Supporting information (SI)

for the article:

Heteroaggregation of nanoplastic particles in the presence of inorganic colloids and natural organic matter

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SI1. Characterization of water from river Rhône

Chromatographic analysis was performed to define the water ion composition using a Dionex ICS-3000 analyzer. Samples were run through an IoMNPac CS12 column to elude the cations with an isocratic concentration of methane sulfonic acid and water, meanwhile to elude the anions with KOH, the same samples were run through an IoMNPac AS19 column. A certified water reference material Ontario-99 from the National Water Research Institute (Canada) was used to verify the accuracy of the measurements. All the reference material results were within the acceptance range of the certificate.

Table S1 Physicochemical parameters of water from river Rhône (08.05.2017)

Parameters	**Value**
pH	7.9 ± 0.1
Conductivity, µSm/cm	302 ± 1
Oxygen, mg/L	10.4 ± 0.2
Alkalinity, mg/L of $CaCO_3$	88 ± 1
Temperature, °C	9.4 ± 0.2
Dissolved organic carbon, mg C/L	0.72 ± 0.1

Table S2 Major ion composition of water from river Rhône obtain using ionic chromatography

Name of element	**Unit**	**Value**	**SD**
Sodium Na^+	mg/L	6.73	0.13
Potassium K^+	mg/L	1.6	0.05
Magnesium Mg^{2+}	mg/L	5.68	0.39
Calcium Ca^{2+}	mg/L	42.33	0.32
Fluoride, F^-	mg/L	0.077	0.001
Chloride, Cl^-	mg/L	9.83	0.01
Bromide, Br^-	mg/L	0.0323	0.0003
Sulfate SO_4^{2-}	mg/L	44.71	0.06
Nitrate, NO_3^{2-}	mg/L	2.23	0.05

SI2. Kinetic of aggregation between PS nanoplastics and Fe_2O_3 in ultrapure water

