

MICROPLASTIC CONTAMINATION OF SEDIMENT AND WATER COLUMN IN THE SEINE RIVER ESTUARY

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Microplastics and the Seine river estuary

○ Scientific questions:

- Is the estuary an accumulation zone of microplastics (MPs) ?
- How does the MPs concentration evolve during a tidal cycle ?
- Does the salinity gradient impact the MPs distribution in the water column?

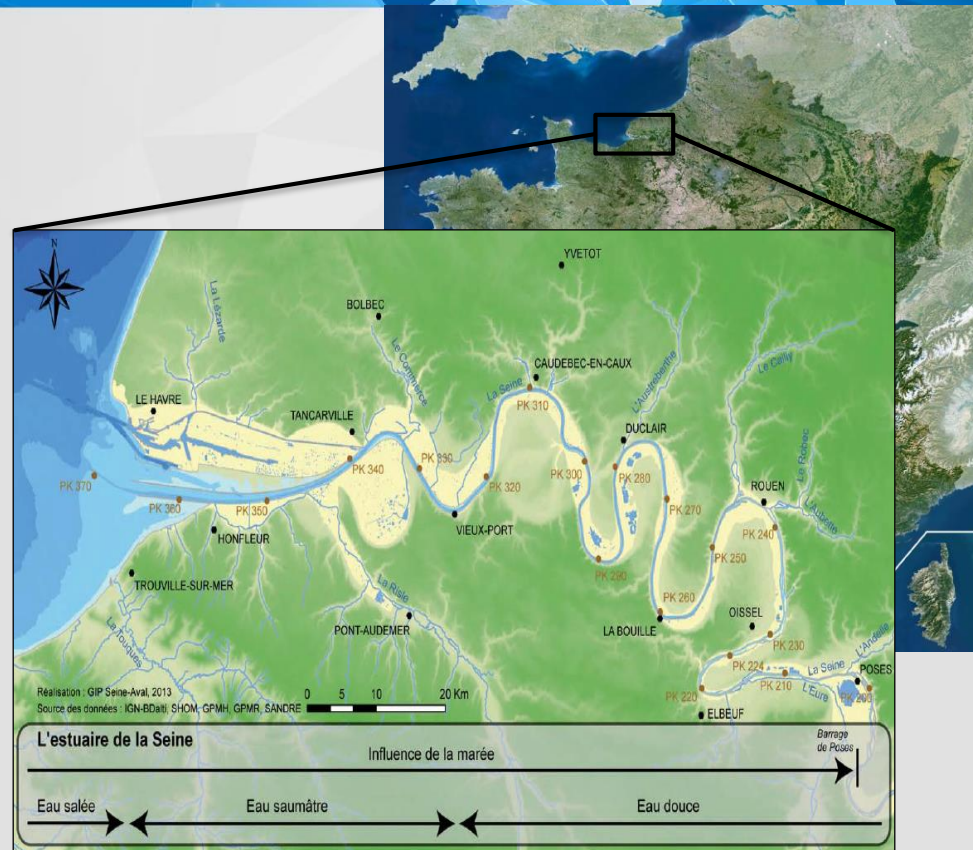
○ Plastic-Seine research project



Microplastics and the Seine River estuary

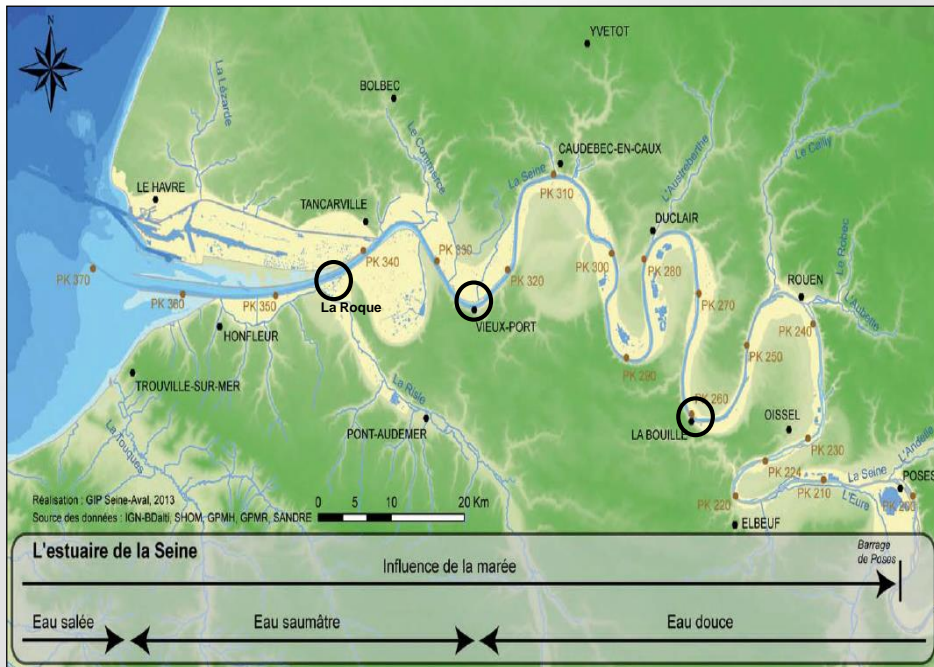
○ Seine river estuary:

- From Poses to Le Havre
- 170 km
- Semi-diurnal tides
- Heavily industrialised → Two industrial harbors
