

2019-03-05

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<http://hdl.handle.net/10026.1/13647>

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10.1016/j.dsr.2019.03.003

Deep Sea Research Part I: Oceanographic Research Papers

Elsevier

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## 7 **Deep sea sediments of the Arctic Central Basin: A potential sink for microplastics**

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19

## 20 **Abstract**

21 Deep sea sediments have in the past decade emerged as a potential sink for microplastics in the  
22 marine environment. The discovery of microplastics in various environmental compartments of  
23 the Arctic Central Basin (ACB) suggested that these contaminants were potentially being  
24 transported to the deep-sea realm of this oceanic basin. For the first time, the present study  
25 conducted a preliminary assessment to determine whether microplastics were present in surficial  
26 sediments from the ACB. Gravity and piston corers were used to retrieve sediments from depths  
27 of 855 – 4353 m at 11 sites in the ACB during the Arctic Ocean 2016 (AO16) expedition. Surficial  
28 sediments from the various cores were subjected to density flotation with sodium tungstate  
29 dihydrate solution ( $\text{Na}_2\text{WO}_4 \cdot 2\text{H}_2\text{O}$ , density  $1.4 \text{ g cm}^{-3}$ ). Potential microplastics were isolated and  
30 analysed by Fourier Transform Infrared (FT-IR) spectroscopy. Of the surficial samples, 7 of the  
31 11 samples contained synthetic polymers which included polyester ( $n = 3$ ), polystyrene ( $n = 2$ ),

32 polyacrylonitrile (n = 1), polypropylene (n = 1), polyvinyl chloride (n = 1) and polyamide (n = 1).  
33 Fibres (n = 5) and fragments (n = 4) were recorded in the samples. In order to avoid mis-  
34 interpretation, these findings must be taken in the context that (i) sampling equipment did not  
35 guarantee retrieval of undisturbed surficial sediments, (ii) low sample volumes were analysed (~  
36 10 g per site), (iii) replicate sediment samples per site was not possible, (iv) no air contamination  
37 checks were included during sampling and, (v) particles <100 µm were automatically excluded  
38 from analysis. While the present study provides some preliminary indication that microplastics  
39 may be accumulating in the deep-sea realm of the ACB, further work is necessary to assess  
40 microplastic abundance, distribution and composition in surficial sediments of the ACB.

41

42 **Keywords:** Microplastic, Marine debris, Arctic Ocean, Sediment, Deep Sea

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44

## 45 **1. Introduction**

46 Microplastics are pervasive, persistent contaminants in the world's oceans that warrant concern  
47 due to the potential threat they pose to marine organisms. Traditionally, microplastic sampling has  
48 been conducted in surface and near-surface waters due to the presumption that the majority of  
49 microplastics would be present in that layer of the water column. However, when plastic  
50 production and projected plastic input to the ocean was considered, there was an evident mismatch  
51 between reported and expected plastic concentrations in surface oceanic waters (Cózar et al. 2014;  
52 Eriksen et al. 2014). It was therefore apparent that apart from surface waters, microplastics were  
53 present in various environmental compartments in the world's oceans (water column, sea ice,  
54 sediments, biota) and that some of these potentially functioned as sinks (Obbard et al. 2014;  
55 Woodall et al. 2014). Deep sea sediments have recently been identified as a potential sink for  
56 microplastics (Woodall et al. 2014; Bergmann et al. 2017). To date, only a few studies have  
57 reported on microplastics in deep sea sediments in various oceanic basins (Van Cauwenberghe et  
58 al. 2013; Woodall et al. 2014; Fischer et al. 2015; Bergmann et al. 2017). Despite the fact that each  
59 of these studies employed different sampling equipment, extraction techniques and reported  
60 microplastic abundance in different units, the consensus was that microplastics have made it to the  
61 deep-sea and that they are pervasive in its sediments. Presently, uncertainty still exists regarding

62 the exact mechanisms that are responsible for the vertical transport of microplastics out of surface  
63 oceanic waters and into deep sea sediments.

