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Microplastic contamination in the Seine River estuary

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PLASTIC-SEINE PROJECT (2017-2020), FUNDED BY GIP SEINE-AVAL



The microplastic problem



- First article on plastic debris in 1972 (Carpenter et al., 1972)
- 2009: Microplastics = particles < 5 mm
- Fragmentation mechanism:
 - Mechanical erosion
 - Photo-degradation
 - biodegradation
- First studies on marine environment then on continental waters
- Now : growing interest for estuaries



(Cole et al., 2013)



Chris Jordan (via U.S. Fish and Wildlife Service Headquarters)



Ifremer

Plastic-Seine project

- Project aims:
 - Status of abiotic compartment contamination on the Seine continuum
 - Inventory of the contamination of the food network in the Seine River estuary

- Seine River estuary :
 - From Poses to Le Havre
 - Semi-diurnal tides
 - Salinity gradient & hydrodynamics
 - Possible microplastics transfer area from fresh water to marine environment

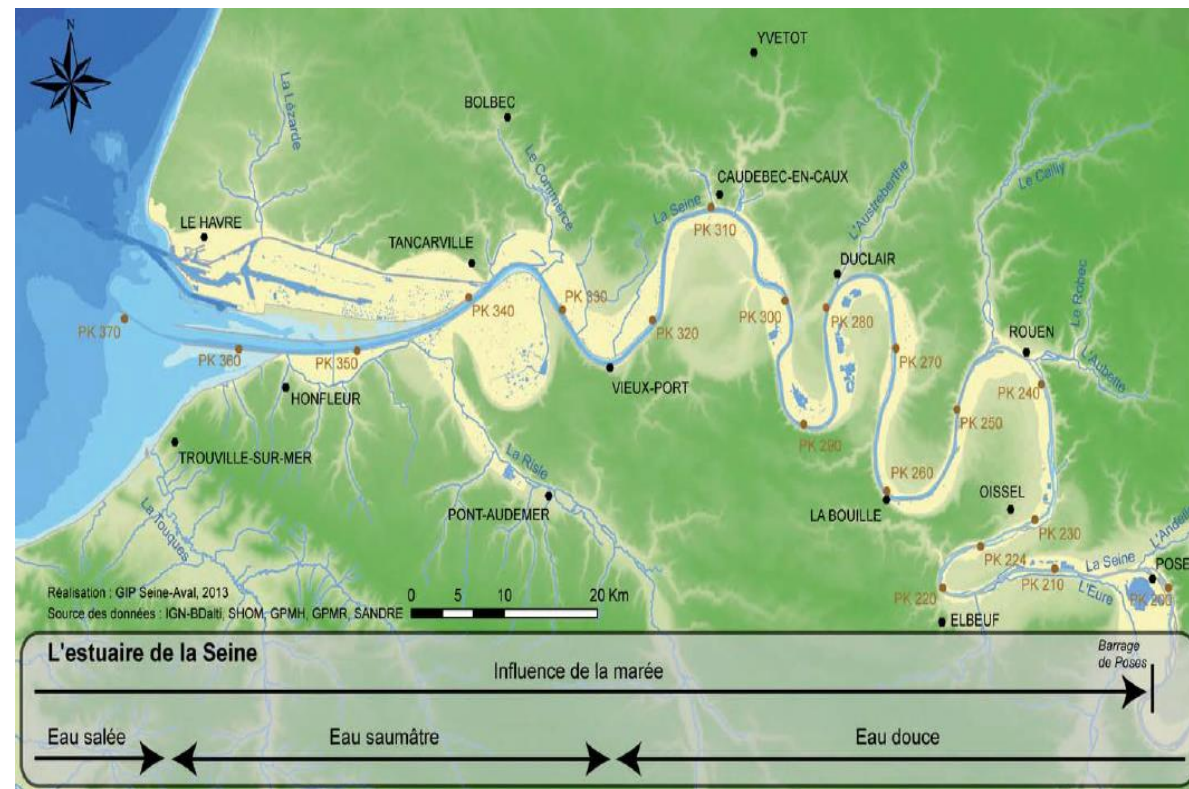


Figure 1: limit of the Seine River estuary (Fisson et al., 2014)

