

Microplastics Census in Sea Ice along the Canadian Arctic Archipelago A44D-09

Alessandra D'Angelo¹, Laura Glastra¹, Jacob Strock¹, Irene Andreu², Nicole Trenholm³, Brice Loose¹

¹University of Rhode Island, Graduate School of Oceanography, ²University of Rhode Island, Rhode Island Consortium for Nanoscience and Nanotechnology & Chemical Engineering, ³University of Maryland Baltimore County

Thursday, 16 December 2021: 14:30 - 15:45, Convention Center, Room 278-279





- ❑ Global composition of marine litter (728 publications, 5466 locations), **61.27%** plastics - AWI LITTERBASE.
- ❑ Concentrations of marine micro-particles were higher in the **Arctic** Basin than all other ocean basins in the world (Barrows et al., 2018). Once reaching the Arctic plastic particles can be incorporated into **sea ice**, which acts as a sink and transport vehicle of microplastics in the Arctic (Peeken et al., 2018).

Table 1. Average concentrations of microplastic particles in various marine habitats of the Arctic Ocean.

Habitat	Sampling area	Sampling year	Average MP concentration (N L ⁻¹)	Reference
Sea ice	Central Arctic	2005/2010	108	Obbard et al., 2014
	Central Arctic	2014/2015	4500	Peeken et al., 2018

Arctic Report Card, Update for 2018 NOAA. Microplastics in the Marine Realms of the Arctic with Special Emphasis on Sea Ice (I. Peeken, M. Bergmann, G. Gerds, C. Katlein, T. Krumpfen, S. Primpke, M. Tekman)

Sea ice	Central Arctic	2016	9.5	Kanhai et al., 2020
---------	----------------	------	-----	---------------------



MICROPLASTICS CENSUS IN SEA ICE ALONG THE CANADIAN ARCTIC ARCHIPELAGO - RESEARCH QUESTIONS

- ❑ What is the census of microplastics (MP) in the Canadian Arctic Archipelago (CAA) sea ice, and what is their distribution across the ice core?

Plastic data from the CAA (Cózar et al. 2017; Mallory et al. 2021), AWI – LITTERBASE. No sea ice data, mainly beached plastics.

