

*Supplementary material*

# Microplastics in marine sediments in Eastern Guangdong in the South China Sea: Factors influencing the seasonal and spatial variations

**Table S1.** Location of sampling sites.

Sampling site	Longitude (E/°)	Latitude (N/°)
A1	116.80	23.30
A2	116.82	23.36
A3	116.90	23.42
A4	116.98	23.48
A5	117.08	23.50
A6	117.16	23.53
A7	116.82	23.26
B1	116.95	23.37
B2	116.87	23.32
B3	116.93	23.25
B4	116.87	23.20
C1	116.91	23.14
C2	116.98	23.20
C3	117.06	23.25
C4	116.97	23.08
C5	117.04	23.12
C6	117.11	23.17
D1	117.19	23.21
D2	117.30	23.29
E5	117.18	23.33
E7	117.21	23.34
E8	117.11	23.35
F1	117.23	23.47
F2	117.31	23.40
F3	117.36	23.36

**Table S2.** Seawater parameters and sediment moisture content in 2021.

Sampling time	Site	Water depth (m)	Salinity (‰)	Temperature (°C)	Sediment moisture content
April	A1	9	32.9	22.4	46.3%
	A2	6	32.2	22.9	45.9%
	A3	6	31.5	22.5	43.8%
	A4	11	30.3	22.5	44.2%
	A5	9	32.7	22.3	41.3%
	A7	11	33.2	22.2	20.8%
	B1	11	33.5	22.2	40.0%
	B2	9	33.4	22.1	35.0%
	B3	19	33.9	22.1	29.5%
	B4	21	34.0	22.0	42.9%

August	C1	25	34.2	22.4	
	C2	22	34.1	22.3	17.7%
	C3	21	34.0	22.0	
	C4	30	34.2	22.6	
	C5	29	34.2	22.2	
	C6	25	34.3	22.3	
	D1	27	34.3	22.4	
	D2	31	34.3	22.4	
	E1	26	34.1	21.9	23.0%
	E2	24	33.9	21.9	
	E3	29	34.2	22.1	23.8%
	E4	17	33.8	21.8	22.7%
	F1	15	33.7	21.6	25.3%
	F2	29	34.2	22.0	17.1%
	F3	30	34.3	22.3	
	A1	7	34.2	22.5	57.6%
	A2	6	34.4	22.4	55.1%
	A3	7	34.1	23.8	51.9%
	A4	14	33.8	24.5	50.3%
	A5	8	34.3	23.8	49.6%
	A6	14	34.3	23.3	17.5%
	A7	11	34.4	22.4	
	B1	9	34.4	22.3	38.8%
	B2	10	34.4	22.2	31.7%
	B3	19	34.5	22.2	29.2%
	B4	24	34.4	22.3	39.3%
December	C1	25	34.4	22.4	22.0%
	C2	23	34.5	22.2	22.8%
	C3	23	34.4	22.2	20.4%
	C4	31	34.4	22.3	15.5%
	C5	29	34.5	22.2	21.2%
	C6	30	34.5	22.1	17.3%
	D1	29	34.5	22.2	18.2%
	D2	31	34.4	22.4	12.7%
	E1	27	34.4	22.2	16.2%
	E2	21	34.4	22.3	22.5%
	E3	27	34.4	22.3	20.1%
	E4	16	34.4	22.3	25.1%
	F1	16	34.4	23.0	24.7%
	F2	32	34.4	22.4	16.0%
	F3	34	34.4	22.5	12.2%
	A1	5	27.9	19.3	59.2%
	A2	9	32.2	18.7	58.8%
	A3	9	32.5	18.8	54.1%
	A4	14	32.7	18.9	52.6%
	A5	9	32.8	19.6	51.4%
	A6	13	32.8	19.0	18.0%
	A7	11	32.4	19.2	28.4%
	B1	9	33.0	19.4	42.0%
	B2	11	32.9	19.0	38.0%
	B3	22	33.1	19.8	29.7%
	B4	22	33.2	20.0	44.6%

C1	26	33.4	20.5	26.0%
C2	25	33.3	20.5	24.6%
C3	26	33.0	20.3	22.3%
C4	32	33.8	20.9	17.1%
C5	30	33.5	20.7	
C6	28	33.4	20.6	19.3%
D1	29	33.6	20.8	19.9%
D2	29	33.4	20.8	12.3%
E1	28	32.9	20.3	
E2	1	32.6	20.0	22.7%
E3	30	33.2	20.6	24.0%
E4	15	32.8	20.1	23.8%
F1	15	32.6	19.1	23.9%
F2	34	32.9	20.4	17.9%
F3	38	33.4	20.8	11.8%