- Material
 - Plankton net modified, 300 μm mesh, collecting upper 15 cm (surface water)
 - Classic plankton net, 300 μm collecting upper 50 cm (subsurface water)

- Methods
 - 3 sampling sites
 - Ebb and rising tide
 - Tide coefficient: 71
 - Flow: 256 $\text{m}^3 \cdot \text{s}^{-1}$

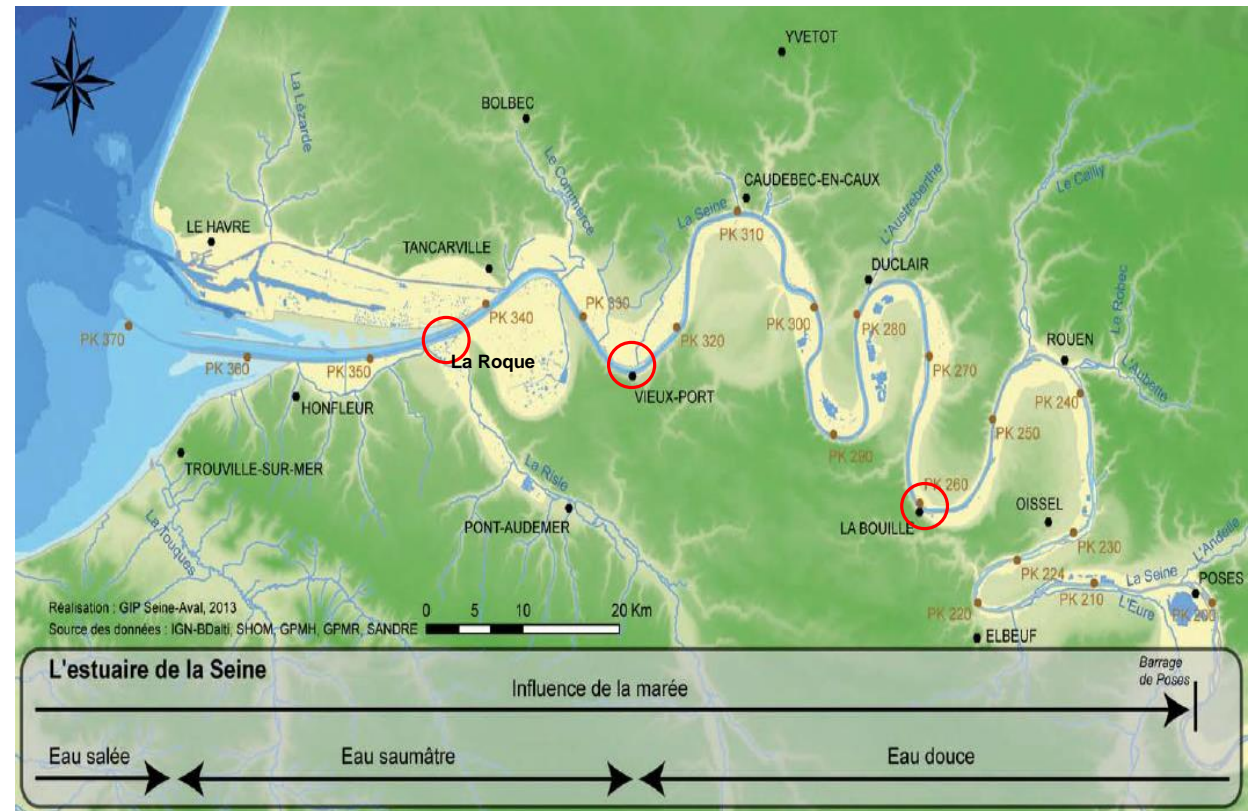


Figure 2 : sampling points (Fisson et al., 2014)

