

CONCENTRATIONS AND MORPHOLOGY OF MICROPLASTICS IN THE SEINE RIVER ESTUARY

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FATE AND IMPACTS OF MICROPLASTICS: KNOWLEDGE, ACTIONS AND SOLUTIONS

Microplastics and the Seine river estuary

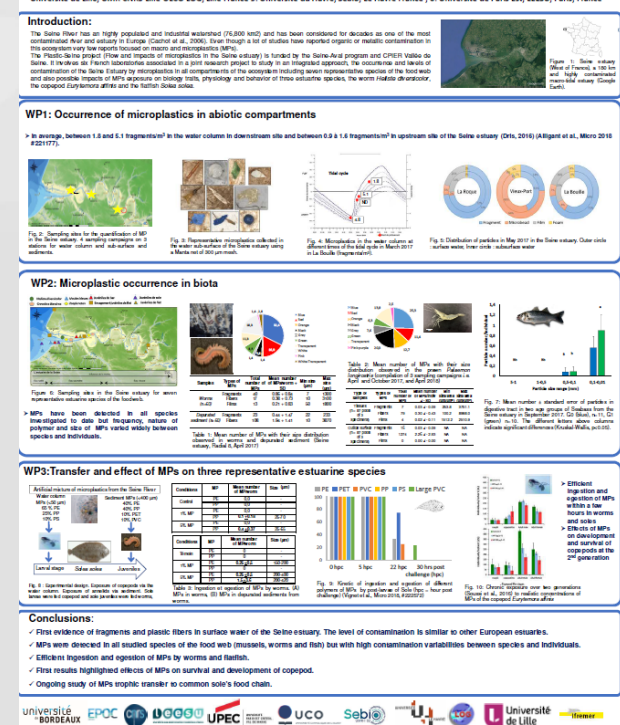


- Plastic-Seine project (J. Gasperi and J. Cachot)

- Task 1: Status of abiotic compartment contamination on the Seine continuum

- Scientific questions

- Is the estuary an accumulation zone of microplastics (MPs) ?
- Is there difference in MPs concentration during a tide cycle ?
- Is salinity gradient impacts MPs distribution in water column



Microplastics and the Seine river estuary

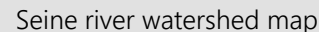
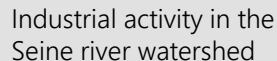
○ Seine river basin :

- 78 600 km² , 17.5 million inhabitants,
85 % urban pop.



Seine river watershed map

- 78 600 km² , 17.5 million inhabitants, 85 % urban pop.,
- 40 % national economic activity



