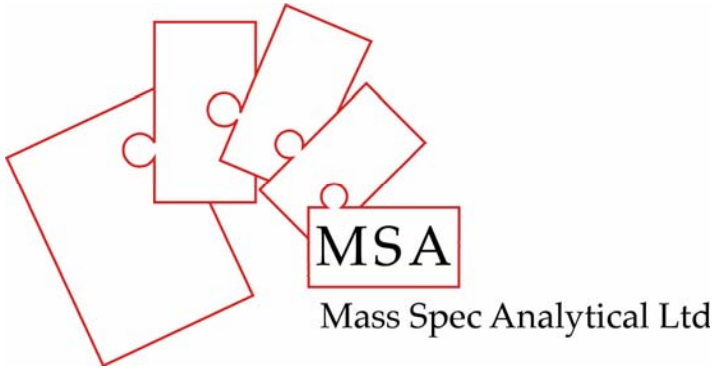
Bulk and compound specific isotopic characterisation of illicit drugs (heroin) and drug packaging

Fay Idoine, Jim Carter, Richard Sleeman



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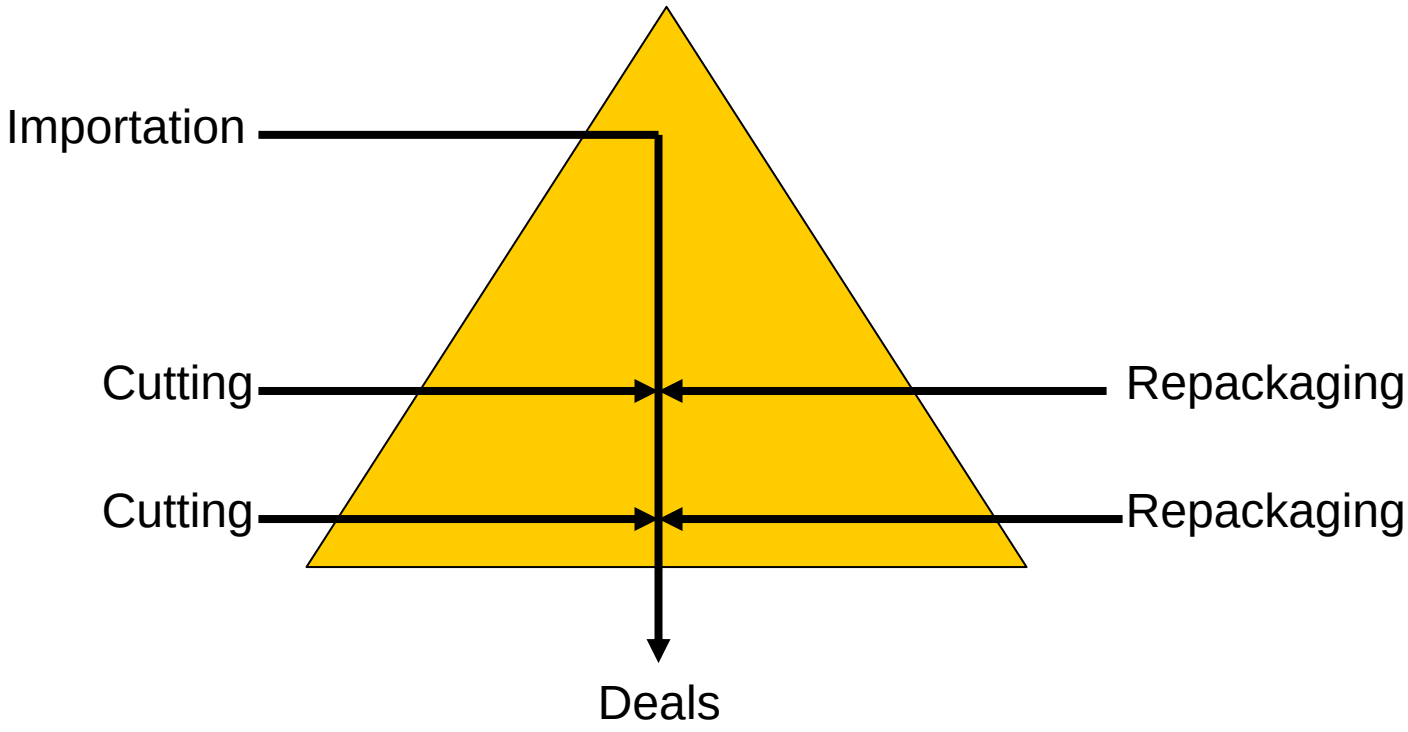

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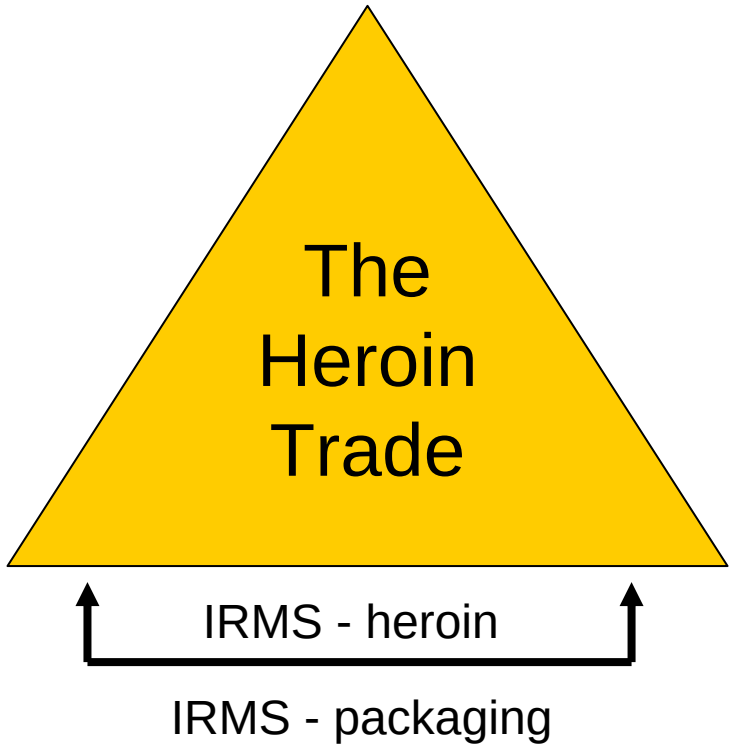
Bulk IRMS Analysis



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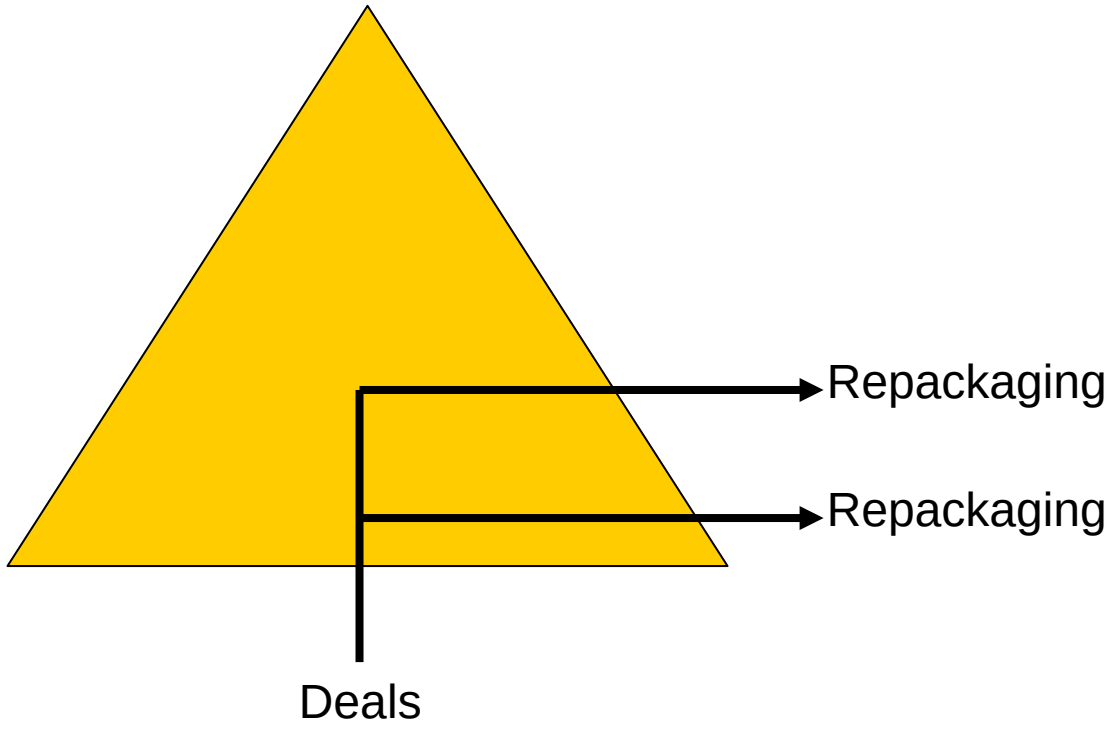
Bulk IRMS Analysis