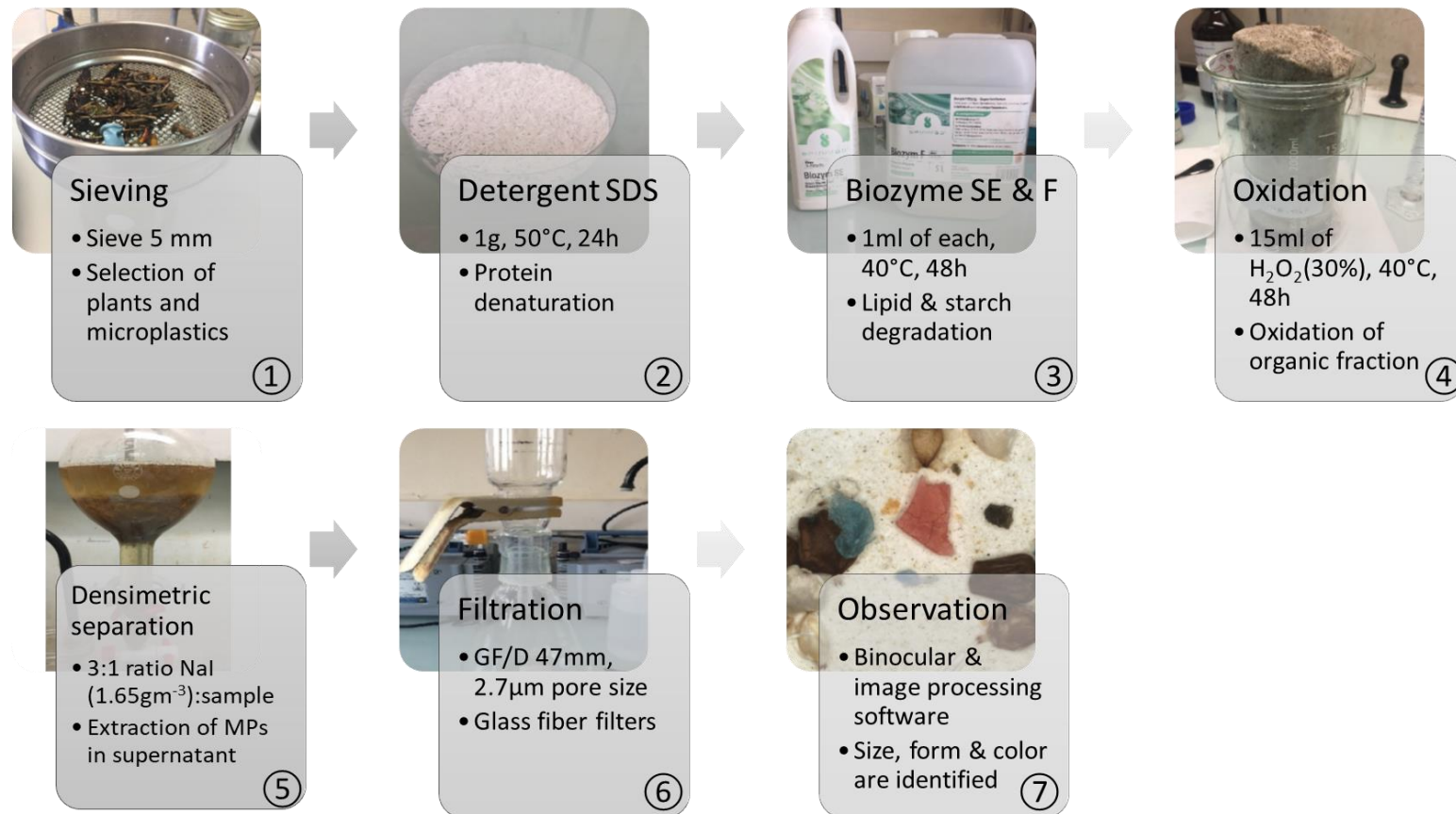


Figure 3: samples treatment protocol (Dris, 2016)

