

First contact: exploring the versatility of the Centri system in environmental forensics

Dr David Santillo
Greenpeace Research
Laboratories at the University of
Exeter



Greenpeace Research Laboratories Mission Statement

- to provide and oversee best scientific practice, quality control, and good quality communication of complex scientific and technical issues,
- to act as a radar for future issues/risks,
- to engage in the debate about the relationship between science and society,
- to represent Greenpeace at relevant policy fora and...
- to carry out these scientific functions on issues that matter to Greenpeace...(across >40 offices)

“bearing witness” through science

Greenpeace Research Laboratories history and roles

- Established 1986 at Queen Mary College, University of London
- Since 1992, based at the University of Exeter
- 8 research staff affiliated to College of Life and Environmental Sciences through Honorary Fellowships
- Technical support staff and research consultants
- Independence to conduct and defend research
- Investigative research (including analytical research)
- Information and advice
- Critical review of output
- Horizon scanning
- Media work
- Training and skillsharing
- Technical support for work with companies and governments and in international policy fora
- Guiding Greenpeace policy development

Liquid injection GC-MS



FT-IR (ATR and micro)



...plus ICP-MS



HR LC-MS



Pyrolysis GC-MS



Existing analytical instrumentation...

...supported by semi-automated sample prep

Solid Phase
Extraction



Accelerated Solvent
Extraction

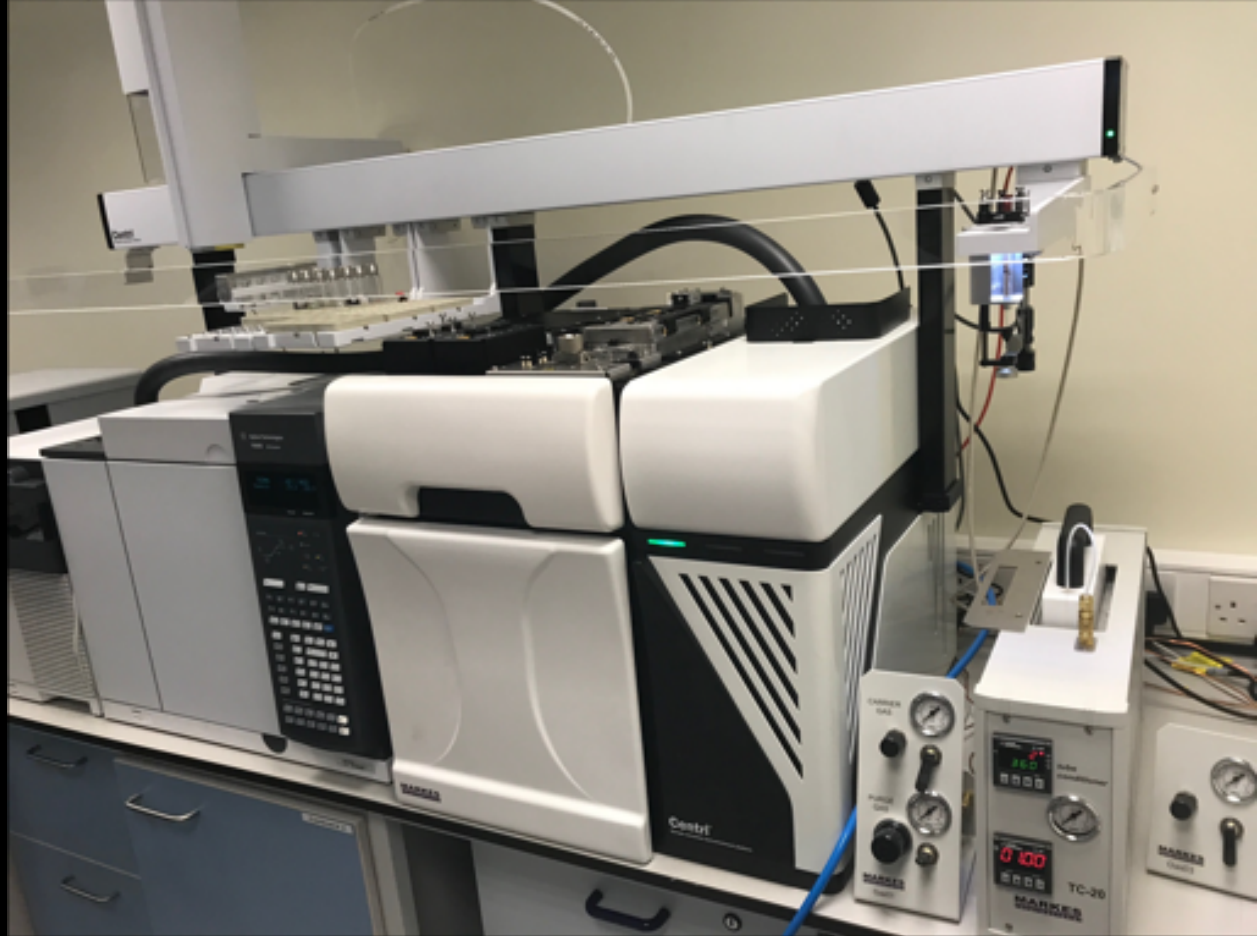


Why a Centri system...?

- Improved versatility for environmental forensics work
- Varied and often complex sample matrices
- Small (and decreasing) research team with expanding remit
- High time pressures and short turn-around expectations
- Need to expand further into air quality research (VOCs)
- Expected obsolescence of older headspace system
- Need to interface with existing GC-MS hardware and software
- Opportunity to future-proof analytical offer

Our system...

...linked to Agilent 7890B
GC and 5977A MSD,
running Masshunter
emulating Chemstation
and using both Wiley and
NIST spectral libraries



Our system...



Matrices and research projects (so far...)

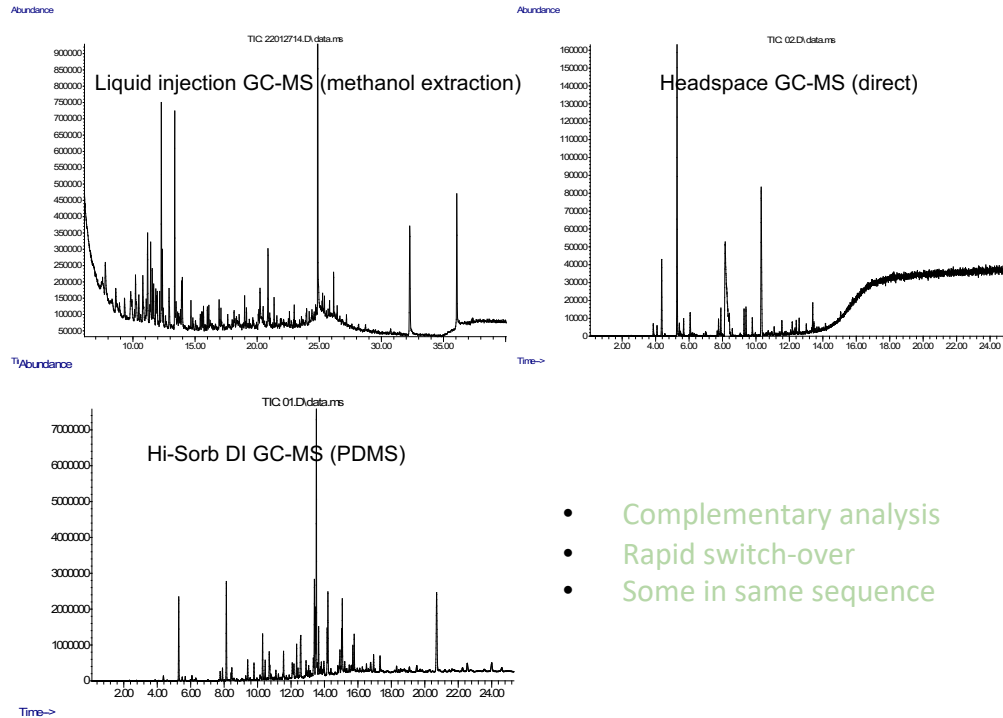
Headspace and Hi-Sorb

- Waters and wastewaters – e.g. landfill leachate and industrial discharges
- Soils and sediments – e.g. urban soils and possible post-conflict assessment
- Plastics and bioplastics – e.g. additives and contaminants in recyclate and in bioplastic formulations