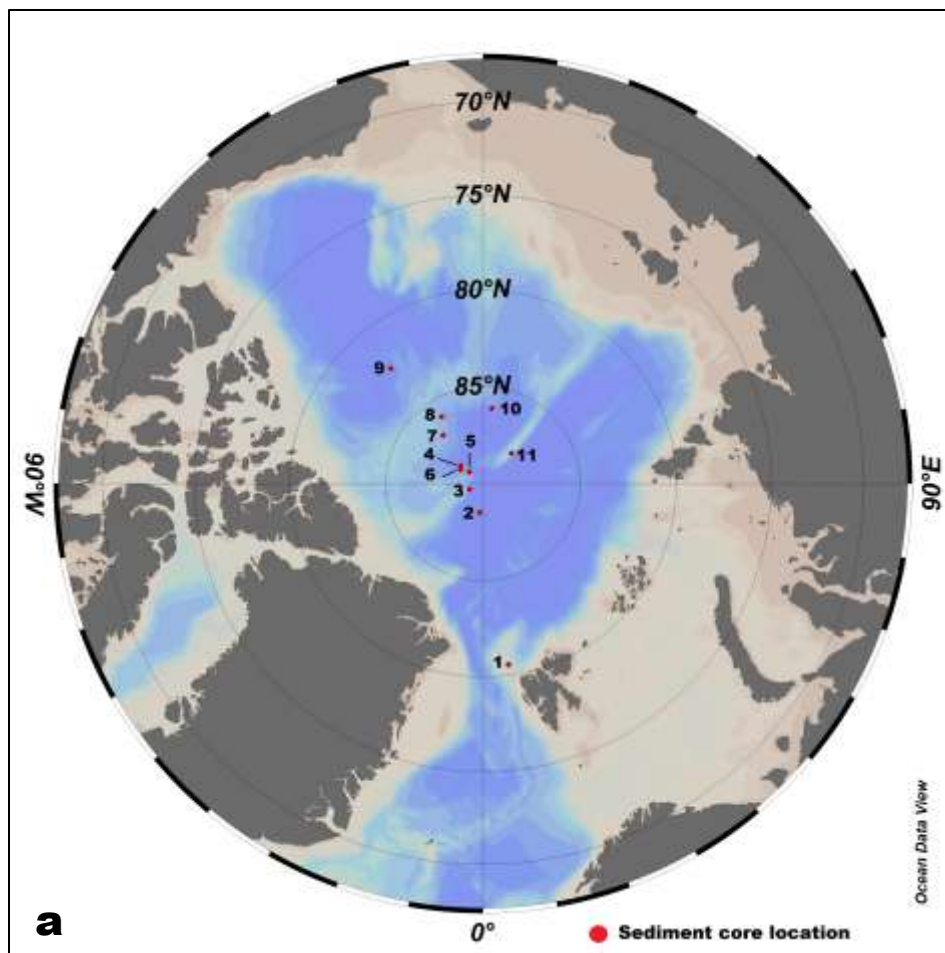
64  
65 The Arctic Ocean, though one of the most remote oceanic basins in the world, has been subject to  
66 the entry of plastic debris into its ecosystem. It has been suggested that this plastic debris, in  
67 particular microplastics, could have entered the Arctic ecosystem via a combination of (i) long-  
68 range transport processes, e.g. via oceanic currents (Zarfl and Matthies 2010; van Sebille et al.  
69 2012), biotransport (Mallory 2008; Provencher et al. 2012) and riverine input (Obbard et al. 2014)  
70 and, (ii) local anthropogenic activities, e.g. shipping (Tekmann et al. 2017). Specifically,  
71 microplastics were discovered in the surface/sub-surface waters and sediments (Lusher et al. 2015;  
72 Bergmann et al. 2017; Cózar et al. 2017; Mu et al. 2019) of the Arctic. Further north, in the Arctic  
73 Central Basin (ACB), microplastics were recorded in sea ice, biota, such as juvenile polar cod  
74 (*Boreogadus saida*) and benthic organisms, and sub-surface waters (Obbard et al. 2014; Kanhai et  
75 al. 2018; Kuhn et al. 2018; Peeken et al. 2018; Fang et al. 2018). The fact that microplastics have  
76 been reported in the various water layers of the ACB, in particular its deep waters, suggests that  
77 these particles are pervasive in the water column and that they are being transported out of its  
78 surface waters (Kanhai et al. 2018). It was therefore hypothesized that microplastics would be  
79 present in deep sea sediments in the ACB. To our knowledge, the present study sought for the first  
80 time to determine whether microplastics were present in surficial sediments of the Arctic Central  
81 Basin (ACB) and to establish whether the deep sea in this oceanic basin is possibly acting as a sink  
82 for microplastics.