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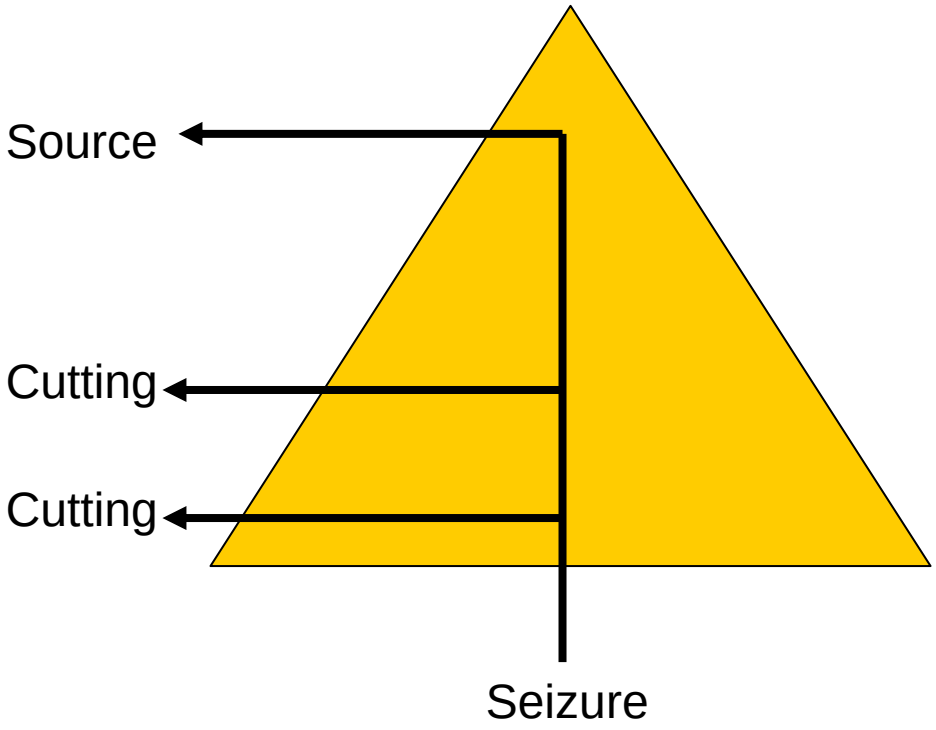
Compound specific GC-IRMS Analysis



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IRMS
vs
“classical”

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IRMS
vs
“classical”

Visual appearance (particle size)
Diacetylmorphine content (%)
Alkaloid profile
Presence of diluents

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IRMS
vs
“classical”

Bulk heroin - $\delta^{2}H$ / $\delta^{13}C$ / $\delta^{15}N$ / $\delta^{18}O$
Packaging - $\delta^{2}H$ / $\delta^{13}C$ / $\delta^{18}O$
Compound specific heroin - $\delta^{2}H$ / $\delta^{13}C$

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Seized Heroin Samples

13 heroin exhibits supplied by
Avon and Somerset Constabulary
Scientific Investigations

1 In-house reference

1 exhibit = 1 x “wrap”
1 exhibit = 2 x “wrap”
1 exhibit = 3 x “wrap”
1 exhibit = “drug bubble”

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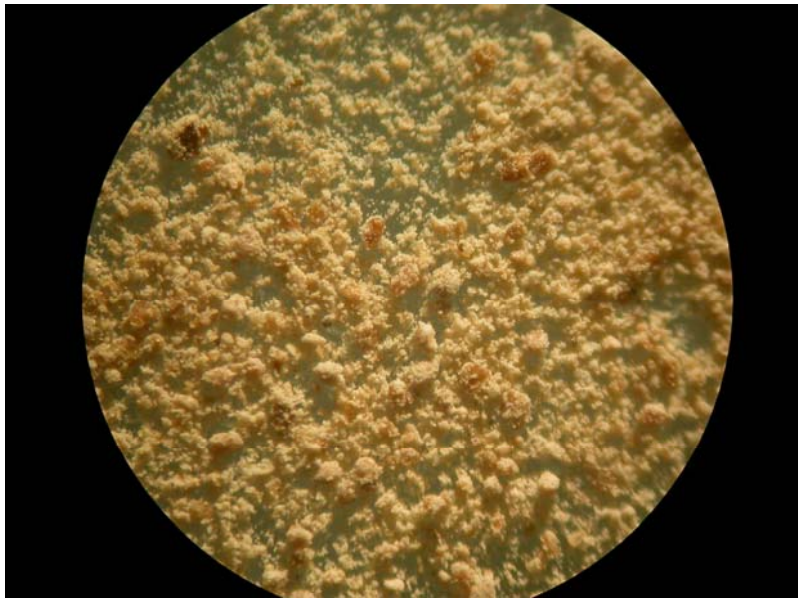
Visual appearance



“A pale brown inhomogeneous powder”

Suggests an origin in south west Asia

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Visual appearance

“A pale brown smooth ellipsoidal pill”

Drug bubble

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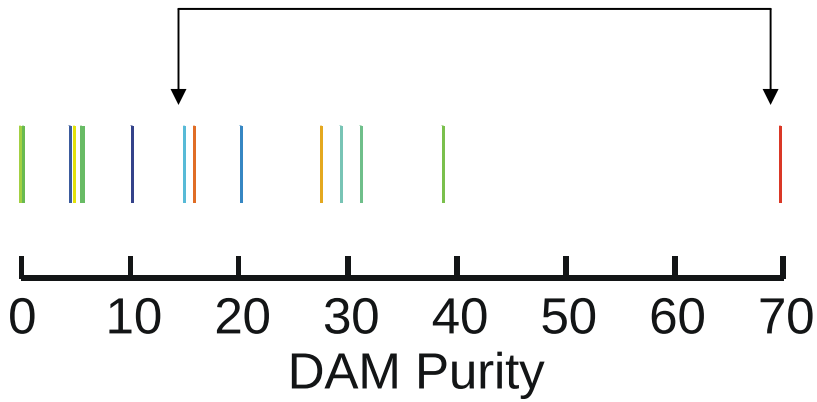
Diacetylmorphine purity

DAM purity 0.0 to 69.7%



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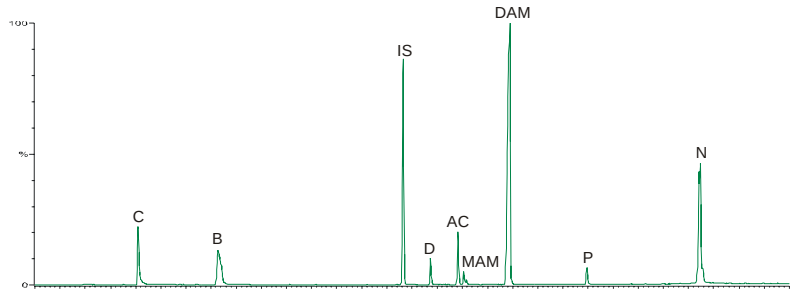
Alkaloid composition (diluents)



A - ACETAMINOPHEN
AC - ACETYL CODEINE
B - PHENOBARBITAL
C - CAFFEINE
D - DIAZEPAM
G - GRISOEFULVIN
IS - INTERNAL STANDARD (C24)
MAM - MONOACETYLMORPHINE
N - NOSCAPINE
P - PAPAVERINE

