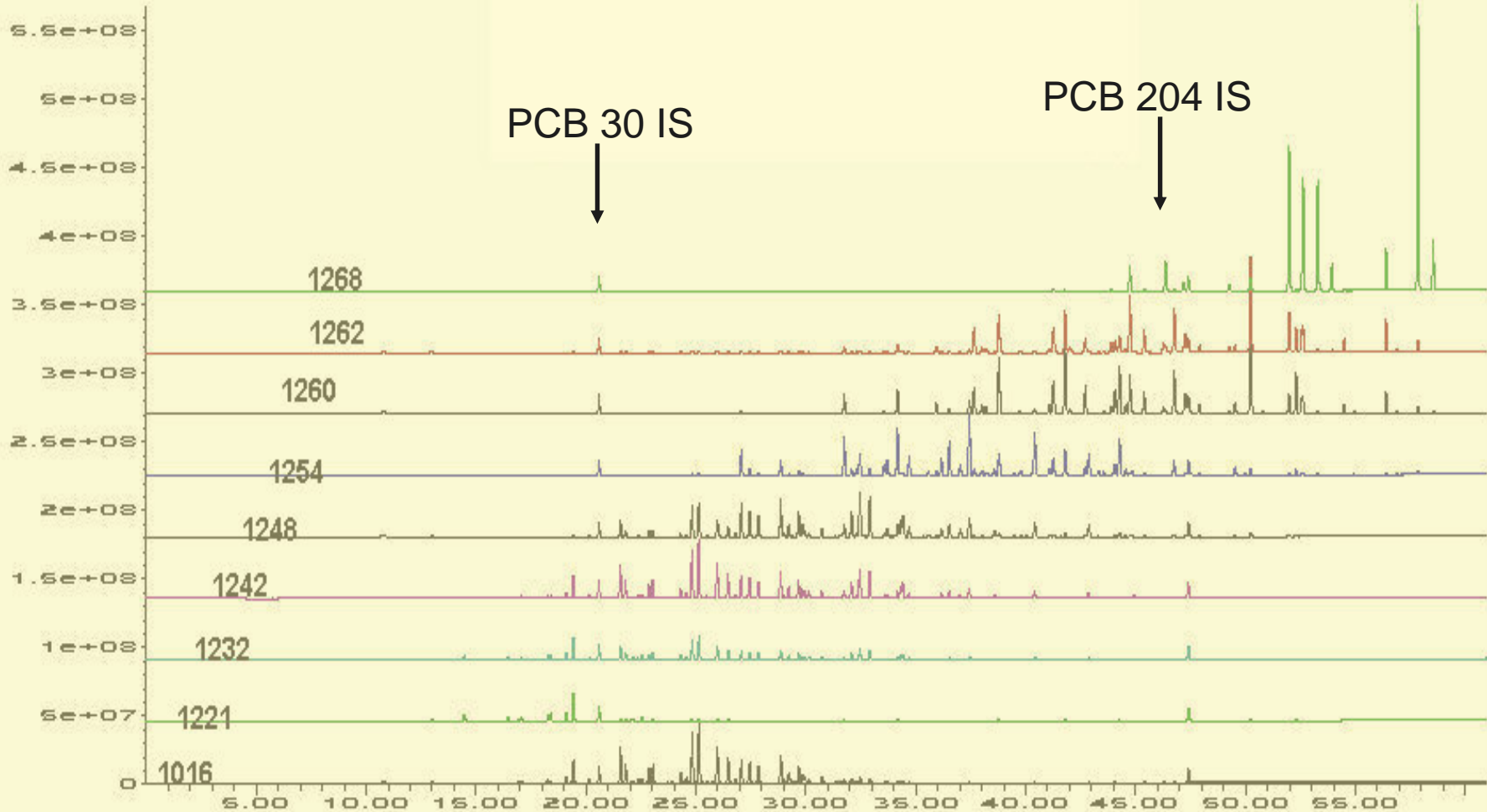
# HT8-PCB Window Mix

Different than for DB -5!

# of Cl	IUPAC#	RRT30	RRT209
1	1	0.624	0.165
	3	0.737	0.195
2	10	0.769	0.203
	15	1.127	0.298
3	19	0.970	0.256
	37	1.645	0.435
4	54	1.180	0.312
	<u>77</u>	2.252	0.595
5	104	1.476	0.390
	<u>126</u>	2.796	0.739
6	155	1.803	0.477
	169	3.320	0.877
7	188	2.309	0.610
	189	3.511	0.928
8	202	2.819	0.745
	205	3.669	0.970
9	208	3.376	0.892
	206	3.738	0.988
10	209	3.783	1.000