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Seine river watershed map

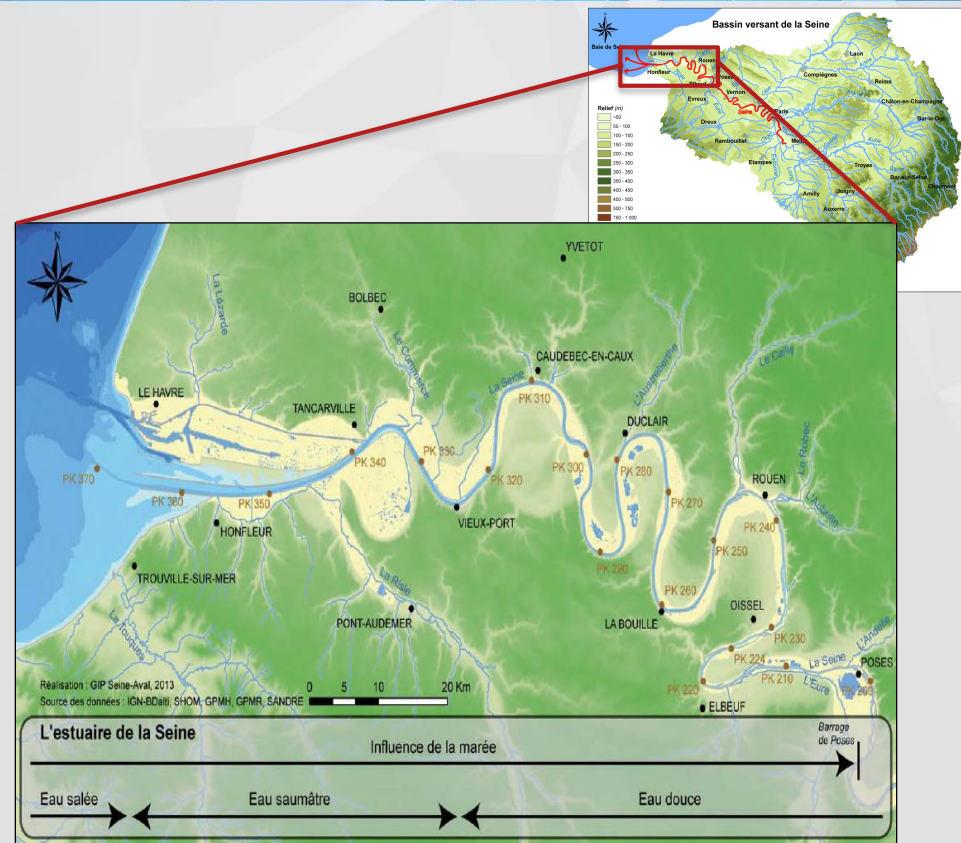
Microplastics and the Seine River estuary

○ Seine river basin:

- 78 600 km² , 17.5 million inhabitants, 85 % urban pop.
- 40 % national economic activity

○ Seine river estuary:

- From Poses to Le Havre
- 170 km
- Semi-diurnal tides
- Heavily industrialised ➔ Petrochemical hub

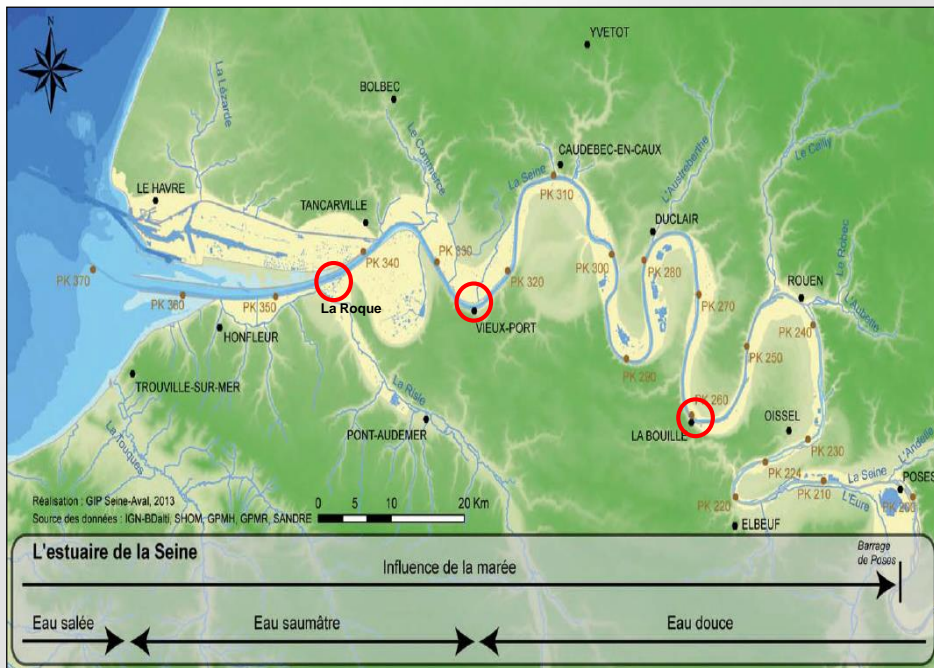


Sampling strategy

- 2017–2019: 4 sampling campaigns

Sampling strategy

- 2017–2019: 4 sampling campaigns
- 3 sampling points



Sampling strategy



Plankton nets used in the collection

- 2017–2019: 4 sampling campaigns
- 3 sampling points
- Two plankton nets, 300 μm mesh, collecting upper 15 cm (surface water) and 50 cm (subsurface water).
- Sampling during ebb and rising tide