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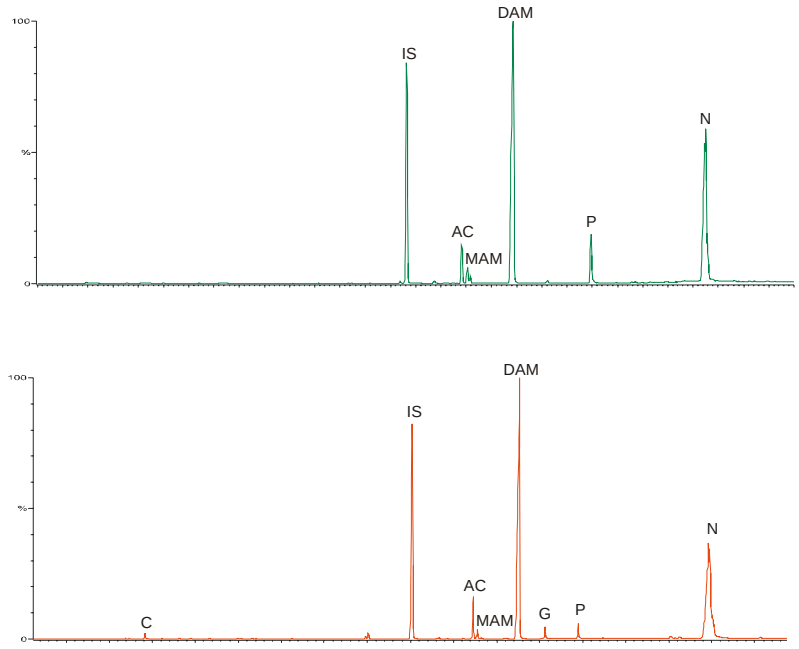
Alkaloid composition (diluents)



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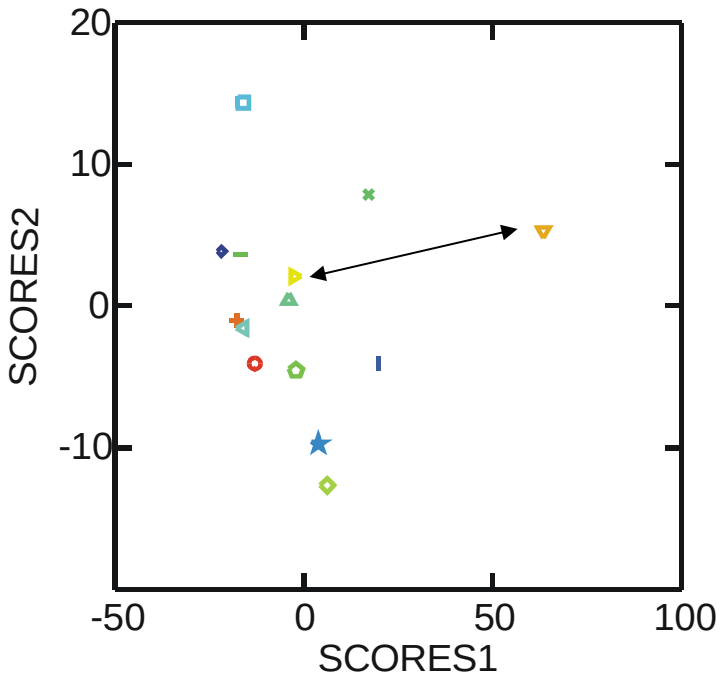
Alkaloid composition (diluents)



3 principle components encompassing 99.14% data

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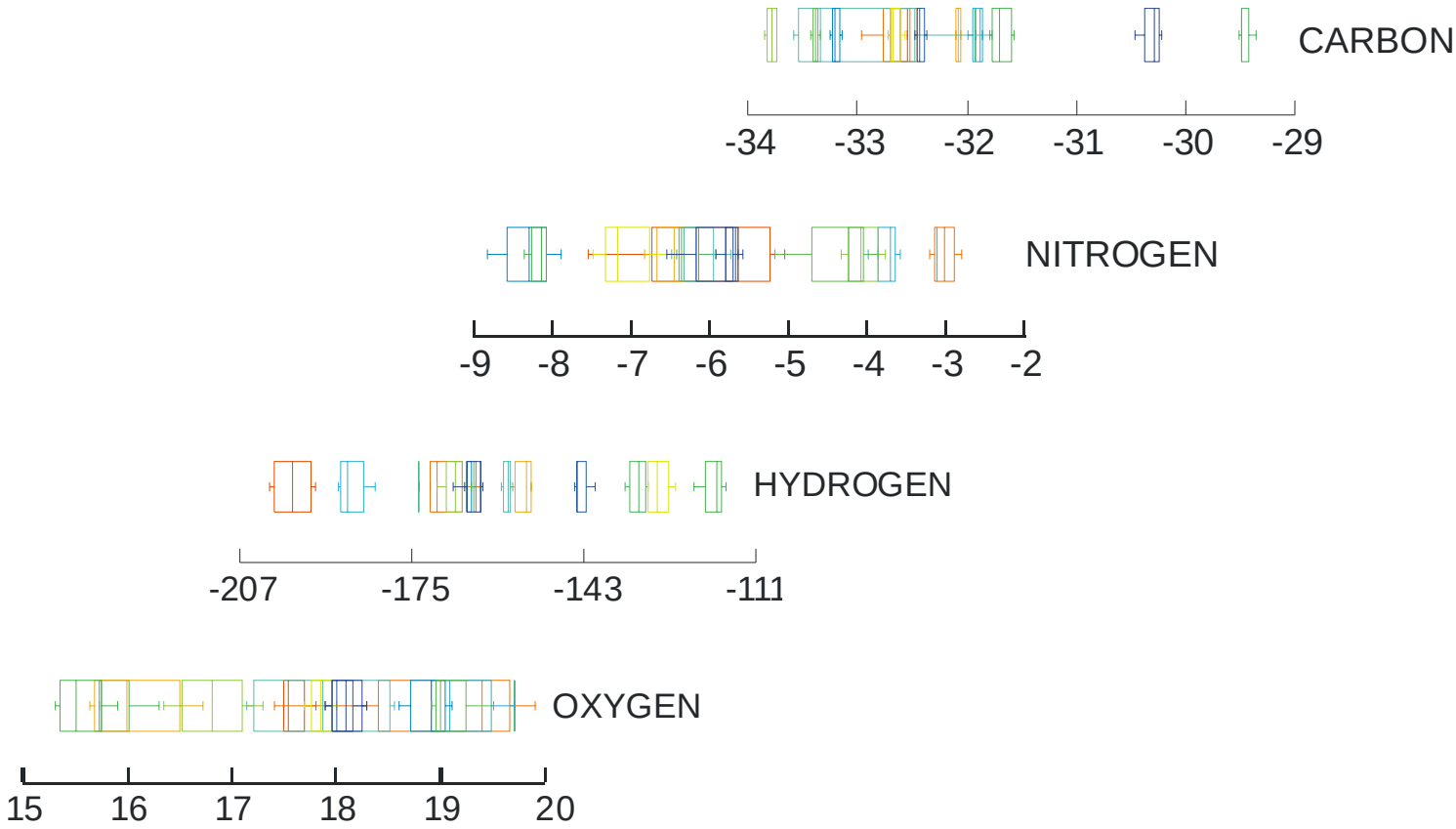
IRMS – bulk heroin



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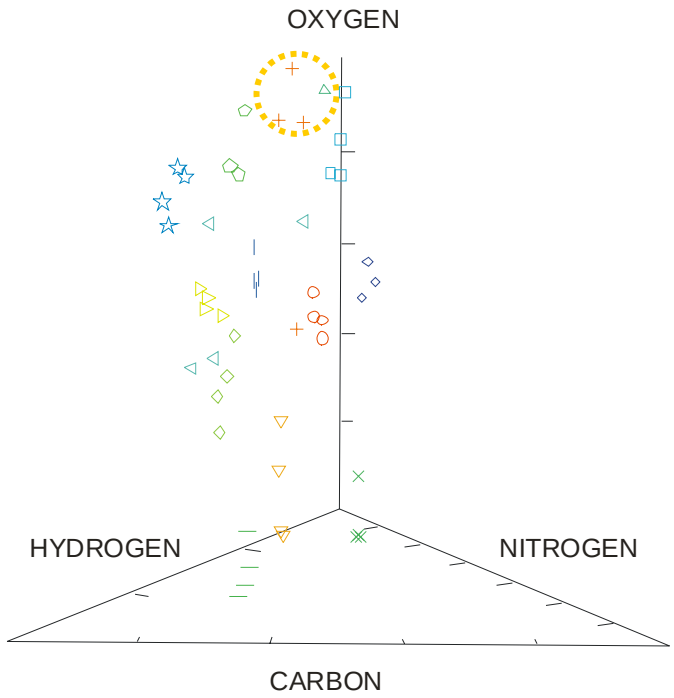
IRMS – bulk heroin



