Mikroplast i Mennesker

Jes Vollertsen

Kara Koffman-Rea, Manasi Agrawal, Laura Simon Sánchez, Claudia Lorenz, Jeanette Lykkemark, Karen Samonds, Kristine Allin, Alvise Vianello

AALBORG UNIVERSITY

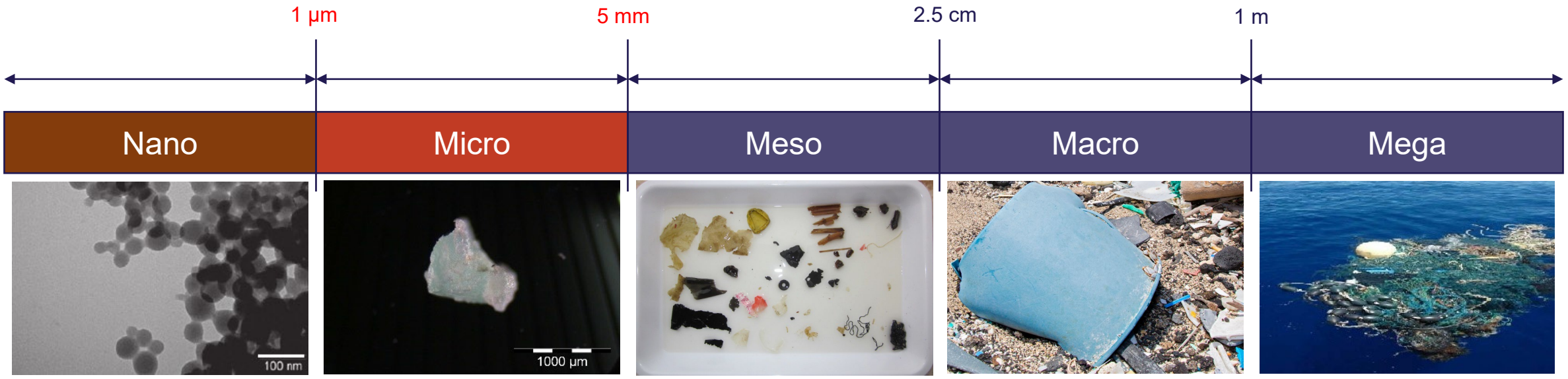
Northern Illinois University

Icahn School of Medicine at Mount Sinai

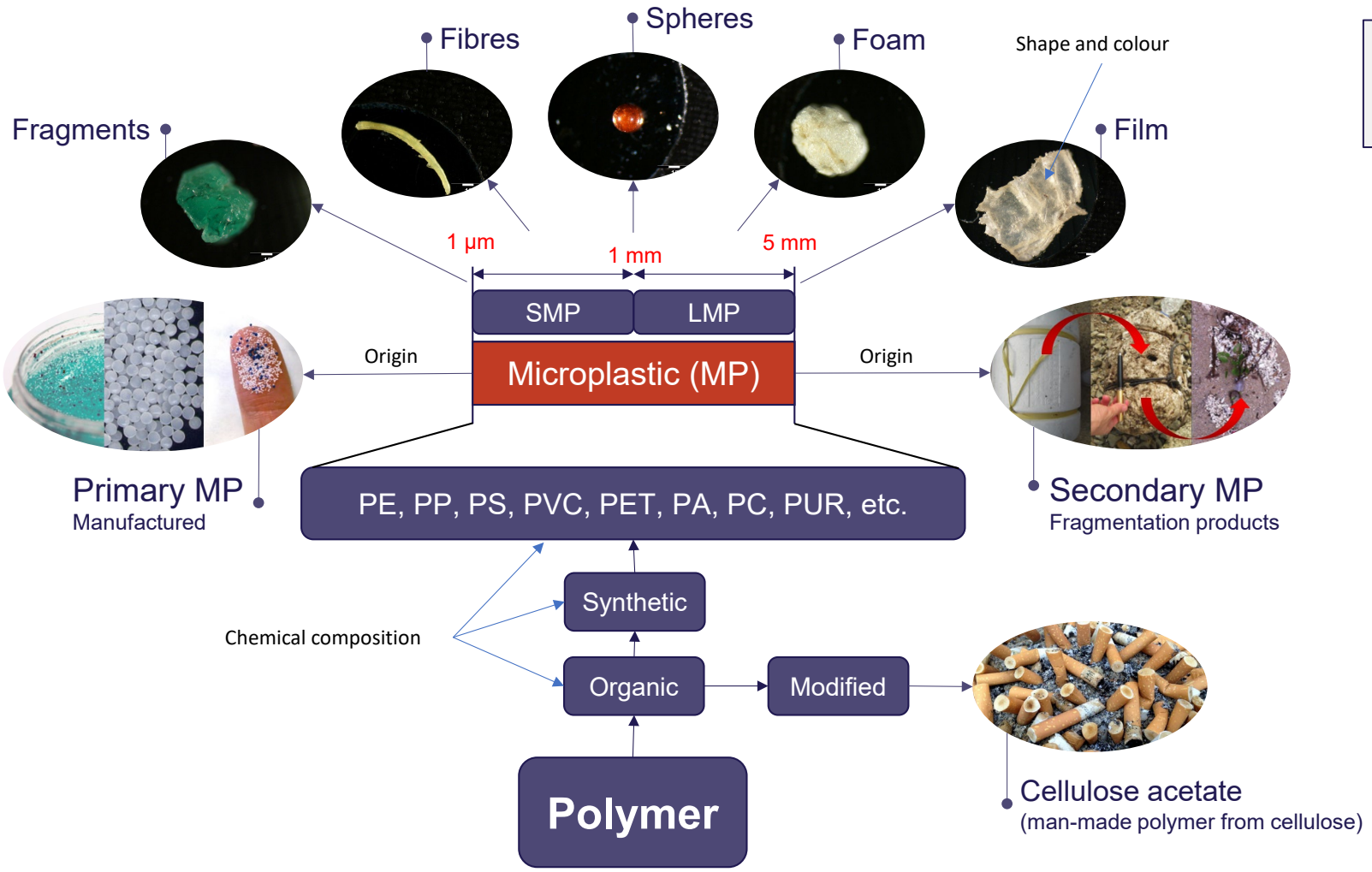
PREDICT

North Atlantic Microplastic Centre

Micro- and nanoplastics definition



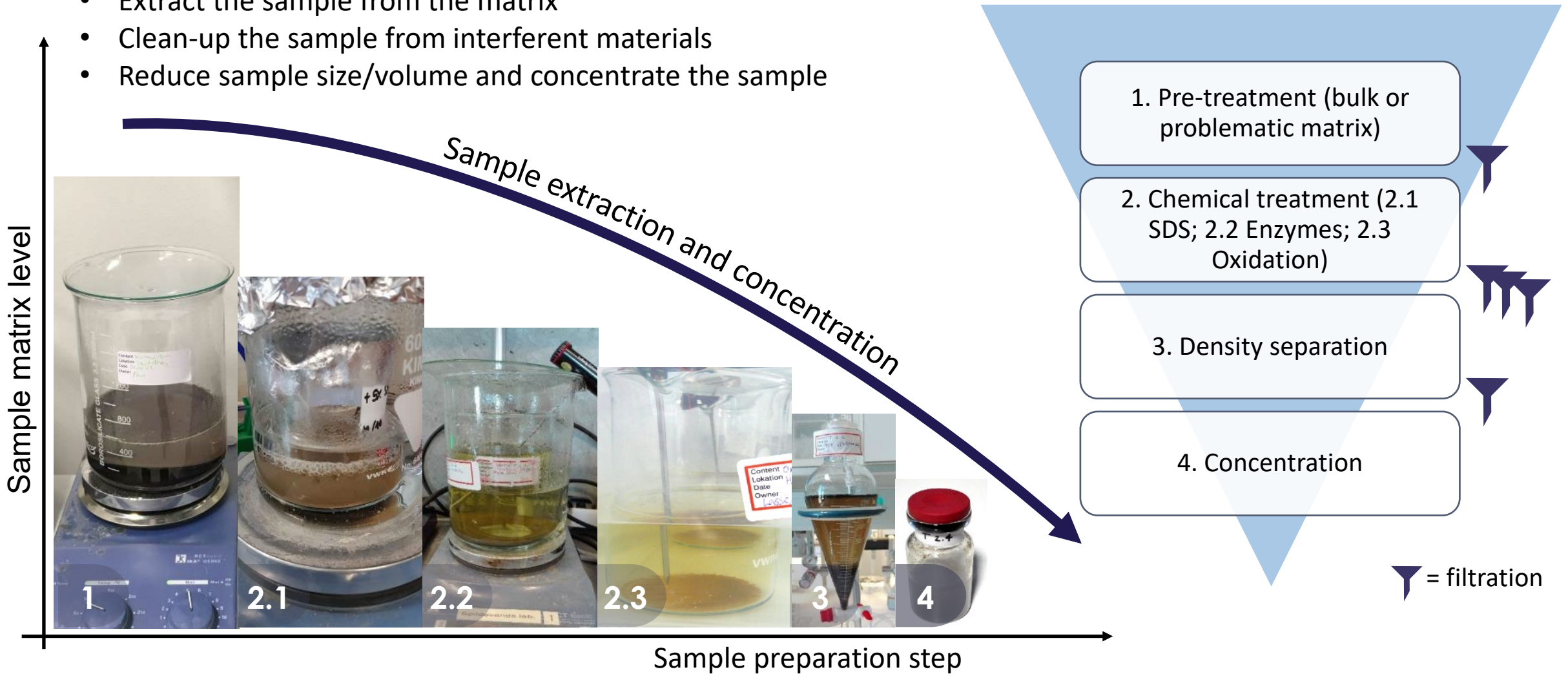
Micro- and nanoplastics definition



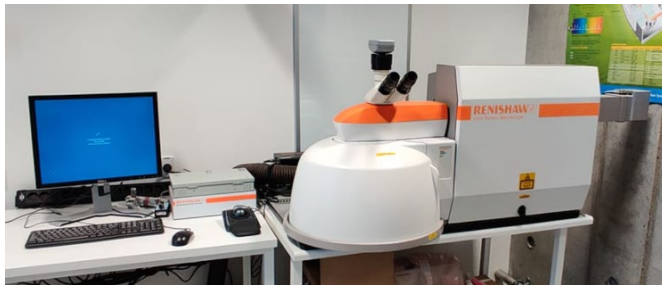
Microplastics come in all shapes and many materials

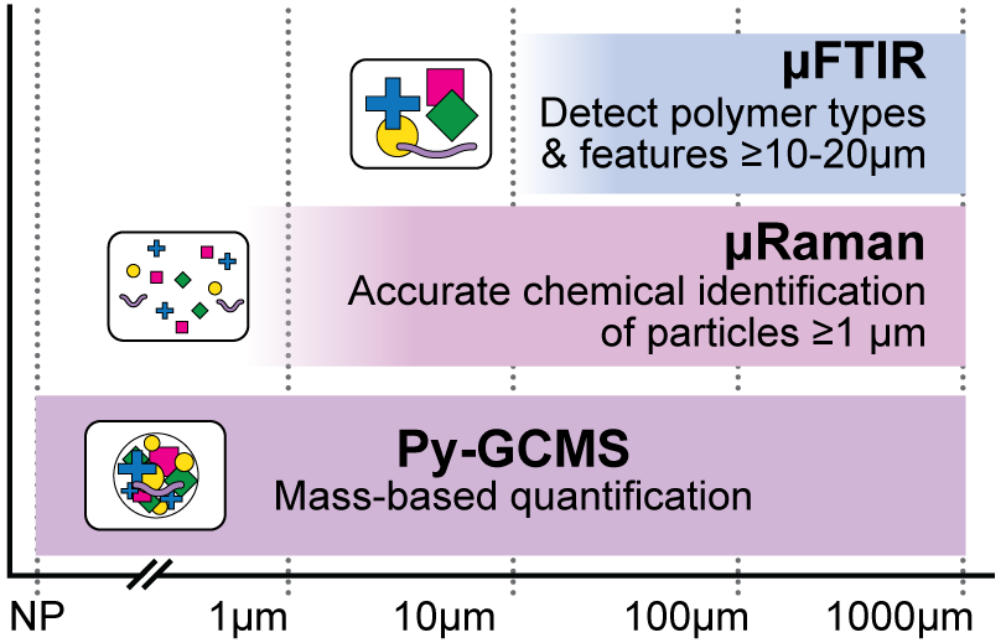
Micro- and nanoplastics analysis

- Extract the sample from the matrix
- Clean-up the sample from interferent materials
- Reduce sample size/volume and concentrate the sample



Micro- and nanoplastics analysis





There are huge differences in the methods people have applied for analysis
Some use quite crude methods, e.g. microscopy. Methods should be able chemically determine the composition of a particle !!!