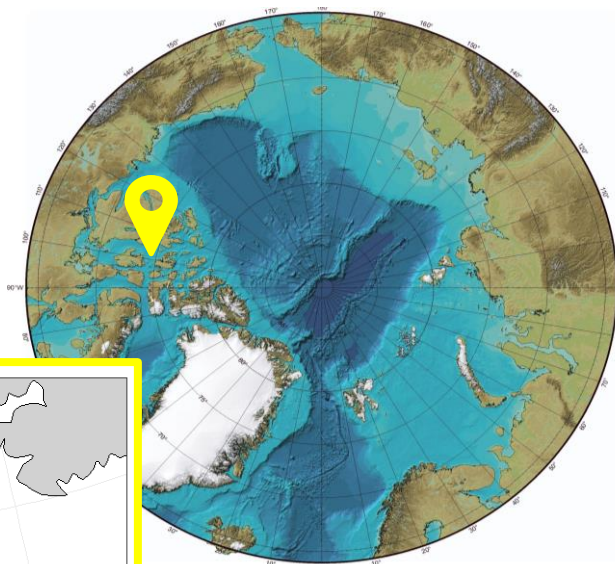




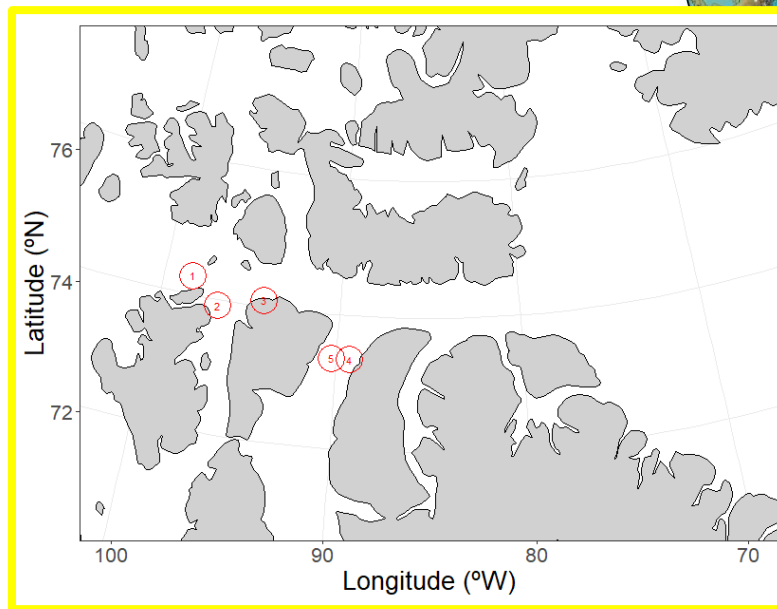
NORTHWEST PASSAGE PROJECT EXPLORING A CHANGING ARCTIC



Oden icebreaker
Photo: Donglai Gong



The international bathymetric chart of the arctic ocean (ibcao)





MICROPLASTICS CENSUS IN SEA ICE ALONG THE CANADIAN ARCTIC ARCHIPELAGO - **SEA ICE SAMPLES**

Multi-year ice MYI (av. Salinity = 1.98 ± 1.17) most likely originated in the Central Arctic (Pfirman et al. 1997; Rigor and Wallace 2004; Girard-Ardhuin and Ezraty 2012; Wohleben et al. 2012)





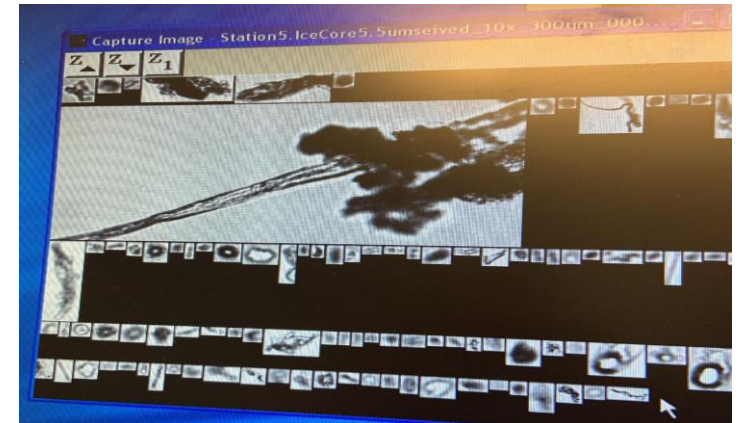
MICROPLASTICS CENSUS IN SEA ICE ALONG THE CANADIAN ARCTIC ARCHIPELAGO - METHODS

**Rinse all the tools with ethanol first and MilliQ then, before being in contact with the sample*

1. Collect the sea ice core in multilayer foil bags
2. Filter the melted core + H₂O₂ (35%) onto GF/F and nitrocellulose disks
3. Store the filters in foil paper at -20°C

Modified method from Obbard et al. (2014) and Peeken et al. (2018).

***A Control sample was used prior each step to assess the lab contamination*



- 20 ml of the mlted ice core were processed via FlowCam with a 300 µm flow cell and 10x objective