Sampling trip on May 15, 2017

Estimations of collected volumes on May 15, 2017

	Collected Volume (m ³)
La Roque Surface water	91
La Roque Subsurface water	38
Vieux-Port Surface water	74
Vieux-Port Subsurface water	14
La Bouille Surface water	5
La Bouille Subsurface water	20

Downstream



Upstream

- Tide coefficient : 71
- Flow: 256 m³.s⁻¹
- Low flow period
- High variability of collected volume due to the tide cycle

Sample purification



Sieving

- Sieve 5 mm
- Selection of plants and microplastics

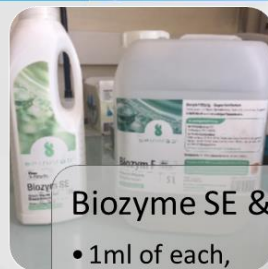
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Detergent SDS

- 1g, 50°C, 24h
- Protein denaturation

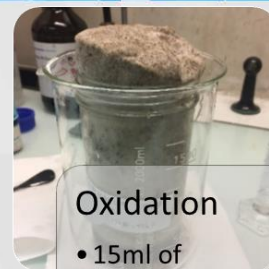
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Biozyme SE & F

- 1ml of each, 40°C, 48h
- Lipid & starch degradation

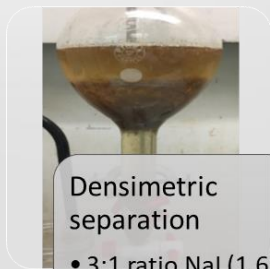
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Oxidation

