Method optimization of fingermark residue using comprehensive two-dimensional gas chromatography

Emma Macturk, B.Sc., Katelynn A. Perrault Uptmor, Ph.D
M.S. Candidate at William & Mary
elmacturk01@wm.edu

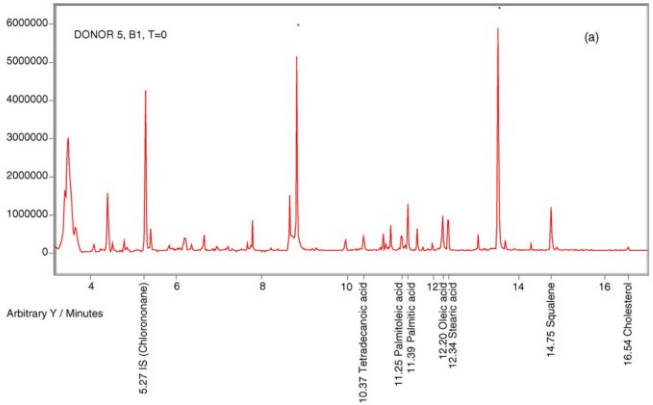
seplab.pages.wm.edu

@seplab_wm

Nontargeted Separations Laboratory WM

What is a fingermark?

- Fingermarks are incomplete or smudged fingerprints that cannot be used in suspect identification
- Chemical residue from fingerprints can provide donor class characteristics



Characteristic	Biomarker #1	Biomarker #2
Sex – female	Higher octadecanol conc.	Higher eicosanol conc.
Sex – male	Lower octadecanol conc.	Lower eicosanol conc.
Relative age – child	Higher cholesterol conc.	Higher free fatty acid conc.
Relative age – adult	Higher squalene conc.	

Primeau et al., *Journal of Forensic Sciences* 68 (2023).
N.E. Archer et al. *Forensic Science International* 154 (2005) 224–239.

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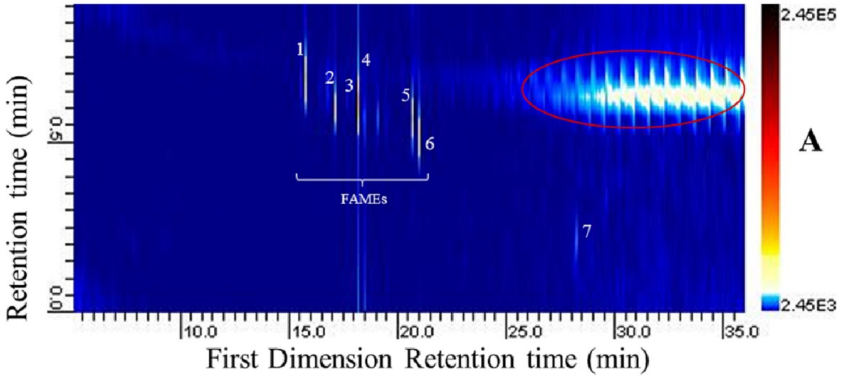

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Kindell & Bridge, *Forensic Chemistry* 32 (2023).

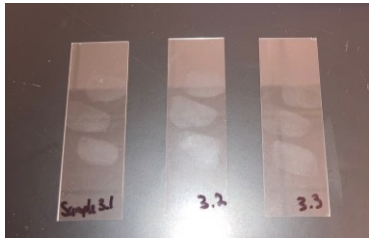
Study Goals

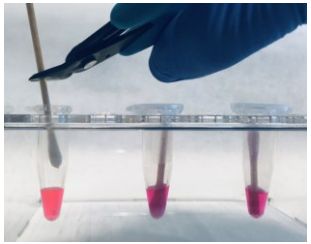
1. To optimize a GC×GC method for nontargeted identification of fingermark residue compounds

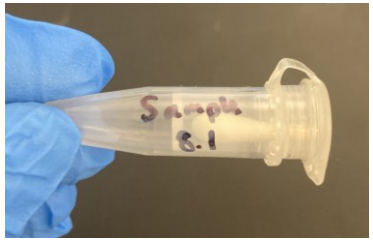
2. To translate that optimized helium method to a usable and efficient method using hydrogen gas