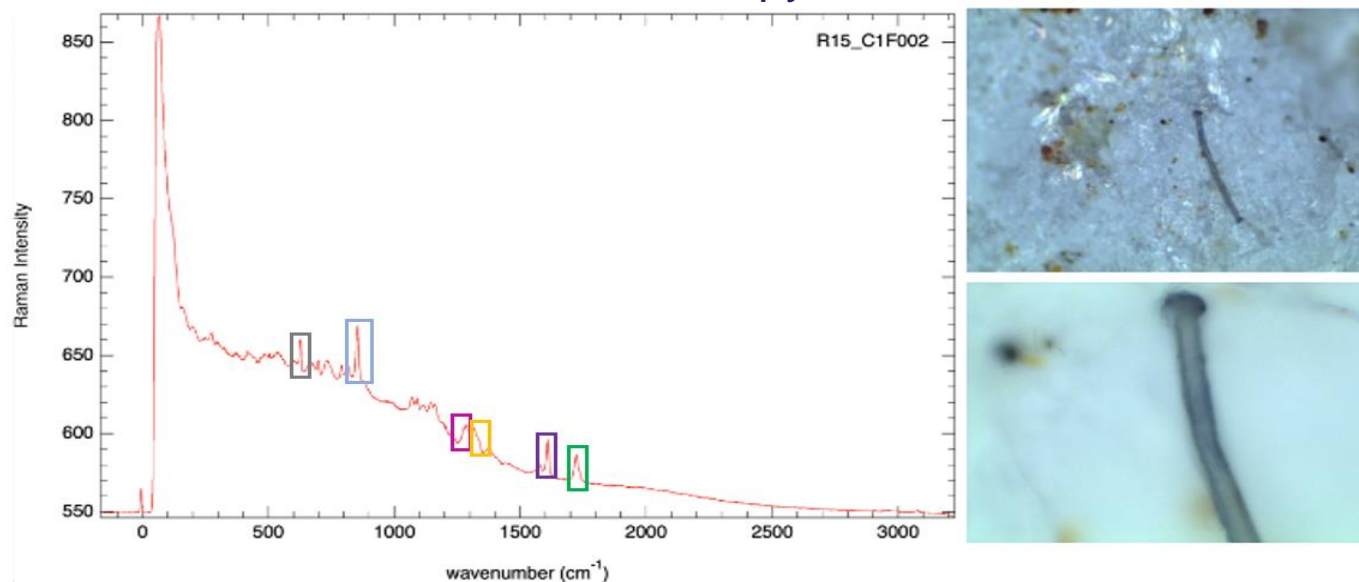


MICROPLASTICS CENSUS IN SEA ICE ALONG THE CANADIAN ARCTIC ARCHIPELAGO - METHODS

1. MP counting and classification by shape-type



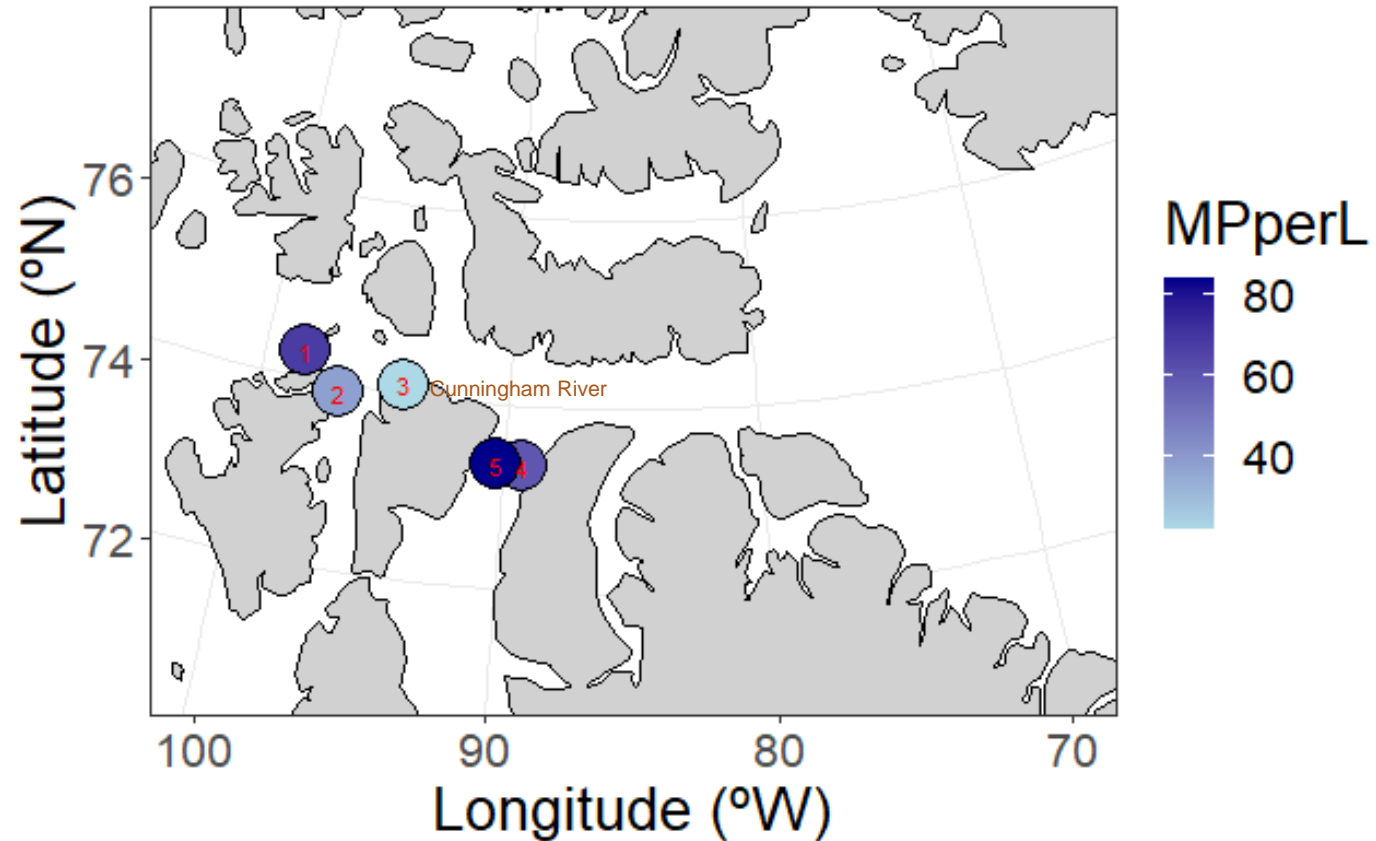
2. Polymer identification via Raman confocal microscopy