- 15ml of H_2O_2 (30%), 40°C, 48h
- Oxidation of organic fraction

④



Densimetric separation

- 3:1 ratio NaI (1.65 g.cm^{-3}):sample
- Extraction of MPs in supernatant

⑤



Filtration

- GF/D 47mm, $2.7\mu\text{m}$ pore size
- Glass fiber filters

⑥



Observation

- Binocular & image processing software
- Size, form & color are identified

⑦

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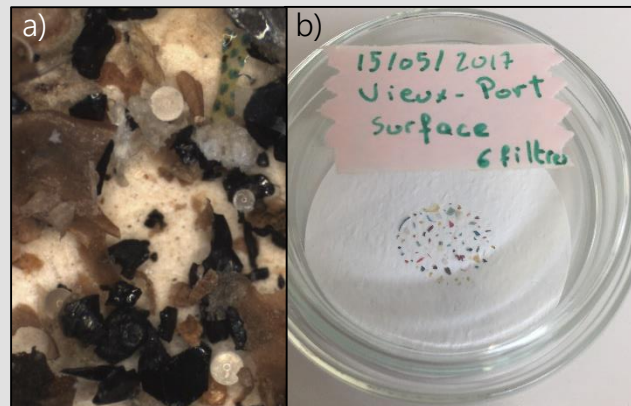
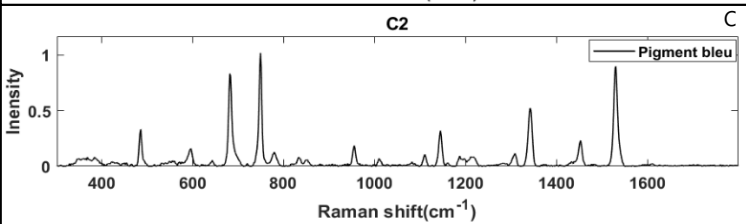
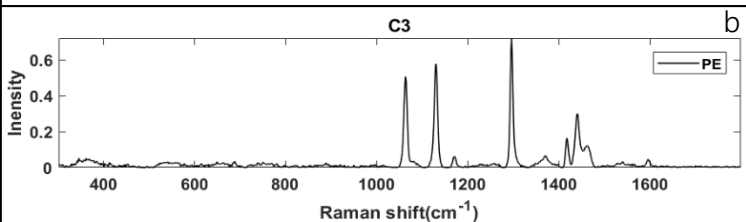
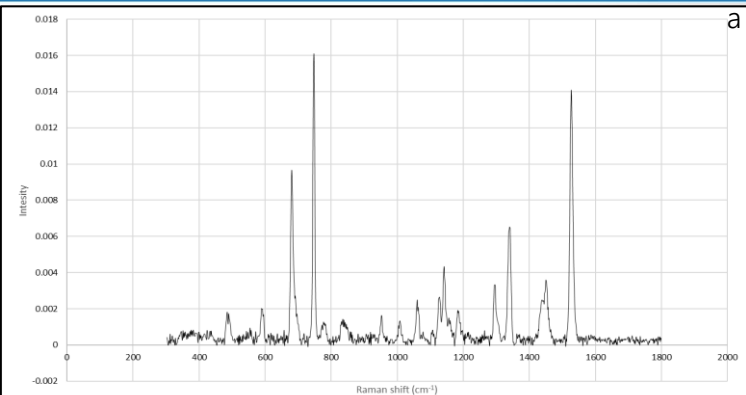
- Binocular & image processing software
- Size, form & color are identified

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- Only particles are considered (no fibers)
- Observation detection limit = $50 \mu\text{m}$

Polymer characterisation

- Raw filters too full to be analysed as it is!
→ Selection of particles and deposition on a new filter under binocular microscope
- About 25% of each sample analysed
- Raman spectroscopy
→ Matching > 75 %




a) raw filter, b) selected particles

a) normalized spectrum of a PE + PB (blue pigment) particle collected, b) pure spectrum of PE, c) pure spectrum of PB

Concentration of microplastics in the Seine River Estuary


Estimations of MPs concentrations in the Seine River estuary (MP-like particles)

		Collected Volume (m ³)	Particles number	Levels (particles.m ⁻³)
 Downstream	La Roque Surface water	91	258	2.8
	La Roque Subsurface water	38	268	7.1
	Vieux-Port Surface water	74	639	8.6
	Vieux-Port Subsurface water	14	619	45.0
	La Bouille Surface water	5	55	1.7
	La Bouille Subsurface water	20	24	2.0
Upstream				