Evidence of MNPs contamination in humans

Environment International 163 (2022) 107199

Contents lists available at ScienceDirect

Environment International

journal homepage: www.elsevier.com/locate/envint

Full length article

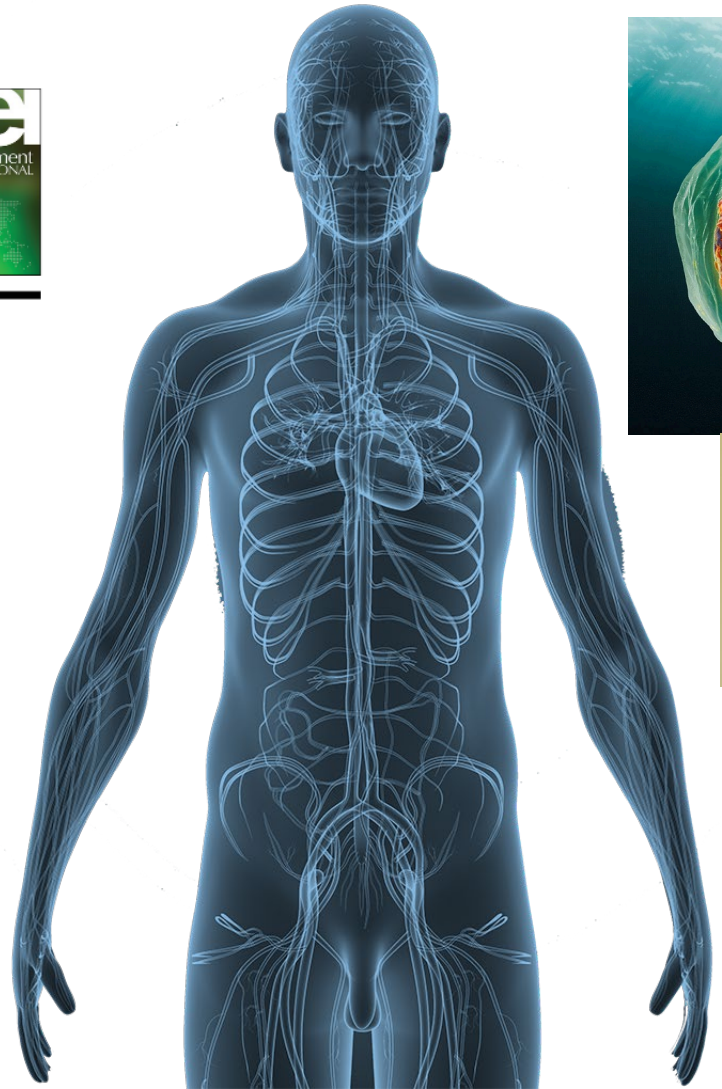
Discovery and quantification of plastic particle pollution in human blood

Heather A. Leslie [a], Martin J.M. van Velzen [a], Sicco H. Brandsma [a], A. Dick Vethaak [a,b], Juan J. Garcia-Vallejo [c], Marja H. Lamoree [a,*]

A small set of donors were studied.

The mean of the sum quantifiable plastic particles in blood was 1.5 µg/g

This is about the same as one finds in raw wastewater



Evidence of MNPs contamination in humans

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Microplastics and Nanoplastics in Atheromas and Cardiovascular Events

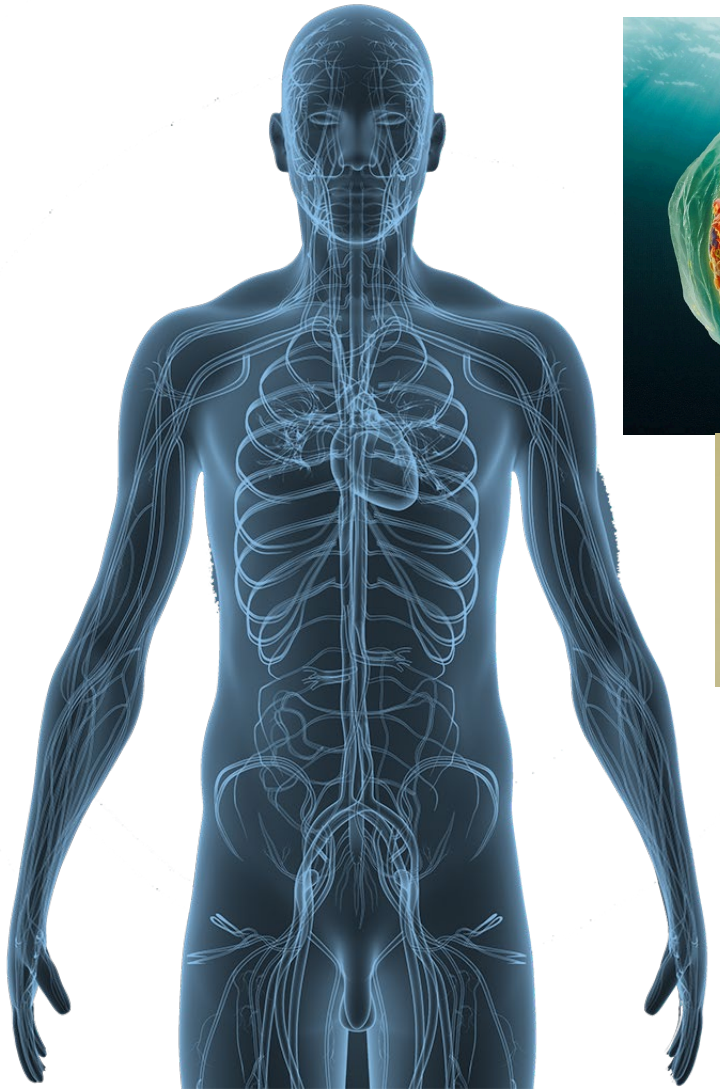
R. Marfella, F. Prattichizzo, C. Sardu, G. Fulgenzi, L. Graciotti, T. Spadoni,