**Table S3.** Comparisons of abundance and characteristics of microplastics found in marine sediments.

Study area	Sampling time	Abundance (items/kg dw)	Shape	Colour	Size	Composition	Reference
Huruslahti Bay, Finland	N/A	200	fibre, fragment	red, white	4–380 µm	PE, PP, PET	(Saarni et al., 2021)
Kiel Fjord, Germany	September 24 to October 3, 2016	1.8–30.2	fibre, fragment	transparent dominant	200–5000 µm	PE, PS, PP and PA	(Schröder et al., 2021)
Coastlines of Ireland	May and November, 2016	average 42–60	84.31% fibre, 15.69% fragment	56% transparent, 19% blue, 13% black, 6% red	63–5000 µm	PE, PP (dominant)	(Marques Mendes et al., 2021)
Lagoon of Venice, Italy	N/A	672–2175	fragment, 11% fibre, 2% film, 1% pellet	N/A	15–2413 µm, 93% 30–500 µm	48.4% PE, 34.1% PP, 5.2% Poly(ethylene-propylene)	(Vianello et al., 2013)
	July, 2019	180	fragment, 35% filament, 22% film	26% blue, 21% yellow, 19% white, 16% black, 10% transparent, 8% red	32.6% 501–1000 µm		
Bay of Bengal, India	January, 2020	380	fragment, 35% filament, 24% film	30% transparent, 23% blue, 16% yellow, 14% red, 9% black, 8% white	33.72% 501–1000 µm	PA, PE, PP, PVC	(Dhineka et al., 2022)
	July, 2020	200	59% fragment, 34% filament, 7% film	29% blue, 20% black, 20% yellow, 12% red, 10% white, 9% transparent	30.95% 501–1000 µm		

Jakarta Bay, Indonesia	August, 2020	166.8	55.7% fibre, 31.1% film, 9.9% fragment, 3.2% pellet	N/A	N/A	50% PP, 33.3% PE, 16.7% PS	(Takarina et al., 2022)
Singapore mangroves	August to November, 2012	12.0–62.7	72.0% fibre, 23.3% film, 4.7% granule	transparent, blue and red dominant	58% <40 µm	PE, PP, nylon and PVC	(Nor and Obbard, 2014)
Beibu Gulf, China	July, 2017	20–1200, average 405 ± 336	69.6% fibre, 30.4% non-fibre	transparent (predominant), white, green, blue, red, and purple	fibres: >50% 1000–5000 µm; non-fibres: >60% 100–500 µm 66.25–4982.59 µm; 37.87% <500 µm, 33.19% 500–1000 µm, 28.95% 1000–2500 µm 46.8–4968.7 µm; 1% 0–100 µm, 23% 100–500 µm, 34% 500–1000 µm, 42% 1000–5000 µm	68.7% PP, 18.5% PE	(Xue et al., 2020)
Bohai Sea and Yellow Sea, China	June to July, 2016	40–340, average 72.0–123.6	93.88% fibre, 2.55% fragment, 2.04% pellet, 1.53% film	N/A		61.24% rayon, 16.29% PE, 12.36% PET, 7.30% PP	(Zhao et al., 2018)
Changjiang Estuary, China	September, 2015	20–340, average 121	93% fibre, 6% fragment, 1% pellet	42% transparent, 25% blue, 16% black, 7% yellow, 6% red, 4% white		63.1% rayon, 18.5% polyester, 13.9% acrylic	(Peng et al., 2017)
Sanggou Bay, China	July 25 and August 9, 2017	2178	90.88% fibre, 3.50% fragment, 1.29% granule, 1.22% film	51.92% transparent, 22.24% black, 16.72% blue, 6.74% red, 2.52% yellow, 0.05% white	37.1%–42.9% 50–100 µm	31% PP, 24% polyester, 19% nylon, 15% PS, 6.5% PET, 4.5% others	(Wang et al., 2019a)
South Yellow Sea, China	August to September, 2017	560–4205	83.4% fibre, 7.5% granule, 6.2% fragment	59.6% transparent. 19.4% black, 12.6% blue	36% 50–0.1 µm, 31% 100–500 µm, 14% 500–1000 µm, 12% 1000–2000 µm, and 7% 2000–5000 µm 22.5–4363.3 µm; 56.2% 101–500 µm, 21.3% 501–1000 µm, 11.1% 10–100 µm, 11.3% 1001–5000 µm	31% PP, 24% PE, 19% nylon, 15% PS	(Wang et al., 2019b)
Eastern Guangdong, the South China Sea, China	April, August and December, 2021	0–444.4, average 93.1±12.5	55.8% fragment, 36.4% fibre, 7.8% pellet	60.9% transparent, 14.3% yellow, 7.2% red, 10.5% white, 6.1% blue, 1.1% black		22.41% PP, 17.89% PPPE, 15.28% PET, 12.96% PE	This study

**Table S4.** Spearman's correlation among microplastics abundance at coastal locations and the offshore sites with short (B1–B4) and long distance (C1–C6) across the year.