- Concentrations between 1.7 particles.m⁻³ and 45 particles.m⁻³

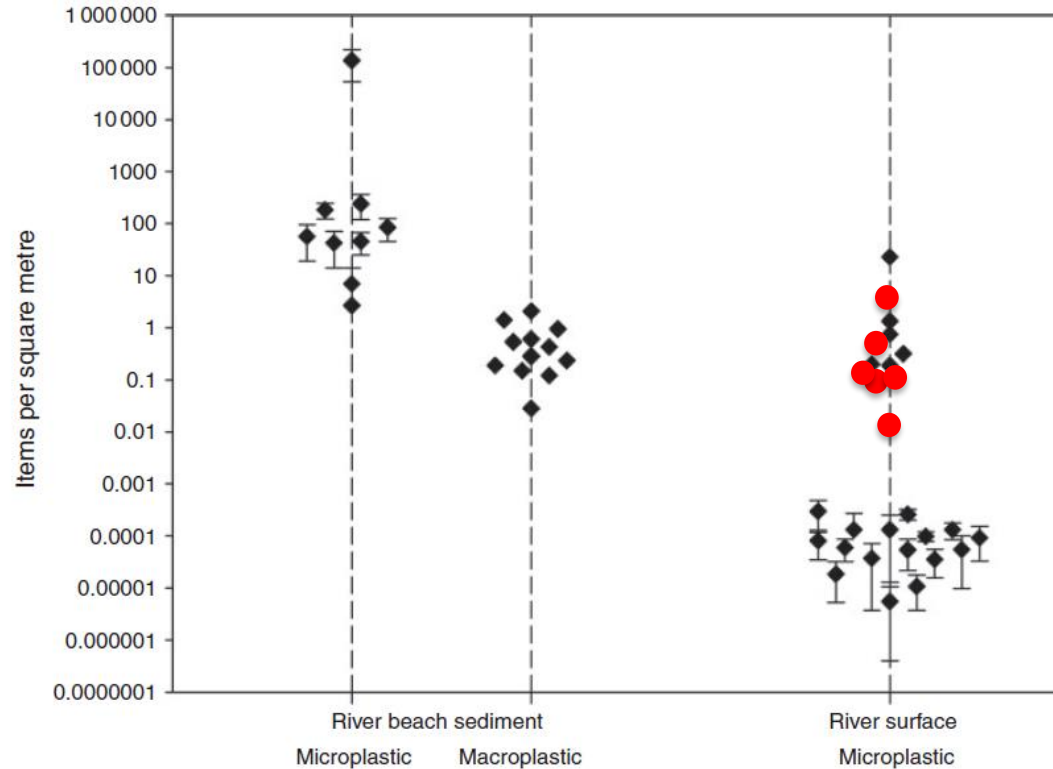
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Upstream				

- Concentrations between 1.7 particles.m⁻³ and 45 particles.m⁻³
- Same order of magnitude in concentration of MPs between upstream and downstream

Concentration of microplastics in the Seine River Estuary



Source : Beyond the ocean: contamination of freshwater ecosystems with (micro-)plastic particles (Dris et al., 2015)

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○ Under salt-water intrusion:



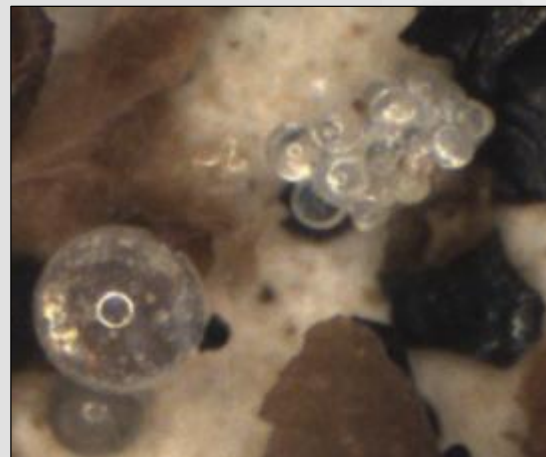
→ Difference between
surface and subsurface

Concentration of microplastics in the Seine River Estuary

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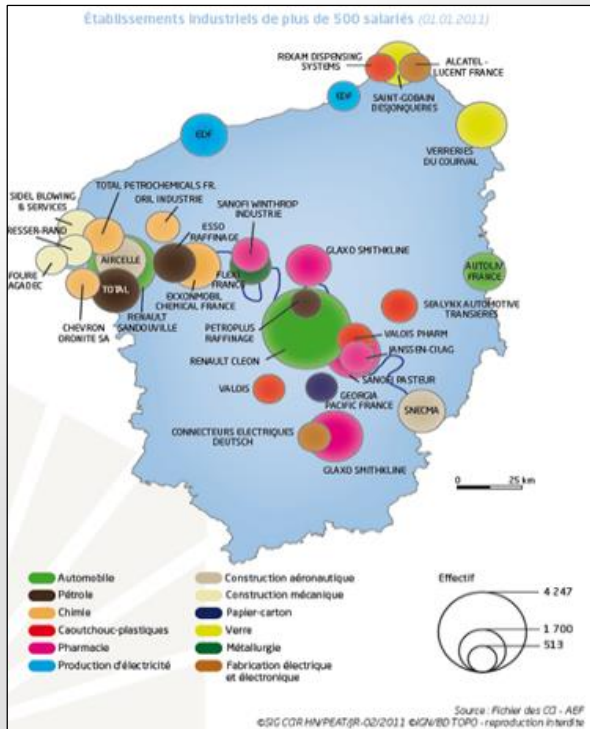
- Higher concentrations in Vieux-Port
 - Point-source pollution of crystal PS microbeads