Petrochemical hub



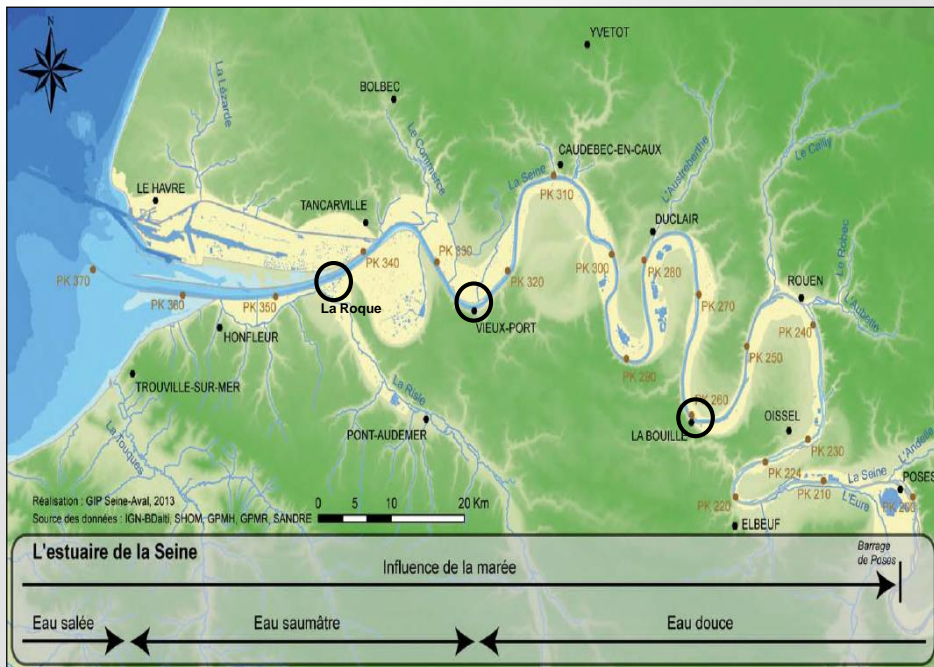
Limit of the Seine river estuary (Fisson et al., 2014)

Sampling strategy



- 2017–2019: 4 sampling campaigns
- 3 sampling points along the estuary with different salinity gradient

Sampling strategy



- 2017–2019: 4 sampling campaigns
- 3 sampling points along the estuary with different salinity gradient
- Ebb tide

Sampling strategy



Plankton nets used in the collection

- 2017–2019: 4 sampling campaigns
- 3 sampling points along the estuary with different salinity gradients
- Ebb tide
- Two plankton nets, 300 μm mesh size, collecting upper 15 cm (surface water) and 50 cm (subsurface water)
- Van Veen grab for sediment samples