# Aroclor vs. Congener Specific Analysis

Response\_

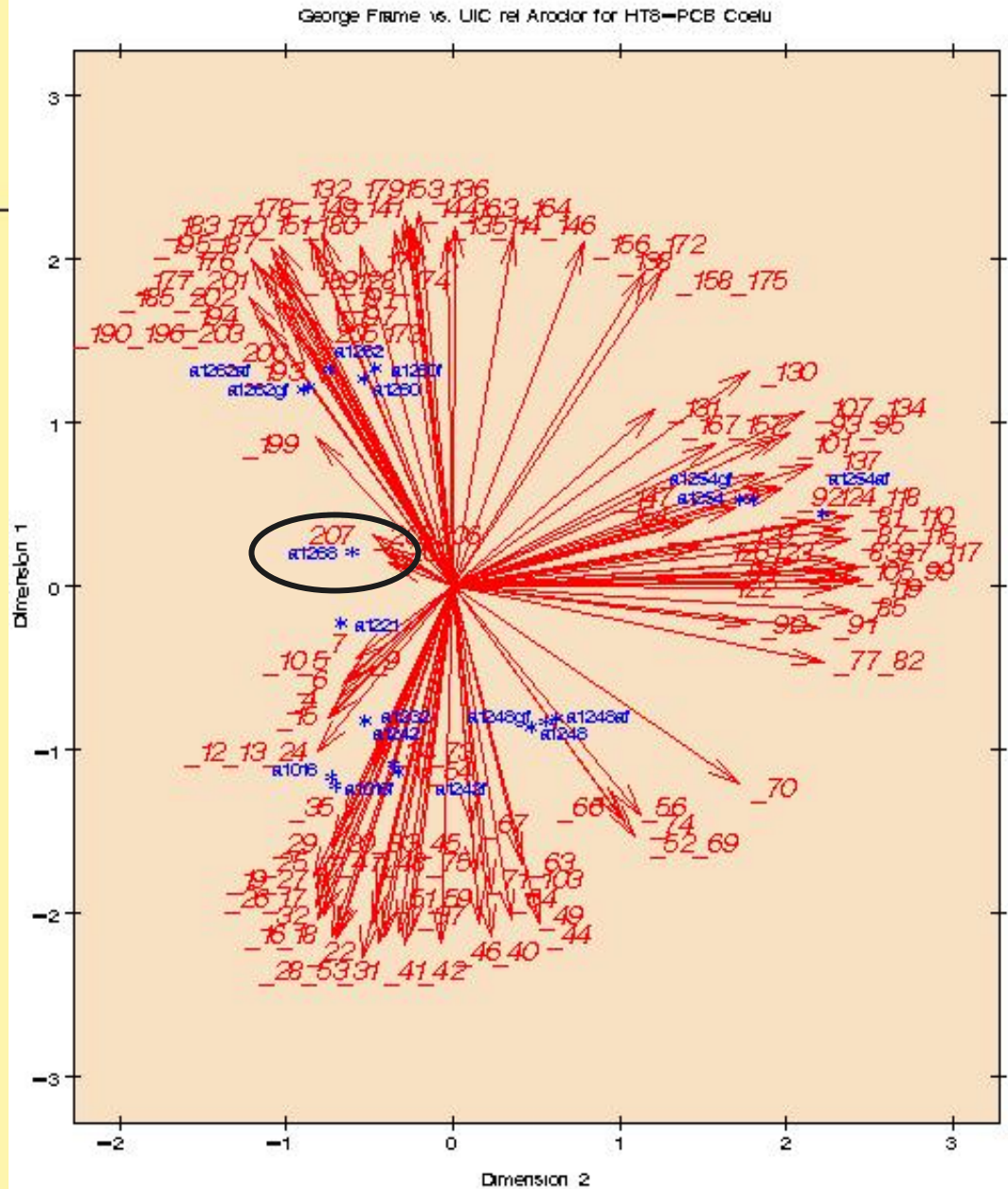


Time



## Principal Component Analysis:

- Observed Aroclor pattern matches with Frame for 1016-1262
- 1268 is different



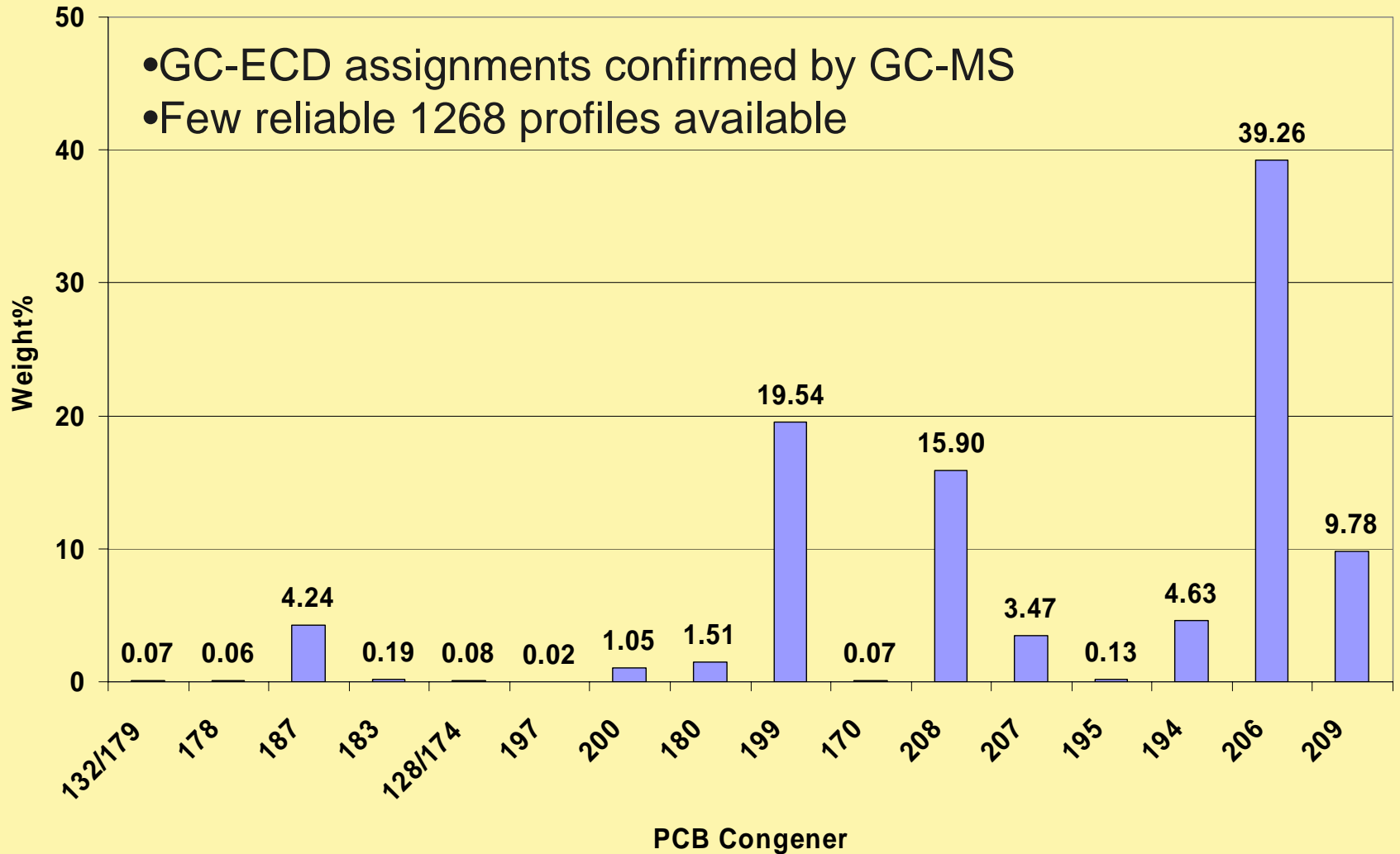
# Cosine Theta Similarity Matrix for Aroclors Published (Frame) vs. UIC Analysis

Frame Profiles

	a1016f	a1242f	a1248af	a1248gf	a1254af	a1254gf	a1260f	a1262af	a1262gf	a1268
a1016	<u>0.933649</u>	0.897073	0.61113	0.578959	0.036022	0.09925	0.005834	0.016308	0.008331	0
a1242	0.881333	<u>0.937972</u>	0.764618	0.747566	0.21871	0.223088	0.021578	0.022263	0.014121	0
a1248	0.638616	0.788444	<u>0.955516</u>	<u>0.948532</u>	0.46787	0.454819	0.078756	0.054711	0.048926	0.00099
a1254	0.096212	0.210091	0.489422	0.449613	0.863379	<u>0.952835</u>	0.477726	0.27666	0.290528	0.015989
a1260	0.003174	0.020312	0.06839	0.075015	0.3152	0.453994	<u>0.972482</u>	0.883667	0.902013	0.110661
a1262	0.040081	0.052358	0.076341	0.08714	0.204567	0.29706	0.906436	<u>0.969693</u>	<u>0.971362</u>	0.245032
a1268	0	4.69E-06	5.45E-05	0.00079	0.00238	0.004035	0.099013	0.202876	0.199387	1

Congener-specific totals can be expressed as Aroclor and compared to Aroclor Analysis result. Example: Congener specific result=700 pg/ $\mu$ L, Aroclor expected Result=780 (approx. 10% difference)

