6 Occurrence of Microplastics in the Antarctic Seas (Microplastics)

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Objectives

We aim to advance our knowledge and understanding of the sources of microplastics (MP) in the remote Antarctic marine ecosystem. By applying material flow analysis and integrating the results into an ocean circulation model, we will evaluate the evidence that MP can cross the Antarctic Circumpolar Current (ACC) into the Southern Ocean around Antarctica.

A successful outcome will include achieving the following goals:

- Providing baseline information on concentrations, composition and distribution of MP in surface and sub-surface waters, as well as form ice cores from the Southern Ocean,
- Evaluate the sources of MP in the Southern Ocean, by: (1) comparing MPs in the more anthropogenically impacted Scotia Sea (SS) and Western Antarctic Peninsula (WAP) versus relatively pristine Weddell Sea (WS) and (2) modeling MP transport within and to/from Antarctica.

These comparisons will be based on characterization of MP properties, such as particle morphology, polymer composition, extent of degradation, and (b) examination of the microbial communities of the MP (Plastisphere).

Work at sea

The upper 18 cm of surface water were sampled for MP with a Manta Trawl (floating neuston net towed to on-board crane for trawling; *n* = 24, Fig. 6.1 and Tab. 6.1). Sub-surface water was sampled by filtering pumped seawater from beneath the vessel at approximately 11.2 m depth (*n* = 85, Fig. 6.2 and Tab. 6.2). When possible, samples were scanned visually for MP on board using a dissection microscope. Suspicious particles were analyzed using Fourier Transform Infrared Spectrometry (FT-IR) to confirm that particles are synthetic polymers and to evaluate the polymer composition. Surface water samples with high densities of biological material were stored frozen at -20°C and will be analyzed at the home laboratory at University of Basel subsequently to a purification treatment. Sub-surface water samples with particle sizes smaller 300 µm will be analyzed at the laboratories of AWI Helgoland in cooperation with Gunnar Gerdts (AWI) applying Focal Plane Array (FPA) – based FT-IR (Löder et. al 2015). MP collected will be analyzed for polymer type, particle morphology and size.

Suspended surface solids sampled by Manta Trawl:

24 trawls were performed during PS117 (Fig. 6.3 and Tab. 6.1). Except for one trawl which was aborted due to ice accumulation in the mesh after 20 minutes (MT 7; PS117_32-2), all trawls were completed successfully with a sampling time of 30 minutes. The Manta Trawl (MT)

(aperture: 60 cm x 18 cm) is equipped with a mechanical flowmeter and a 300 µm mesh with a removable cod end. The MT (total weight ≈ 15 kg) was deployed by an on-board crane adding an 8 kg steel weight to the end of the cranes steel rope connected with the rope of the MT to improve stability against dynamic forces such as wind and waves (Fig. 6.1). The on-board crane was extended to its maximum and the steel rope of the crane was released long enough to allow for a flat sampling angle (≤ 30°). Thus, during sampling the MT was approximately 20 m behind the crane and 5 m away from the side the hull (depending on wind, current and vessel course) at starboard side. The tows were performed at a vessel speed of 2 knots during a target trawling duration of 30 minutes. This resulted in an average (± SD) of approximately 203 ± 60 m^3 of filtered seawater per successful sample and a total of 4690,03 m^3.

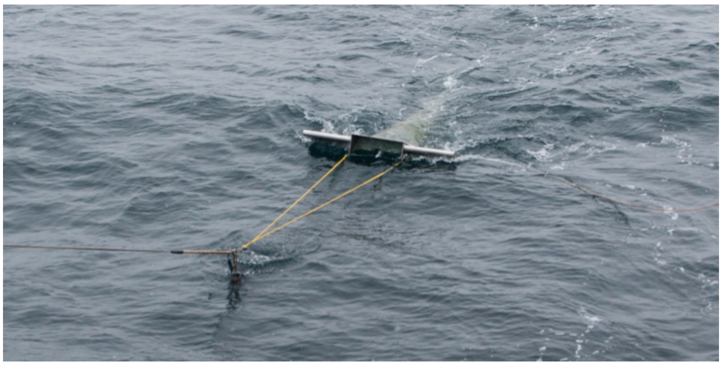

Fig. 6.1: Manta Trawl (MT) deployed in the Southern Ocean. Between the yellow brindle of the MT and the steel rope of the on-board crane an 8 kg steel weight is attached to stabilise the trawl.