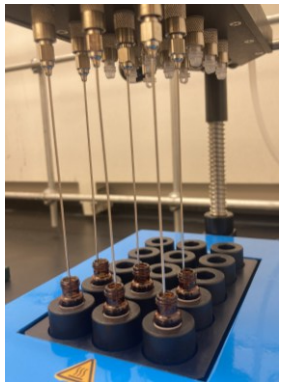
Extraction Methods

Fingermark donation → Cotton swab extraction → Centrifugation in spin baskets → Sample blow down → Sample reconstitution









Method Optimization Parameters

Parameter	Option A	Option B	Option C
Modulation Period	3 s	4 s	5 s
Hot Pulse Time	1 s	1.2 s	1.5 s
Hold Time at Oven Start	1 min	2 min	5 min
Hold Time at Oven End	8 min	10 min	12 min
Oven Ramp Rate	5 °C	10 °C	15 °C
Secondary Oven Offset	5 °C	10 °C	N/A

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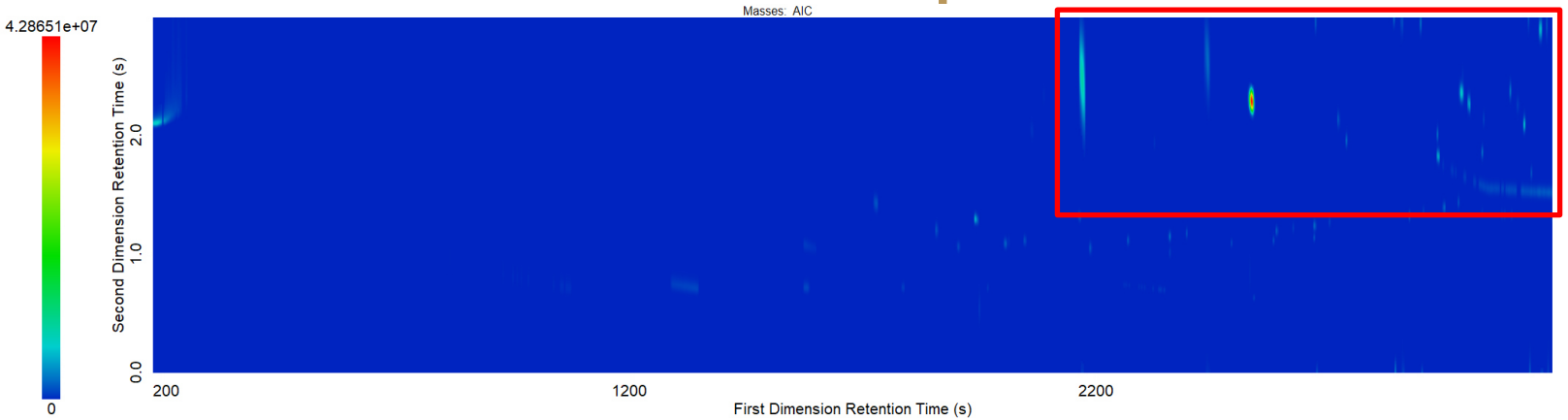
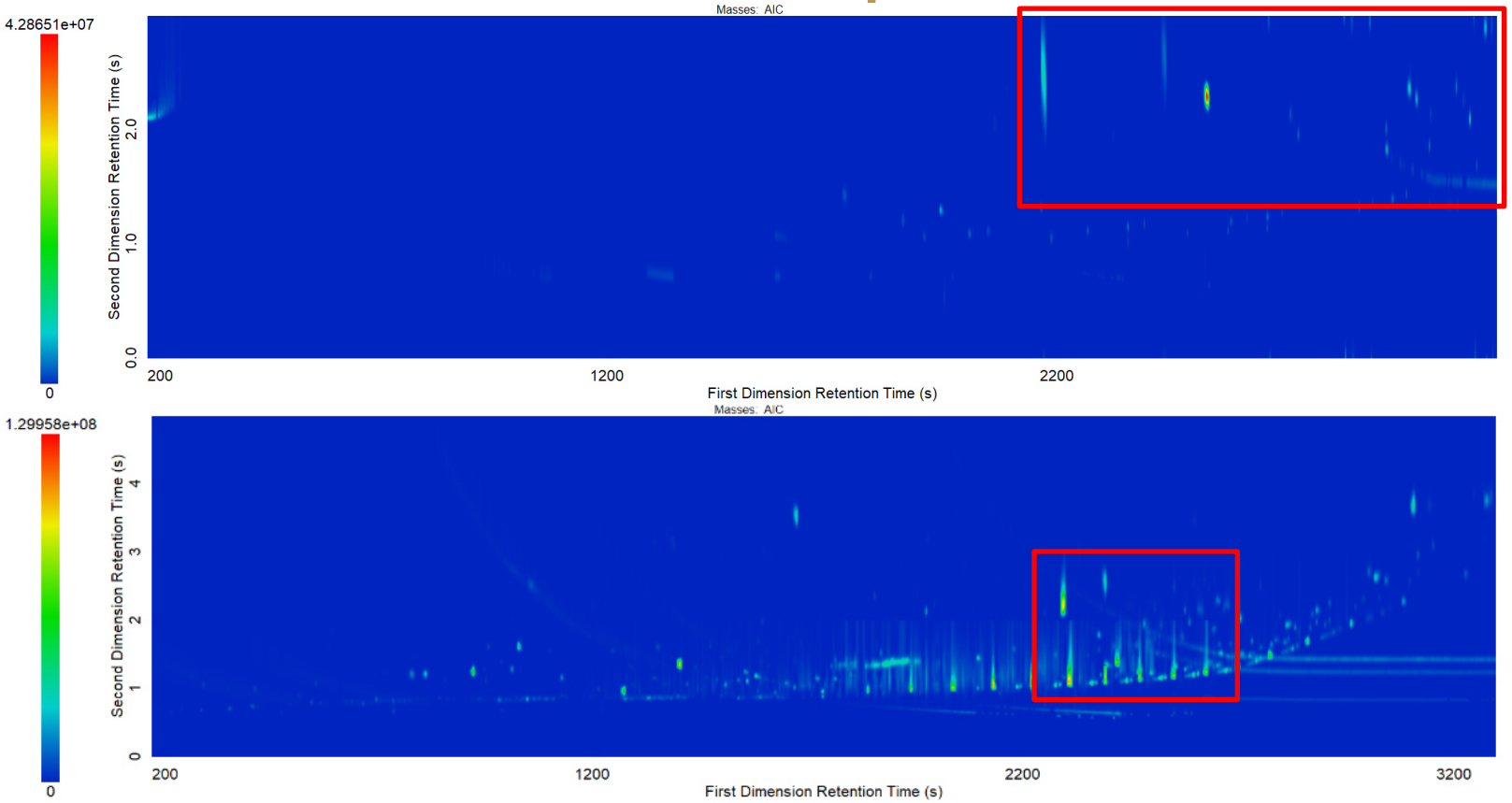
Before Method Optimization