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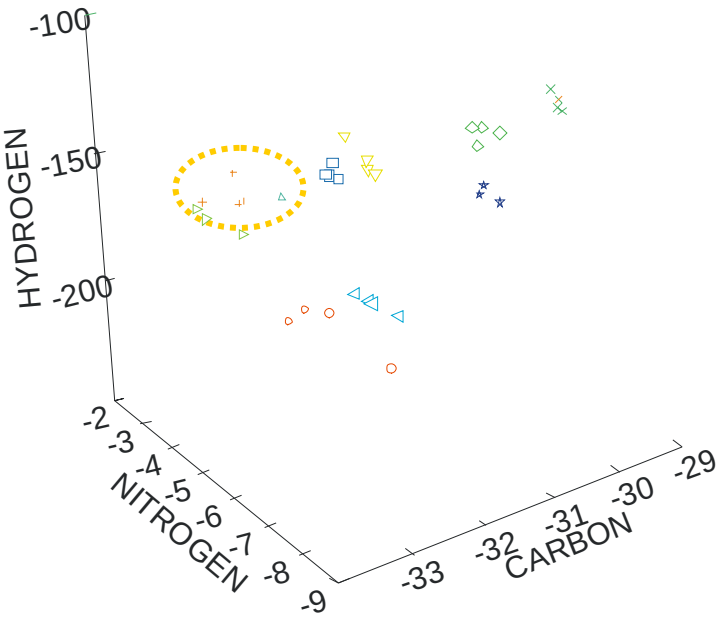
IRMS – bulk heroin



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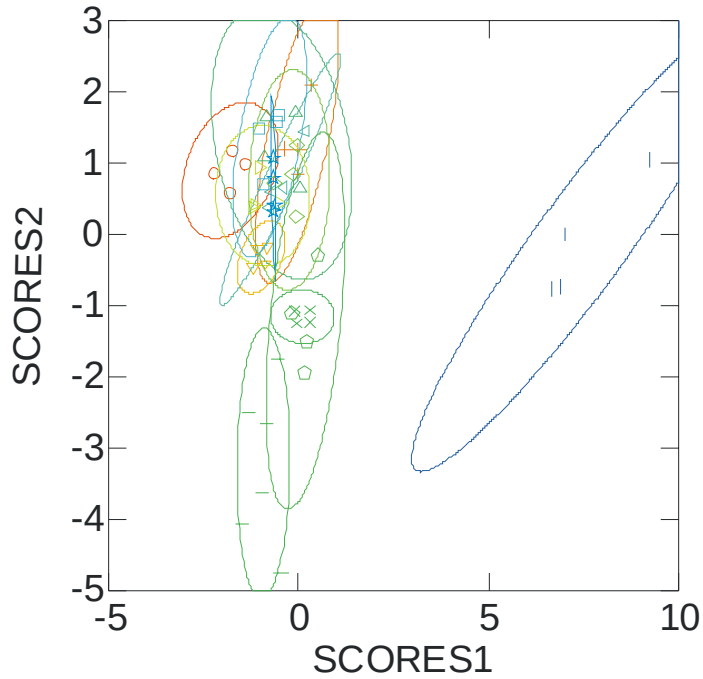
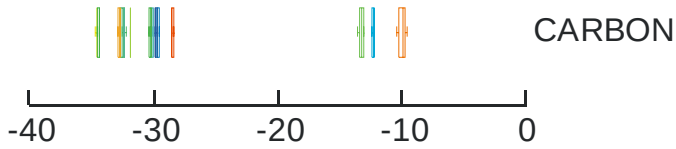
IRMS – bulk heroin

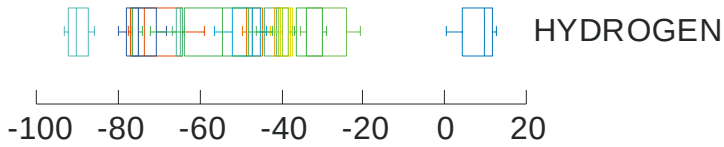


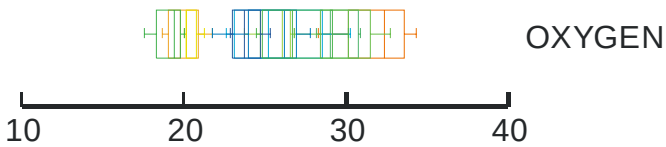
3 principle components encompassing 89.1% data

IRMS – bulk clingfilm

15 background clingfilm samples

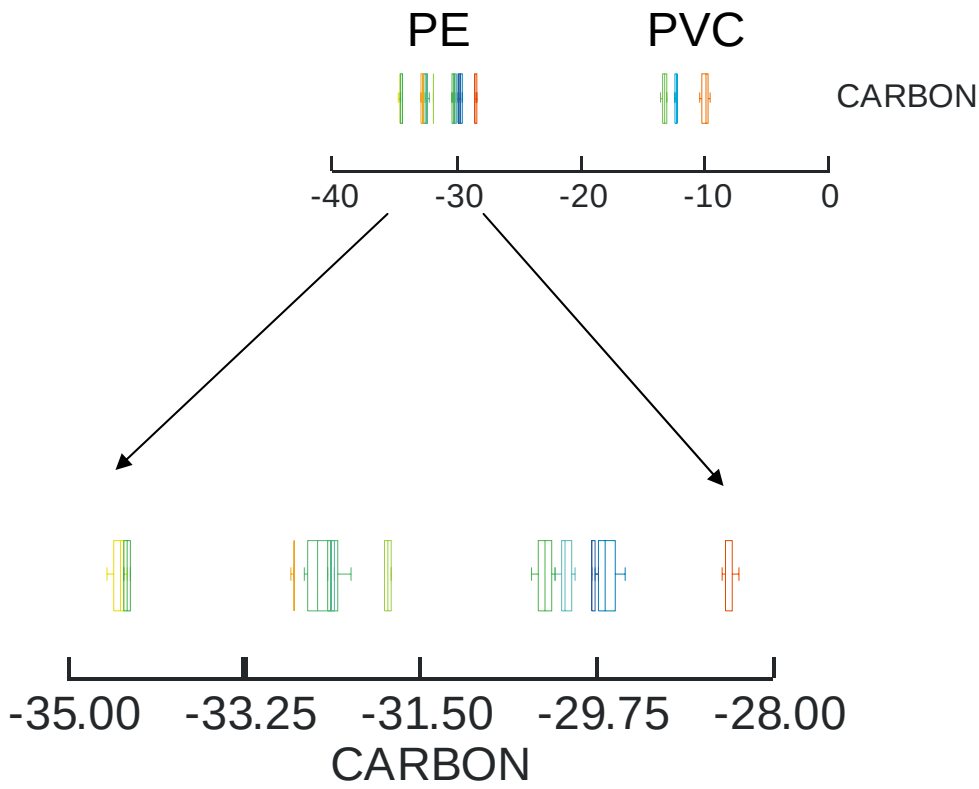






IRMS – bulk clingfilm

15 background clingfilm samples



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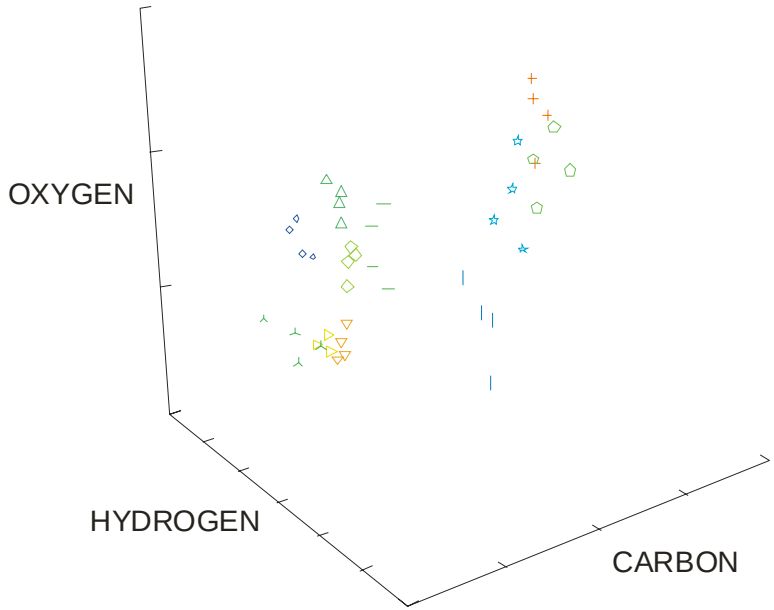
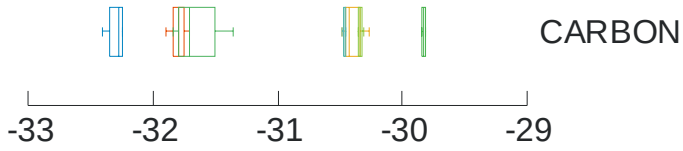
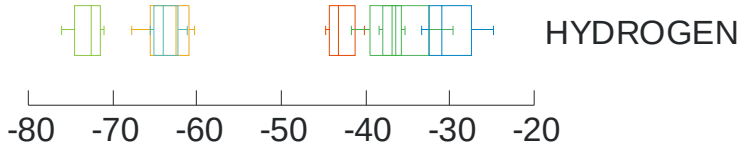
IRMS – bulk clingfilm