Thermal desorption

- Fenceline and urban air – e.g. VOCs in communities close to petrochemical and plastics facilities
- Plastics – e.g. rapid screening for PET fragments in bottled water

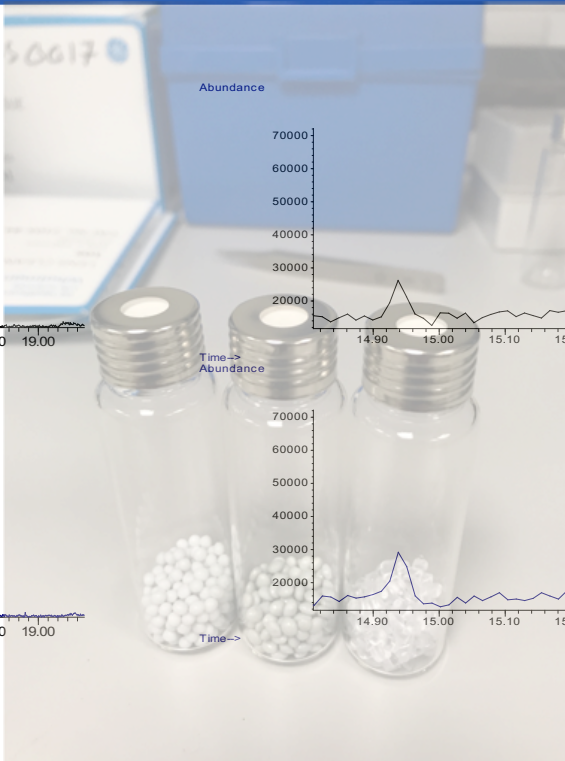
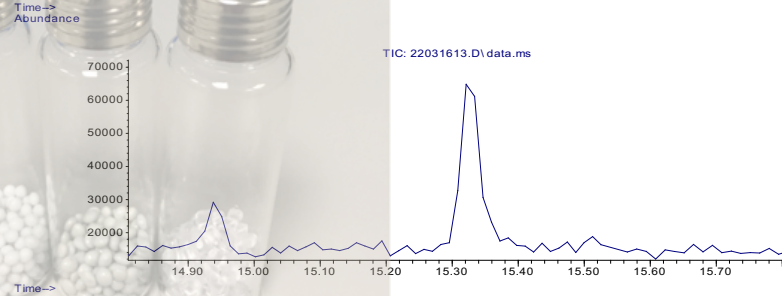
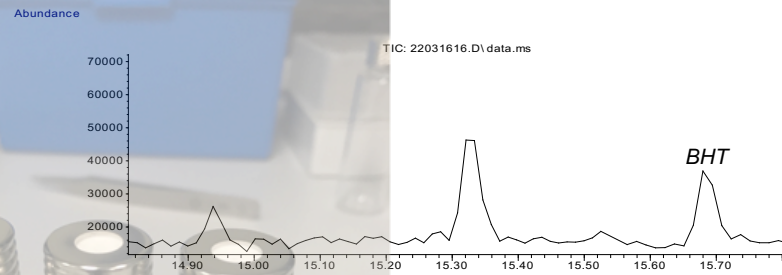
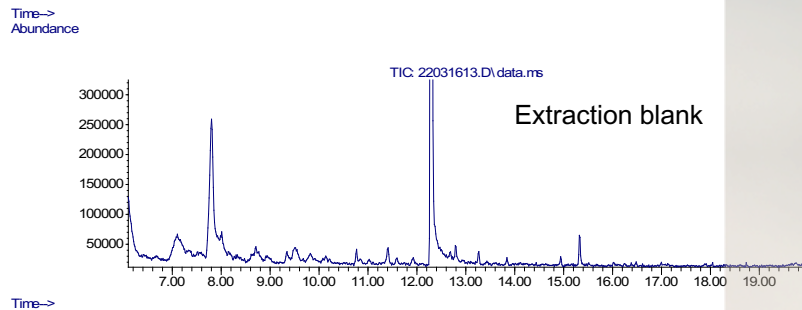
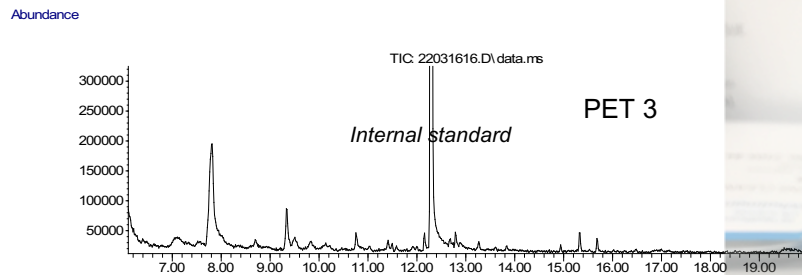
Rapid screening of a landfill leachate