## 83 84 **2. Material and methods**

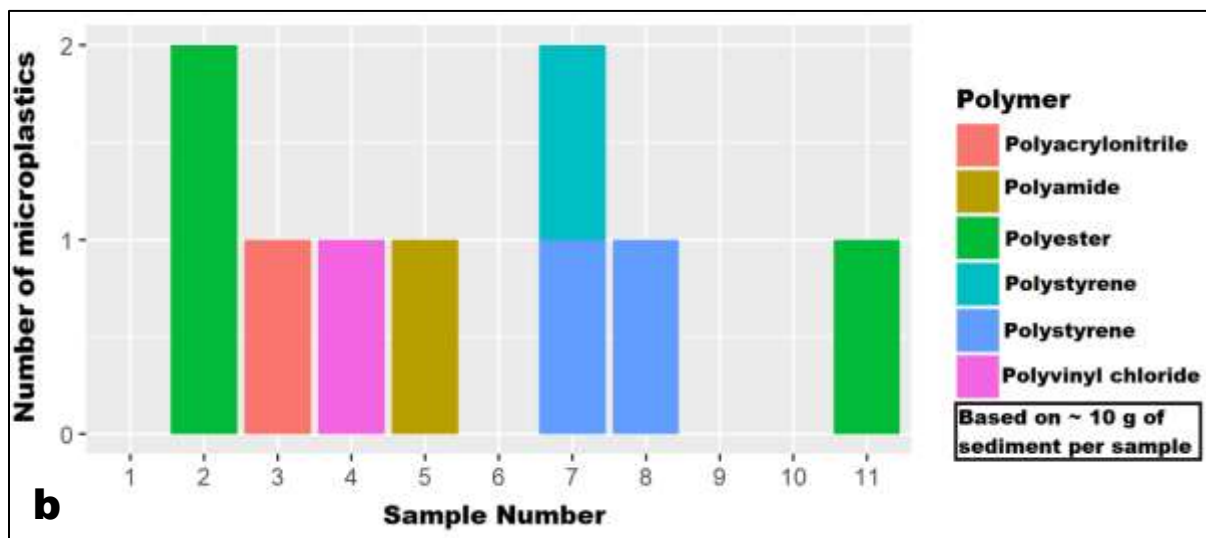
85 The Arctic Ocean, the world's smallest ocean, is comprised of a deep central basin surrounded by  
86 extensive continental shelves. The bathymetry of the Arctic Ocean is such that the Lomonosov  
87 Ridge divides the central basin into the Canadian (Amerasian) and Eurasian sub-basins (Jakobsson  
88 et al. 2004). Within each of the sub-basins, there are further divisions as well as the existence of  
89 Abyssal Plains (APs) which are deep water areas of low relief. In the Amerasian basin, the Alpha-  
90 Mendeleev Ridge separates the Canada Basin (with its Canadian AP) and the Makarov Basin (with  
91 its Fletcher AP) while in the Eurasian basin, the Gakkel Ridge separates the Amundsen Basin (with  
92 its Pole AP) and the Nansen Basin (with its Barents AP), (Jakobsson et al. 2004).

93

94 This study was conducted onboard the Swedish icebreaker Oden between August 8<sup>th</sup> to September  
95 19<sup>th</sup> 2016 during the Arctic Ocean 2016 expedition. During the transit of 4943 nautical miles,  
96 sediments were retrieved using a gravity corer or a piston corer with an associated trigger weight  
97 corer. Cores from 11 stations were sampled for microplastics (Supplementary Table 1, Figure 1).



98



99

100 Figure 1: Locations at which sediment cores were collected in the Arctic Central Basin (a) and  
 101 synthetic polymer composition in surficial sediments from the various cores (b).

102 [Figure 1a generated using Ocean Data View (ODV) Version 4.7.10 (Schlitzer 2017); Figure 1b  
 103 generated using R version 3.4.4 (R Core Team 2018)]

104

105 Cores were split, wrapped in plastic film (polyethylene) and transported to the laboratory where  
106 they were processed prior to sampling for microplastics. Processing usually involved (i) scraping  
107 the core half (with a polypropylene scraper) to remove liner fragments and sediment disturbed  
108 during core splitting and, (ii) visually describing the lithostratigraphic properties. Sheer strength  
109 measurements, sediment pH and samples for paleomagnetic measurements were taken prior to  
110 microplastic sampling for four of the eleven cores (gravity and piston cores). Approximately 10  
111 cm<sup>3</sup> of sediment was sampled from the top 2 cm of the working half of each core using a scoop  
112 (polypropylene). Sediment samples were placed into clean, labelled plastic bags (polyethylene)  
113 and stored in a freezer (-20°C).

114

115 Although it is acknowledged that such a low volume of sediment may not be representative of  
116 sediments at individual sampling stations, the sampling technique used in the present study, i.e.  
117 coring, limited the volume of sediment that was available per site. Precautions taken onboard the  
118 ship to limit cross-contamination included (i) minimal exposure of the sediment samples to the  
119 atmosphere, (ii) samples collected/stored in new materials (scoops, bags) and, (iii) sampling  
120 conducted by one individual. A record was also kept of all plastic materials that came into contact  
121 with the sample during collection and processing. One limitation was that no air contamination  
122 check was included during sediment sampling onboard the vessel.