304 patients – PE (polyethylene) detetected in arotid artery plaque of 150 patients

Mean level of 21.7±24.5 µg per milligram of plaque (which means that 2.17% of the plaque was plastic …)

31 patients had measurable amounts of PVC (polyvinyl chloride)

“Patients in whom MNPs were detected within the atheroma were at higher risk for a primary end-point event than those in whom these substances were not detected”



Evidence of MNPs contamination in humans

Science of the Total Environment 831 (2022) 154907

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Detection of microplastics in human lung tissue using μFTIR spectroscopy

Lauren C. Jenner [a], Jeanette M. Rotchell [b], Robert T. Bennett [c], Michael Cowen [c], Vasileios Tentzeris [c], Laura R. Sadofsky [a,*]

[a] Hull York Medical School, University of Hull, Hull HU6 7RX, United Kingdom
[b] Department of Biological and Marine Sciences, University of Hull, Hull HU6 7RX, United Kingdom
[c] Department of Cardiothoracic Surgery, Castle Hill Hospital, Cottingham HU16 5JQ, United Kingdom

Environmental Science & Technology

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Article

Detection of Various Microplastics in Patients Undergoing Cardiac Surgery

Yunxiao Yang, Enzehua Xie, Zhiyong Du, Zhan Peng, Zhongyi Han, Linyi Li, Rui Zhao, Yanwen Qin, Mianqi Xue, Fengwang Li, Kun Hua,* and Xiubin Yang*

Cite This: Environ. Sci. Technol. 2023, 57, 10911−10918 Read Online

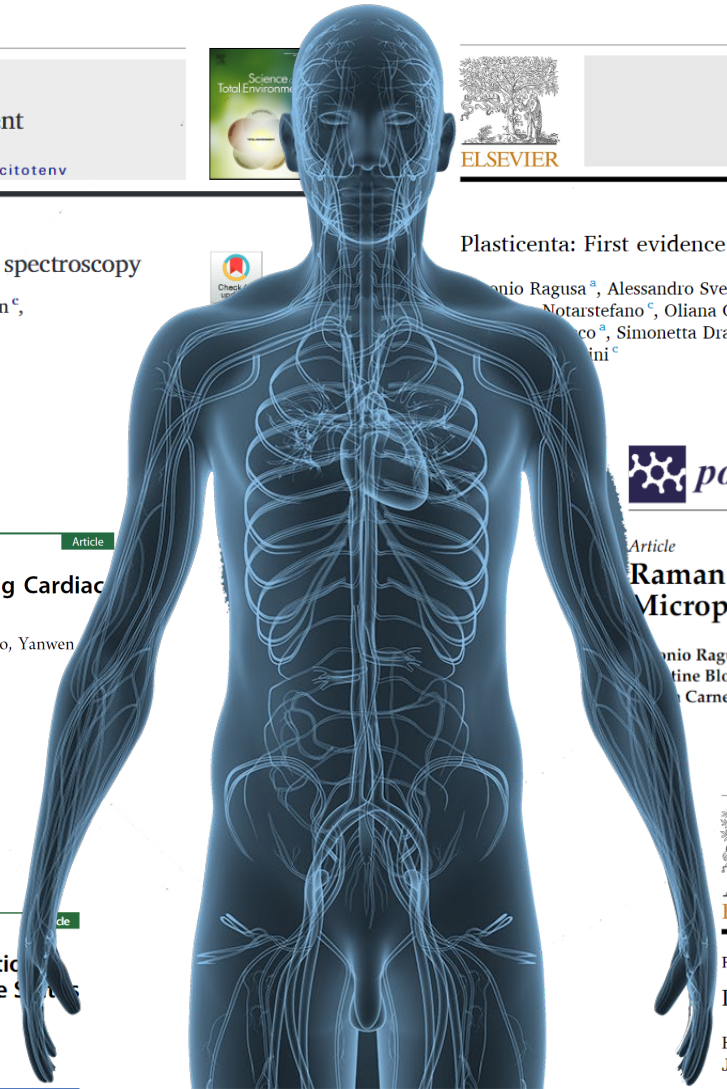
Environmental Science & Technology

pubs.acs.org/est

Analysis of Microplastics in Human Feces Reveals a Correlation between Fecal Microplastics and Inflammatory Bowel Disease Status

Zehua Yan, Yafei Liu, Ting Zhang, Faming Zhang,* Hongqiang Ren, and Yan Zhang*

Cite This: Environ. Sci. Technol. 2022, 56, 414−421 Read Online



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Environment International 146 (2021) 106274

Contents lists available at ScienceDirect

Environment International

journal homepage: www.elsevier.com/locate/envint

Plasticenta: First evidence of microplastics in human placenta

onio Ragusa [a], Alessandro Svelato [a,*], Criselda Santacroce [b], Piera Catalano [b], Notarstefano [c], Oliana Carnevali [c], Fabrizio Papa [b], Mauro Ciro Antonio Rongioletti [b], co [a], Simonetta Draghi [a], Elisabetta D'Amore [a], Denise Rinaldo [d], Maria Matta [e], ini [c]

polymers

Article

Raman Microspectroscopy Detection and Characterisation of Microplastics in Human Breastmilk

onio Ragusa [1], Valentina Notarstefano [2,*], Alessandro Svelato [3], Alessia Belloni [2], Giorgia Gi tine Blondeel [3], Emma Zucchelli [3], Caterina De Luca [3], Sara D'Avino [3], Alessandra Gulotta [4], Carnevali [2] and Elisabetta Giorgini [2]

Environment International 163 (2022) 107199

Contents lists available at ScienceDirect

Environment International

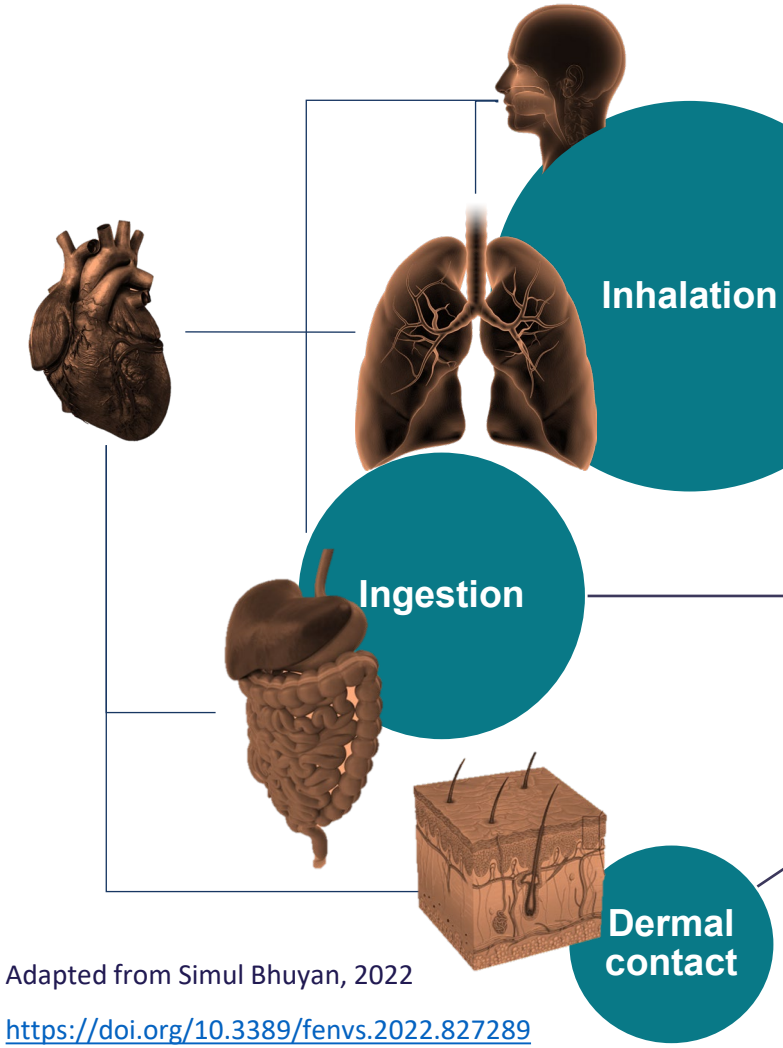
journal homepage: www.elsevier.com/locate/envint