Water samples purification



Sieving

- Sieve 5 mm
- Selection of plants and microplastics

①



Detergent SDS

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

②



Biozyme SE & F

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

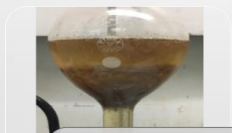
③



Oxidation

- 15ml of H₂O₂(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, 2.7µm pore size
- Glass fiber filters

⑥



Observation

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

⑦



Identification

- Raman spectroscopy
- 25 % of collected particles

⑧



- Only particles are considered (no fibers)
- Observation detection limit = 50 µm

Protocol adapted from Dris et al., 2016

Sediment samples purification



Densimetric separation

- 4 x 25 g + NaI (1.65 g.cm⁻³)
- settle for 24h



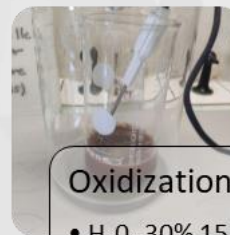
Filtration

- metallic filter 10 μm mesh
- 47 mm diameter



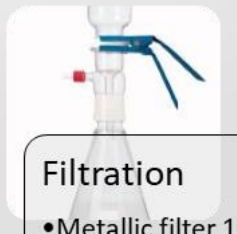
SDS digestion

- C = 1.75 g.L⁻¹
- 40°C, 24h



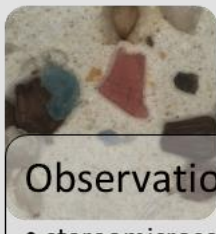
Oxidization

- H₂O₂ 30% 15 ml
- 40°C, 48h



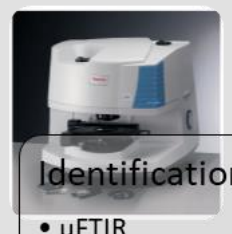
Filtration

- Metallic filter 10 μm mesh
- 47 mm diameter



Observation

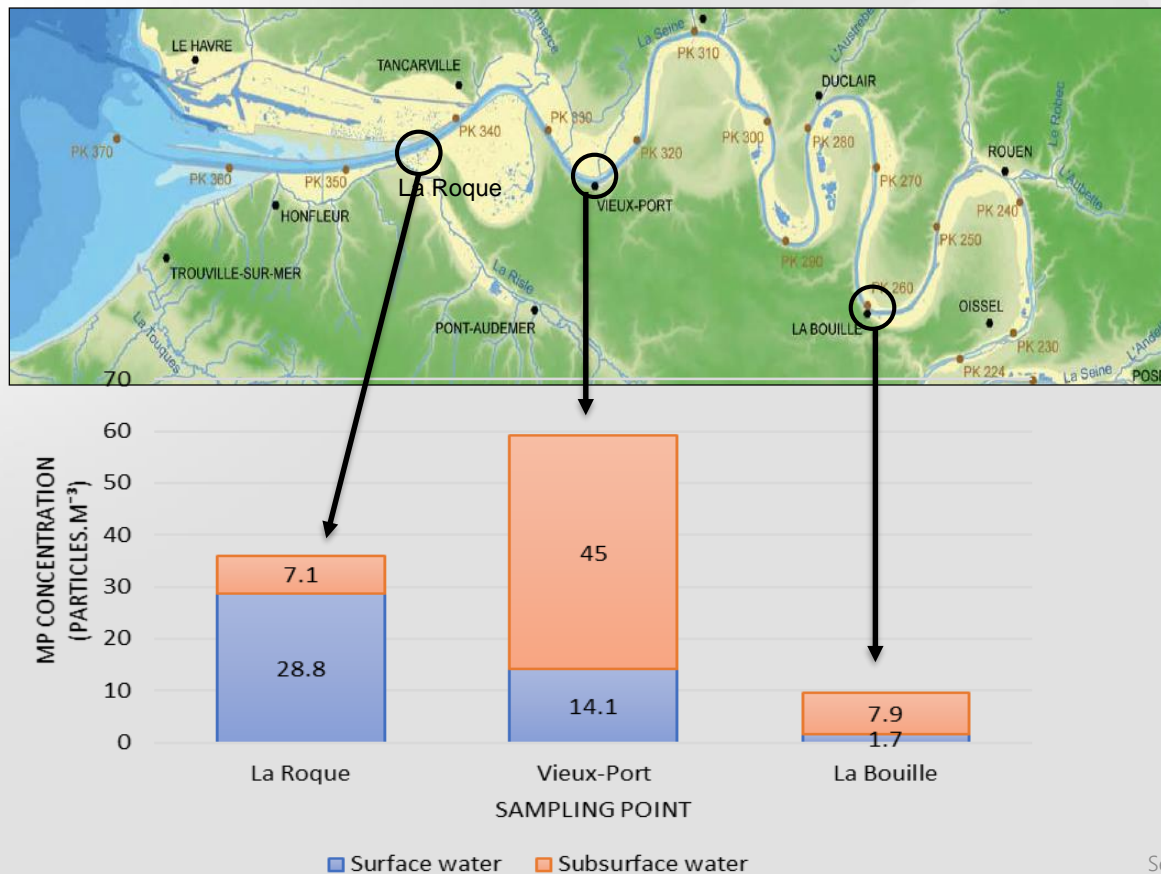
- stereomicroscope
- enumeration, shape and size