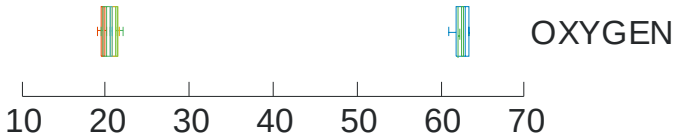


IRMS – bulk clingfilm

7 exhibit clingfilm samples







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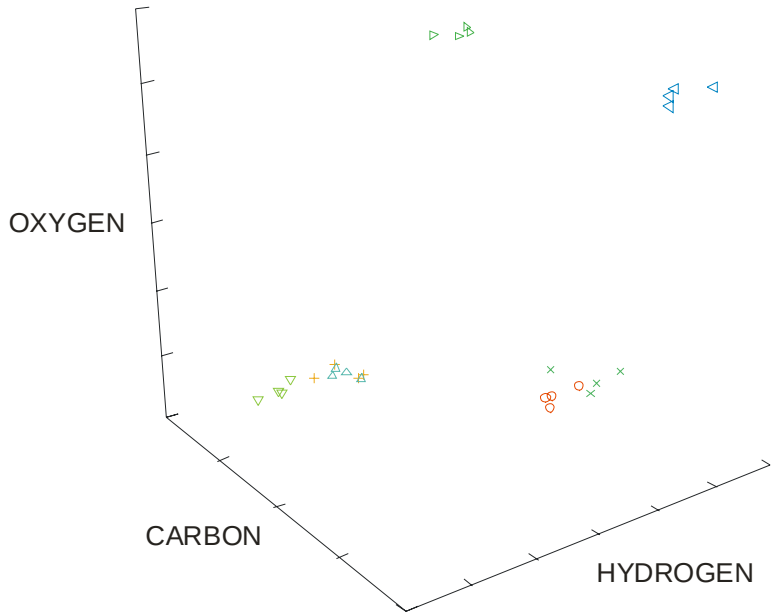
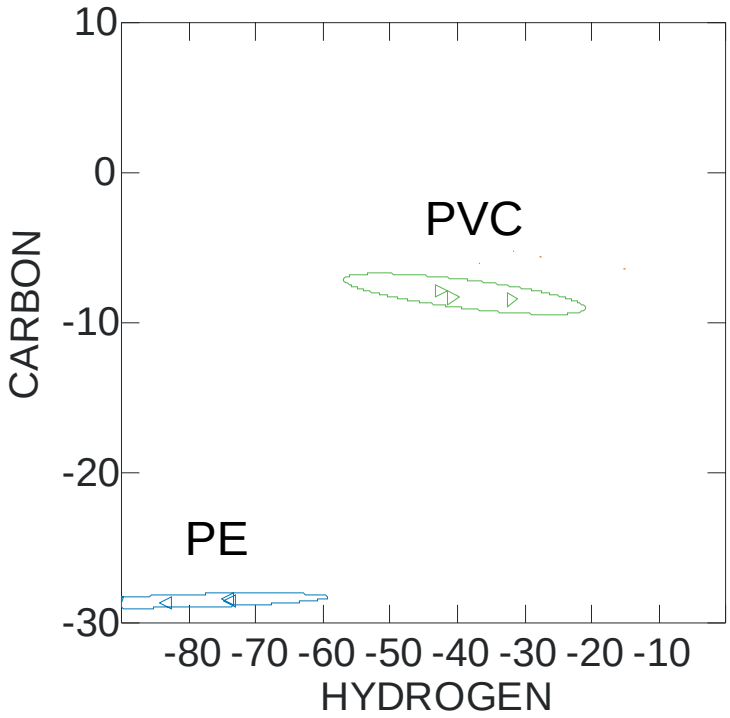
IRMS – bulk clingfilm

7 exhibit clingfilm samples



IRMS – bulk clingfilm

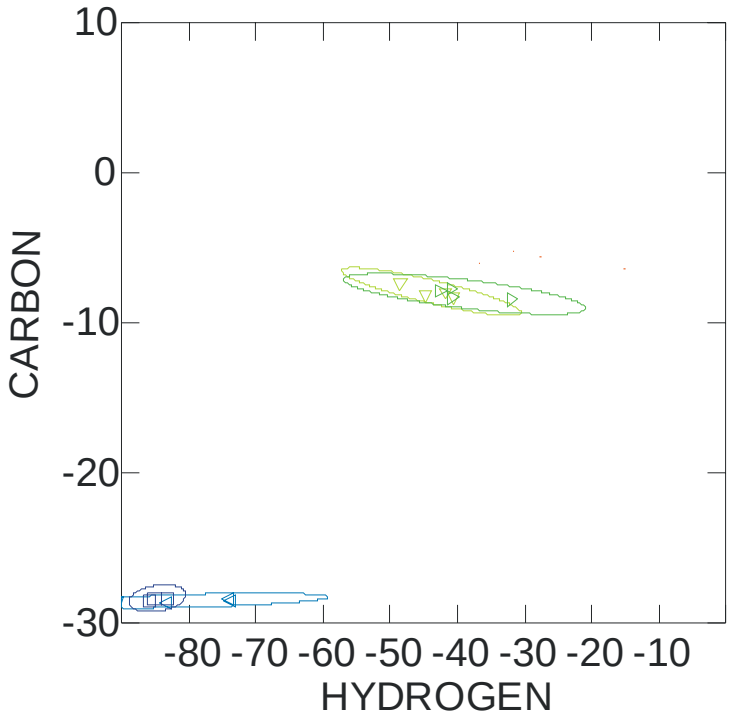
An aside – what happens when you wash clingfilm ?



Unwashed clingfilms

IRMS – bulk clingfilm

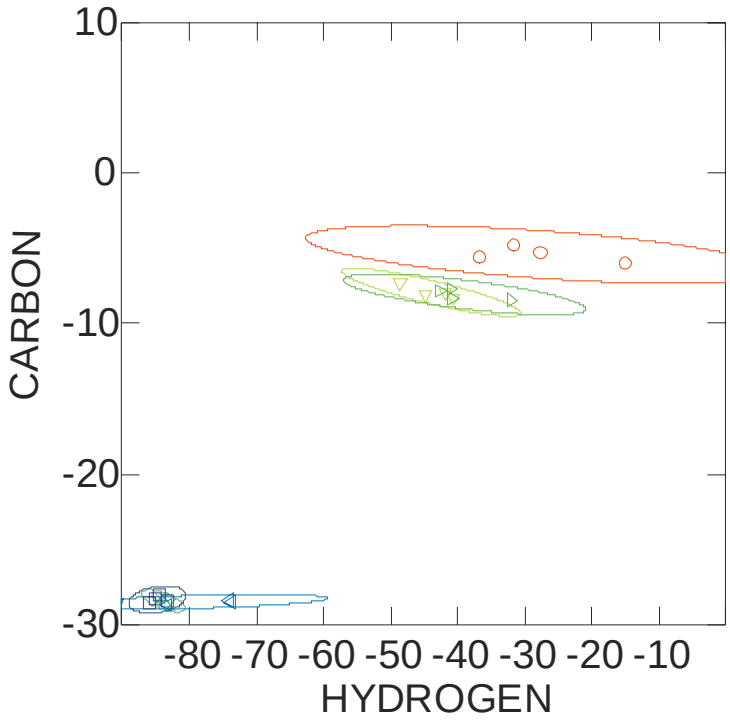
An aside – what happens when you wash clingfilm ?