After every tow the MT was hauled from the water and the mesh's outside was rinsed down with the seawater hose so that particles attached to the mesh were rinsed down into the removable cod end. Subsequently the cod end was removed, transferred to a rinsed glass jar immediately and sealed with a metal lid to prevent air bore contamination of the sample. After inspecting the sample visually for MP suitable for Plastisphere analysis (inhabiting microbial community characterizations) in the laboratory the content of the cod end was rinsed with milli-Q into a pre-rinsed glass beaker and filtrated to decrease the volume of the Sample (70 µm or 250 µm filters cut to size from PTFE-gauze). For visual inspection samples were transferred to a Bogorov counting chamber and screened using a stereomicroscope (Olympus SZ61) equipped with a camera (Olympus SC50) and connected to the imaging software CellSens (Version 2.1; 6 samples will need purification treatment at the home laboratory prior to visual inspection due to the high abundance of biological residue). Samples, with very low concentrations of biological residues were inspected for MP directly on 70 µm PTFE filters. In total 11 surface water samples were analyzed on board.

Putative anthropogenic particles were sorted and analyzed for polymer composition using FT-IR spectroscopy (Agilent 4500 Portable FTIR with MicroLab PC software). Recorded spectra will be compared against a larger reference spectra library (KnowItAll IR Spectral Library) in our home laboratory at the University of Basel to confirm the results.

Samples for microbial DNA-analysis were subdivided into three pieces. One piece was fixed in 2 mL PureGene lysis buffer, another sub-sample for microscopy via FISH and CLASI-FISH was fixed in paraformaldehyde (for less than 24 hours) then transferred to 50 % ethanol in PBS for storage at –20°C. The third piece was used to identify polymer composition using FT–IR. For the comparison of free-living microbial communities with those on MP, 2 L of seawater were drawn with a steel bucket during MT trawling and subsequently filtered through a 0.2 µm Sterivex™ cartridge filter (Millipore). Cartridges were subsequently run dry and flooded with 2 ml of PureGene lysis buffer. Four items were saved for this purpose, one from MT1 and three from a Multiple opening Rectangular Midwater Trawl (RMT, PS117_52-1; one cable binder, a piece of black tape and a rope). However, two of the items (the particle from MT1 and rope found in the RMT sample) were not identified to be synthetic polymers.

Sub-surface suspended solids sampled by on-board sea water pump:

To address the MP load in the sub-surface water layer, 85 samples were taken from the pumped seawater intake in the on-board wet lab. A Klaus Union Sealex Centrifugal Pump (Bochum, Germany) delivered seawater from approx. 11.2 m depth to the laboratory via stainless steel pipes (first described by Lusher et al., 2014). The first two sub-surface samples (SP1 and 2) were taken parallel to the first two MT using a stack of three geological sieves and a lower mesh boundary of 20 µm (combined with a 100 µm and a 300 µm sieve) according to the protocol of T. Mani (University of Basel) from PS111. Afterwards the protocol was modified, and samples were taken continuously along the cruse track starting at latitude -44,66768 and longitude 7,0858 (Fig. 6.3; 2019-12-18, 09:46 (UTC)). The lower mesh size was increased to 100 µm combined with a 300 µm sieve to prevent clogging and an overflow of the samples. Every 12 or 24 hours both size fractions were transferred to pre-rinsed glass jars individually, using milli-Q and a PTFE-Squirt bottle as rinsing agent (during that procedure sampling was interrupted for 5 minutes in average). To investigate MP that might be released during ballast water exchange to the environment, one sub-surface water sample (SP8; lower mesh size 20µm) was taken parallel to the exchange of approximately 250 m^3 of ballast water. Samples were sealed with metal lids, and stored in v:v 50:50 suspended sample:EtoH at + 4° C. While samples of the >300 µm fraction were transferred to cellulose filters (pore size 12-25µm) for visual inspection (56 samples analyzed on board), samples of the smaller 100 µm-300 µm fraction will be analyzed at the laboratories of AWI in Helgoland.