Crystal PS microbeads on raw filter

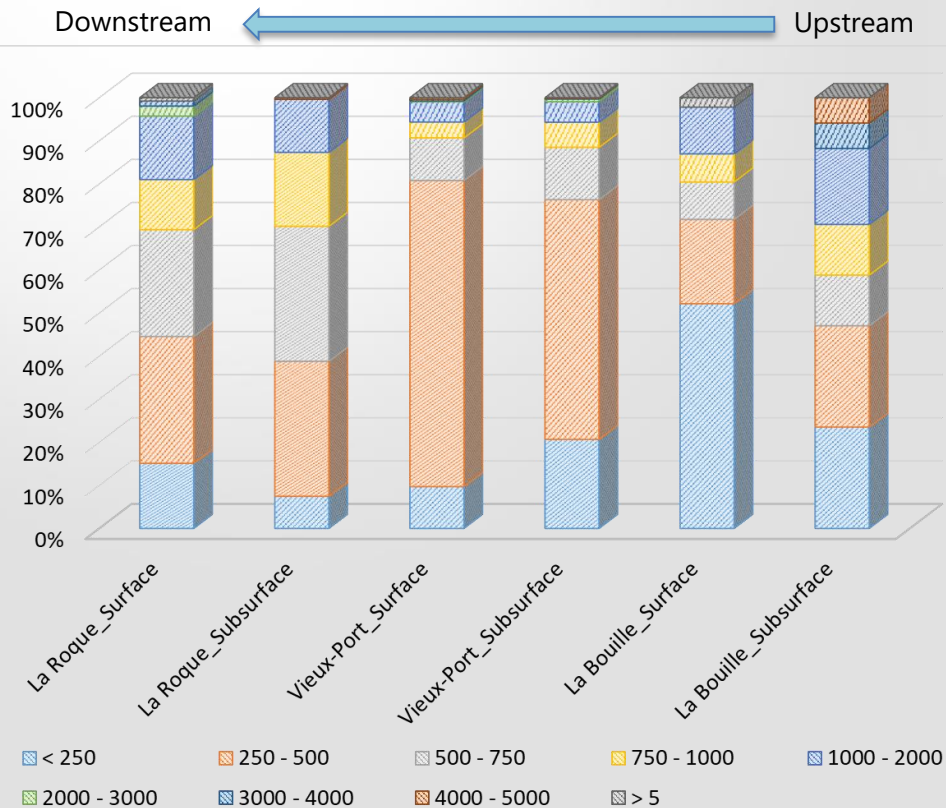
Concentration of microplastics in the Seine River Estuary

- Higher concentrations in Vieux-Port
- Point-source pollution of crystal PS microbeads
- Large petrochemical hub