Full length article

Discovery and quantification of plastic particle pollution in human blood

Heather A. Leslie [a], Martin J.M. van Velzen [a], Sicco H. Brandsma [a], A. Dick Vethaak [a,b], Juan J. Garcia-Vallejo [c], Marja H. Lamoree [a,*]

Different exposure pathways…several target organs…and potential effects in humans



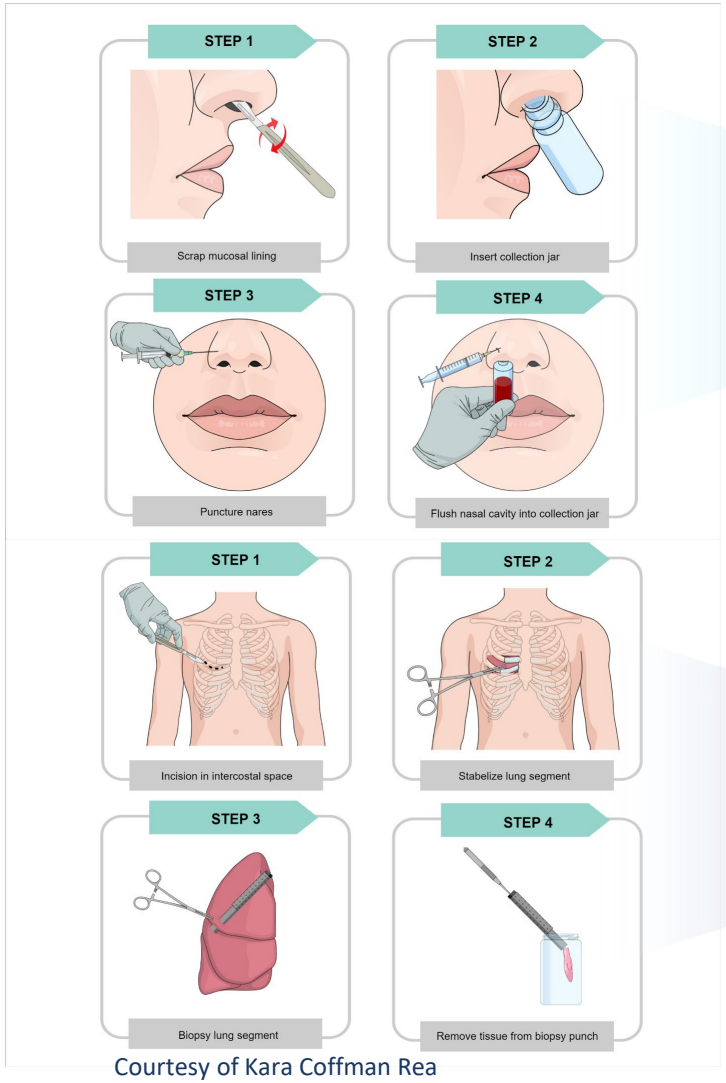
Translocation to distant tissues
Dysregulation of immune
Metabolism alte
Oxidati ss
Cyt city
Neu city
Carcinogenity
Reproductive toxicity

Adapted from Simul Bhuyan, 2022

https://doi.org/10.3389/fenvs.2022.827289

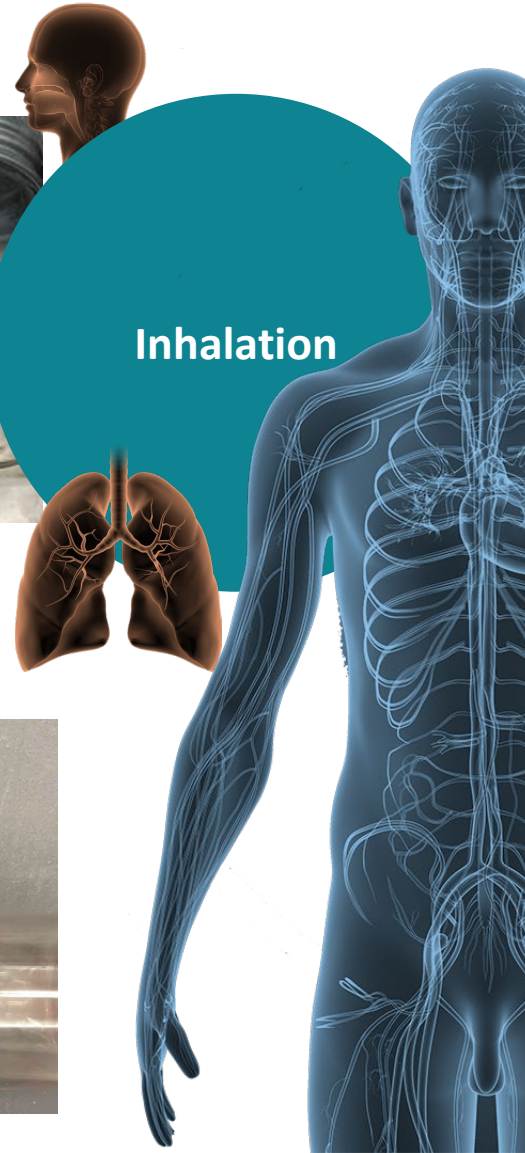
MPs in lung tissue (and nasal cavity) from cadaver specimen