Fig. 6.2: Wooden protection covering geological sieves to allow for undisturbed sampling. Samples are taken from the on-board seawater intake system connected to the protected sieve stack with a water meter and a silicone hose.

During sampling sieves were protected from airborne contamination by a dimension-tailored solid wooden construction (Fig. 6.2, adapted from Kanhai et al., 2016). The sampling effort resulted in a total of 85 samples per size fraction. A mean (± SD) water flow duration of 12.8 ± 4.7 hours at 0.09 ± 0.02 L s^{-1} resulted in an average of 3.8 ± 1.4 m^3 filtered seawater per sample. In total 322.3 m^3 of subsurface water were filtered. A similar volume to an average MT sample (203±6 m^3) was yielded after SP55 with a total of 205,5 m^3 of filtered seawater.

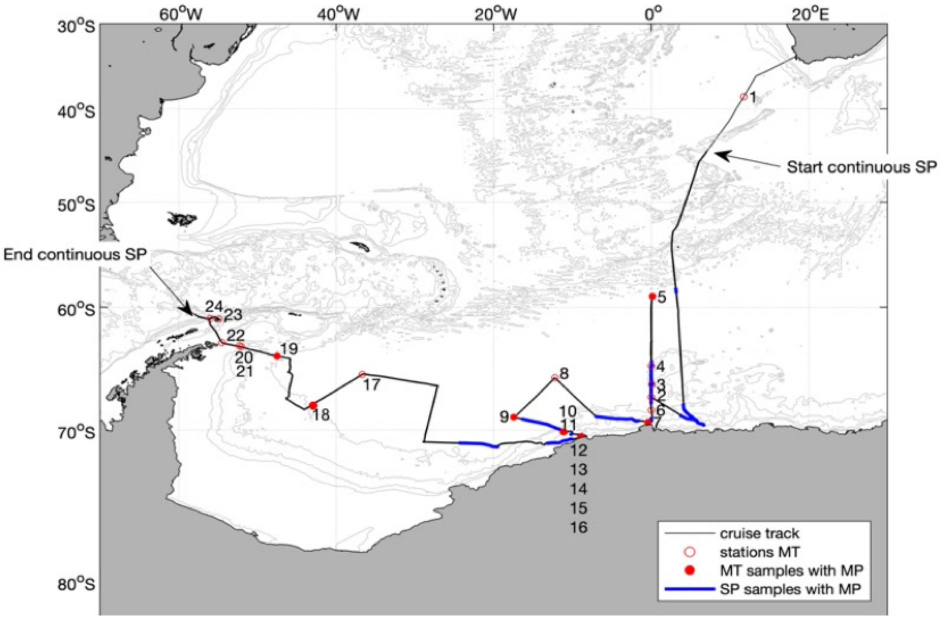

Fig. 6.4: Preliminary frequency distribution of anthropogenic particles m^{-3} in 15 surface water samples (MT) analysed on board. Samples taken during PS117 will undergo further visual inspection, spectroscopic analysis and evaluation in the home laboratory (University of Basel).

Ice Cores for MP studies:

During PS117 five sea ice cores were taken by the SIPES2 group for MP analyses (see table 7.1 SIPES). Ice cores were stored in plastic bags at – 20°C and will be processed and analyzed according to Peeken et al. (2018) in cooperation with Ilka Peeken (AWI) and Gunnar Gerdts (AWI).