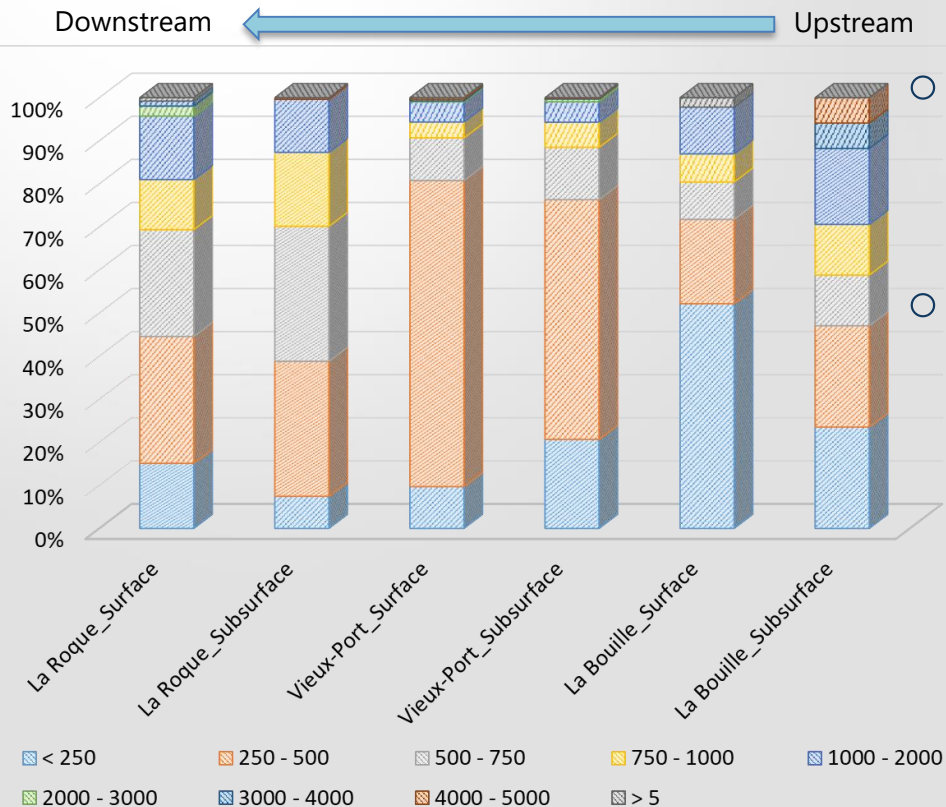


Industrial activity in the Seine river watershed

Particle length distribution



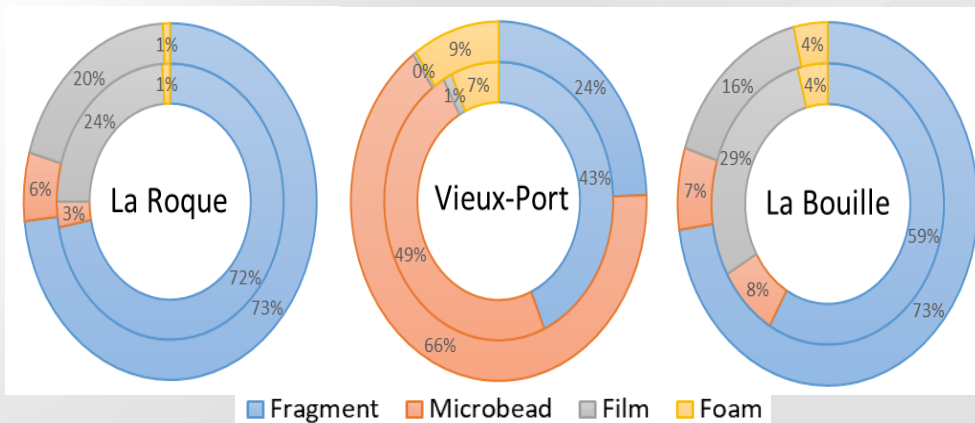
Particle length distribution



○ Most of the particles are smaller than 1 mm.