Sampling protocol specifically developed for MPs analysis

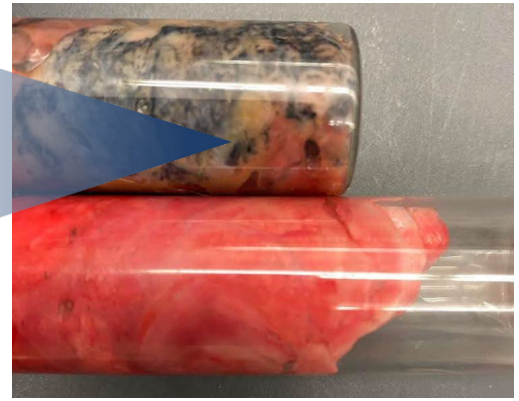


Courtesy of Kara Coffman Rea

nasal swab samples

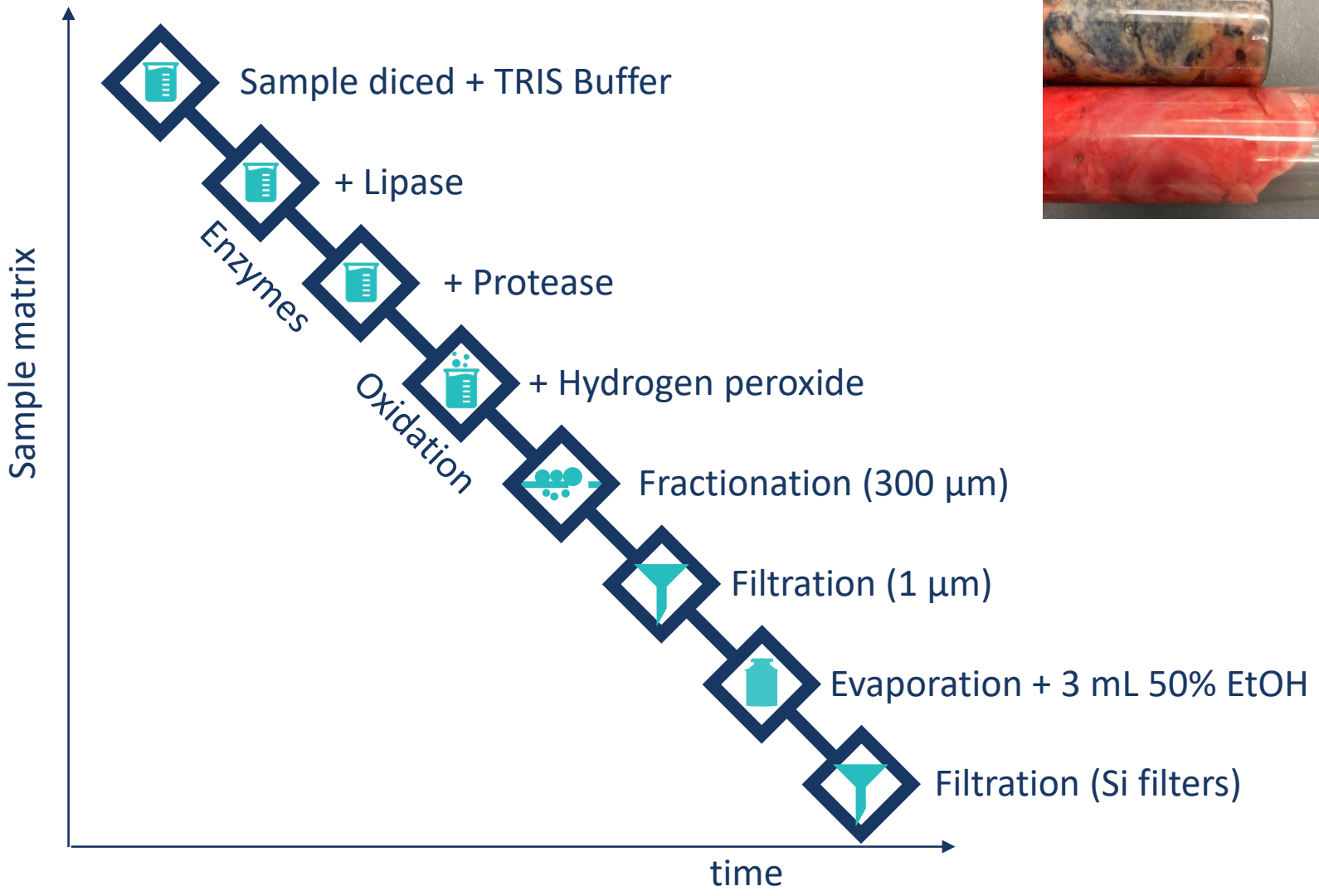


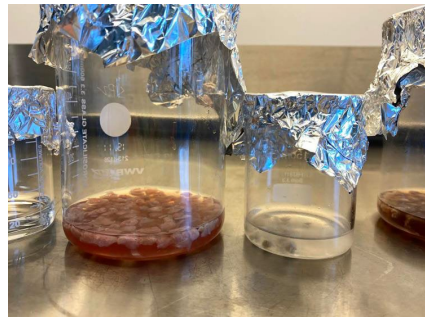
lung tissue samples

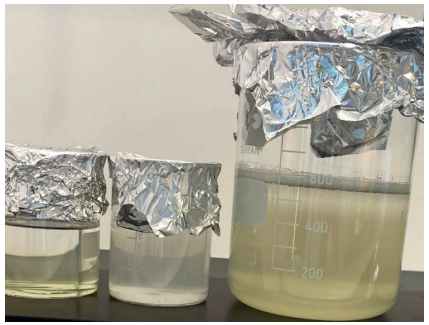


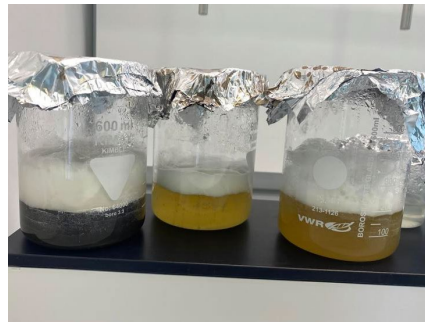
MPs extraction from lung tissue and nasal swap

Multi-step MPs extraction









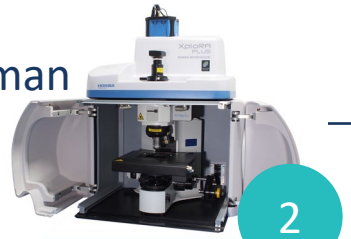
The analytical TOOLBOX for this study

Versatile **TOOLBOX** of **COMPLEMENTARY techniques**

- **reliable quantification and characterization of MNPs and associated chemicals**