Tab. 6.1: Summary of Manta Trawl samples for microplastics on PS117

Sample ID	Station Name	Date	Coordinates Start	Coordinates End	Area [m^2]	Filtered Vol. [m^3]
Manta Trawl (MT) 1	PS117_3-4	2018-12-17	-38,605676; 11,765578	-38,614186; 11,786013	1420,02	255,60
MT 2	PS117_14-3	2018-12-26	-67,500007; 0,014731	-67,499536; 0,088869	1405,8	253,04

Sample ID	Station Name	Date	Coordinates Start	Coordinates End	Area [m²]	Filtered Vol. [m³]
MT 3	PS117_15-7	2018-12-27	-66,50279; 0,09293	-66,497953; 0,14088	190,06	1055,90
MT 4	PS117_17-2	2018-12-28	-65,001679; 0,013812	-65,005529; 0,073552	962,1	173,178
MT 5	PS117_22-3	2018-12-31	-59,035363; 0,1622	-59,047307; 0,130238	1193,4	214,81
MT 6	PS117_26-3	2019-01-03	-68,500118; 0,009492	-68,49669; 0,063063	562,32	101,22
MT 7 [a]	PS117_32-2	2019-01-04	-69,430119; -0,401573	-69,431673; -0,431255	657	118,26
MT 8	PS117_34-6	2019-01-19	-65,969758; -12,232134	-65,982962; -12,272461	2262,42	407,24
MT 9	PS117_35-1	2019-01-08	-69,054347; -17,474316	-69,05798; -17,428181	876,78	157,82
MT 10	PS117_36-2	2019-01-09	-70,150757; -11,083026	-70,15648; -11,15486	894,06	160,93
MT 11	PS117_38-2	2019-01-19	-70,151107; -11,201088	-70,161906; -11,207465	1106,64	199,19
MT 12	PS117_41-5	2019-01-11	-70,513894; -8,803236	-70,533164; -8,795118	1236,42	222,56
MT 13	PS117_41-7	2019-01-11	-70,507945; -8,81752	-70,523945; -8,798333	1238,22	222,88
MT 14	PS117_41-11	2019-01-12	-70,507945; -8,81752	-70,523229; -8,826951	1241,28	223,43
MT15	PS117_41-14	2019-01-12	-70,515384; -8,781321	-70,526729; -8,82164	1252,62	225,47
MT16	PS117_48-3	2019-01-19	-70,509151; -8,991134	-70,513422; -8,931363	1266,48	227,96

Sample ID	Station Name	Date	Coordinates Start	Coordinates End	Area [m²]	Filtered Vol. [m³]
MT17	PS117_56-7	2019-01-23	-65,697443; -36,687479	-65,708079; -36,724115	781,74	140,71
MT18	PS117_57-5	2019-01-24	-70,507945; -8,81752	-70,523229; -8,826951	1171,26	210,83
MT19	PS117_64-3	2019-01-27	-64,196628; -47,505391	-64,213986; -47,492906	721,08	129,79
MT20	PS117_81-3	2019-01-30	-63,341187; -52,303992	-63,34944; -52,292096	1069,56	192,52
MT21	PS117_83-1	2019-01-31	-63,426911; -52,041347	-63,442039; -52,052781	1199,52	215,91
MT22	PS117_95-2	2019-02-01	-63,080642; -54,49727	-63,066914; -54,512013	1156,5	208,17
MT23	PS117_99-4	2019-02-01	-61,012926; -56,015099	-61,019839; -56,046805	1312,02	236,16
MT24	PS117_100-2	2019-02-02	-61,054374; -54,867545	-61,059536; -54,906191	1068,48	192,33

Aborted after 20 min. due to ice accumulation in Manta Trawl a

Tab. 6.2: Summary seawater pump samples for microplastics on PS117

Sample ID	Coordinates Start	Coordinates End	Filtered Vol. [L]	Mesh Size [µm]
Seawater Pump (SP) 1	-38,61351; 11,791623	-38,60131; 11,754382	178	20
SP 2	-43,30161; 8,233274	-43,45973; 8,101273	152,5	20
SP 3	-44,66768; 7,0858	-48,20596; 5,093206	526	20