123

124 In the laboratory, sediments were defrosted, transferred into clean covered aluminium foil trays  
125 and oven dried at 60°C for approximately 96 hours. Approximately 10 g of oven-dried sediment  
126 was weighed and placed into a pre-cleaned glass jar. 105 mL of sodium tungstate dihydrate  
127 (Na<sub>2</sub>WO<sub>4</sub>·2H<sub>2</sub>O, 40 % w/v, density 1.4 g cm<sup>-3</sup>), as recommended by Frias et al. (2018) and Pagter  
128 et al. (2018), was added to each glass jar, the mixture was shaken for approximately 1 minute and  
129 the sediments were allowed to settle. From each sample jar, the overlying sodium tungstate  
130 dihydrate solution was removed using a pipette and filtered under vacuum onto glass microfiber  
131 paper (GF/C), Whatman 47 mm, pore size 1.2 µm, using a Buchner funnel and an Erlenmeyer  
132 flask. Minimal volumes of ultrapure water (< 2 mL) were used to wash down the sides of the glass  
133 jars with the sediments. Introducing water into the remaining extraction solution can lead to a  
134 change in the density of the solution and thus this was minimised. Ultrapure water was also used

135 to wash the pipette and sides of the Buchner funnel. Filter papers for the samples were placed into  
136 clean petri dishes and stored until analysis. Potential contamination was evaluated by using (i) air  
137 contamination checks-clean petri dishes with filter paper (n = 2) were exposed to the air during  
138 sample processing and, (ii) method blanks-jars devoid of sediment (n = 2) were processed in the  
139 same manner as actual samples. Measures taken to prevent contamination in the laboratory  
140 included (i) wearing lab coats and gloves during sample processing and, (ii) washing all glass jars  
141 used during sample processing with a 6 % nitric acid solution and Ultra-pure water.

142  
143 Filter papers were visually examined under a dissecting microscope (Olympus SZX10) equipped  
144 with a polariser and camera (Q Imaging Retiga 2000R). Potential microplastics were isolated and  
145 processed (photographed and length measurements taken) prior to transferring to a clean filter  
146 paper in a labelled petri dish (Kanhai et al. 2017). Due to the difficulties that arise when handling  
147 particles < 100 µm, such particles were automatically excluded for any analysis. All potential  
148 microplastics and any plastic material that was in direct contact with the samples either during  
149 sampling or laboratory processing were analysed by Fourier transform infrared (FT-IR)  
150 spectroscopy on a Bruker Vertex 70 Infrared Spectrometer coupled to a Hyperion 1000 microscope  
151 (Kanhai et al. 2017). Samples which produced spectra with a match < 60 % were automatically  
152 rejected while those which produced a match of > 70 % were accepted. All spectra with matches  
153 > 60 % were individually examined to ensure that there was clear evidence of peaks from the  
154 sample corresponding to known peaks of standard polymers.

155

### 156 **3. Results**

157 In the present study, the following plastic materials made direct contact with the sediment samples  
158 either during collection or processing (i) plastic film – low density polyethylene (LDPE), (ii) core  
159 liner – polyvinyl chloride (PVC) or polycarbonate (PC), (iii) scraper - polypropylene (PP), (iv)  
160 sediment collection scoop – polypropylene (PP) and, (v) sample bag – low density polyethylene  
161 (LDPE). In the surficial sediment samples, no polyethylene particles were recovered. However, in  
162 two instances, synthetic polymers from surficial sediments matched plastic materials used during  
163 sample processing but were not eliminated since they were of different colours than the materials  
164 used. This was so for 2 particles in sediment core 4 (single PVC fragment, different colour from  
165 liner) and sediment core 7 (polypropylene fragment, different colour from collection



166 scoop/scrapper). To assess whether synthetic polymers were introduced during laboratory  
167 processing of the samples, air contamination checks (ACs), (n = 2), and method blanks (MBs), (n  
168 = 2), were included. No synthetic polymers were found in the air contamination blanks. However,  
169 a total of three fibres were found in the two method blanks (MB1 – blue polyester fibre, 1.28 mm;  
170 MB2 – blue polyester fibre, 0.49 mm and red polyester fibre, 0.53 mm). All samples were blank  
171 corrected such that if any blue or red polyester fibres were found in the sediment samples, they  
172 were removed from the final results.

173  
174 Based on visual identification, fifteen particles from the sediment samples were isolated and  
175 subjected to FTIR spectroscopy. Of these, four were natural cellulosic fibres. The remaining eleven  
176 were identified as synthetic polymers with one macroplastic (> 5 mm) and ten microplastics (< 5  
177 mm). After blank correction of the samples, there were a total of nine microplastics (<5 mm),  
178 (Supplementary Table 2). Synthetic polymers detected in the sediments included polyester (n = 3),  
179 polystyrene (n = 2), polyacrylonitrile (n = 1), polyamide (n = 1), polypropylene (n = 1) and  
180 polyvinyl chloride (n = 1). Both fibres (n = 5) and fragments (n = 4) were present in the samples.  
181 In terms of colour, most of the synthetic polymers were transparent (n = 5) with the remainder  
182 black (n = 1), brown (n = 1), white (n = 1) and blue (n = 1). With respect to length, most (n = 5)  
183 were < 1 mm, 3 were between 1 – 2 mm and 1 was > 2 mm. Of the surficial sediment samples  
184 analysed from the Arctic Central Basin (ACB), 7 of the 11 samples contained between 1 – 2  
185 synthetic polymers (Figure 1b).