- MPs quantification/MASS estimate
- Polymer composition
- Size and morphology

µRaman



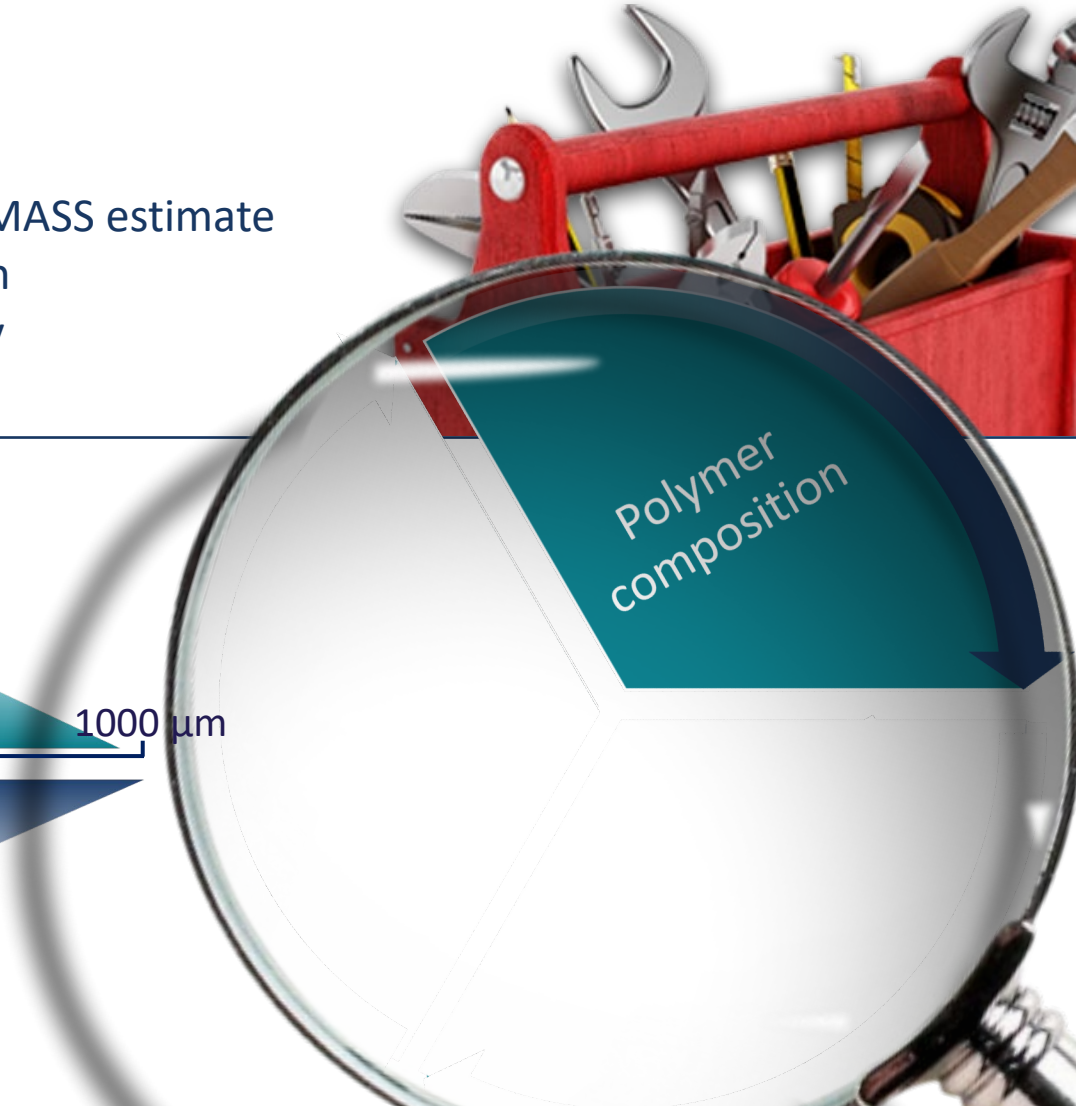
µFTIR

1 µm | 10 µm | 100 µm | 500 µm | 1000 µm

Nano

- MPs MASS quantification
- Polymer composition
- Additives

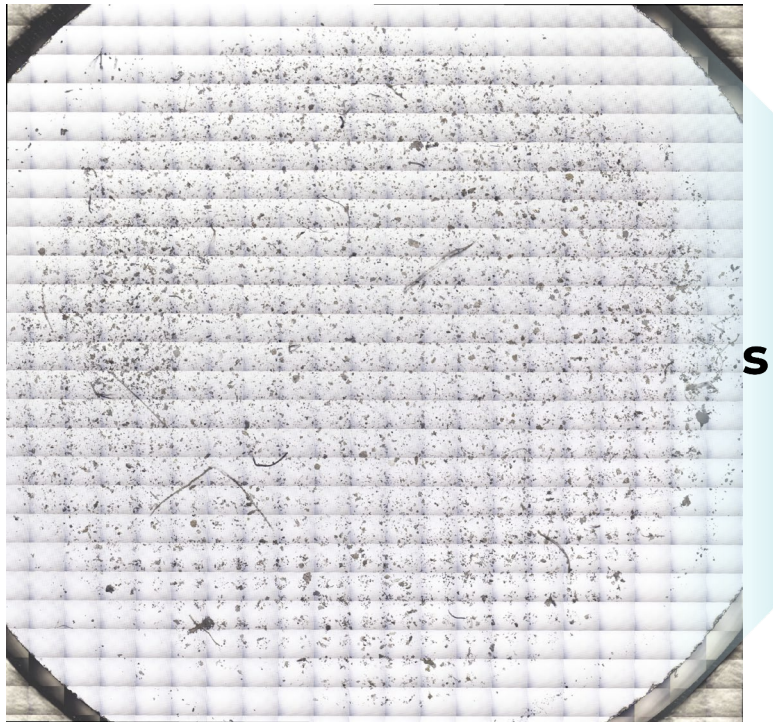
Py-GCMS



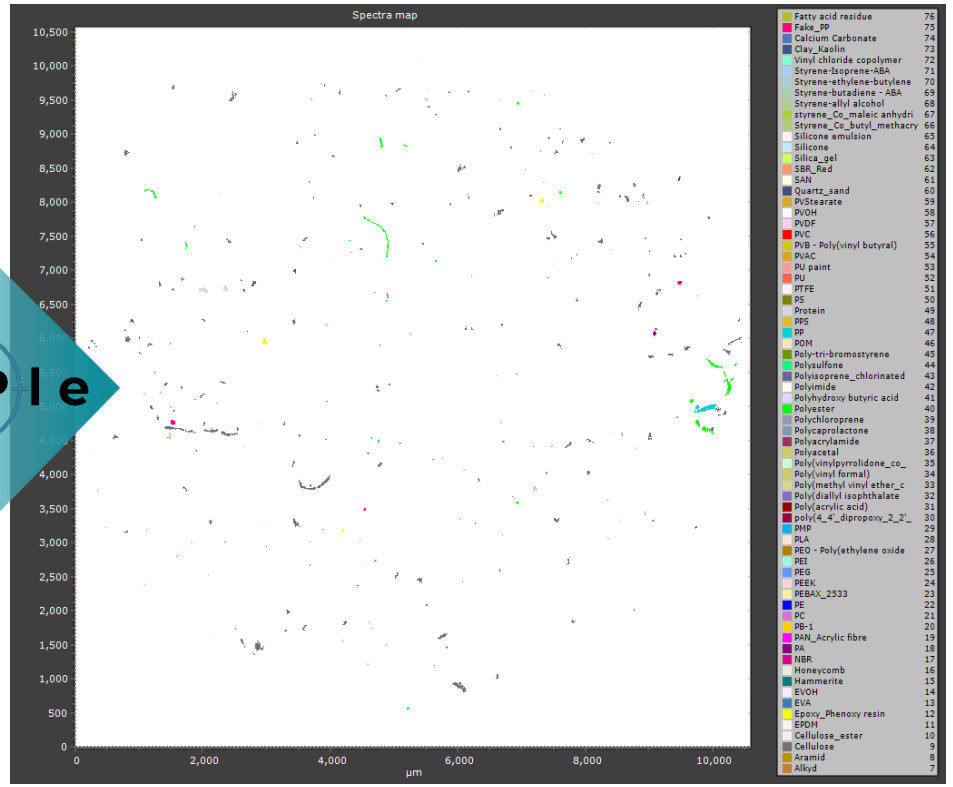
MPs in the lungs using µFTIR

µFTIR-Imaging – **MPs analysis down to 11 µm**

- spectral (**WHAT**) and spatial (**WHERE**) information simultaneously



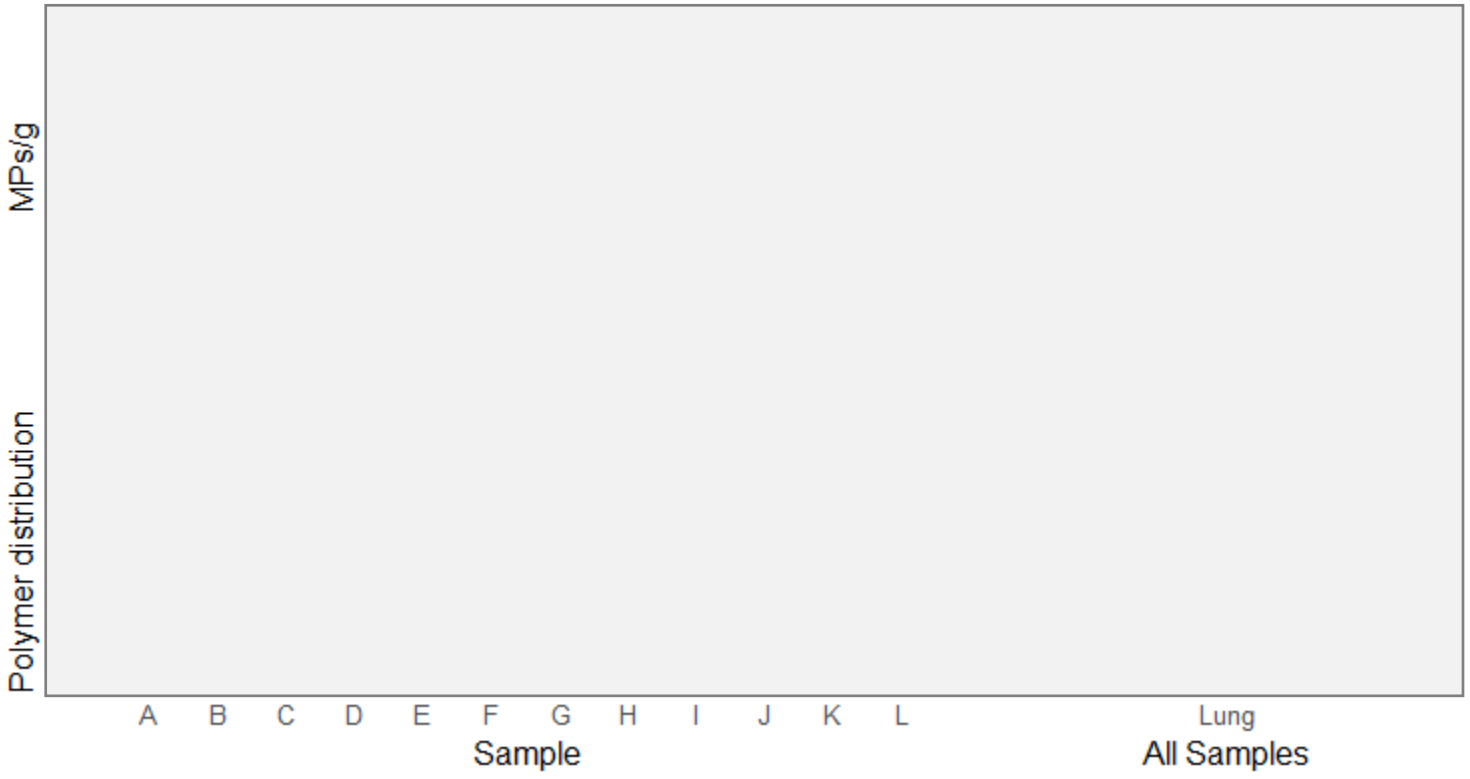
siMPle



- MPs quantification
- MPs mass estimate
- Polymer composition
- Size and morphology