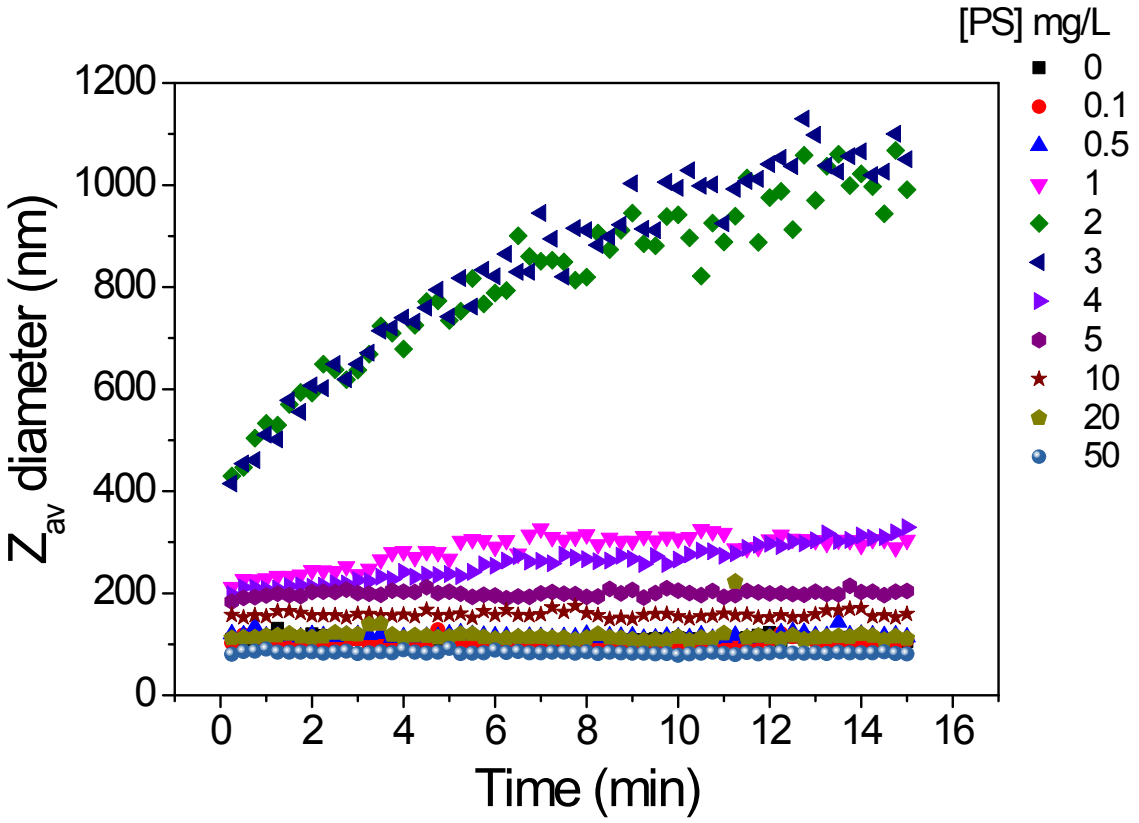


Fig. S1. Variation of z-average hydrodynamic diameter of PS nanoplastics with time at increasing nanoplastic concentration. Experimental conditions: [Fe_2O_3] = 5 mg/L, pH = 8.0 ± 0.2, ultrapure water.