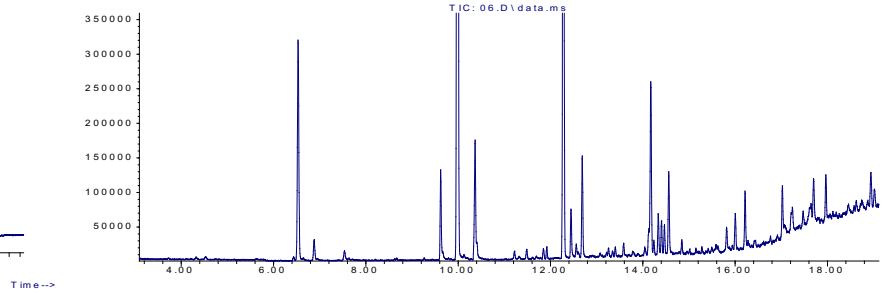
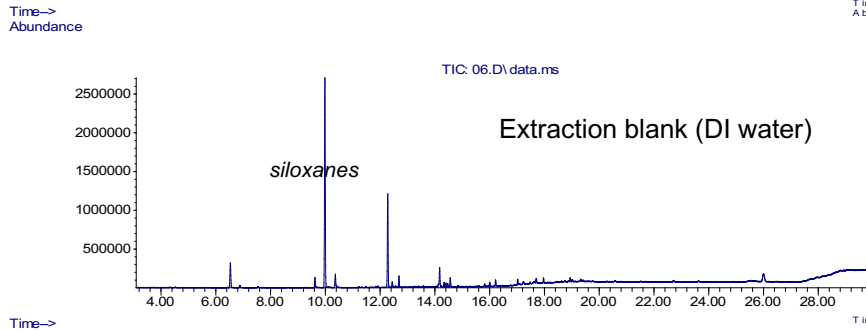
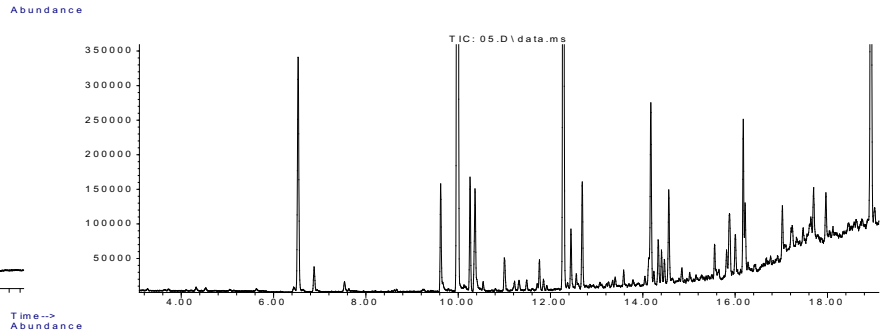
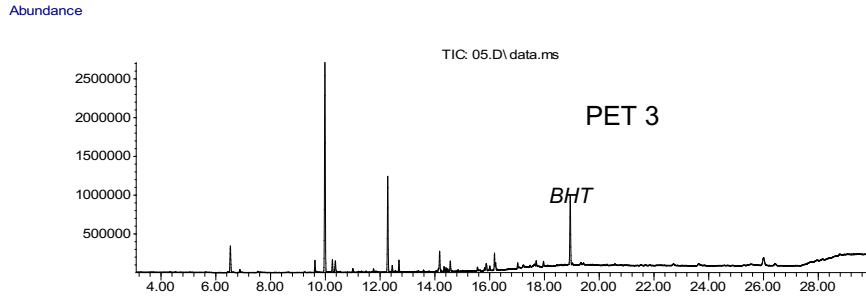
- Complementary analysis
- Rapid switch-over
- Some in same sequence