3. Processing of spectra via siMPle software (Systematic Identification of MicroPLastics in the Environment, developed by Aalborg University (DK) and Alfred Wegener Institute (GE)).



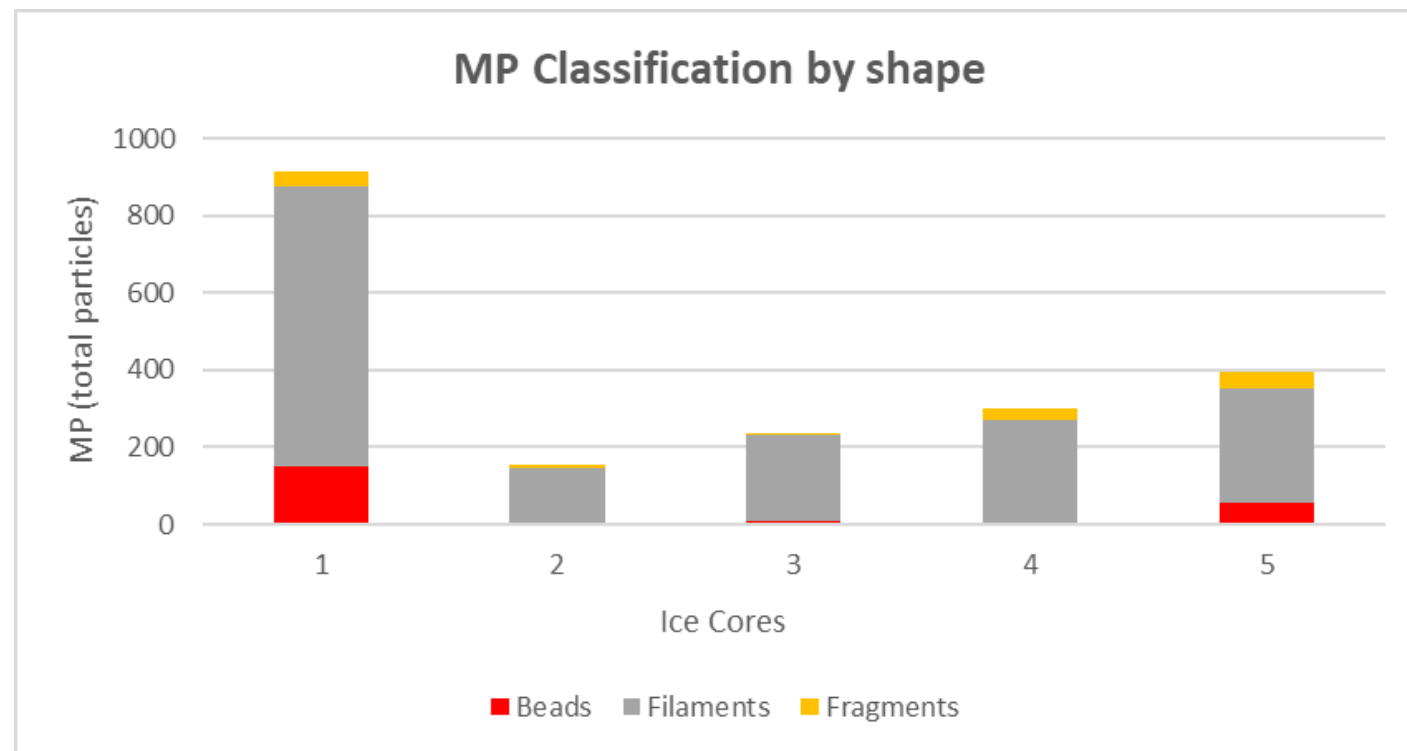
MICROPLASTICS CENSUS IN SEA ICE ALONG THE CANADIAN ARCTIC ARCHIPELAGO - RESULTS