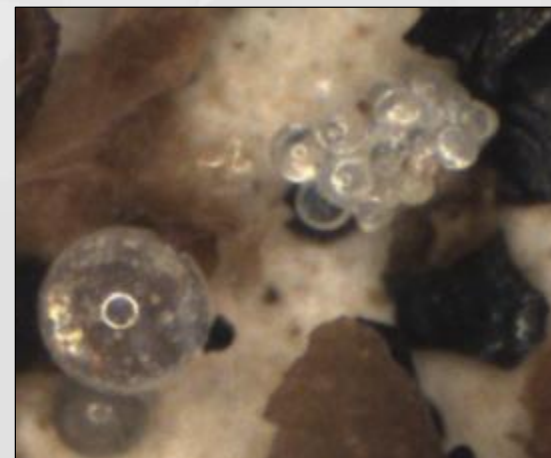
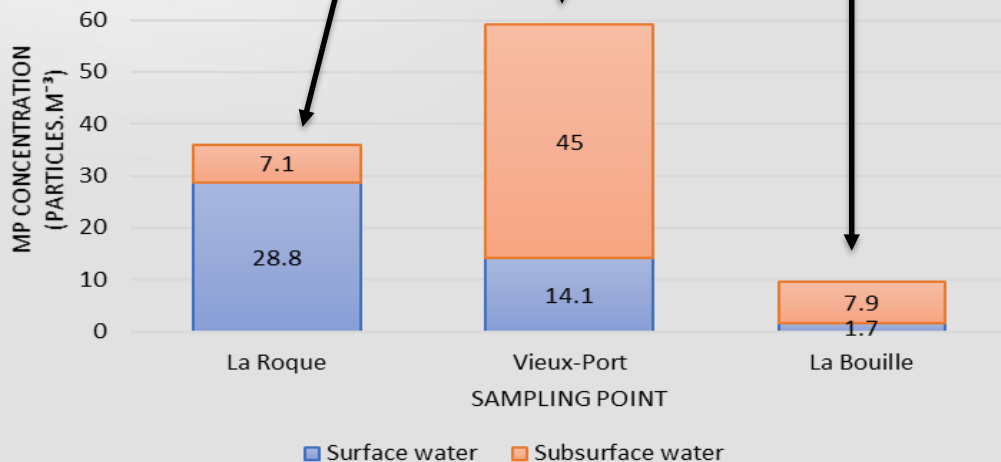
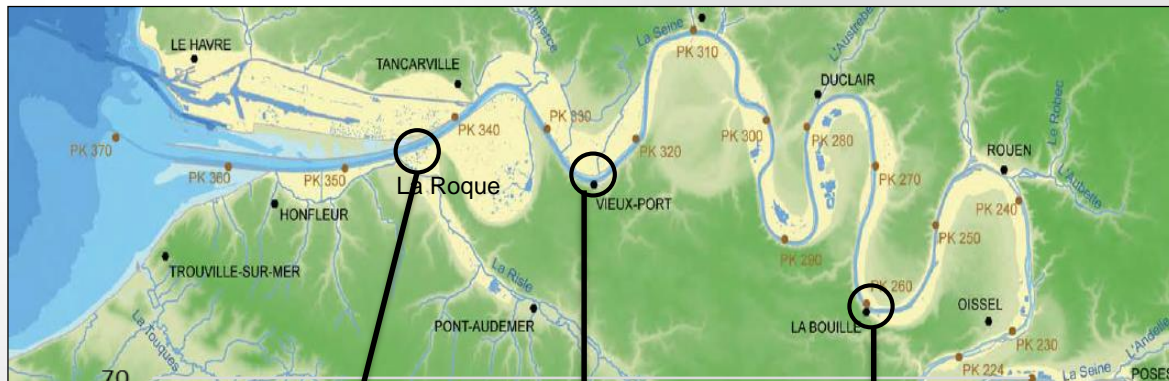
Identification