186

#### 187 **4. Discussion**

188 Elucidation of the transport and fate of microplastics in the marine environment is a critical step  
189 towards assessing the threat that these contaminants potentially pose to organisms inhabiting  
190 different compartments of an ecosystem. In the Arctic Central Basin (ACB), only a few studies  
191 have reported on microplastic presence in the sea ice, biota and water column (Obbard et al. 2014;  
192 Kuhn et al. 2018; Kanhai et al. 2018; Peeken et al. 2018). Based on these studies, the key  
193 suggestions regarding microplastics in this oceanic basin are that (i) sea ice acts as a sink and  
194 means of transport for microplastics, and (ii) the pervasiveness of microplastics in the various  
195 water layers of the ACB indicates that there is vertical transport of microplastics out of surface  
196 waters into deeper waters (Obbard et al. 2014; Kanhai et al. 2018; Peeken et al. 2018). In context,

197 the findings of the present study expand the knowledge base about microplastics in the Arctic  
198 Ocean by providing preliminary information that suggests microplastics are present in surficial  
199 sediments of the Arctic Central Basin and that within this oceanic basin the sediment compartment  
200 is potentially acting as one of the sinks for microplastics. Microplastic presence on the seafloor of  
201 the ACB lends credence to the suggestion that there is vertical transport of microplastics within  
202 the water column. Laboratory and field studies have shown that marine organisms, such as  
203 zooplankton, larvaceans and other pelagic filter feeders, which are capable of ingesting  
204 microplastics and egesting them in their faecal pellets and discarded houses (as in the case of the  
205 larvaceans), could contribute to the vertical flux of microplastics in the water column when their  
206 waste products sink (Cole et al. 2016; Katija et al. 2017). The incorporation of microplastics into  
207 marine aggregates and the biofouling of microplastics are other processes which may influence the  
208 vertical transport of these particles in the water column (Long et al., 2015; Fazey and Ryan 2016).  
209

210 The presence of microplastics in sediments of the Arctic Central Basin implies that interactions  
211 between these particles and deep-sea organisms that inhabit or depend upon this environmental  
212 phase is plausible. Although the Arctic Ocean has generally been regarded as oligotrophic, the fact  
213 remains that marine organisms do inhabit its' deep-water environment with the most speciose  
214 groups being arthropods, foraminiferans, annelids and nematodes (Bodil et al. 2011). Depending  
215 on the foraging behaviours and feeding habits of deep-sea benthos in the ACB, the possibility  
216 exists that some of them may be interacting with microplastics in the sediment phase. Recently,  
217 Fang et al. (2018) reported that microplastics were discovered in 11 different benthic species that  
218 were recovered from depths of 35 – 151 m in the Bering-Chukchi Sea shelves. Fibres were the  
219 predominant type of microplastics found in the organisms with synthetic polymers including  
220 polyamide, polyethylene, polyester and cellophane (Fang et al. 2018). Microplastics were also  
221 discovered in 3 different phyla (Echinodermata, Arthropoda, Cnidaria) of deep sea organisms  
222 recovered from depths of 334 – 1783 m in the equatorial mid-Atlantic and SW Indian Ocean  
223 (Taylor et al. 2016). Although the presence of a contaminant in the marine environment does not  
224 directly imply harm, laboratory experiments have indicated that benthic organisms exposed to  
225 microplastics in sediments may be negatively impacted. For example, Wright et al. (2013) reported  
226 that exposure of the deposit-feeding marine polychaete worm (*Arenicola marina*) to unplastified

227 polyvinyl chloride (UPVC) led to a depletion in energy reserves of the worms which could have  
228 been caused by reduced feeding, longer gut residence time of ingested matter and inflammation.

229  
230 The present study confirmed via FT-IR spectroscopy that polyesters were recovered from surficial  
231 sediments of the ACB. Such findings are corroborated by previous studies which investigated other  
232 environmental phases in this oceanic basin. Obbard et al. (2014) reported that of the synthetic  
233 polymers found in sea ice, the majority were polyester (21 %). Kanhai et al. (2018) similarly found  
234 that of the synthetic particles present in the sub-surface waters, polyesters (74 – 78 %) were also  
235 predominant. Upon melting, sea ice can act as a local source of microplastics to the water column  
236 (Obbard et al. 2014; Peeken et al. 2018). Synthetic polymers that are present in surface waters of  
237 this oceanic basin could then be subject to vertical transport, persist in the water column as  
238 evidenced by Kanhai et al. (2018) and at some stage a fraction of these particles could end up in  
239 the sediment phase. Of interest is the fact that the present study found low density polymers such  
240 as polypropylene and polystyrene fragments in the sediments of the ACB. Based on the inherent  
241 densities of the virgin resins, such particles are unlikely candidates for the sediment phase in that  
242 they are positively buoyant and are expected to float. However, this suggests that there are  
243 mechanisms operating within the ACB that could be affecting the density of these particles and in  
244 effect causing them to end up in the sediment phase. Long et al. (2015) showed that under  
245 laboratory conditions marine aggregates of various algal species (*Chaetoceros neogracile*,  
246 *Rhodomonas salina*) were capable of incorporating and concentrating polystyrene microbeads  
247 which in turn led to an increase in their sinking rates. Such mechanisms can potentially explain  
248 the presence of low-density polymers in surficial sediments of the ACB. Of note is the fact that  
249 the present study is not the first to report the presence of low density polymers in deep sea  
250 sediments since polyethylene and polypropylene particles were found in surficial sediments from  
251 the Fram Strait (Bergmann et al. 2017).