# Aroclor 1268 Congener Profile

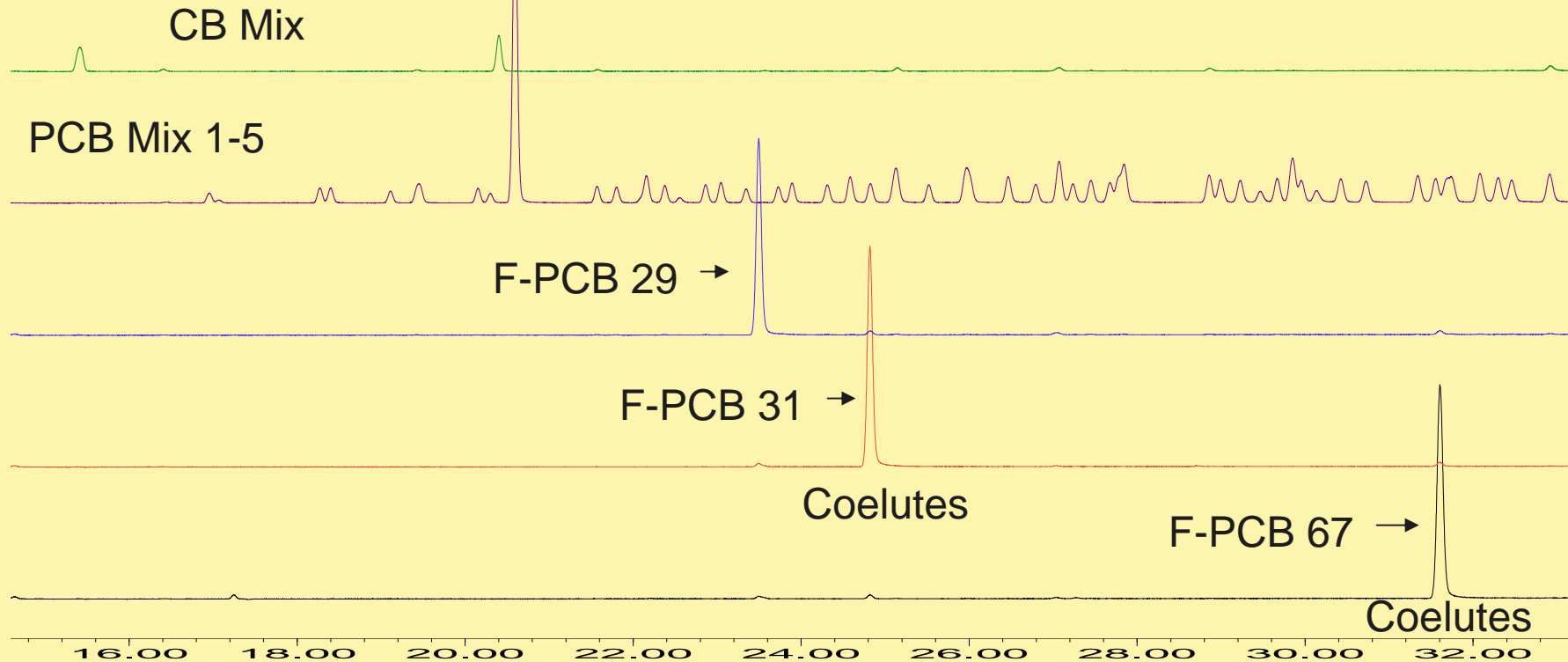




# F-PCB Studies

HT8-PCB 60m Column

Signal: ds040817-18.D\IECD1A.CH  
Signal: DS040817-17.D\IECD1A.CH (\*)  
Signal: DS040817-16.D\IECD1A.CH (\*)  
Signal: PCB MIX1-5WIS1PG.D\IECD1A.CH (\*)  
Signal: CBMIX1PG.D\IECD1A.CH (\*)





# Conclusions on HT8-PCB

- Good precision and accuracy
- Increased sensitivity
- Increased selectivity for coplanar PCBs
- Nearly 6X increase in analysis time
- Robust, thermally stable
- Currently appears to offer best combination of simplicity, speed, separation

# Acknowledgements

- Grant Funding Sources

- USEPA Region V
- USEPA HQ
- Illinois EPA

- Unnamed steel mill

- Facility access

- Tisch Environmental

- Donation of a HiVol Sampler to project

- Chiron Inc.

- Donation of F-PCBs

- SGE Inc.

- Donation of 60m HT8-PCB column, and others

- Mills Consulting Inc.

- Salary donation for Dr. Mills, Students, Consumables



*Disclaimer*

This presentation has not been reviewed or approved by any of the above groups.



# Questions

- Any questions or comments would be greatly appreciated!
- References available upon request