- μFTIR
- 5% of the sample

MPs concentrations in water samples

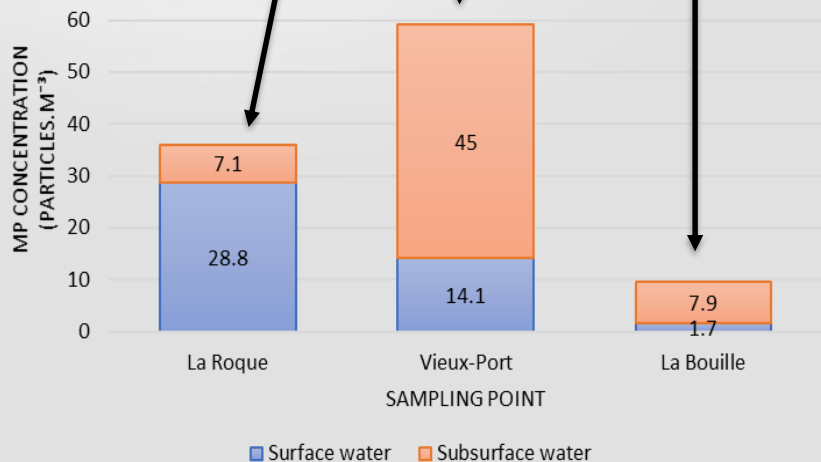
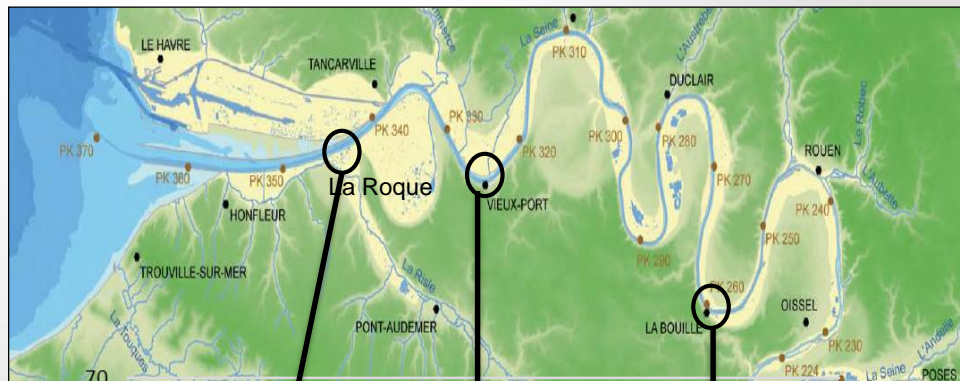