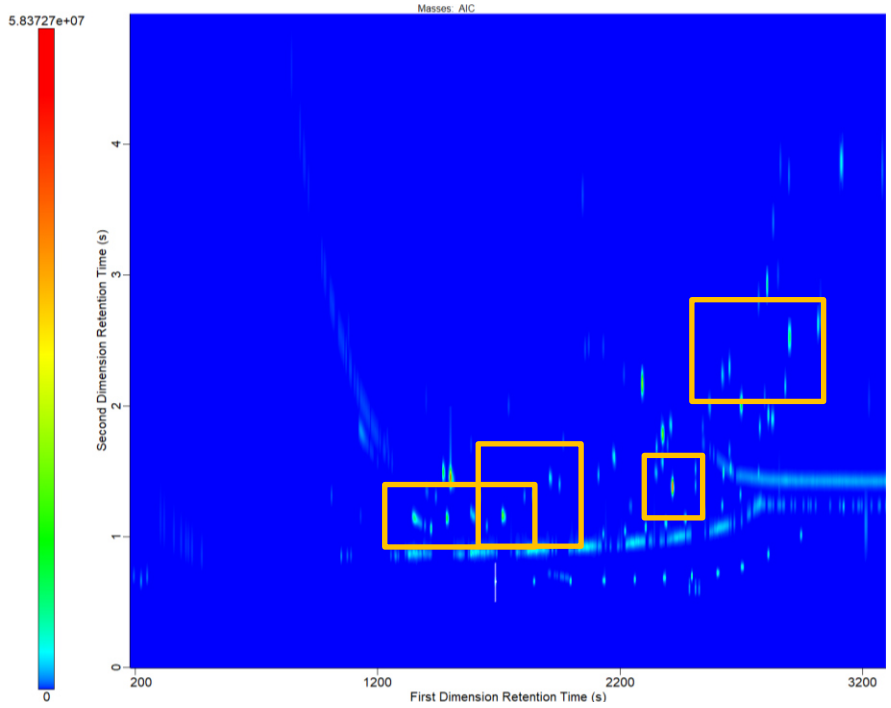


After Method Optimization



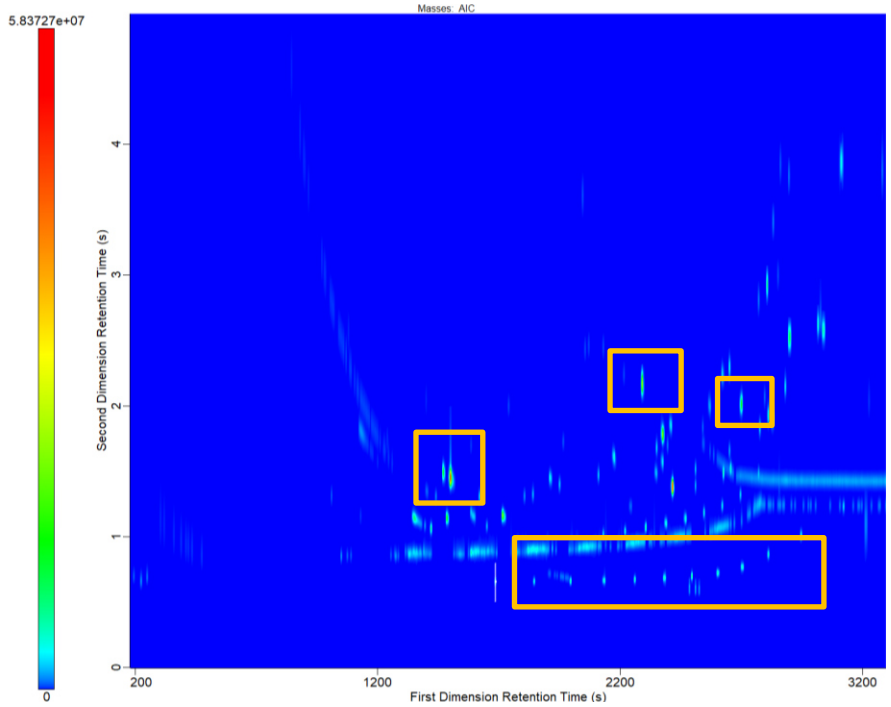
Nontargeted Compound Class Identities

- Sterols and precursors
- Fatty acid methyl esters
- Fatty alcohols
- Steroids



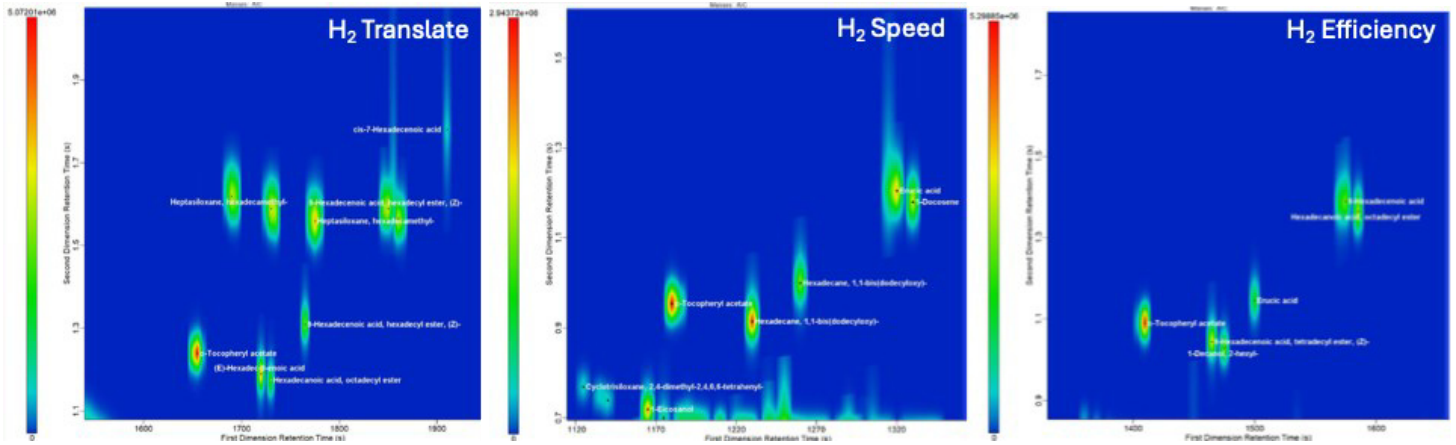
Unexpected Anthropogenic Compounds

- Octocrylene
- Octisalate
- Avobenzone
- Diisopropyl adipate
- α-Tocopherol acetate
- Phthalates



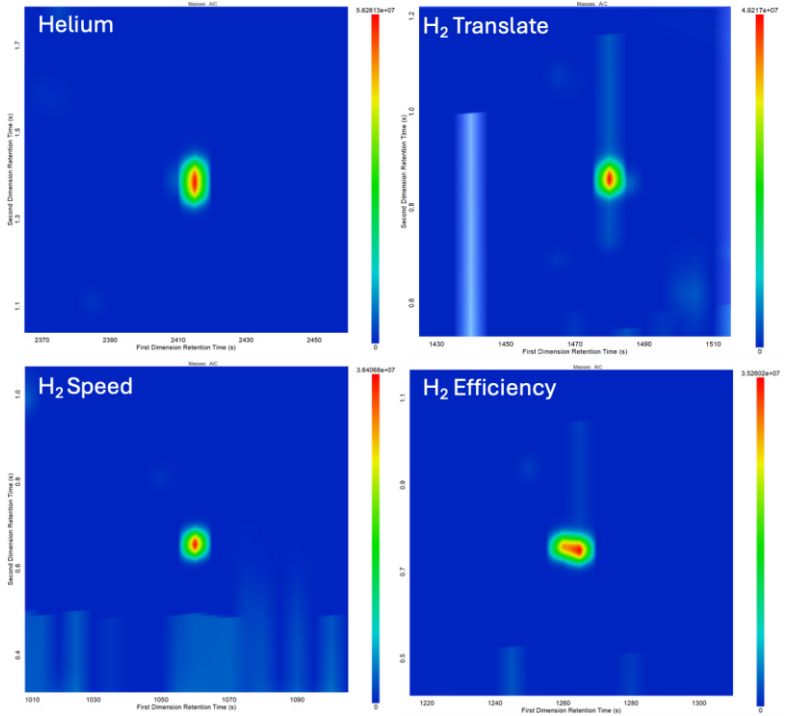
Translation to Hydrogen Gas Method

- Translation of reference helium method to hydrogen gas using Restek modeler
- All three hydrogen gas methods can comparably resolve congested chromatographic areas similar to helium



Translation to Hydrogen Gas Method

- Comparison of squalene and cholesterol peak shape favor the “translate” and “speed” methods
- H_2 Translate was chosen as the optimal method due to greatest number of identifiable peaks



Conclusions

1. Nontargeted analysis allows us to probe further into the chemical composition of a fingermark
2. Successful resolution of endogenous and exogenous compounds is possible with ample peak capacity for forensic applications
3. Comparable success in translating an optimized helium gas method to a method using hydrogen gas

Questions?

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