SI3. Size distribution (DLS) of PS nanoplastic particles and Fe_2O_3 particles

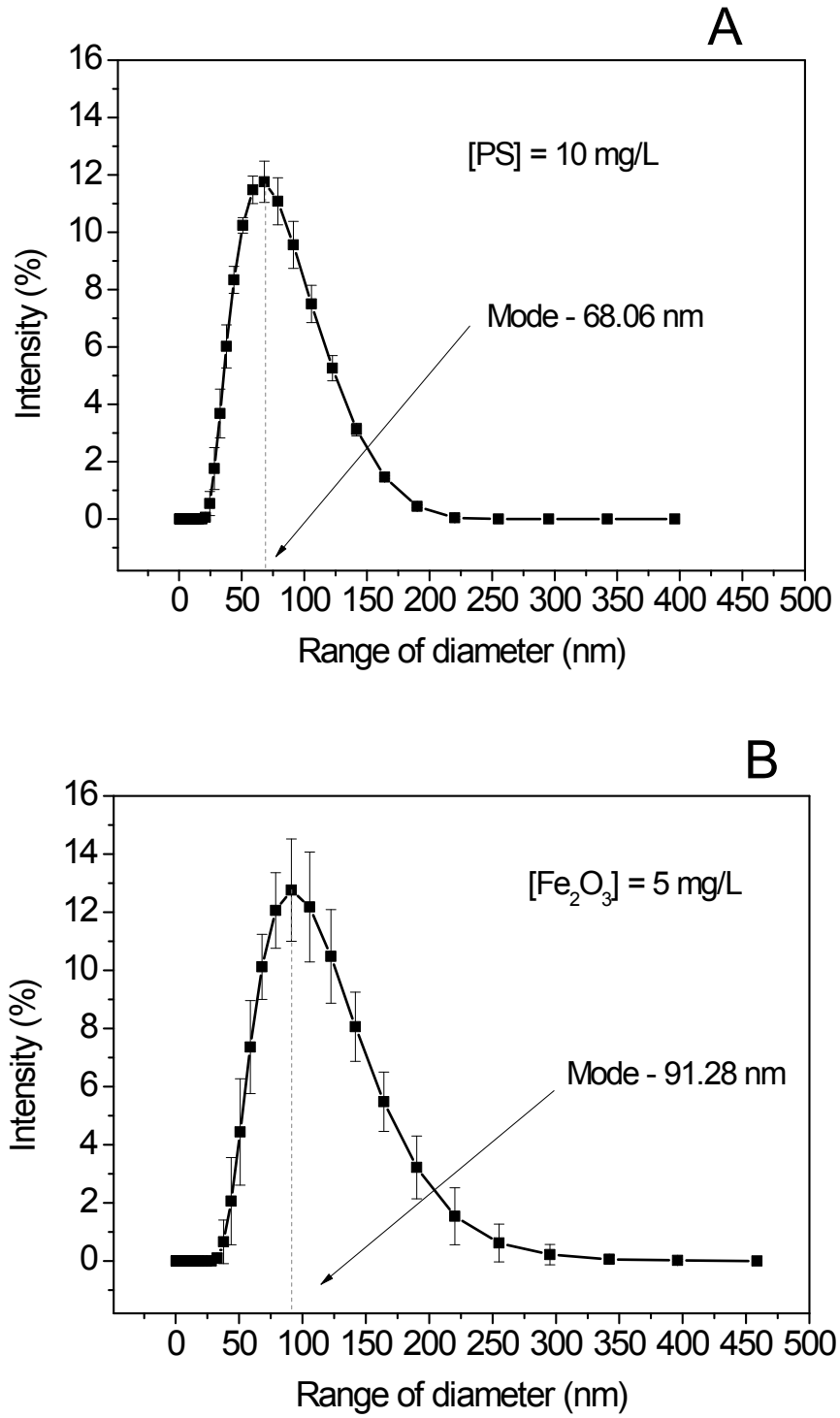