Table 1: estimations of microplastics concentrations in the Seine River estuary

	Tide	Time (s)	Current speed (m.s ⁻¹)	Collected Volume (m ³)	Particles number	Levels (particles.m ⁻³)
La Roque Surface water	Ebb tide	367	1.3	91	258	2.8
La Roque Subsurface water		483	1.5	38	268	7.1
Vieux-Port Surface water	Rising tide	364	1.04	74	639	8.6
Vieux-Port Subsurface water		481	0.55	14	619	45.0
La Bouille Surface water	Ebb tide	367	0.46	5	55	1.7
La Bouille Subsurface water		476	0.48	20	24	2.0

- Concentrations in microplastics between 1.7 and 45.0 particles.m⁻³
- High variability of current speed and volume collected
- Maximum concentrations at Vieux-Port
- Compare to literature:
 - Greater Paris area → 0.88 to 1.57 particles.m⁻³ (Dris, 2016)
 - Tamar estuary, England: 0.74 particles.m⁻³ (Sadri et Thompson, 2014)

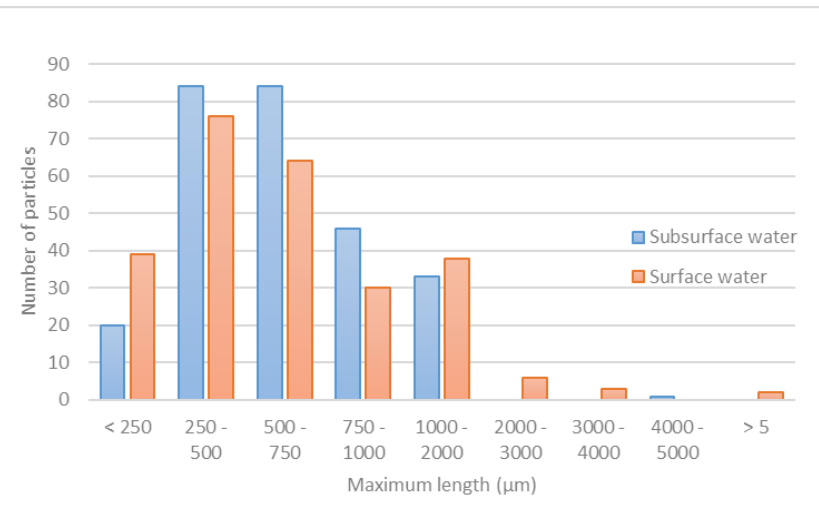


Figure 4: Maximum length of particles (µm) at La Roque

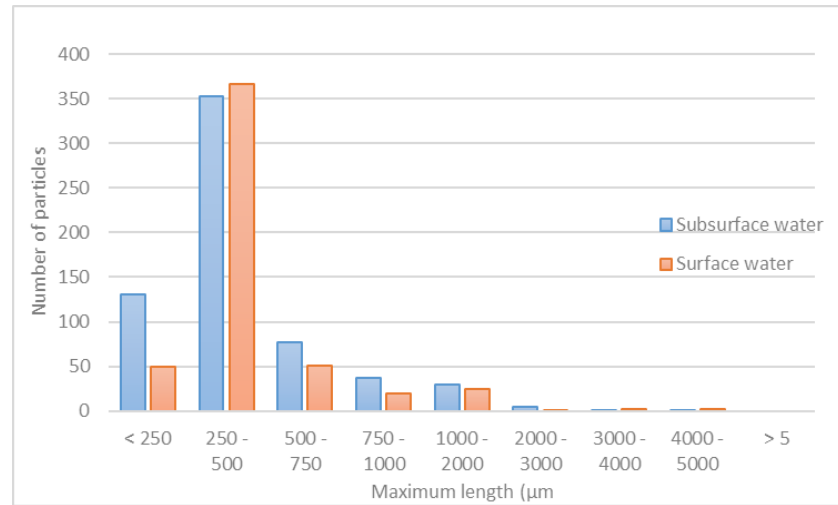


Figure 5: Maximum length of particles (µm) at Vieux-Port

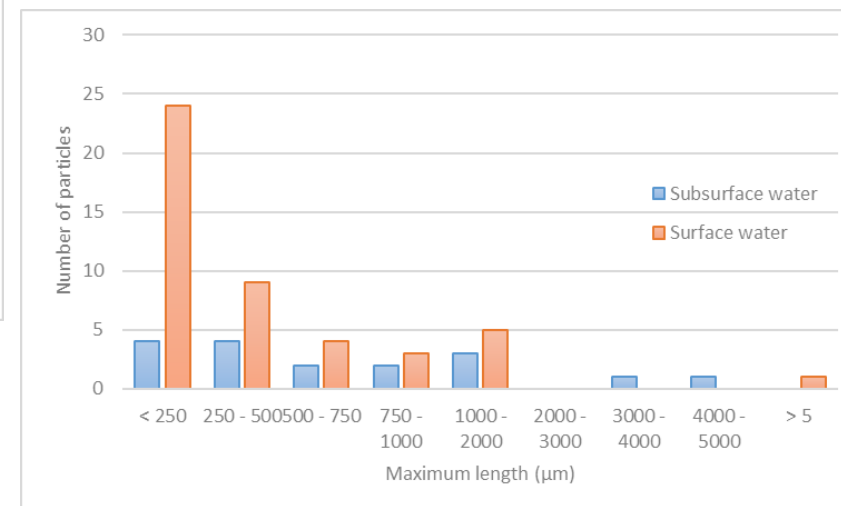


Figure 6: Maximum length of particles (µm) at La Bouille

○ High proportion of microplastics < 1 mm

Shape distribution of microplastics in the Seine River estuary

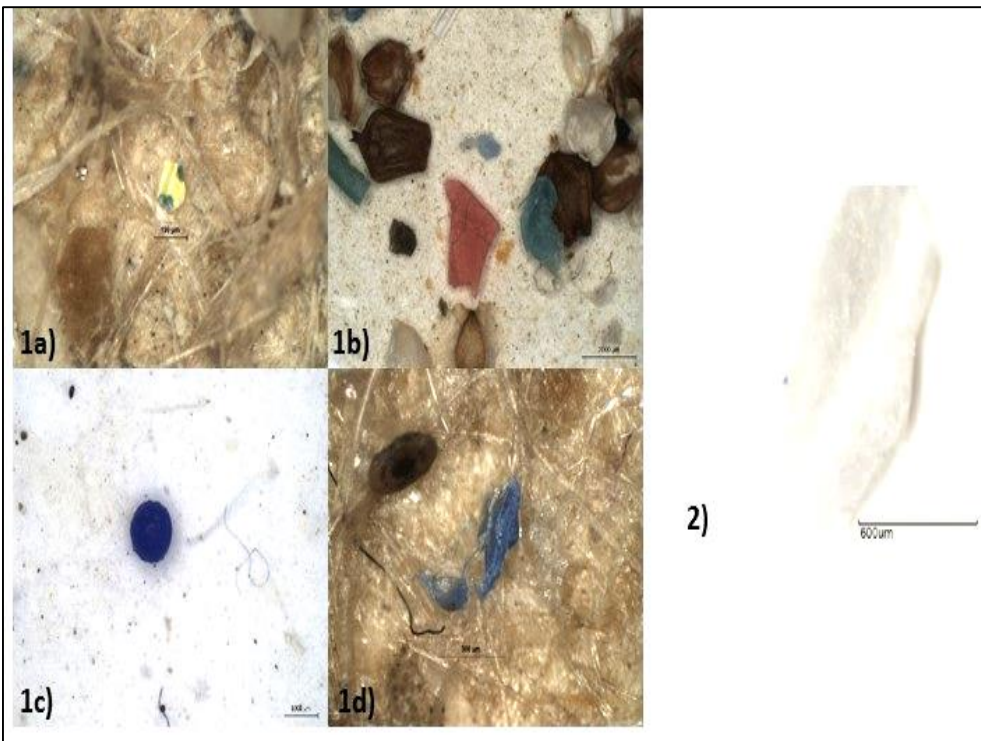


Figure 7: shapes of microplastics 1a) & 1b) fragment; 1c) sphere ; 1d) film ; 2) foam (Marine & Environmental Research Institute)

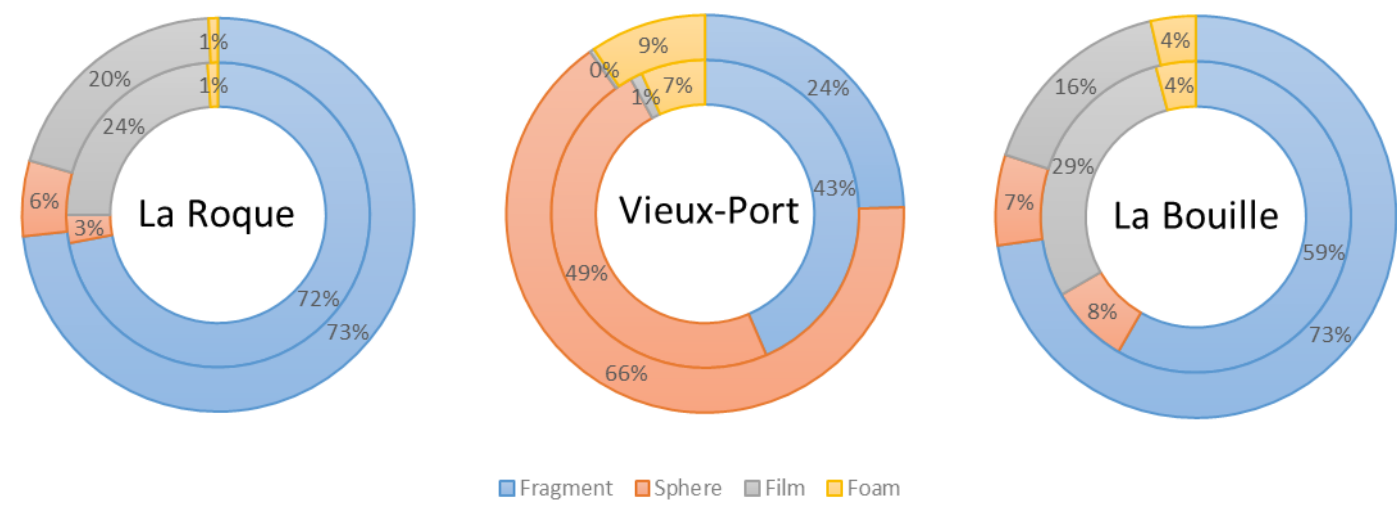


Figure 8: Shape distribution of particles sampled in May 2017, exterior: surface water, interior: subsurface water.

- Dominance of spheres at Vieux-Port → casual pollution ?
 - Prevalance of fragments at La Roque and La Bouille
 - Twice as many films in subsurface water at La Bouille

CONCLUSIONS

- Levels of contamination higher than in the literature
- High proportion of particles < 1 mm
- Potential heterogeneity in shape distribution depending on depth

PROSPECTS

- Characterization of particles is in progress
- Confirm/infirm shape distribution heterogeneity
- Evaluation of the potential role of the salinity gradient on the distribution dynamics of microplastics in the water column

Thank you for your attention

References

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