Water washed clingfilms

IRMS – bulk clingfilm

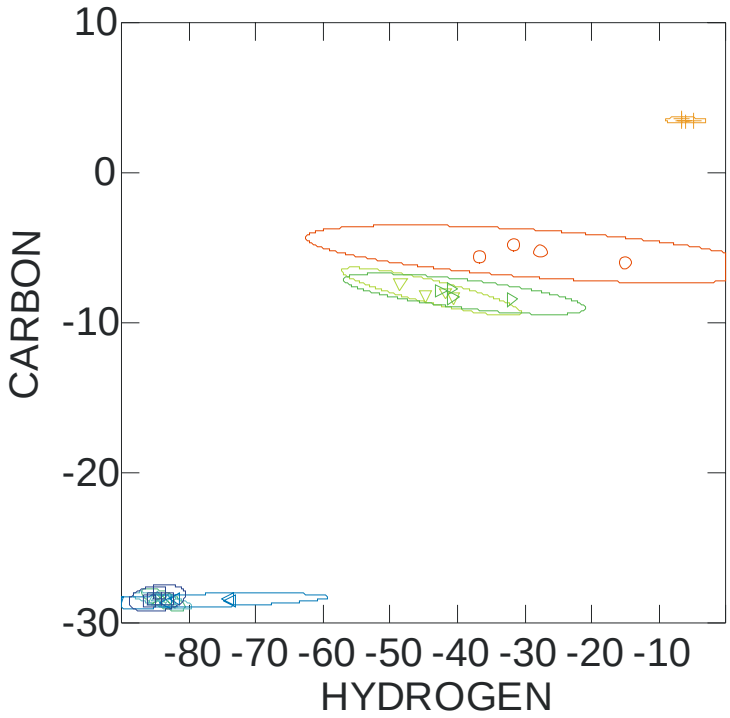
An aside – what happens when you wash clingfilm ?



Methanol washed clingfilms

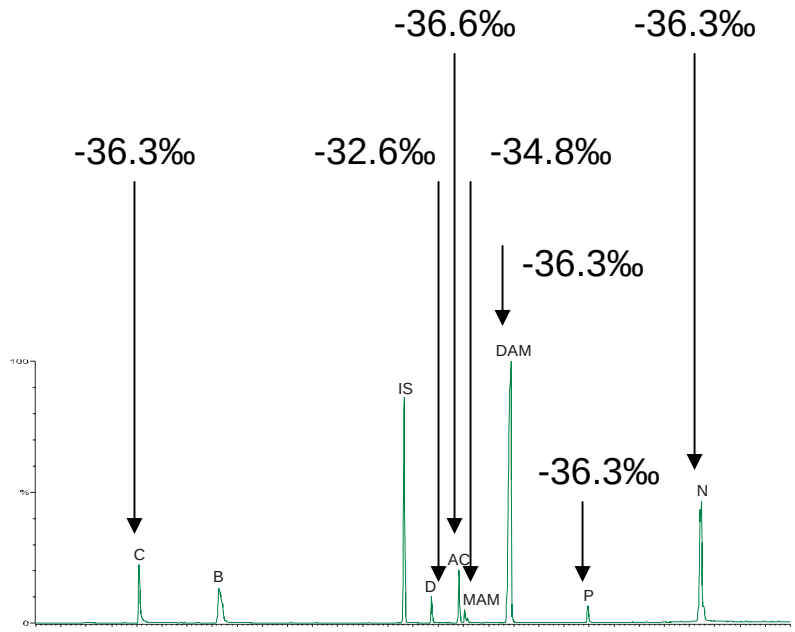
IRMS – bulk clingfilm

An aside – what happens when you wash clingfilm ?



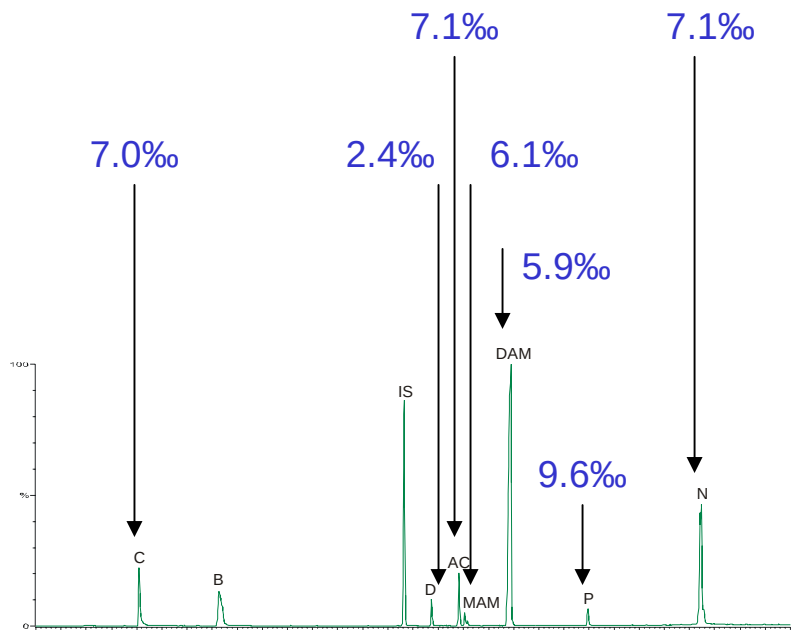
Chloroform washed clingfilms

GC-IRMS – $\delta^{13}C$



N/P	n= 76
MAM/DAM/AC	n= 66
Caffeine	n= 57
Morphine	n= 4

GC-IRMS – $\delta^{13}C$



N/P	n= 76
MAM/DAM/AC	n= 66
Caffeine	n= 57
Morphine	n= 4

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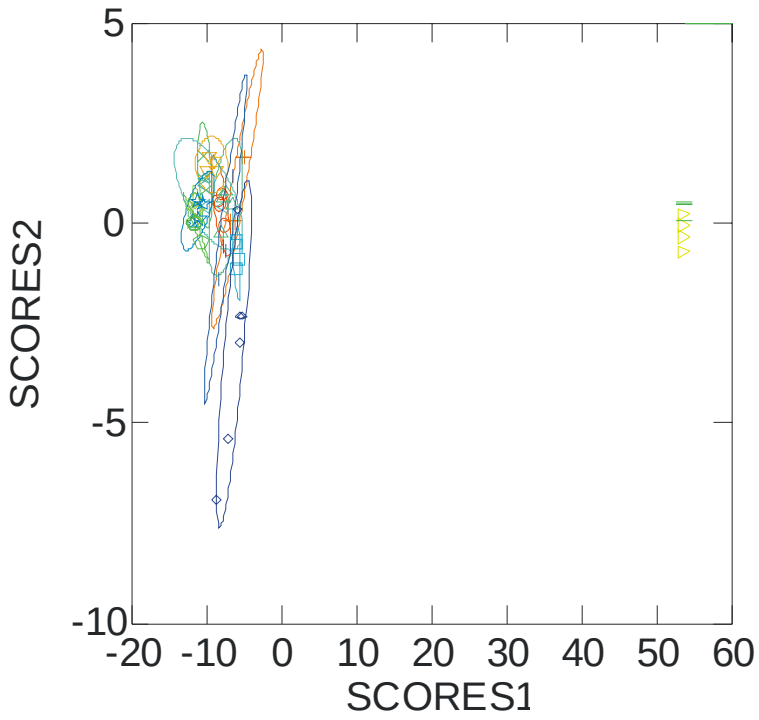
GC-IRMS – $\delta^{13}C$