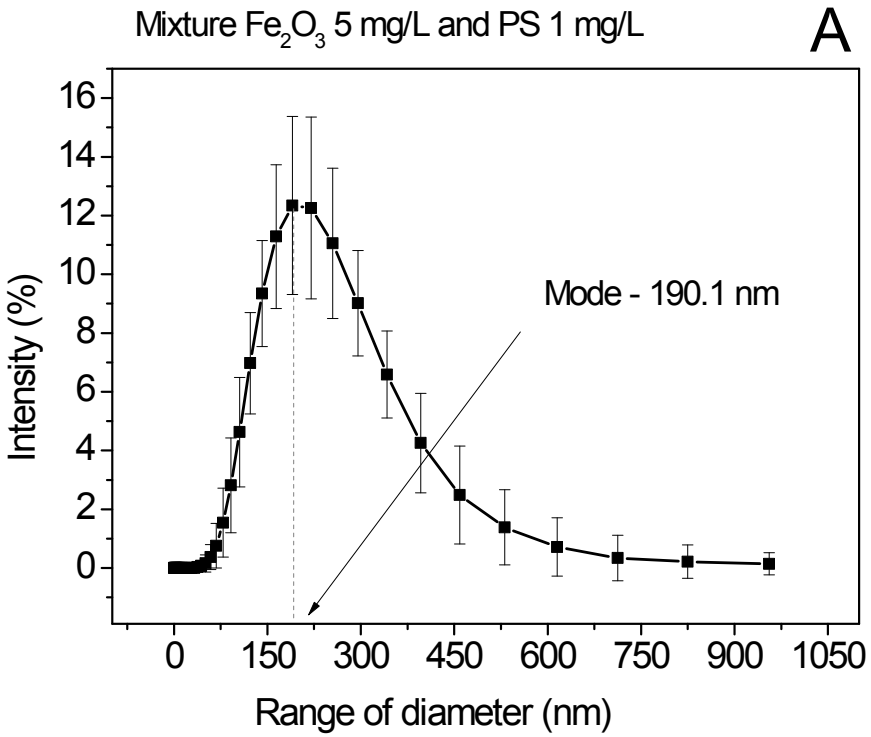
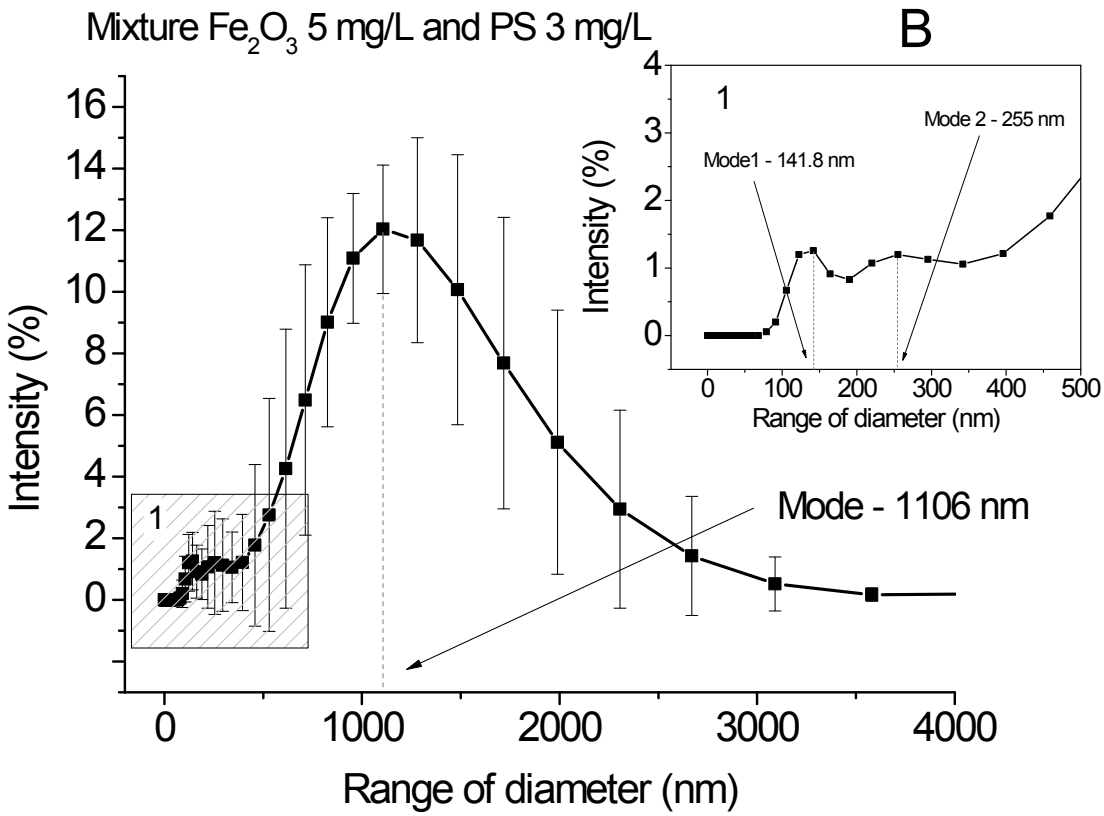