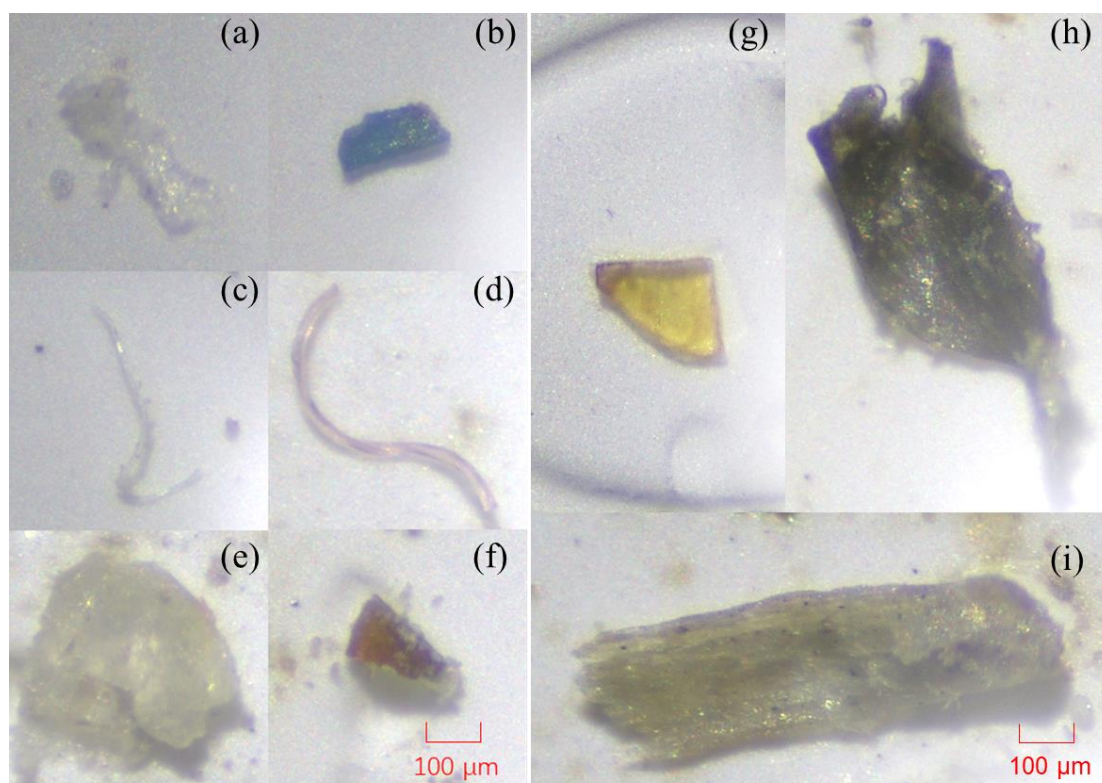
Normality test.						
Abundance	N	Kolmogorov–Smirnov <sup>a</sup>		Shapiro–Wilk		
		Statistic	<i>p</i>	Statistic	<i>p</i>	
Coastal	19	0.297	0.000	0.819	0.002	
Offshore B1–B4	12	0.317	0.002	0.628	0.000	
Offshore C1–C6	12	0.231	0.075	0.839	0.027	
a. Lilliefors Significance Correction						
Spearman's correlation						
Correlation coefficient					-0.505	
Sig. (2-sided)					0.001	
N					43	

**Table S5.** Results of normality test and Mann–Whitney *U* test for microplastics abundance comparisons between coastal locations (A1–A7) and the offshore sites (B2–B4 and C1–C6).