252  
253 Within the last decade, deep-sea sediments were for the first time identified as a potential sink for  
254 microplastics with four studies reporting on the issue in various oceanic basins (Supplementary  
255 Table 3). Comparison between these studies is particularly challenging and not straightforward  
256 due to the fact that each used different sampling equipment, extraction techniques and reported  
257 microplastic abundance/concentration in different units (Supplementary Table 3). Microplastic

258 abundance in surficial sediments of the ACB was estimated to range between 0 – 200 microplastics  
259 kg<sup>-1</sup> dry sediment based on the findings of the present study. However, it is unlikely that these  
260 estimates are reflective of the situation in the ACB since (i) the equipment used for sample retrieval  
261 (gravity and piston corers) may have led to the collection of disturbed surficial sediment samples,  
262 (ii) low sample volumes (~ 10 g per site) were used to assess microplastic abundance, (iii) the  
263 density of the extraction solution was only 1.4 g cm<sup>-3</sup> and thus could have excluded high density  
264 polymers, (iv) replicate sediment samples per site was not possible, (v) particles < 100 µm were  
265 excluded by virtue of the procedure used to identify/isolate potential microplastics. During the  
266 AO16 expedition, gravity and piston corers were used to retrieve sediments from several metres  
267 in depth from the ACB. Among the corers, gravity and piston corers are not guaranteed to retrieve  
268 undisturbed surficial sediment samples due to the shock wave that they generate during descent  
269 (Gallmetzer et al. 2016). It is therefore likely that any shock waves generated by the corers used  
270 in the present study may have triggered a resuspension of surficial material (sediments and  
271 microplastics) into the water column leading to an overall reduction and subsequent  
272 underestimation of microplastic abundance in the samples. When sampling surficial marine  
273 sediments, equipment such as box and multi-corers may be more suitable for the recovery of  
274 undisturbed surficial sediment samples (Georgiopoulou 2018). Box corers were recommended by  
275 Frias et al. (2018) due to (i) the minimal impact they have on surface deformation of sediments  
276 and, (ii) their ability to maintain sediment integrity during sampling.

277  
278 Furthermore, due to the heterogenous nature of sediments, it is unlikely that the low sample  
279 volumes (~ 10 g of sediment) used in the study were reflective of the situation at the respective  
280 sites. Future studies should ensure that replicate samples are collected per site. Multi-corers may  
281 be particularly useful since they can facilitate the collection of replicate samples in a single  
282 deployment. When density separation is used to extract microplastics from sediment samples, the  
283 density of the extraction solution is important in determining which synthetic polymers are  
284 extracted from the samples. Although sodium tungstate dihydrate (density 1.4 g cm<sup>-3</sup>) was used in  
285 the present study based on a safety-price index assessment (i.e. cost and health hazard), the density  
286 of the solution could have led to the exclusion of some high-density polymers (Frias et al. 2018).  
287 Loder and Gerds (2015) recommended the use of zinc chloride based on its cost effectiveness and  
288 its higher density of 1.8 g cm<sup>-3</sup>. However, the health hazard is high for this particular extraction

289 solution (Frias et al. 2018). Finally, the methods employed by investigators for the isolation and  
290 identification of microplastics influences the final reported microplastic abundance. In the present  
291 study, particles < 100  $\mu\text{m}$  were automatically excluded from analysis. However, it must be noted  
292 that at the Atlantic gateway to the Arctic Ocean i.e. the Fram Strait, Bergmann et al. (2017)  
293 reported that the majority (80 %) of microplastics in surficial sediments from that area were < 25  
294  $\mu\text{m}$ . Bergmann et al. (2017) used a combination of ATR-FTIR spectroscopy as well as a  $\mu\text{FTIR}$   
295 microscope equipped with a focal plane array detector to detect microplastics. It is therefore likely  
296 that if similar analytical techniques were employed to analyse the surficial sediment samples of  
297 the present study, higher microplastic abundances may have been reported, especially in the cases  
298 where zero microplastics were reported in certain samples.

299  
300 Another limitation of the present study is the non-inclusion of an air contamination check during  
301 sampling onboard the vessel. Such a check would have been necessary to rule out airborne  
302 contamination during sampling. Since this was not done, the possibility exists that one or more of  
303 the particles reported as present in the surficial sediments of the ACB could have been introduced  
304 into the samples as a result of airborne contamination. The findings of the present study should  
305 therefore be regarded as preliminary and be used as a justification for future studies which can  
306 provide more comprehensive assessments of microplastics in deep-sea sediments of the Arctic  
307 Central Basin.