Fig. S2. Size distribution of PS nanoplastics (A) and Fe_2O_3 IC (B) particles individually dispersed in ultrapure water at pH 8.0 ± 0.2. Experimental conditions: [PS] = 10 mg/L, [Fe_2O_3] = 5 mg/L. The mode of the range of particle diameter is equal to 68.06 nm for PS and 91.28 nm for Fe_2O_3.


Mixture Fe_2O_3 5 mg/L and PS 1 mg/L
A
Intensity (%)
Mode - 190.1 nm
Range of diameter (nm)


Mixture Fe_2O_3 5 mg/L and PS 3 mg/L
B
Intensity (%)
Mode - 1106 nm
Range of diameter (nm)
1
Mode1 - 141.8 nm
Mode 2 - 255 nm

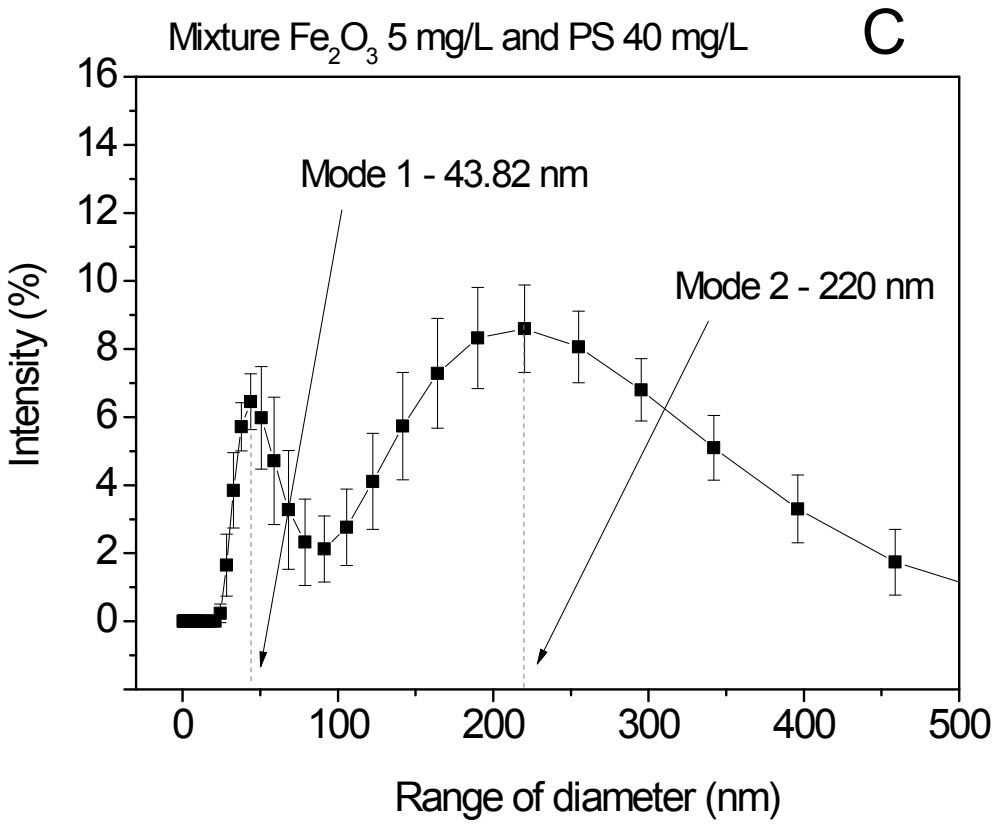


Fig. S3. Size distribution of a mixture of PS nanoplastics and Fe_2O_3 particles in ultrapure water at increasing nanoplastic concentration at pH 8.0 ± 0.2. Experimental conditions: [Fe_2O_3] = 5 mg/L in all samples, (A) [PS] = 1 mg/L, corresponding to the beginning of heteroaggregation, the mode of the range of particle diameter is equal to 190.1 nm.; (B) [PS] = 3 mg/L, corresponding to the peak of heteroaggregation, there are three peaks with the modes equal to 141.8 nm, 255 nm and 1106 nm; (C) [PS] = 40 mg/L, corresponding to the excess of the nanoplastic particles and limited heteroaggregation with two peaks with mode equal to 43.82 nm and 220 nm.