MPs concentrations in water samples



Crystal PS microbeads on raw filter in Vieux-Port

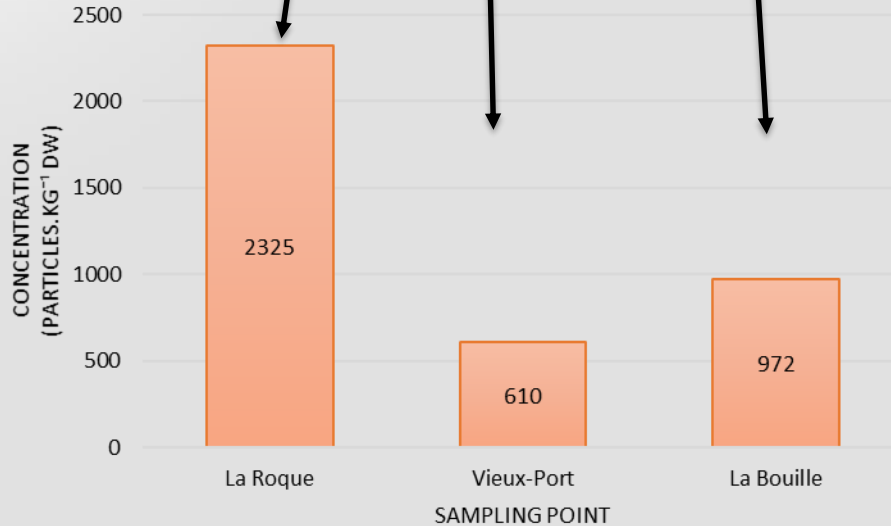
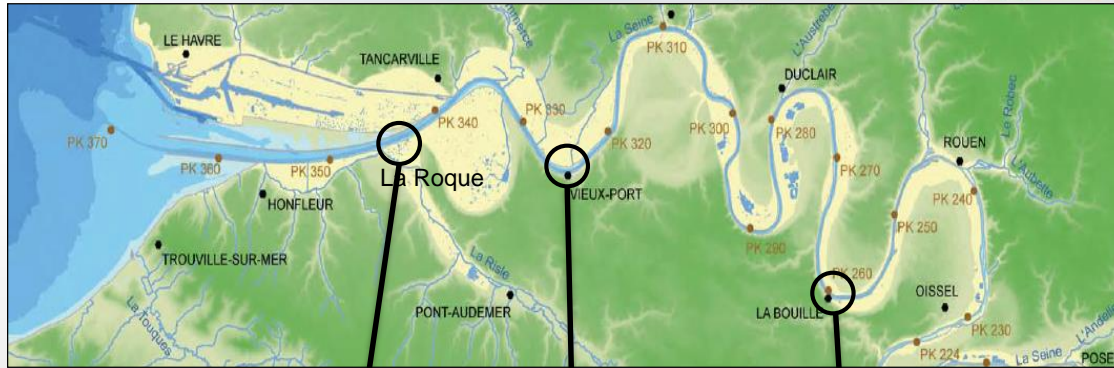
MPs concentrations in water samples



Water column contamination in literature

- Tamar estuary, England (Sadri et Thompson., 2014):
 - 0.74 particles.m⁻³
- Guanabara bay, Brazil (Olivatto et al., 2019):
 - 1.4 – 21.3 particles.m⁻³
- Urban estuaries, China (Zhao et al., 2015):
 - 136 - 249 particles.m⁻³

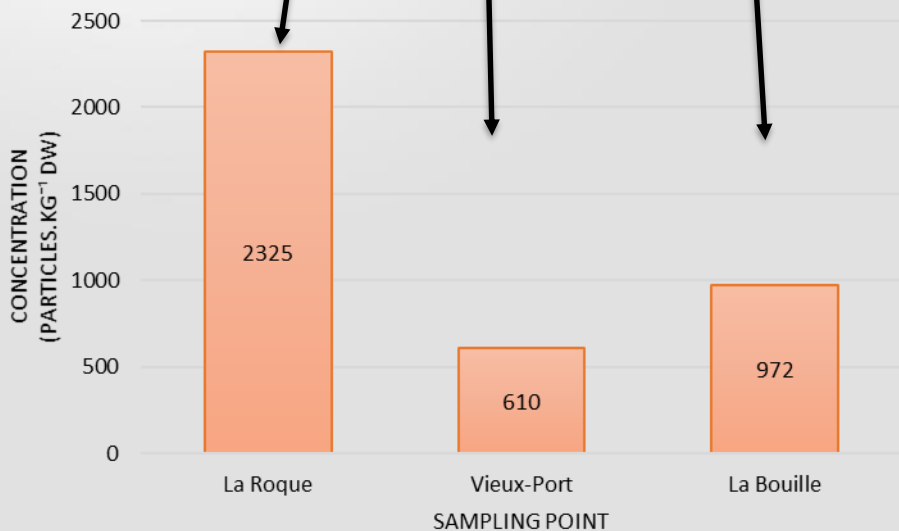
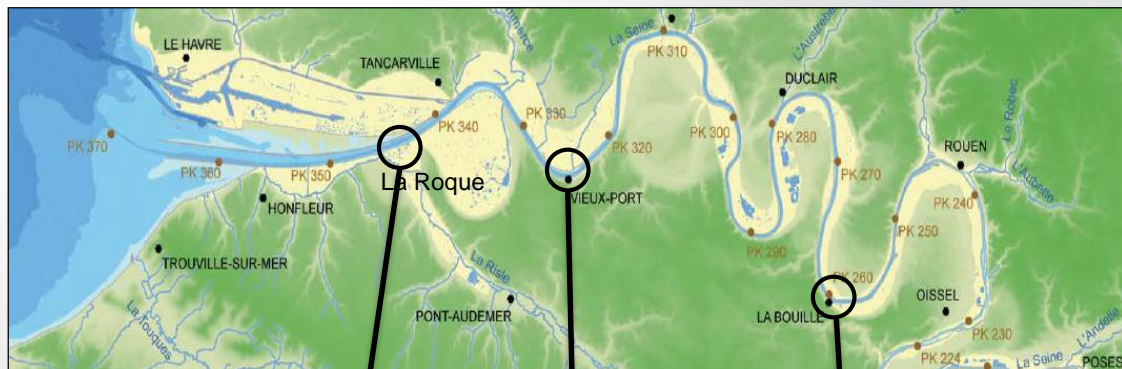
MPs concentration in sediment samples



