Occurrence of microplastics in the aquatic environment

Vasiliki-Maria Archodoulaki[1], Miriam Huber[1,2], and Markus Gahleitner[2]
[1] TU Wien, Institute of Materials Science and Technology, Austria
[2] Borealis Polyolefine GmbH Linz, Austria

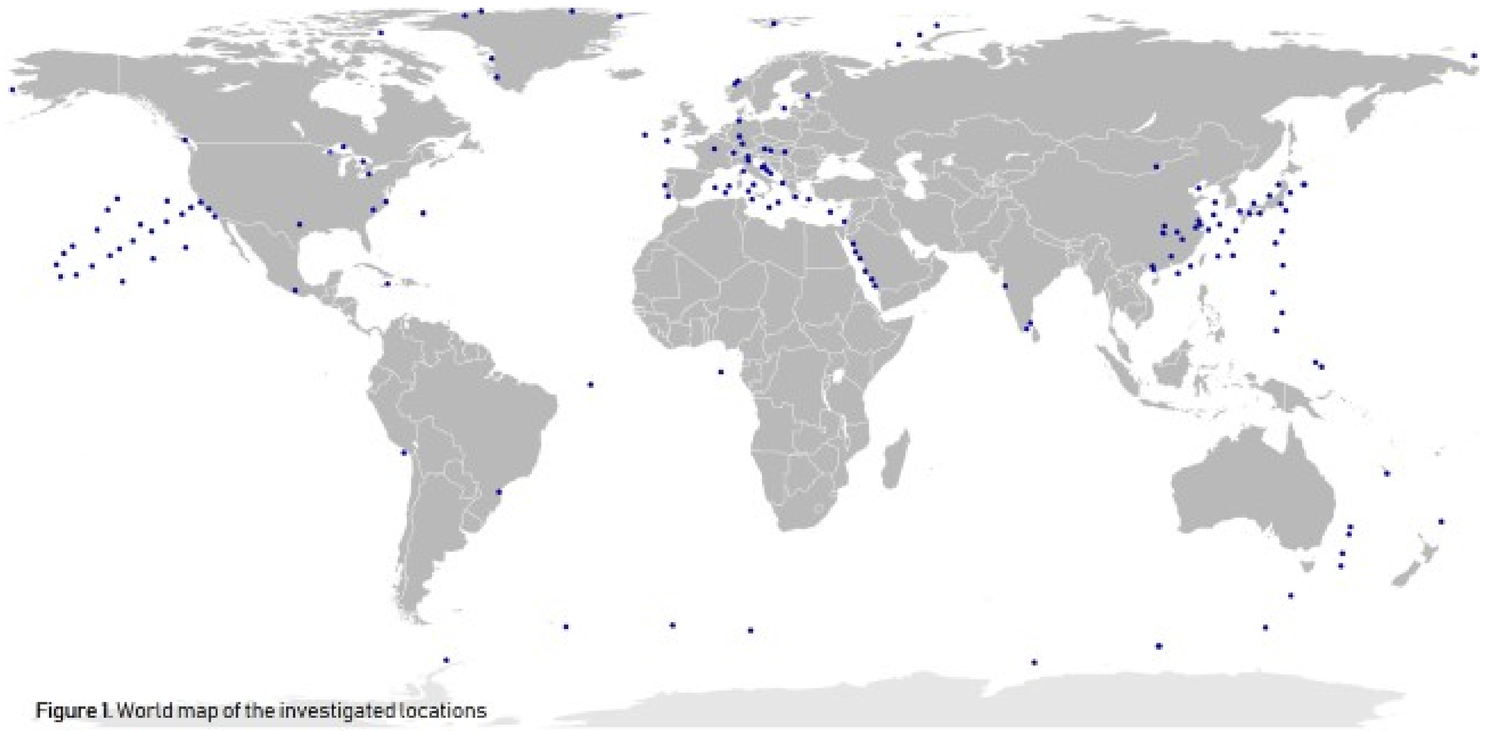

Figure 1. World map of the investigated locations

Literatur overview

- 34 Seawater studies
- 17 Freshwater studies
- 19 Marine sediment studies
- 7 Freshwater sediment studies

68 % have evaluable general data, even less details on size, type etc.