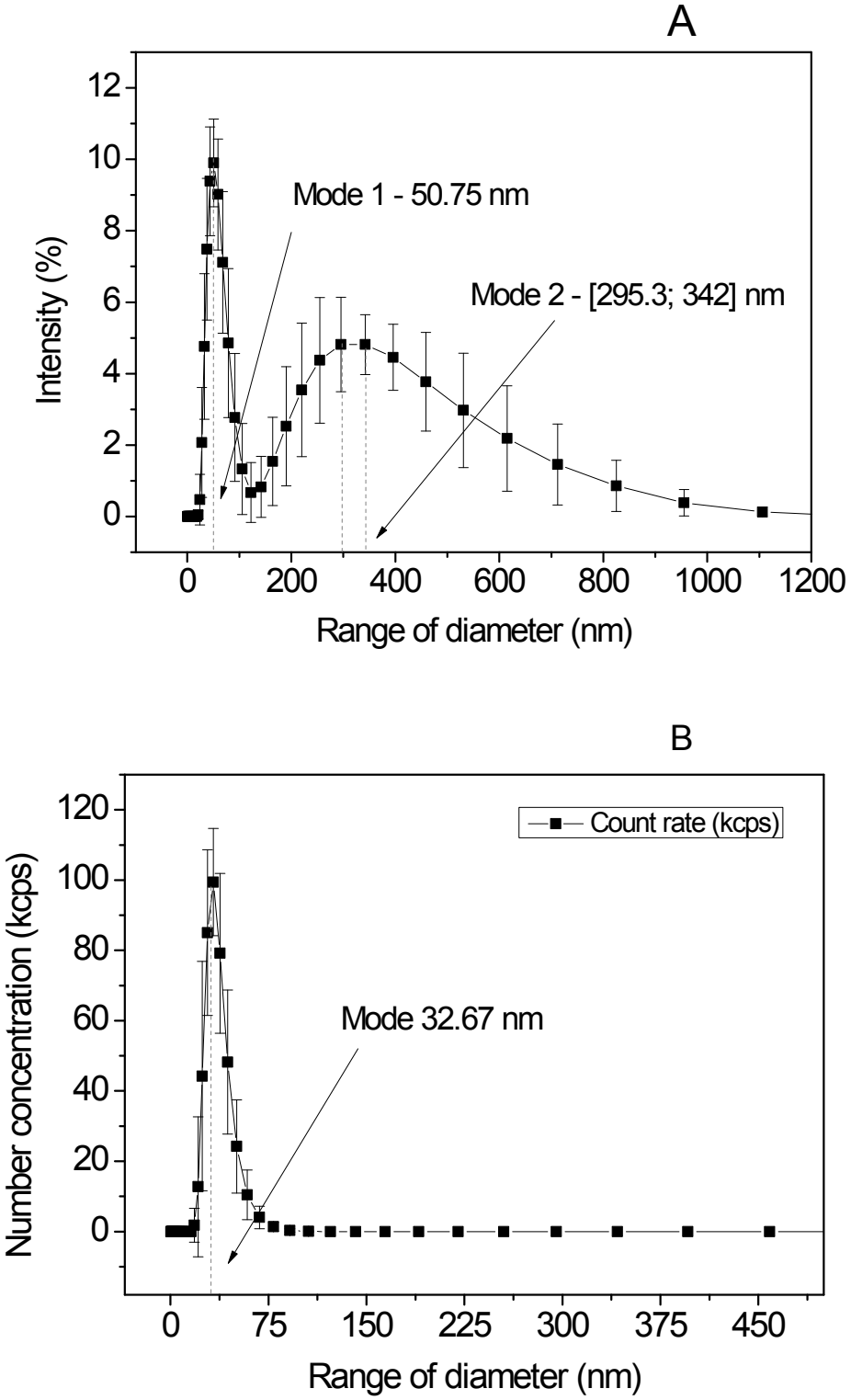


Fig. S4. Size distribution of PS nanoplastics in Rhône water in excess of nanoplastics. Experimental conditions: [PS] = 40 mg/L. (A) Intensity weighted distribution (%) with two peaks equal to 50.75 nm and [295.3; 342] nm corresponding to the individual PS particles and heteroaggregates; (B) Number weighted distribution (kcps) with one peak representing nanoplastics with mode equals 32.67 nm.