MICROPLASTICS CENSUS IN SEA ICE ALONG THE CANADIAN ARCTIC ARCHIPELAGO - RESULTS

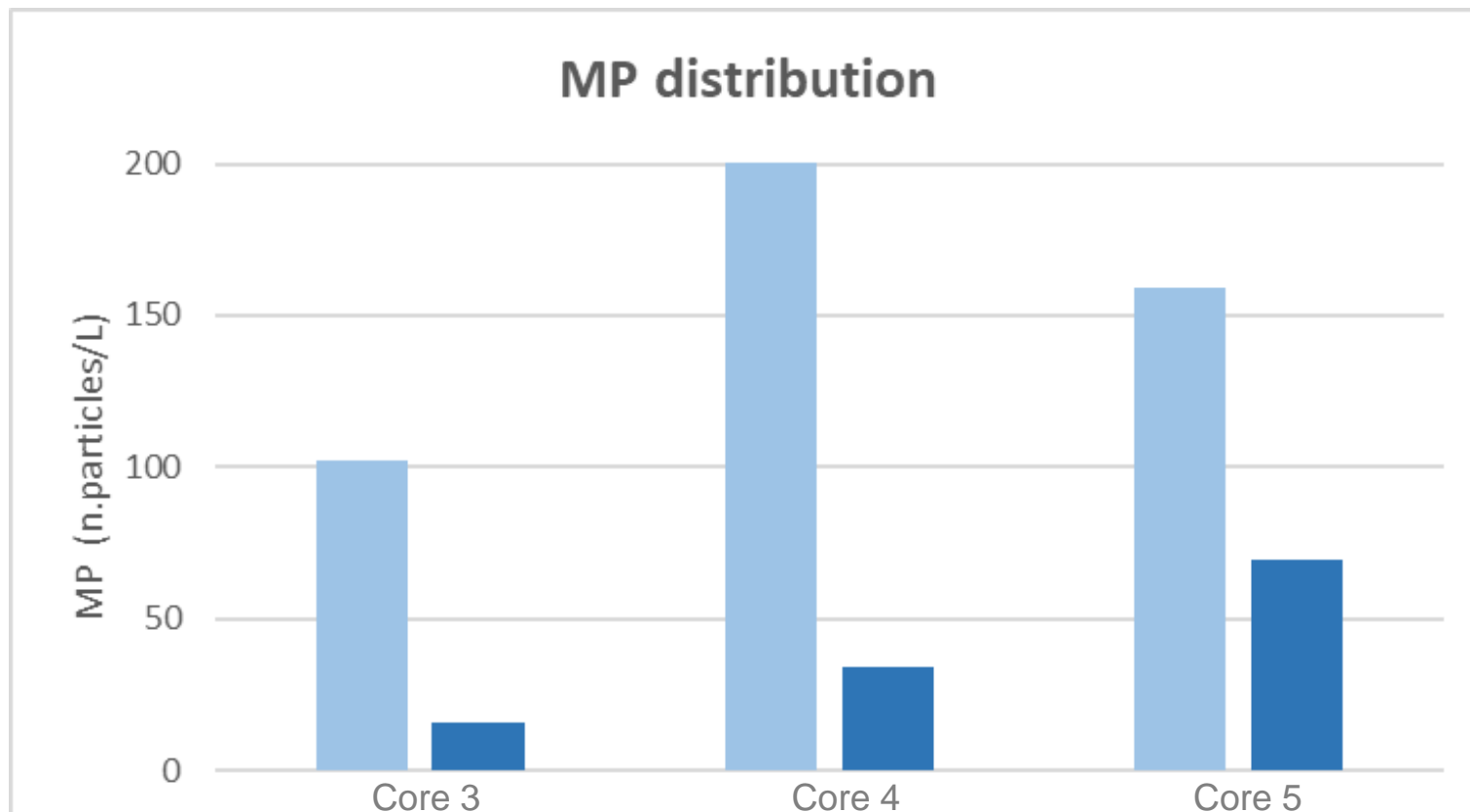
Core	Filaments (%)	Beads (%)	Fragments (%)
1	79.04	16.59	4.37
2	93.59	0.64	5.77
3	93.67	3.80	2.53
4	89.04	0.33	10.63
5	75.51	13.89	10.61