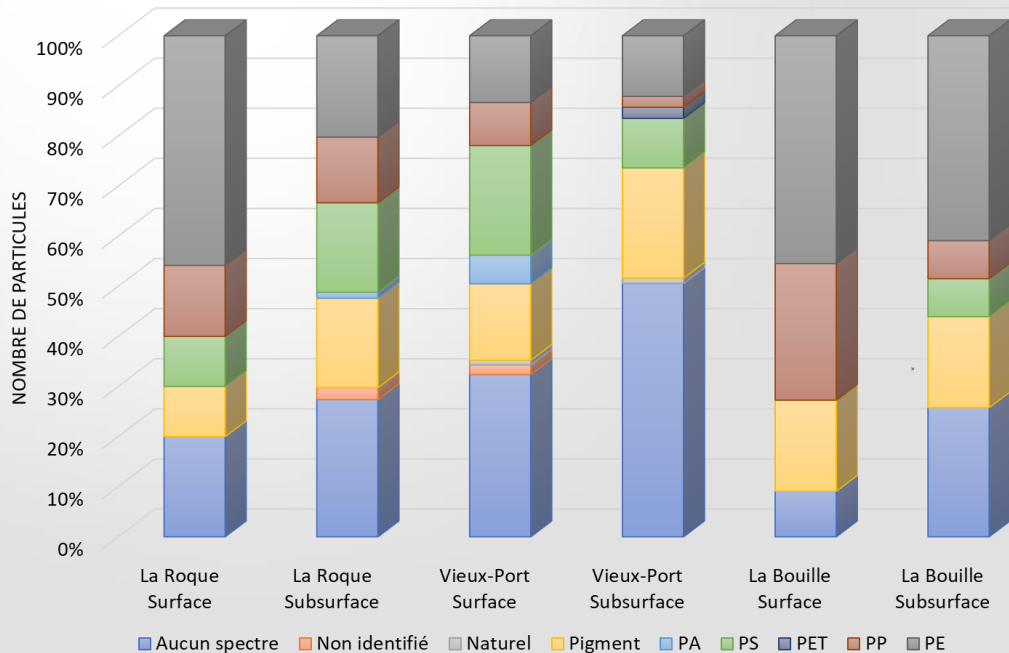
MPs concentration in sediment samples

Sediment contamination in literature

- Pearl river, China (Fan et al., 2019) :
 - 258 – 685 particles.kg⁻¹
- Ebro delta, Spain (Simon-Sanchez., 2019) :
 - 2052 particles.kg⁻¹