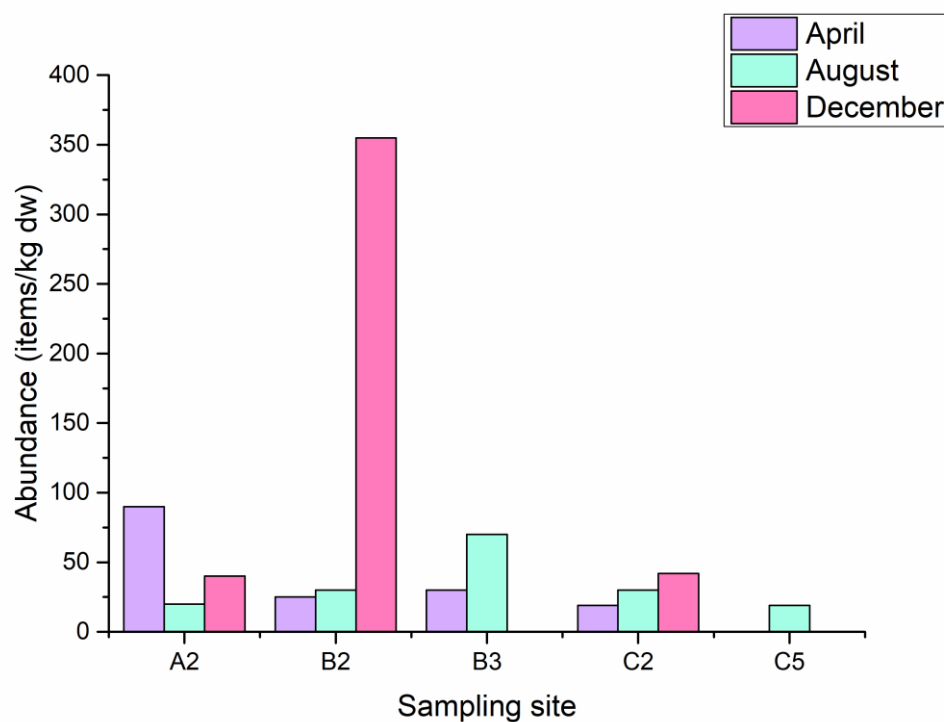
Normality test in April of 2021					
Abundance	N	Kolmogorov–Smirnov <sup>a</sup>		Shapro–Wilk	
		Statistic	<i>p</i>	Statistic	<i>p</i>
Coastal	6	0.349	0.021	0.621	0.001
Offshore	5	0.295	0.180	0.812	0.102
a. Lilliefors Significance Correction					
Mann–Whitney <i>U</i> test in April of 2021					
Total N				11	
Mann–Whitney U				0.000	
Wilcoxon W				15.000	
Test statistics				0.000	
Standard deviation				5.465	
Standardised test statistics				-2.745	
Asymp. Sig. (2-sided)				0.006	
Exact Asymp. Sig. (2-sided)				0.004	
Normality test in 2021					
Abundance	N	Kolmogorov–Smirnov <sup>a</sup>		Shapro–Wilk	
		Statistic	<i>p</i>	Statistic	<i>p</i>
Coastal	19	0.297	0.000	0.820	0.002
Offshore	24	0.254	0.000	0.590	0.000
a. Lilliefors Significance Correction					
Mann–Whitney <i>U</i> test in 2021					
Total N				43	
Mann–Whitney U				105.000	
Wilcoxon W				405.000	
Test statistics				105.000	
Standard deviation				40.848	
Standardised test statistics				-3.011	
Asymp. Sig. (2-sided)				0.003	

**Table S6.** Biomass of benthos in the Nanpeng Nature Reserve and peripheral area in spring and summer (unit: g/m<sup>2</sup>).

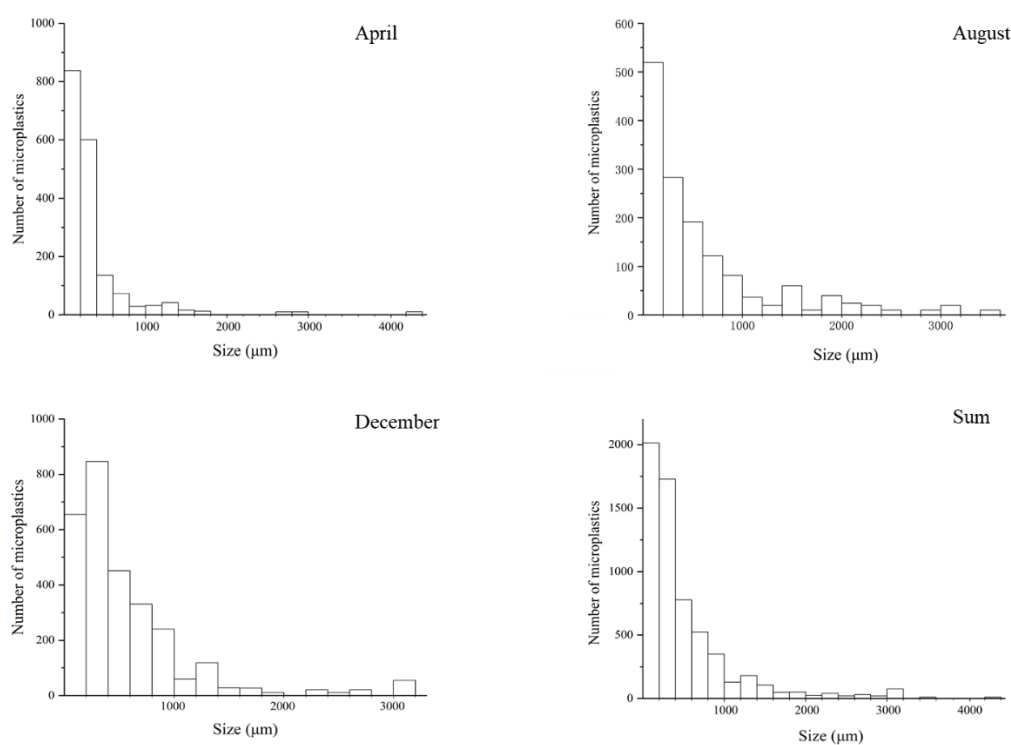
Season	Mollusca	Annelida	Chordata	Echinodermata	Nemertea	Arthropoda	Total
Spring	5.8	5.6	1.5	9.0	0.0	5.8	27.7
Summer	26.6	5.2	5.6	0.0	2.2	14.0	53.6