- 138 discrete compounds isolated in total (from combination of conventional SPE with elution into methanol, Hi-Sorb with PDMS probe and Headspace)
- 108 compounds identified to high match quality (>90% confidence)
- Compounds identified included terpenoids, plasticizers, antioxidants, flame retardants, silicones, bisphenols, plastics precursors, industrial solvents, pharmaceuticals and dyestuff-related chemicals
- Some overlap between compound groups identified using the three different sample prep/introduction methods, but also some distinct compounds
- Approximately 15% of compounds were only identified using Hi-Sorb GC-MS

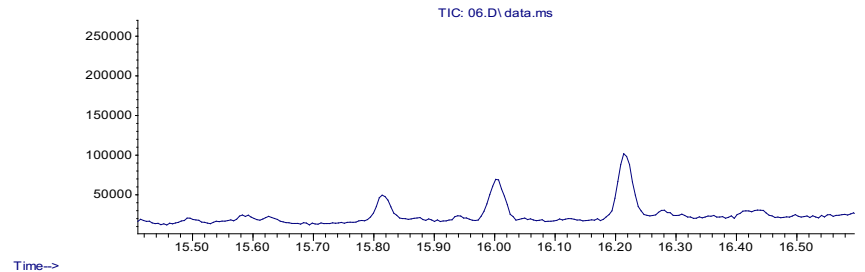
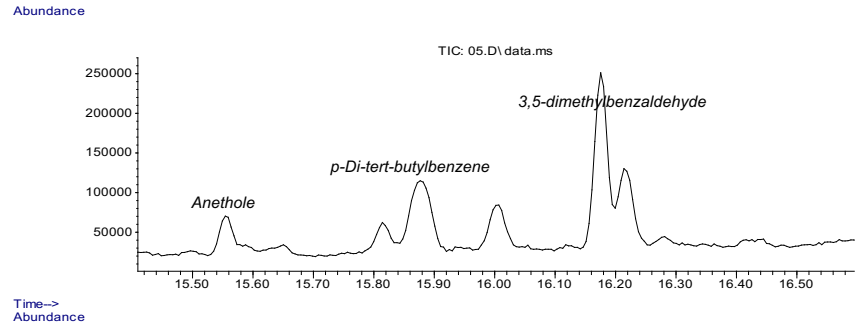
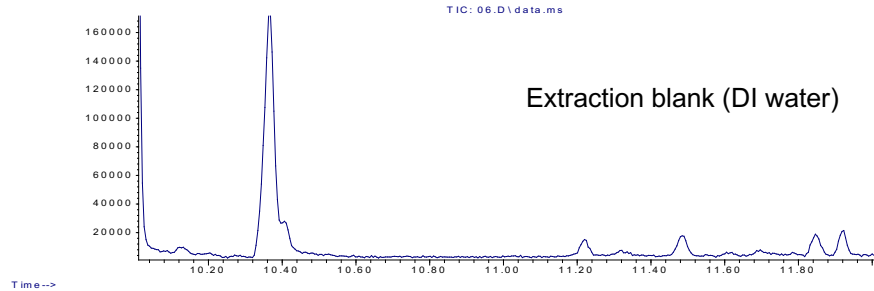
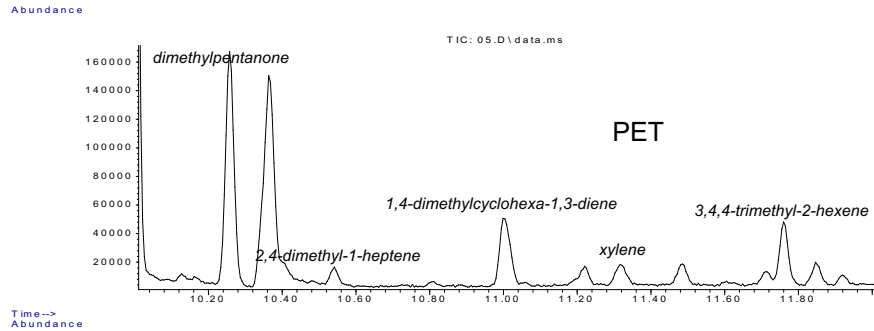
Additives/contaminants in PET (hot methanol extraction)