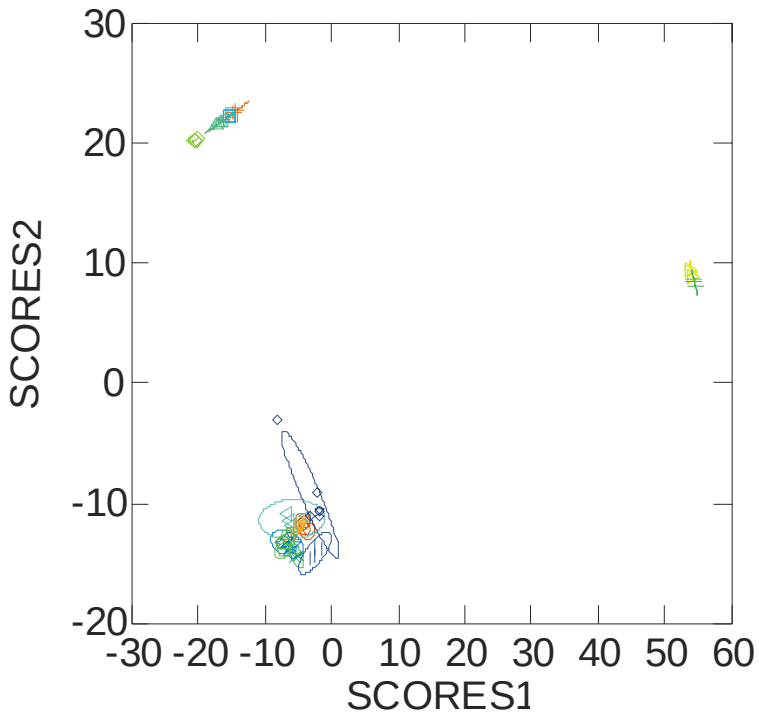
Excluding caffeine



3 principle components
encompassing 99.5% data

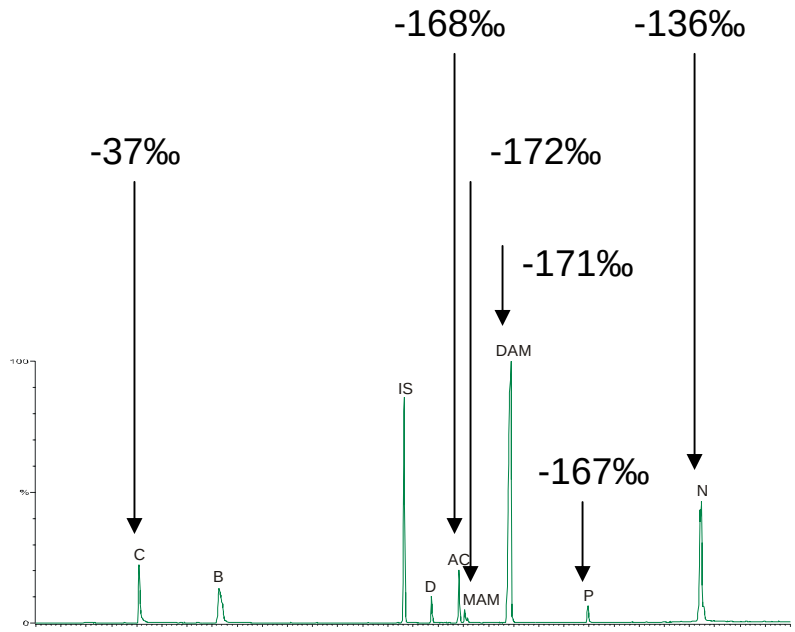
GC-IRMS – $\delta^{13}C$

Including caffeine



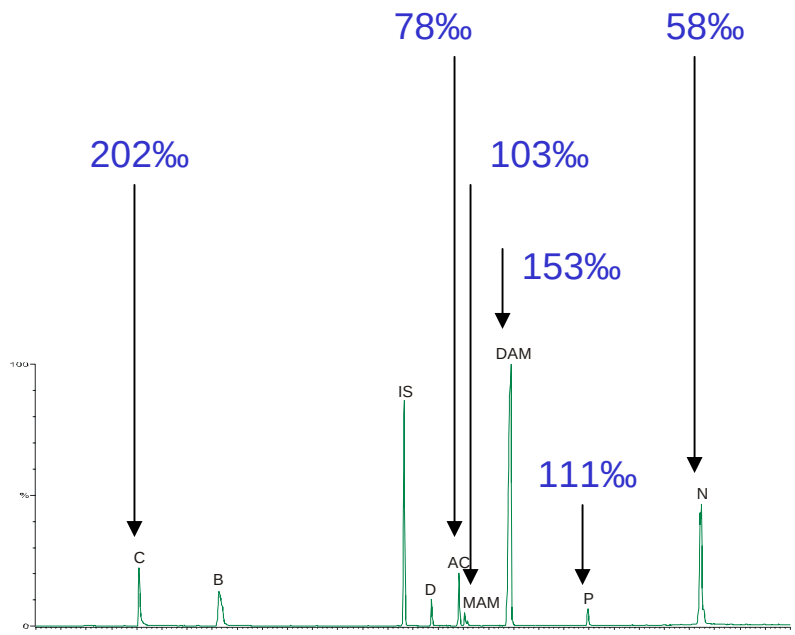
3 principle components
encompassing 99.6% data