Sample ID	Coordinates Start	Coordinates End	Filtered Vol. [L]	Mesh Size [µm]
SP 4	-48,24225; 5,078457	-52,20356; 3,403959	1674	100
SP 5	-52,23723; 3,388744	-54,59126; 2,590244	6435	100
SP 6	-54,67503; 2,601824	-57,33656; 2,979147	3594	100
SP 7	-57,38811; 2,987054	-58,02244; 3,080343	3812	100
SP 8	-58,26027; 3,115871	-58,76528 3,192664	830,5	100
SP 9	-58,83714; 3,203444	-62,21459; 3,564964	773,5	20
SP 10	-62,23731; 3,566866	-65,00854; 3,812596	4875	100
SP 11	-65,05664; 3,817129	-67,96025; 4,104577	3452,5	100
SP 12	-67,99669; 4,106763	-69,54479; 6,388922	3797	100
SP 13	-69,54668; 6,438313	-68,85369; 3,620448	3651,5	100
SP 14	-68,82288; 3,52709	-67,49855; -0,000018	3606	100
SP 15	-67,49857; -0,000079	-66,51486; -0,169729	4243	100
SP 16	-66,51512; -0,17006	-66,52085; -0,091653	3721,5	100
SP 17	-66,011767; -0,004262	-64,535269; 0,033176	95	100

Sample ID	Coordinates Start	Coordinates End	Filtered Vol. [L]	Mesh Size [µm]
SP 18	-63,00069; 0,001347	-60,99677; -0,009448	2231	100
SP 19	-60,99656; -0,009755	-59,08385; 0,100012	3168	100
SP 20	-59,08404; 0,098945	-63,59823; -0,0129	8122	100
SP 21	-63,6129; -0,011185	-65,98879; -0,00766	7530,5	100
SP 22	-66,00824; -0,007549	-67,99976; -0,00104	7690,5	100
SP 23	-67,99974; -0,001088	-68,971; 0,15246	6059	100
SP 24	-68,97837; 0,159809	-69,16674; 0,006688	3919,5	100
SP 25	-69,17175; 0,006624	-69,36571; -0,158526	3592,5	100
SP 26	-69,36592; -0,159442	-69,30268; -1,579487	3844,5	100
SP 27	-69,30372; -1,584887	-69,00693; -6,99193	804,5	100
SP 28	-69,00763; -6,993489	-69,01373; -7,003758	6786	100
SP 29	-69,01482; -6,99408	-67,85038; -9,059098	4007	100
SP 30	-65,96891; -12,22967	-67,84162; -9,074264	4000	100
SP 31	-65,96856; -12,22128	-65,96875; -12,23105	3758,5	100

Sample ID	Coordinates Start	Coordinates End	Filtered Vol. [L]	Mesh Size [µm]
SP 32	-65,96854; -12,23059	-67,68612; -15,01383	3960	100
SP 33	-67,69748; -15,0326	-69,05671; -17,43267	3814,5	100
SP 34	-69,0567; -17,43072	-69,16548; -16,55439	3639	100
SP 35	-69,17287; -16,50136	-70,16063; -11,24673	2556	100
SP 36	-70,1624; -11,27275	-70,17646; -11,00258	3244	100
SP 37	-70,17653; -11,0027	-70,29848; -10,03482	4170	100
SP 38	-70,29852; -10,03535	-70,30832; -10,19833	3752	100
SP 39	-70,30847; -10,1898	-70,35264; -8,999914	3907	100
SP 40	-70,35257; -9,000182	-70,51579; -8,789991	3272	100
SP 41	-70,52239; -8,768191	-70,5228; -8,774486	4377	100
SP 42	-70,52285; -8,772641	-70,44725; -8,484728	3607,5	100
SP 43	-70,44849; -8,482395	-70,50389; -8,191863	3801,5	100
SP 44	-70,50389; -8,191864	-70,50398; -8,190612	4454	100
SP 45	-70,50398; -8,190612	-70,50402; -8,190597	3501	100