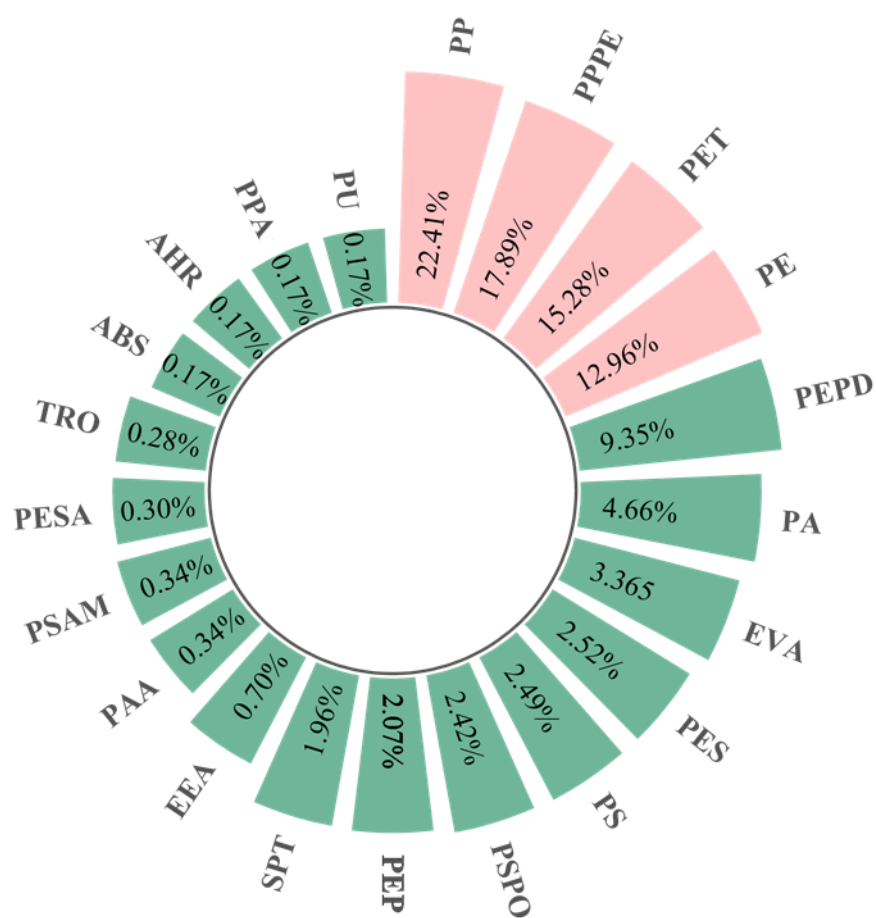
**Figure S1.** Microscopic images of typical microplastics: (a) transparent fragment, (b) blue fragment, (c) transparent fibre, (d) red fibre, (e) transparent pellet, (f) red pellet, (g) yellow fragment, (h) black fragment, (i) white fragment.



**Figure S2.** The microplastic abundance along the estuary section of the Han River from nearshore to offshore in April, August and December.



**Figure S3.** Size distribution of microplastics in surface sediments of multiple-used zones in Eastern Guangdong, the South China Sea; please note that the y axes are in different scale.



**Figure S4.** The overall proportions of polymer types in microplastics abundance in surface sediments of multiple-used zones in Eastern Guangdong, the South China Sea.