308

## 309 **5.0 Conclusion**

310 To our knowledge, this is the first study to present preliminary information regarding microplastics  
311 in surficial sediments of the Arctic Central Basin (ACB). The potential discovery of these particles  
312 in the sediment phase of this seemingly remote oceanic basin emphasizes the pervasiveness of  
313 microplastics in the marine environment. The possible presence of microplastics, specifically low-  
314 density polymers such as polypropylene (PP) and polystyrene (PS), in the sediment phase of the  
315 ACB suggests that there are mechanisms operating within this oceanic basin that are potentially  
316 affecting the density of microplastics and that are potentially driving the vertical transport of these  
317 particles through the water column. Microplastics that are present in sediments of the ACB are  
318 likely to interact with organisms inhabiting or depending upon this environmental phase. At  
319 present, whether those interactions are occurring with benthic organisms within the ACB and the

320 consequences of those interactions to individual organisms and the ecosystem services that they  
321 perform remains uncertain. Due to the numerous limitations of the present study, the findings  
322 should not be taken as conclusive regarding the status of microplastics in the surficial sediments  
323 of the ACB but instead be used as a foundation for future work seeking to quantify microplastic  
324 abundance, distribution and composition in surficial sediments of the Arctic Ocean.

325

### 326 **Acknowledgements**

327 The authors acknowledge the invaluable support of the staff of the Swedish Polar Research  
328 Secretariat (especially Jeanette Axelsson, Robert Holden, Lars Lehnert, Asa Lindgren, Axel  
329 Meiton and Per Salo) and the crew of icebreaker Oden with the Arctic Ocean 2016 expedition. The  
330 expert guidance of Mr. Andrew Tonkin (University of Plymouth) during FT-IR analyses is also  
331 acknowledged. The first author also acknowledges the support of the coring technicians (Draupnir  
332 Einarsson, Markus Karasti), fellow early career scientists (especially those of the Sediment Work  
333 Package: Grace Shephard, Luz María Ramirez, Steffen Wiers) and other researchers (especially  
334 Asa Johannisson) during the expedition.

335

### 336 **Funding**

337 Sampling in the Arctic Ocean was funded by the Swedish Polar Research Secretariat (SPRS) under  
338 the Early Career Scientist (ECS) Programme in which the first author was a participant. This work  
339 was also co-funded through a MARES Grant. MARES is a Joint Doctorate programme selected  
340 under Erasmus Mundus and coordinated by Ghent University (FPA 2011-0016). The funders had  
341 no role in study design, data collection, analysis and interpretation, decision to publish, or  
342 preparation of the manuscript.

343

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Supplementary Table 1: Site-specific information for sediment cores sampled for microplastics in the Arctic Central Basin

Sample No. <sup>a</sup>	Core ID	Latitude	Longitude	Location in the ACB	Water Depth (m)	Core Type <sup>b</sup>
1	AO16-1-GC1	80.5532	8.0520	Yermak Plateau	855	GC
2	AO16-2-PC1	88.5022	-6.6195	Amundsen Basin	4353	PC
3	AO16-3-TWC1	89.2530	-66.6097	Foot of Lomonosov Ridge	3777	TWC
4	AO16-4-TWC1	88.5290	-128.5048	Marvin Spur	3936	TWC
5	AO16-5-TWC1	89.0780	-130.5470	Crest of Lomonosov Ridge	1253	TWC
6	AO16-7-PC1	88.6332	-121.4477	Marvin Spur	3941	PC
7	AO16-8-GC1	86.7795	-140.6433	Alpha Ridge	2620	GC
8	AO16-9-TWC1	85.9557	-148.3258	Alpha Ridge	2212	TWC
9	AO16-10-TWC1	82.3980	-141.2450	Nautilus Basin	2872	TWC
10	AO16-11-TWC1	86.0993	173.1877	Makarov Basin	3066	TWC
11	AO16-12-TWC1	87.8577	136.9875	Crest of Lomonosov Ridge	1269	TWC

<sup>a</sup>Sample numbers correspond to those on Figure 1a; <sup>b</sup>GC (Gravity core); PC (Piston core); TWC (Trigger weight core)

#### Supplementary Information related to particle size and organic carbon content analysis

*Method:* For particle size analysis, approximately 0.1 g of wet sediment from each sediment core was transferred to a test tube. To this, 3 mL of sodium metaphosphate solution (10%) was added and the total volume brought to 10 mL using de-ionized water. The contents of the tube were stirred, ultrasonicated for approximately 30 seconds to facilitate disaggregation and then transferred to the Hydro LV wet dispersion unit of a Mastersizer 3000 laser diffraction particle size analyser (Malvern Instruments, UK). De-ionized water was used to bring the final volume in the wet dispersion unit to 600 mL prior to analysis. The particle size of surficial sediments from each core was based on the analysis of three sub-samples. Following Pagter et al. (2018), approximately 3 g of dried sediment (105 °C, 4 h) from each sample was placed into a furnace at 450 °C for 6 hours in order to estimate the organic content of the sediment samples based on loss on ignition. Grain size composition of the surficial sediment data was conducted using Gradistat Version 8 (Blott 2010).