Sample ID	Coordinates Start	Coordinates End	Filtered Vol. [L]	Mesh Size [µm]
SP 46	-70,50402; -8,190598	-70,50403; -8,190532	3579	100
SP 47	-70,50403; -8,190526	-70,50402; -8,190645	3868	100
SP 48	-70,50403; -8,190642	-70,50403; -8,190578	4336	100
SP 49	-70,50403; -8,190528	-70,32506; -8,766672	2501	100
SP 50	-70,32477; -8,772601	-70,50554; -8,937188	3800,5	100
SP 51	-70,50551; -8,937024	-70,50394; -8,190229	4338,5	100
SP 52	-70,50396; -8,190245	-70,67946; -9,910464	4230,5	100
SP 53	-70,68892; -9,925345	-70,98264; -13,28406	4182,5	100
SP 54	-70,9831; -13,28891	-70,87252; -15,46381	4040	100
SP 55	-70,87133; -15,48842	-71,23834; -19,64886	3570	100
SP 56	-71,23863; -19,64943	-70,96427; -24,44725	3874	100
SP 57	-70,96371; -24,4805	-70,8779; -28,99613	3556	100
SP 58	-70,87927; -28,98561	-70,05584; -28,55931	3971,5	100
SP 59	-70,04611; -28,55484	-67,62811; -27,52557	3480,5	100

Sample ID	Coordinates Start	Coordinates End	Filtered Vol. [L]	Mesh Size [µm]
SP 60	-67,62002; -27,52231	-66,6024; -27,0629	3732	100
SP 61	-66,60231; -27,06345	-66,16765; -31,35781	3940	100
SP 62	-66,16579; -31,37127	-65,84219; -34,43346	3657,5	100
SP 63	-65,84169; -34,44335	-65,69301; -36,67069	3843	100
SP 64	-65,69295; -36,66994	-66,44405; -38,62307	3732	100
SP 65	-66,45808; -38,65897	-68,44515; -44,00705	3419	100
SP 66	-68,45057; -44,02344	-68,46515; -44,01802	3196,5	100
SP 67	-68,46513; -44,018	-67,6676; -46,32515	4490,5	100
SP 68	-67,66745; -46,32557	-67,46764; -46,03488	3639	100
SP 69	-67,46148; -46,02367	-65,50127; -46,0873	3845	100
SP 70	-65,50324; -46,0884	-64,41016; -45,84601	3827	100
SP 71	-64,41036; -45,8456	-64,25409; -47,01163	3891	100
SP 72	-64,25425; -47,01232	-64,18999; -47,50533	3638	100
SP 73	-64,18744; -47,5002	-64,06783; -48,39712	3866	100

Sample ID	Coordinates Start	Coordinates End	Filtered Vol. [L]	Mesh Size [µm]
SP 74	-64,06782; -48,40614	-63,86032; -49,56743	3894	100
SP 75	-63,85696; -49,58072	-63,73037; -50,37285	3561	100
SP 76	-63,72553; -50,40282	-63,62129; -51,07727	3868,5	100
SP 77	-63,62113; -51,07739	-63,48794; -51,74998	3970,5	100
SP 78	-63,48625; -51,77032	-63,4271; -52,15777	3846	100
SP 79	-63,4265; -52,15767	-63,44849; -51,99276	3753	100
SP 80	-63,44818; -51,99344	-63,22453; -53,65026	3581,5	100
SP 81	-63,21963; -53,68283	-61,36304; -56,07638	3653,5	100
SP 82	-61,35035; -56,078	-60,89787; -55,51887	4235	100
SP 83	-60,89323; -55,49793	-60,89323; -55,49793	3472	100
SP 84	-60,91735; -55,60286	-60,85542; -57,50484	3830	100
SP 85	-60.855628; -57.504516	-60.666318; -57.906921	4015	100

Preliminary (expected) results

All samples taken during PS117 will undergo further visual inspection, chemical and spectroscopic analysis and evaluation in the home laboratory. Thus, we present here only preliminary results.