MPs in the lungs using µFTIR

Preliminary results – **MPs concentration and polymer distribution**



MPs concentration*

- Range =
- Median

MPs polymer distribution**

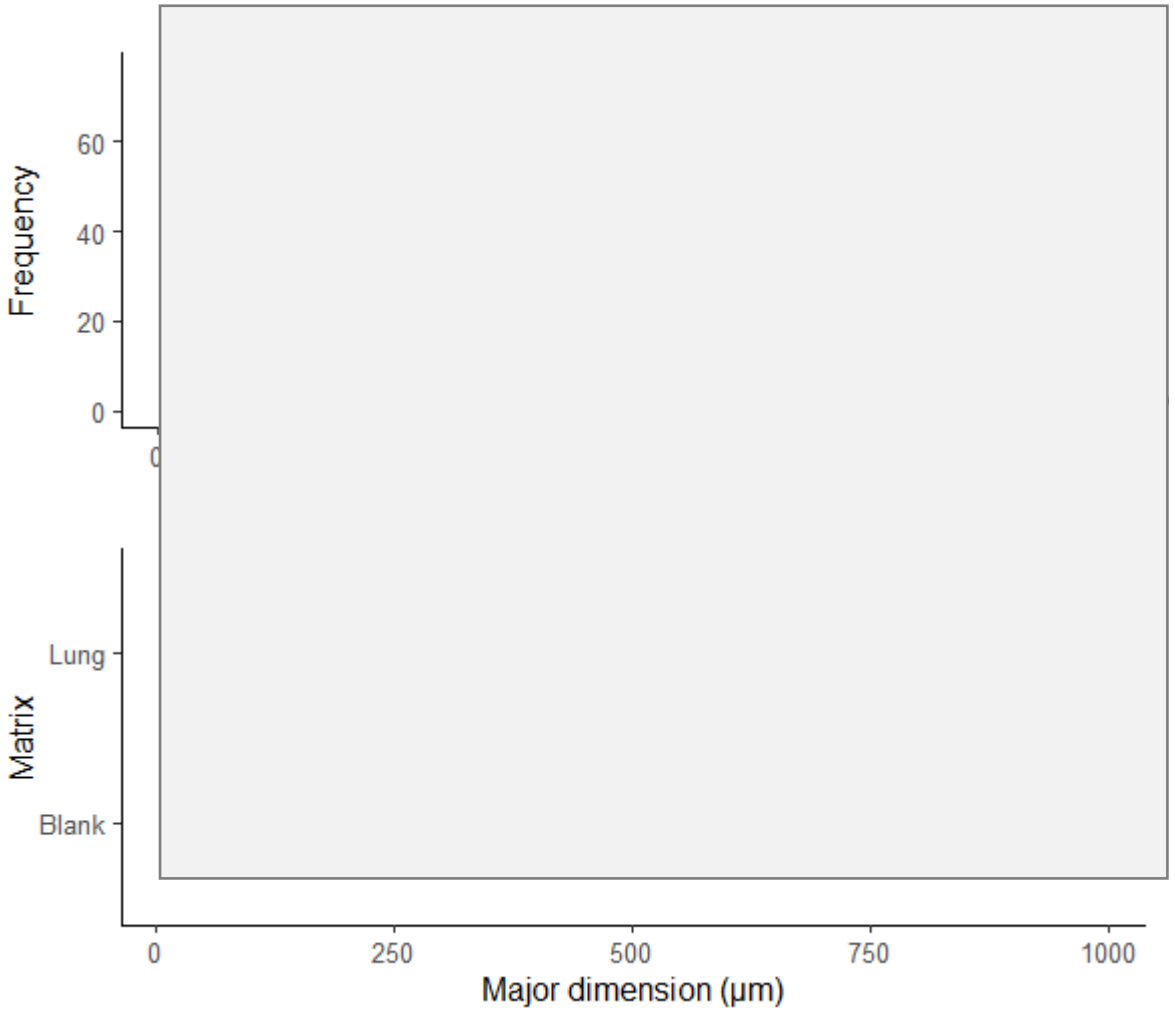
- Polyester
  Epoxy_Ph
  Polyethyl

*Results are NOT blank corrected

**PA (Nylon) is temporarily excluded from the polymer array for potential interference with protein-based materials

MPs in the lungs using µFTIR

Preliminary results – **MPs size distribution**



- Median MPs fragme
- Median MPs fibers =

…Checking MPs size in the blank…
MPs in blanks are significantly smaller than in the tissue

Further data exploration on the presence of long fibers

…From µFTIR to µRaman: a different picture?

- Up to 16 microplastics per m^3 of inhaled air
- **Humans could inhale up to 272 microplastics in 24 h**

µFTIR

SCIENTIFIC REPORTS

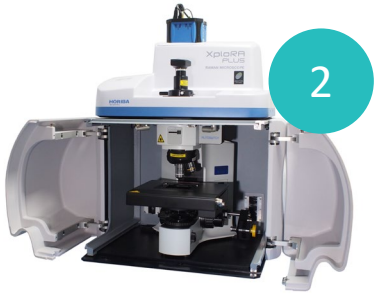
OPEN

Simulating human exposure to indoor airborne microplastics using a Breathing Thermal Manikin

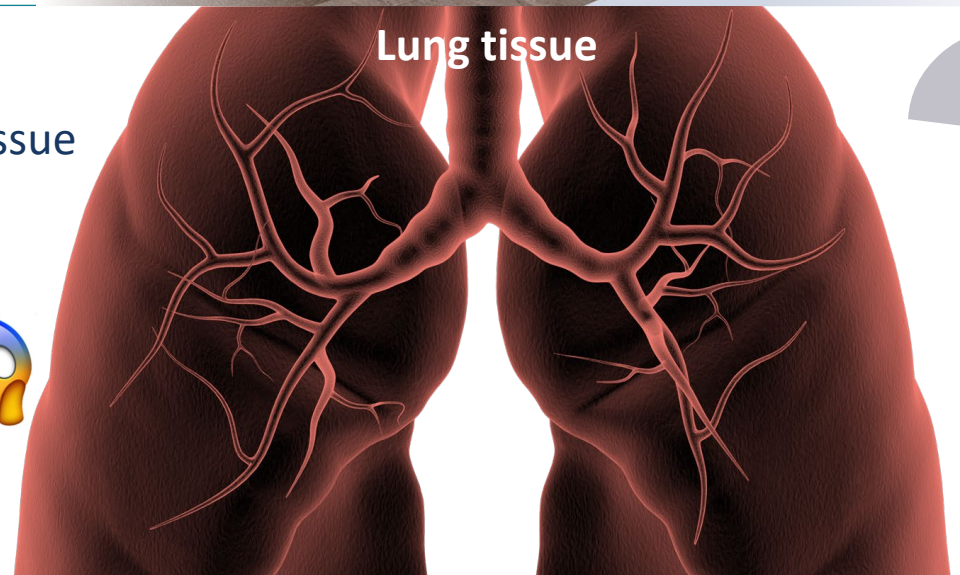
Indoor airborne MPs

- Up to 684 microplastics per m^3 of inhaled air
- **Humans potentially inhale up to 3415 microplastics in 24 h**

µRaman



Lung tissue



- Up to 8 microplastics per g of lung tissue
- **2 lungs ≈ 800 g →Humans could potentially have up to > 6000 microplastics in their lungs??!!…** 😱

(current unpublished study)

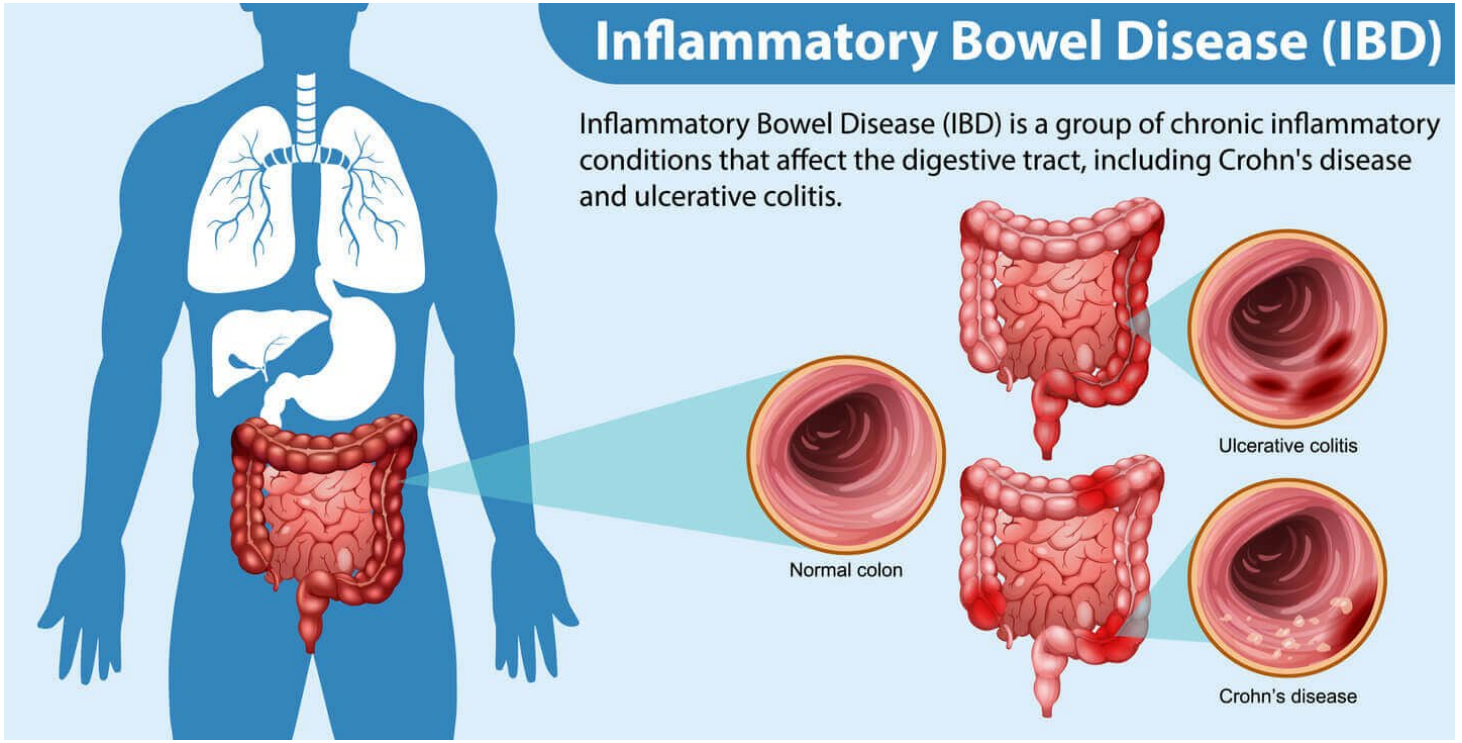
We expect to find quite a lot of MPs (and much smaller!!)