○ Peak in particles density for fraction 250-500 μm

Particle shape distribution

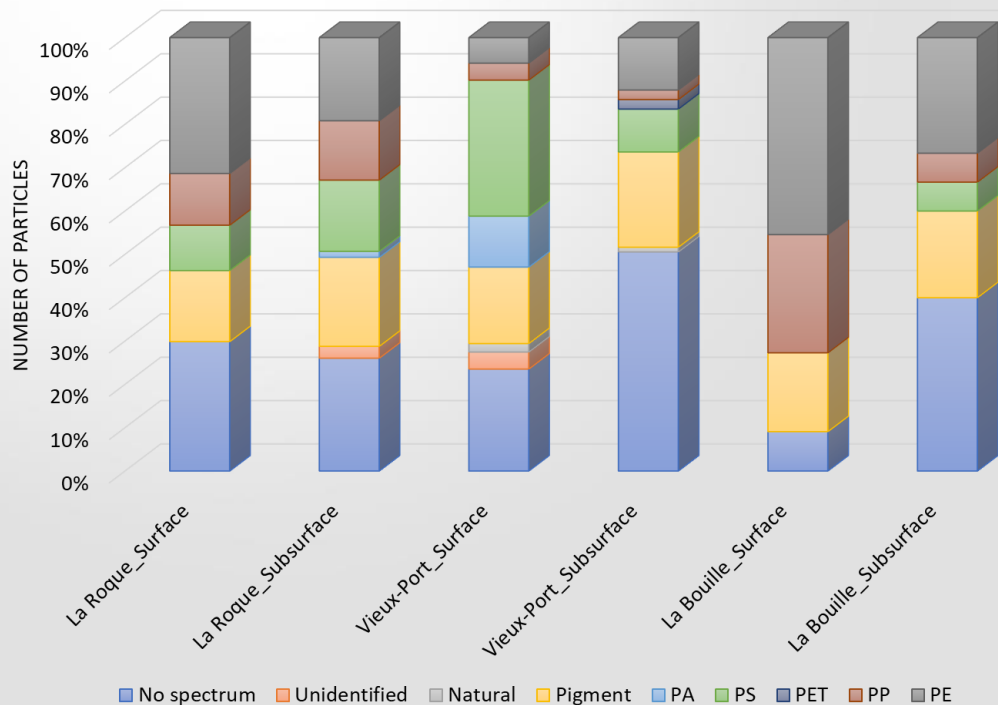


Shape distribution of particles collected on May 15, 2017, exterior:
surface water, interior: subsurface water

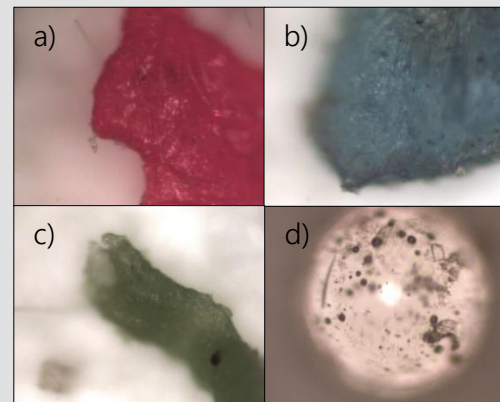
- High proportion of fragments and films
- Difference between surface et sub-surface
- Point-source pollution in microbeads in Vieux-Port
- Fibers will be investigated following a specific strategy

Identification of polymers

- Between 10 % and 50 % particles did not respond or spectrum was not identified
- 2 % maximum of natural material
- PE & PS contribute between 20 % and 45 % of the analysed particles
- Vieux-Port: crystal PS microbeads



Spectroscopy Raman results for 25 % of samples from the Seine River estuary



Type of polymers found, a) PE, b) PA, c) PP, d) PS

Outcomes & perspectives

○ Outcomes:

- High concentration of MPs in the Seine River estuary
- Point-source pollution of crystal PS microbeads in Vieux-Port
- Most of particles < 1 mm
- Between 20 % and 45 % of PE & PS in analysed particles
- High number of particles without spectrum or non identified

Outcomes & perspectives

○ Perspectives:

- Increase percentage of particles identified in each sample
- Tests with μ FTIR for unidentified and no responding particles
- Compare MPs concentrations level with sediment collected in the Seine River Estuary

Thank you for your attention

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References

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