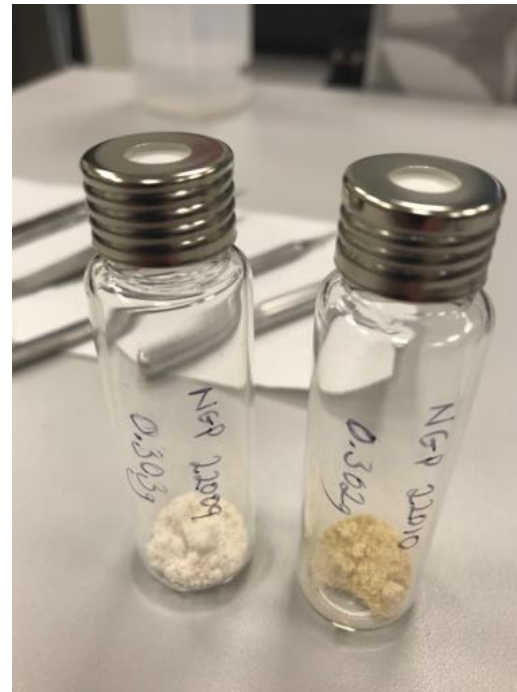
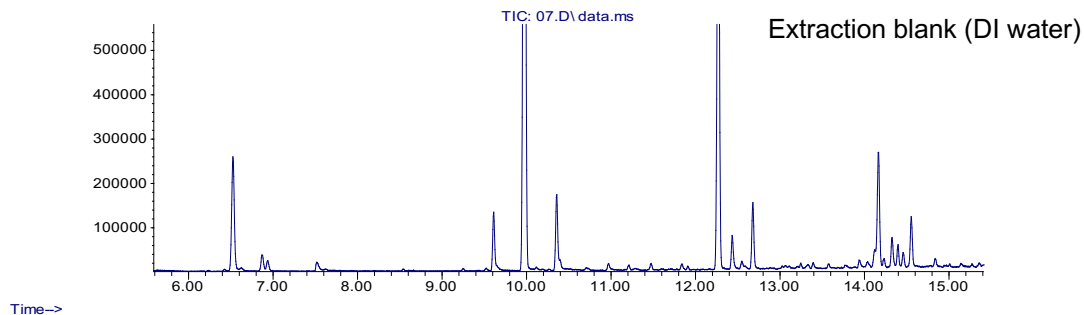
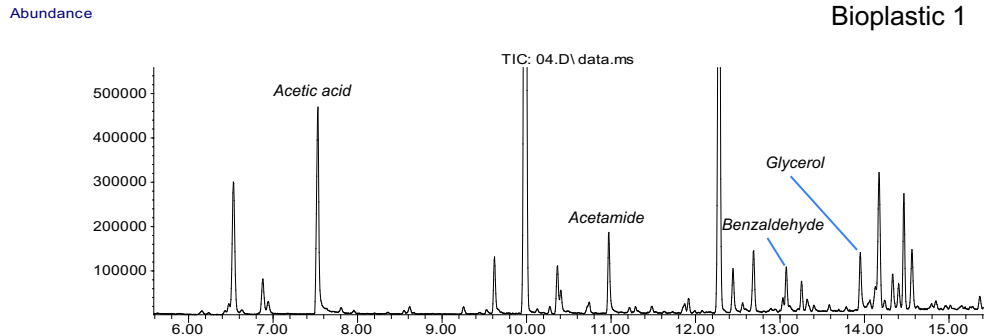
Additives/contaminants in PET (PDMS DI Hi-Sorb in DI water; 20 mins at 70 Celsius)