Ongoing studies: Inflammatory Bowel Disease

No one knows the trigger, what causes it

It is more common in the developed world

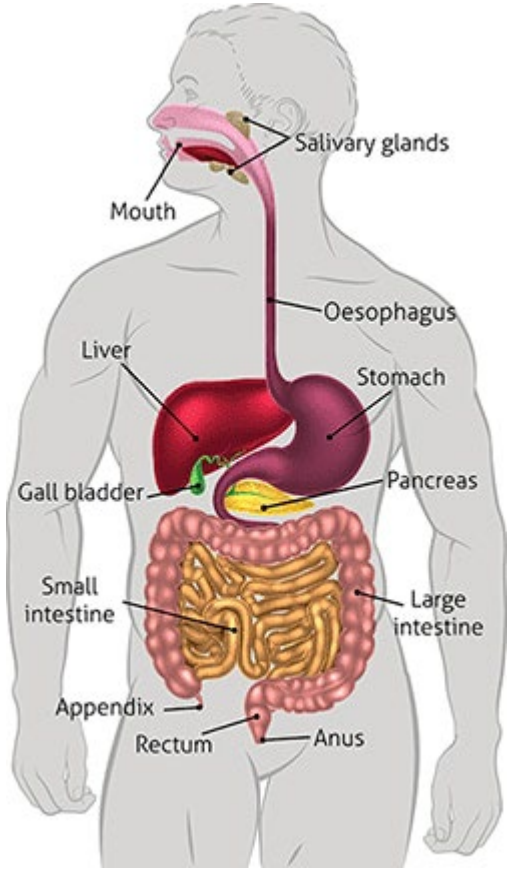
Could it be microplastics? Other anthropogenic particles?



Inflammatory Bowel Disease – Two approaches

Correlation between microplastics in feces and IBD?

Correlation between microplastics in intestine biopsies and IBD?



Inflammatory Bowel Disease

– Correlation between microplastics in feces and IBD?

- Chemically analyze concentration, size, and shape distribution of microplastics in stool samples of women with Crohn's Disease and healthy controls
- Determine the impact of microplastics on intestinal inflammation and microbiome composition among women with Crohn's Disease and healthy controls
- Ongoing work – finished next year

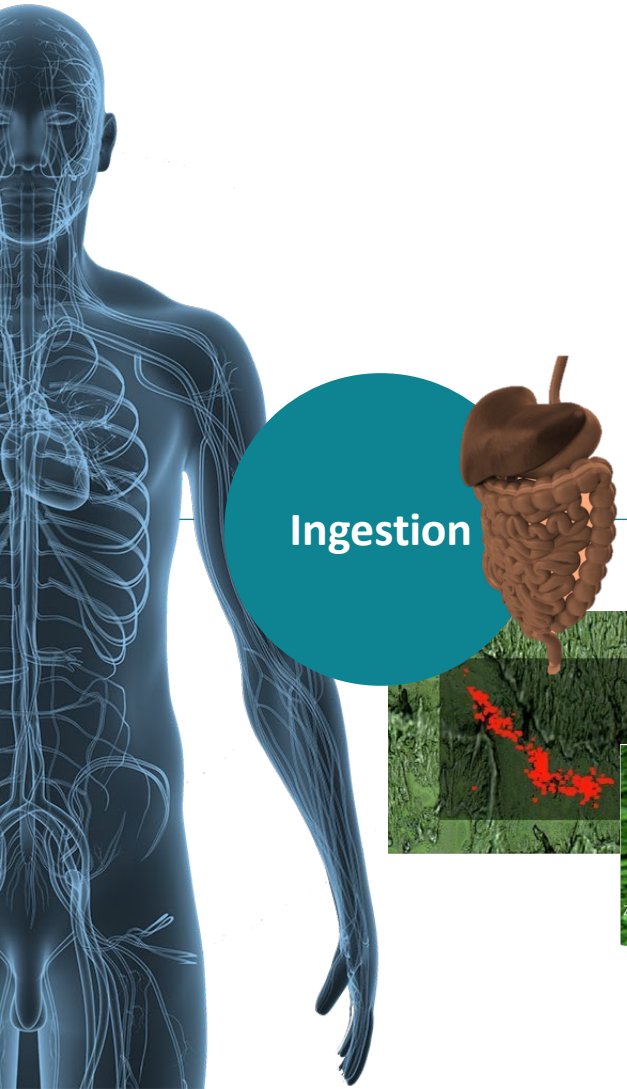
Icahn School of Medicine at Mount Sinai

PREDICT

AALBORG UNIVERSITY DENMARK

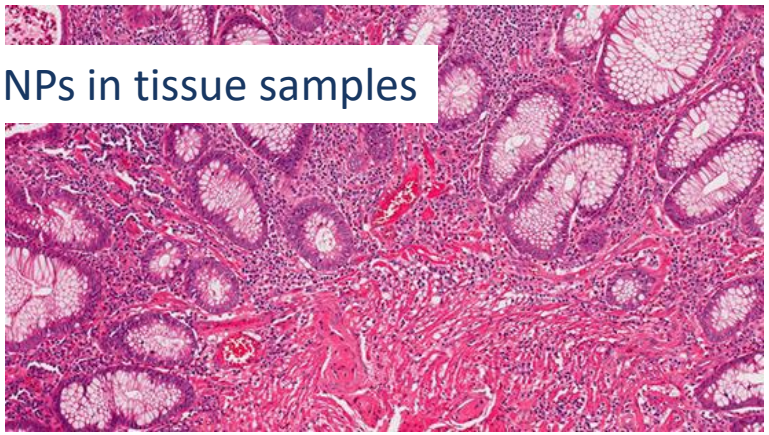
Inflammatory Bowel Disease

– Correlation between microplastics in intestine biopsies and IBD?

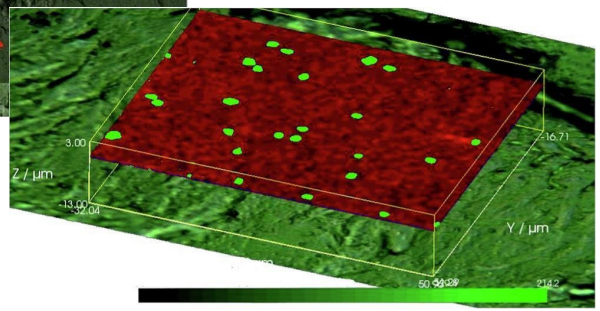


Ingestion

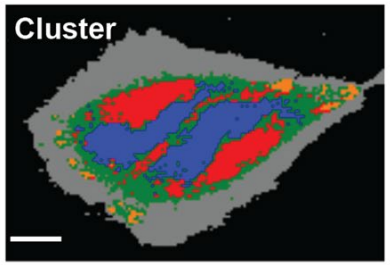
Direct analysis of MNPs in tissue samples

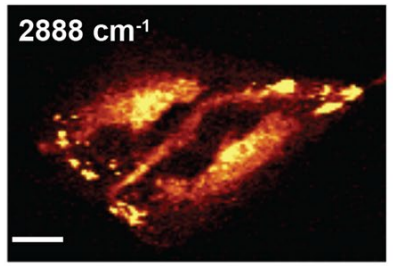


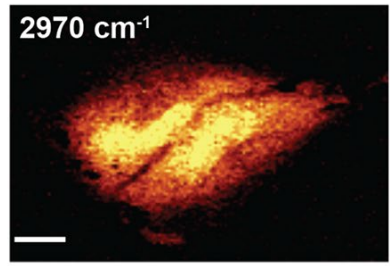
Learning from other fields…



https://doi.org/10.1016/j.scitotenv.2023.162810







https://doi.org/10.1038/s41598-018-30407-8

…directly linking the **presence of MPs to specific inflammation areas in the tissue**


Thank you
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Northern Illinois University
Icahn School of Medicine at Mount Sinai
PREDICT
North Atlantic Microplastic Centre