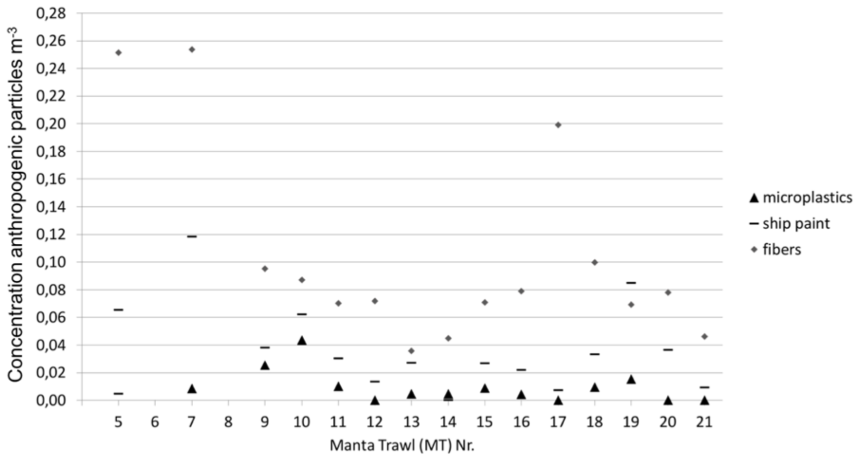

Fig. 6.4: Preliminary frequency distribution of anthropogenic particles m^{-3} in 15 surface water samples (MT) analysed on board. Samples taken during PS117 will undergo further visual inspection, spectroscopic analysis and evaluation in the home laboratory (University of Basel).

15 out of 24 surface water samples collected with the manta trawl were screened for MP on board. All samples yielded fragments of anthropogenic origin with concentrations between 0.004 and 0.13 fragments m^{-3}. Fibers were also found in all MT samples with concentrations between 0.04 and 0.25 fibers m^{-3} (*Fig 6.4)*. With up to 0.12 fragments m^{-3} most of the particles were identified as ship paint by FT-IR spectroscopy and comparison to spectra of reference samples taken from ship paint of *RV Polarstern*. These ship paint particles were found in all analyzed surface water samples except for MT 14. Mostly blue, orange, white and green paint fragments were found (*Fig. 6.5*). While blue fragments might originate from the hull of *RV Polarstern* and the railing, orange particles might derive from the on-board cranes, green particles from the steel frames of the wooden floor of the working deck and the stairs and the floors on the different decks. White ship paint might derive from the railing and from the walls and doors of the vessel. While paint fragments of all colors might be blown or washed from the vessel into the water, blue paint fragments might also be released from the vessels hull due to mechanical abrasion from the water.

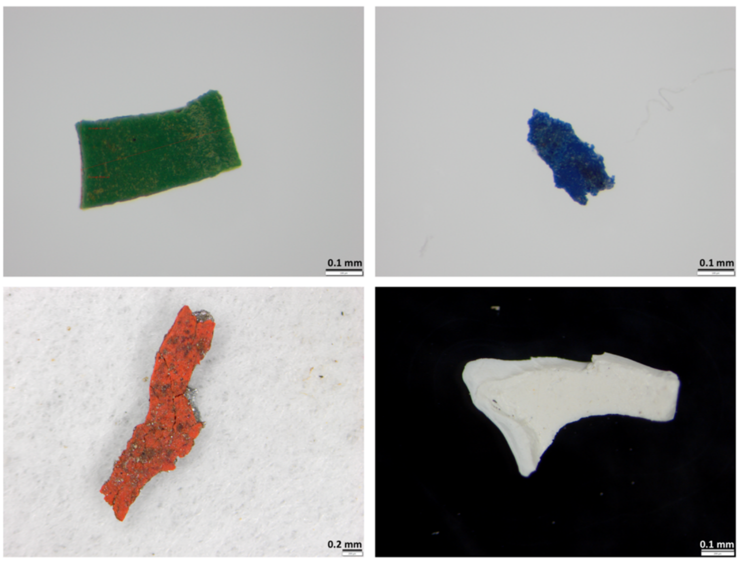

Fig. 6.5: Anthropogenic fragments identified as ship paint from MT 16 (green), MT 18 (blue), MT 7 (red/orange) and MT 10 (white) respectively.

MP were found in 11 out of 15 analyzed MT samples with concentrations between 0 and 0,025 MP m^{-3}. The most abundant polymer type with five fragments was chlorobutyl (three fragments in MT10 and two in MT13; Fig. 6.6 A), a copolymer made of chlorinated isobutylene and isoprene. Due to its low gas and moisture permeability it is manly used for air hoses, seals, tire innerliners and membranes (Polymer Properties Database, 2018). Four particles of nylon and polyester were found, respectively and neoprene was found two times in our samples.