*Results:* Regarding the particle size composition of the sediments, all sampled sites had a predominance of fine-grained sediments where the percentage of silt (59 – 87 %) > clay (10 - 24 %) > sand (1 – 23 %) > gravel (0 – 0.2 %), (Supplementary Table 1). Organic content of the surficial sediment samples ranged between 2.3 – 4.6 % (Supplementary Table 1).

#### Reference:

Blott, S., 2010. Gradistat Version 8: A grain size distribution and statistics package for the analysis of unconsolidated sediments by sieving or laser granulometer. Kenneth Pye Associates Limited, Berkshire, UK.

Supplementary Table 2: Synthetic polymer composition and grain sizes of surficial sediments in the Arctic Central Basin

	Sample Number										
	1	2	3	4	5	6	7	8	9	10	11
<b>Grain size composition (%)</b>											
Total Gravel (%)	0.0	0.0	0.0	0.1	0.0	0.1	0.2	0.0	0.0	0.1	0.0
Total Sand (%)	3.3	5.2	1.2	7.5	12.4	15.2	17.5	16.4	22.6	10.2	7.5
Total Silt (%)	86.9	73.6	76.4	68.4	70.5	65.6	63.4	63.0	59.3	69.8	73.7
Total Clay (%)	9.8	21.2	22.5	24.1	17.1	19.2	18.9	20.5	18.0	19.8	18.7
<b>Organic content (%)</b>											
	4.6	4.0	4.4	3.5	3.3	2.6	3.4	3.6	2.6	2.3	2.8
<b>Polymer Type (n)</b>											
Polyacrylonitrile (PAN)			1								
Polyamide (PA)					1						
Polyester (PES)		2									1
Polypropylene (PP)							1				
Polystyrene (PS)							1	1			
Polyvinyl chloride (PVC)				1							
Total number of synthetic polymers	0	2	1	1	1	0	2	1	0	0	1
Size (mm); Type (Fi-fibre; Fr-fragment) of microplastics		1.84 (Fi) 1.38 (Fi)	0.47 (Fi)	0.91 (Fr)	3.58 (Fi)		0.88 (Fr) 0.54 (Fr)	0.45 (Fr)			1.03 (Fr)
<b>Microplastic concentration</b>											
Mass of dry sediment used (g)	10.02	10.12	7.86	9.83	10.20	10.89	9.31	10.09	10.07	10.36	4.54
Microplastic concentration (items kg <sup>-1</sup> )	0	198	127	102	98	0	215	99	99	97	220

Supplementary Table 3: Microplastics in deep sea sediments of various oceanic basins

Location	Depth (m)	Sampling Equipment	Extraction Method	Microplastic abundance	Synthetic polymers	Study
Porcupine Abyssal Plain Nile Deep Sea Fan Atlantic Sector of the Southern Ocean	1176 – 4843	Multicorer	Density flotation, NaI (1.6 g cm <sup>-3</sup> )	0.5 particles cm <sup>-3</sup> (average, n = 11) 1 particle cm <sup>-3</sup> (max)	No data	Van Cauwenberghe et al. (2013)
Subpolar North Atlantic Ocean NE Atlantic Ocean Mediterranean Sea SW Indian Ocean	300 – 3500	Megacorers Boxcorers	Density flotation, NaCl, Ludox-TM 40 extraction	1.4 - 40 pieces per 50 ml (mean ± s.e., 13.4 ± 3.5)	PA, PES, Acrylic Rayon	Woodall et al. (2014)
Kuril-Kamchatka Trench, NW Pacific	4869 - 5768	Box corer	Sieve-washing of sediments	60 - 2020 pieces m <sup>-2</sup>	No data	Fischer et al. (2015)
HAUSGARTEN observatory, Fram Strait	2340 - 5570	Multiple corer	Density separation, zinc chloride (1.8 g cm <sup>-3</sup> )	42 – 6595 microplastics kg <sup>-1</sup> dry sediment	18 polymer types detected. Majority: PE, PA, PP	Bergmann et al. (2017)
Arctic Central Basin	855 - 4353	Gravity and piston corer	Density separation, sodium tungstate dihydrate (1.4 g cm <sup>-3</sup> )	0 - 200 microplastics kg <sup>-1</sup> dry sediment	PA, PAN, PES, PP, PS, PVC	This study

PA-Polyamide, PAN-Polyacrylonitrile, PES-Polyester, PP-Polypropylene, PS-Polystyrene, PVC-Polyvinyl chloride