SI4. Aggregation kinetic of PS nanoplastics in river Rhône water

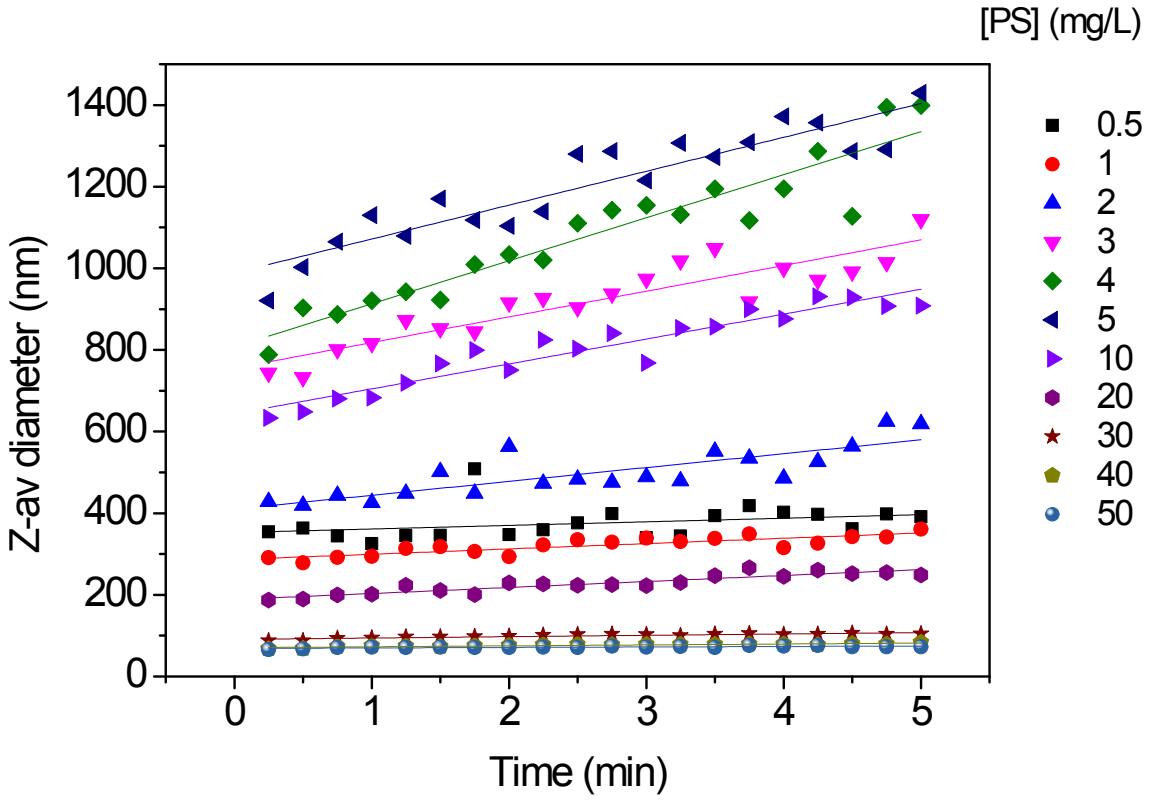


Fig. S5. Variation of z-average hydrodynamic diameter of PS nanoplastics with time at increasing nanoplastic concentration in Rhône water. The straight lines indicate linear fit in order to obtain the aggregation rate. Experimental conditions: Rhône water, pH = 8.0 ± 0.2.

Table S3 Parameters for models from Fig.6

Linear model

Equation	y = a + b*x		
Weight	Instrumental		
Residual Sum of Squares	5.53734		
Pearson's r	--		
Adj. R-Square	0.95451		
		Value	Standard Error
P	Intercept	-13.16495	4.26159
P	Slope	26.56889	2.88304

Exponential decay model

Model	ExpDec1		
Equation	y = A1*exp(-x/t1) + y0		
Reduced Chi-Sqr	7.70862		
Adj. R-Square	0.90523		
		Value	Standard Error
P	y0	1.0626	0.61771
P	A1	190.60341	42.23136
P	t1	6.6445	0.95902