Filaments were the most abundant particles in our samples, both in the surface and in the core body.



MICROPLASTICS CENSUS IN SEA ICE ALONG THE CANADIAN ARCTIC ARCHIPELAGO - RESULTS





MICROPLASTICS CENSUS IN SEA ICE ALONG THE CANADIAN ARCTIC ARCHIPELAGO - RESULTS

- Core 1 polymer identification:
 - 74% Polyvinyl chloride (PVC)
 - 15% Polyester
 - 11% Polyphenylene Sulfide (PPS)

**All results with a siMPle score > 0.1*

Manufacture suggested by the siMPle Raman single file library, Version 1.0:

- 95% PVC belonging to PKSD
- 100% Polyester belonging to NOVAMONT (bio-polyester)
- 100% PPS belonging to BASF



MICROPLASTICS CENSUS IN SEA ICE ALONG THE CANADIAN ARCTIC ARCHIPELAGO – MAIN TAKEAWAYS

Within the CAA MYI the occurrence of the MP recorded an average of 52 ± 22 MP/L, with higher distribution at the top 20 cm of the ice core.

The lower density of MP was recorded in Core 3, closer to land and to the Cunningham River discharge.

The most abundant MP shape-type is the filament (av. $80 \pm 12\%$).

The polymer species in Core 1 (other cores still in progress) in order of magnitude were: PVC, PS, PPS.



THANK YOU

Thanks to all co-authors and to Geotracerkitchen members. We really appreciated the collaboration with Menden-Deuer Lab (URI, GSO).

A special thanks to the NPP Teams and the Nunavut Impact Review Board. We acknowledge the Oden crew for helping in the collection of the samples.

We also would like to thank the the National Science Foundations and Heising-Simons Foundation for giving the opportunity to work at this project during the expedition.

The Raman data was acquired at the RI Consortium for Nanoscience and Nanotechnology, a URI College of Engineering core facility partially funded by the National Science Foundation EPSCoR, Cooperative Agreement #OIA-1655221. The confocal Raman microscope was funded by the National Science Foundation EPSCoR, Cooperative Agreement #OIA-1655221.

a_dangelo@uri.edu

AGU FALL
MEETING