GC-IRMS – δ^2H



N/P	n= 76
MAM/DAM/AC	n= 66
Caffeine	n= 57
Morphine	n= 0

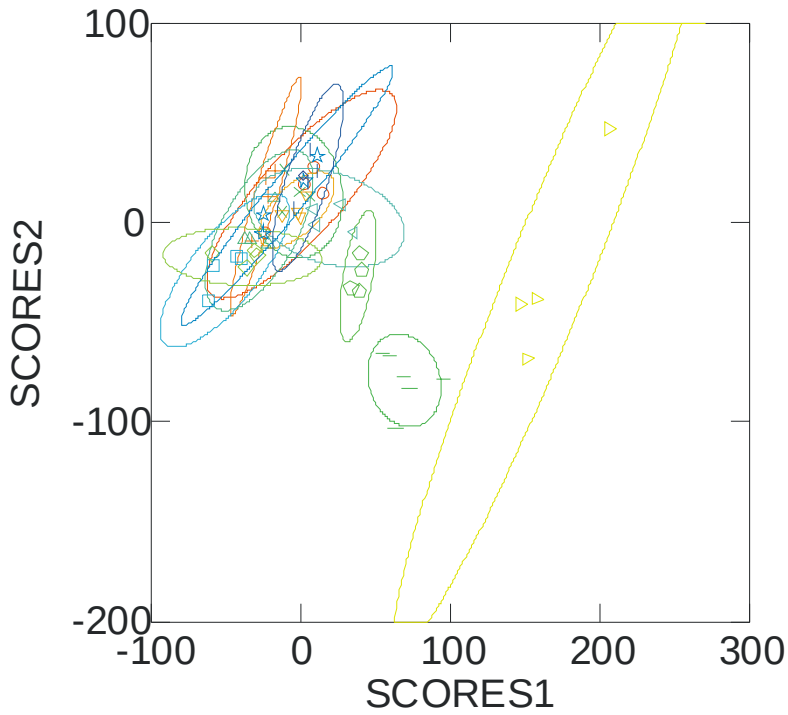
GC-IRMS – δ^2H



N/P	n= 76
MAM/DAM/AC	n= 66
Caffeine	n= 57
Morphine	n= 0

GC-IRMS – δ^2H

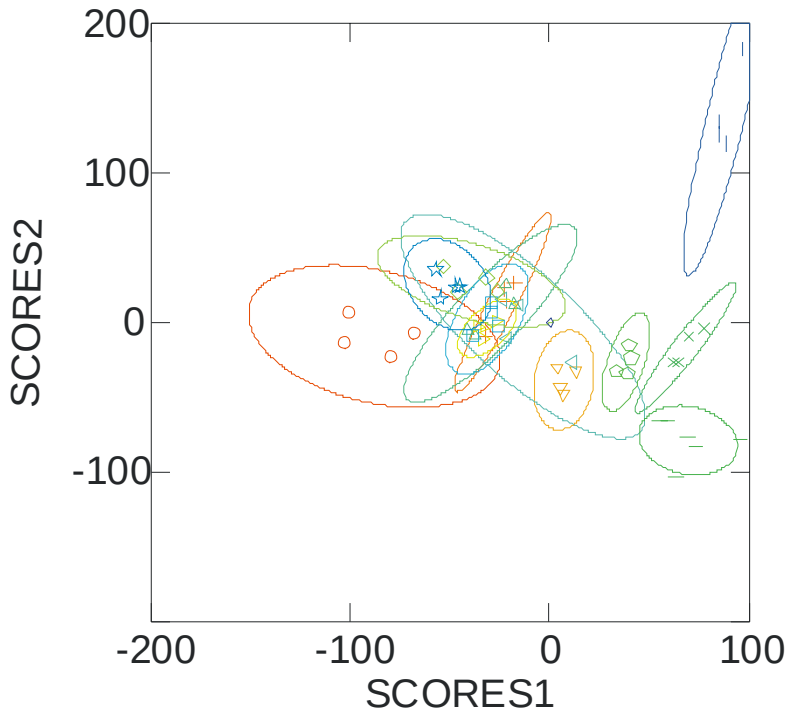
Excluding caffeine



3 principle components encompassing 92.2% data

GC-IRMS – δ^2H

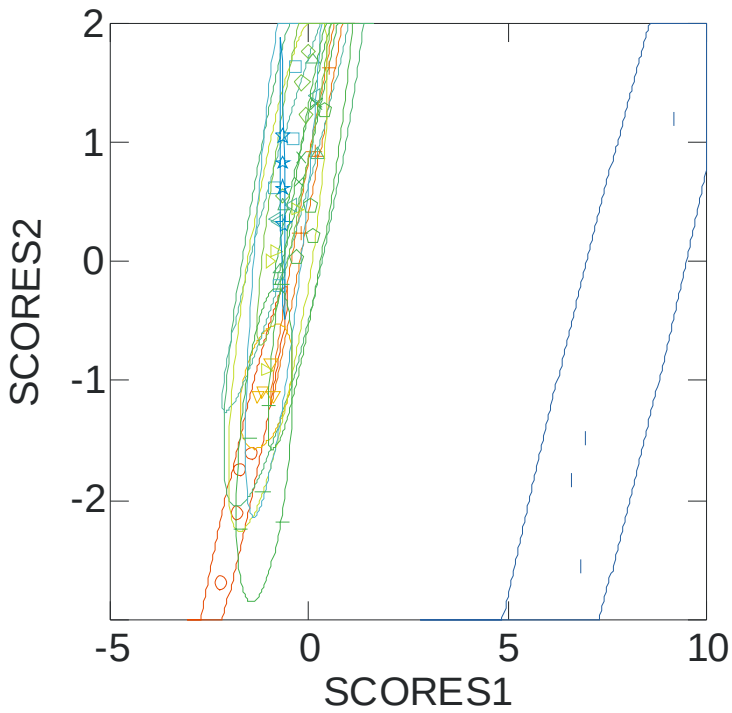
Including caffeine



3 principle components encompassing 92.6% data

GC-IRMS – $\delta^{13}C$ and $\delta^{2}H$

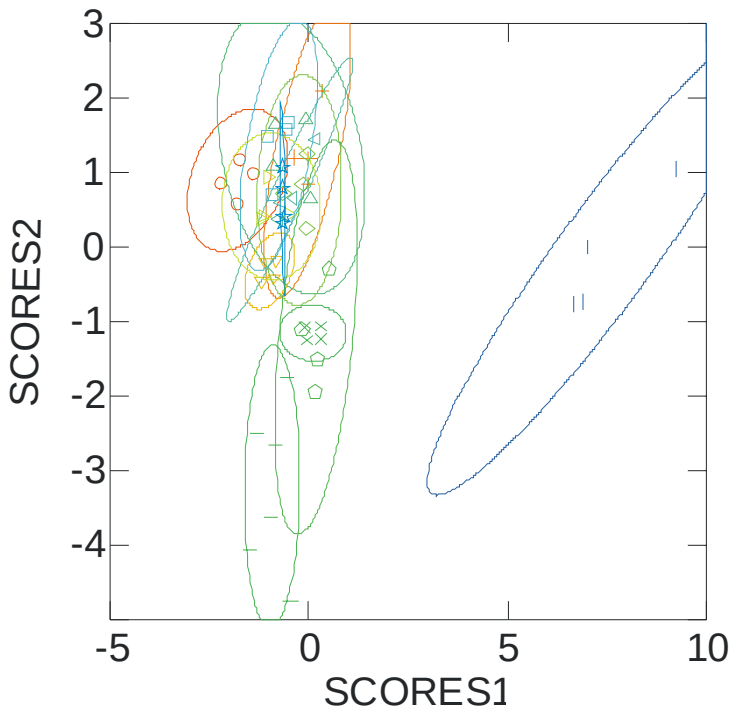
Excluding caffeine



3 principle components encompassing 78.6% data

GC-IRMS – $\delta^{13}C$ and $\delta^{2}H$

Including caffeine



3 principle components encompassing 72.8% data

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Conclusions

Visual Comparison - no significant differences

DAM purity – indicative of cutting / can be misleading

Alkaloid profile – little discriminating power

Presence of diluents – indicative of cutting / very often the same

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Conclusions

IRMS of drug packaging provides a means to link deals
$\delta^{13}C$ of clingfilm = main discriminating factor

GC-IRMS suggests geographical origin
No significant variation in alkaloid composition (*except DAM*)
$\delta^{13}C$ of alkaloids suggests two geographical / temporal origins

GC-IRMS of cutting agents provides a means to link dilution events
$\delta^{13}C$ of caffeine = main discriminating factor
Suggests two (or three) cutting events

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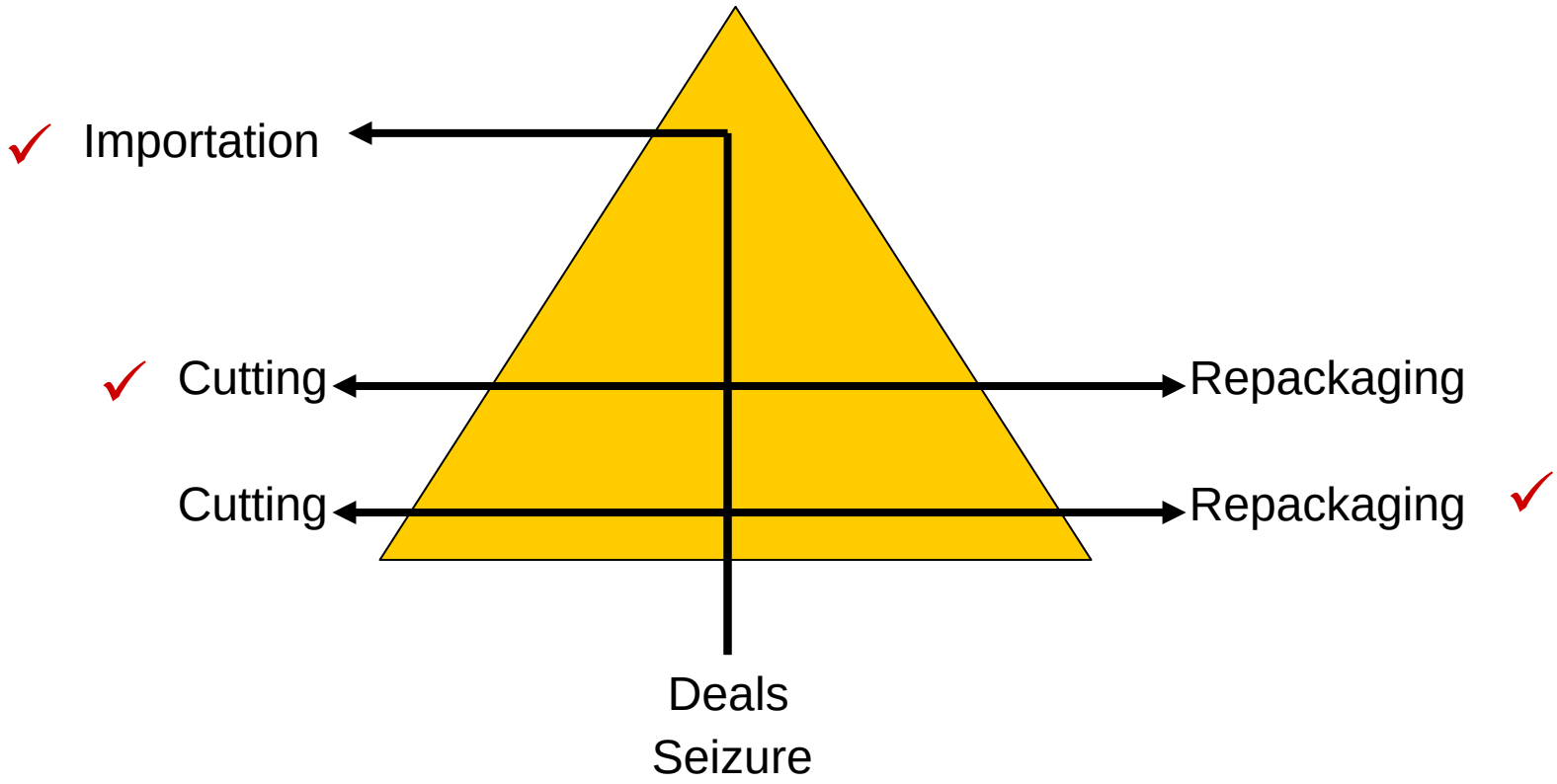
Conclusions



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Acknowledgements

University of Bristol – Centre for Chemometrics

Avon and Somerset Constabulary Scientific Investigations