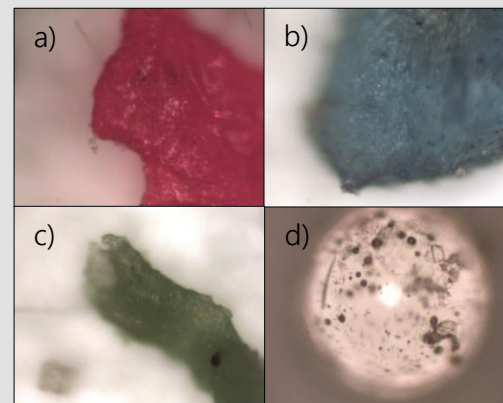


Polymer identification in water samples



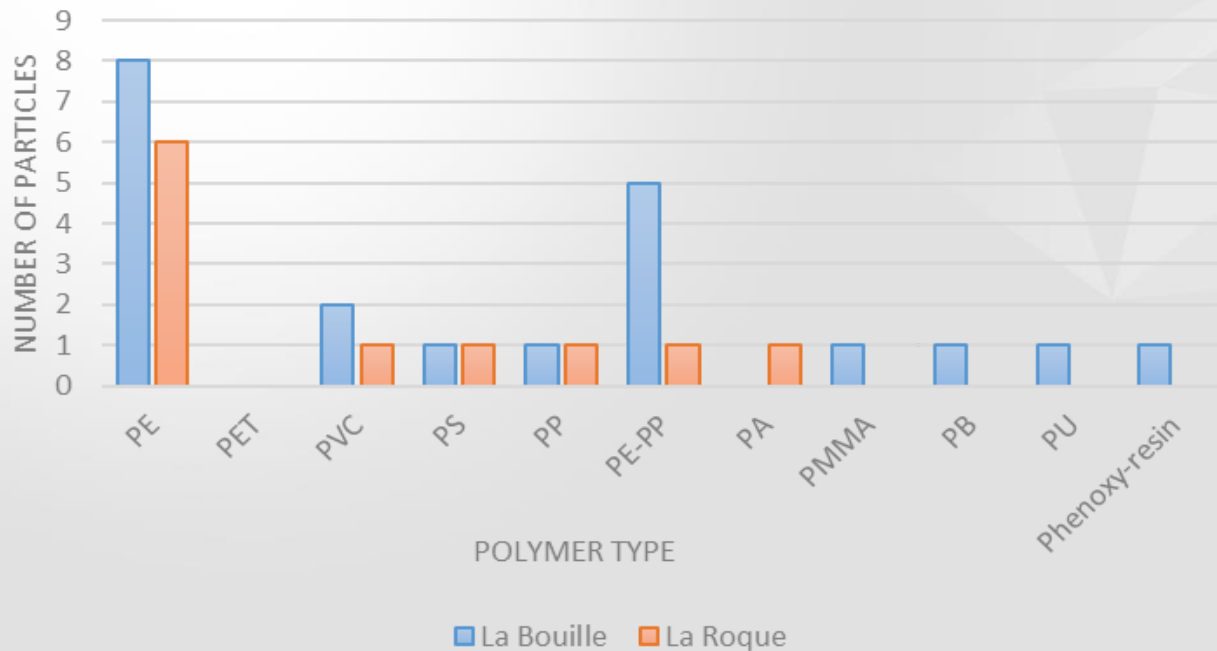
- Between 10 % and 50 % particles did not respond or spectrum was not identified
- PE & PS contribute between 20 % and 45 % of the samples
- Vieux-Port: crystal PS microbeads

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



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

Polymer identification in sediment samples



- High proportion of PE particles and copolymer PE-PP
- Occurrence of PVC not found in water column → high density

μFTIR spectroscopy results for 10 % of sediment samples from the Seine River estuary

Outcomes & perspectives

○ Outcomes:

- High concentration of MPs in water column samples in the Seine River estuary
- Point-source pollution of crystal PS microbeads in Vieux-Port
- Same order of MPs concentration in sediment samples as in the literature
- Between 20 % and 45 % of PE & PS in water column samples
- PVC found only in sediments

Outcomes & perspectives

○ Perspectives:

- Increase the percentage of particles identified in each sample to increase the representativity of the results
- μ FTIR for unidentified and no responding particles to increase percentage of identified particles
- Impact of salinity gradient on the MPs distribution in the water column

Thank you for your attention

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References

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