The 56 sub-surface samples analyzed on board (size fraction >300 µm) yielded a total volume of 219.5 m^{-3} filtered seawater and an average volume of 3.7 m^3 per sample. In contrast to the MT samples no ship paint was found in the samples taken with the seawater pump. Even though ship paint fragments might sink to deeper waters (paint fragments found in our MT samples did always sink to the bottom of the sampling jars having a higher density than water) freshly released fragments might be retained in the water surface layer due to current and bow wave induced turbulences. Further, it might be possible that vessel-released particles are transported away from the hull by the bow wave.

MP were found in 12 sub-surface water samples with concentrations between 0 and 1.24 MP m^{-3}. This excludes the sample taken parallel to the ballast water exchange. Here four polyester fragments were found, yielding a concentration of 4.82 particles m^{-3} (SWP8*; Fig. 6.6 B*). Neoprene was the most abundant polymer (*n=5*; *Fig. 6.5 C*) followed by polyester (*n*=4) and chlorobutyl (*n*=3). Concentrations of fibers varied between 0 and 3.73 fibers m^{-3}.

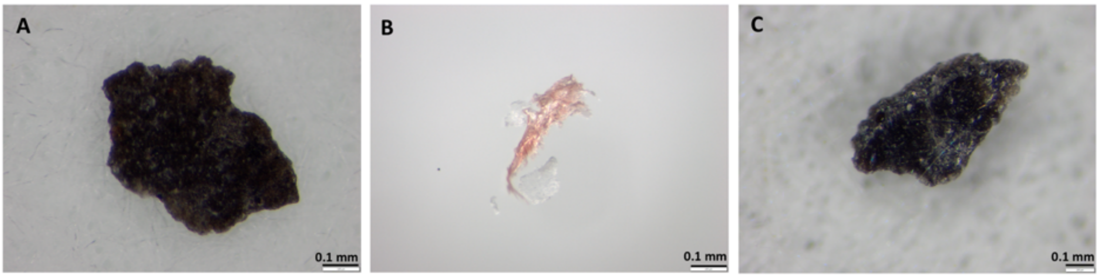

Fig. 6.6: Chlorobutyl fragment from MT 13 (A), polyester fragment from SP 8 (B) and neoprene fragment from SP 12 (C).

Fibers can easily be introduced from clothing and other textiles while processing and analyzing the sample. However, the fact that in 13 inspected sub-surface samples no fibers were found might supports the efficiency of our measures to avoid airborne contamination and give a hint that fibers are present in sub-surface waters of the Southern Ocean.

In contrast to plastic studies in other parts of the world's oceans where manly polyethylene and polypropylene fragments were found (Hidalgo-Ruz et al. 2012) plastic fragments found in our samples are mainly used in isolation panels, tubing and hoses, instrument housings and cable sheathings (Polymer Properties Database, 2018).

Outlook

Especially in a pristine environment like the Southern Ocean vessel-induced contamination might alter the results of microplastic studies. Thus, samplings would ideally be conducted independently from the vessel. At good weather conditions for example sampling with the MT from a small motorboat out of the reach from vessel-induced contamination might result in more undisturbed samples. Further, sediment samples, ingested microplastics by biota such as zooplankton and pelagic fish and ice cores might provide compartments that are relatively undisturbed by vessel-related activity and should be investigated with more effort in the future, not the less to investigate the uptake and impact of MP on Antarctic biota and possible sinks of MP in the Southern Ocean.

Data management

Microplastic samples will either be destroyed by analysis or those not analysed will be stored at the home laboratory at University of Basel. All sequence data will be deposited in EBI's European Nucleotide Archive and will conform to the minimum information standards recommended by the Genomics Standards Consortium (http://gensc.org/projects/mixs-gscproject/). Metadata and results will be stored at data servers of the University of Basel. After a thorough quality control, processing and publication in a peer reviewed journal, the processed data will be stored in the PANGAEA data base.

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