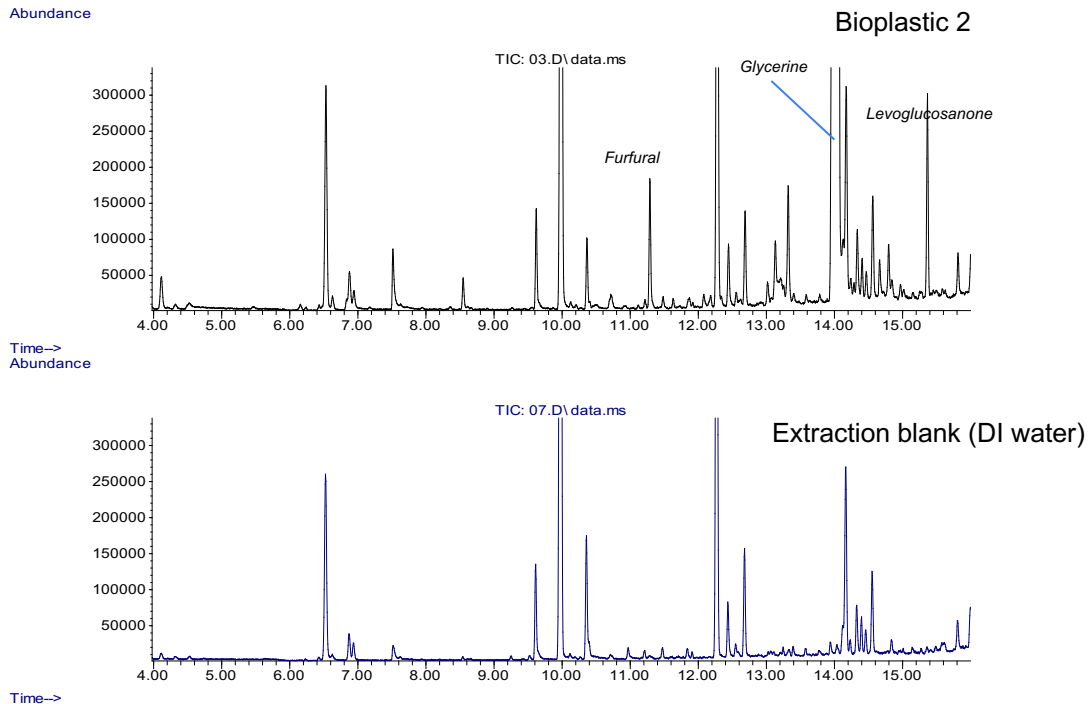
Additives/contaminants in PET (PDMS DI Hi-Sorb in DI water; 20 mins at 70 Celsius)



Additives/contaminants in novel bioplastics (PDMS Hi-Sorb, DI water; 20 mins, 70C)



Additives/contaminants in novel bioplastics (PDMS Hi-Sorb, DI water; 20 mins, 70C)



Lessons learned so far...

- Centri is a versatile sample introduction system for GC-MS
- Invaluable for rapid screening of samples (esp. Headspace & Hi-Sorb)
- Recollection of precious samples on TD tubes is revolutionary
- Different forms of sample introduction are complementary
- Needs focused time to develop – so far have only just scratched the surface
- Needs bench space and height (which thankfully we had)
- Makes sense to get familiar with diagnostics from the outset
- Technical and method development support from Markes has been based on genuine interest in enabling our work
- We have a long way to go ... and a lot to discover!

Questions...?
(& hopefully some answers)