Sampling and preparation methods

The sampling method has a significant impact on the following size classification, as most samples are collected by a minimum mesh size of 333 µm, making scarcely any data for smaller particles available. The lower boundary of the mesh size is limited by natural material clogging the mesh.

The preparation of the sample includes several different stages with varying order, though the digestion of natural organic matters with H_2O_2 is essential. Remaining non-microplastics materials are separated by density or flotation separation, as their specific weight is usually higher than the one of microplastics.

The processed sample is further dried, and a qualitative analysis follows by optical techniques and Fourier transform infrared spectroscopy (FT-IR) or Raman spectroscopy, for identifying the polymer components of the particles.

The chosen evaluation criteria allow identification of sources and possible degradation processes.

Sampling

- **Water**
- Manta net (150 - 333 µm)
- (multi-level) net tows
- Metal container
- Pump
- Melting of an ice core

- **Sediment**
- Box corer
- Grid digging
- Depth: 2 – 10 cm

Processing

- Sieving
- Filtration
- H_2O_2 treatment, $FeSO_4$ pre-treatment
- Density or flotation separation
- Drying
- Optical analysis, RAMAN, FT-IR spectroscopy

Evaluation

- Size range
- Polymer composition
- Quantification by particle counting
- Mass distribution
- Shape
- Colour

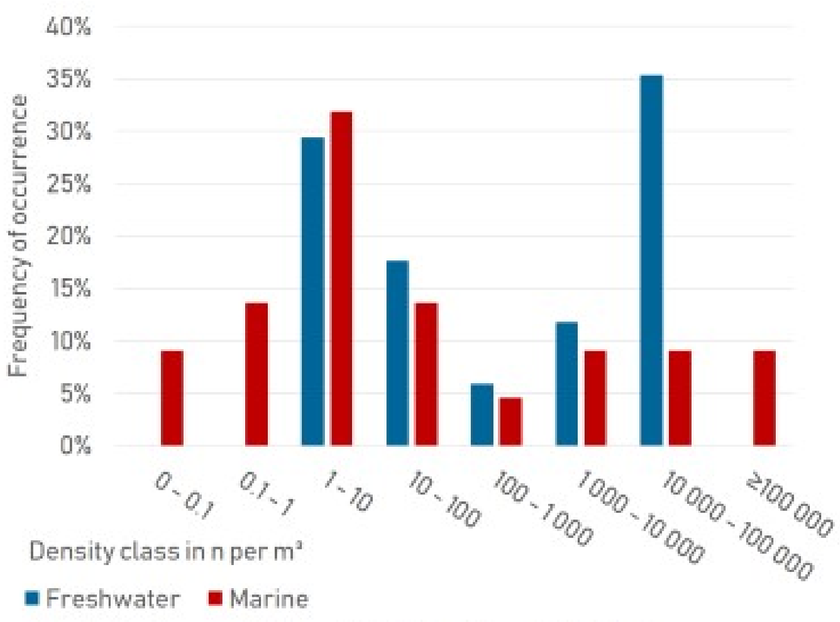

Figure 2. Maximum particle density distribution in logarithmical scale

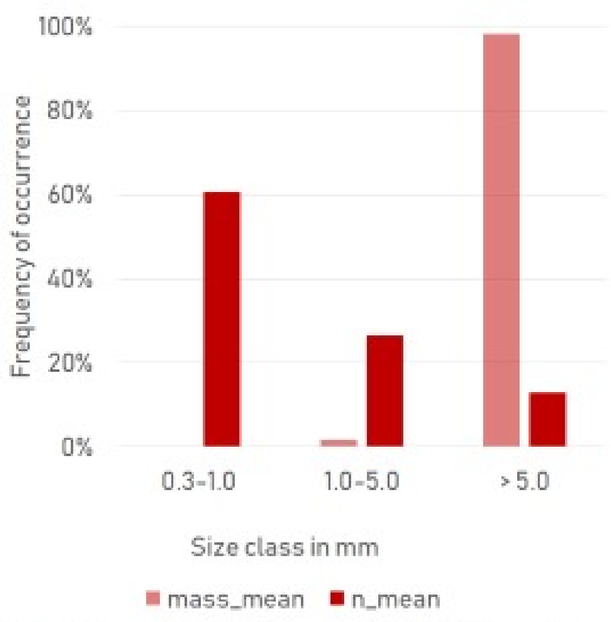

Figure 3. Mean particle number and weight distribution, marine

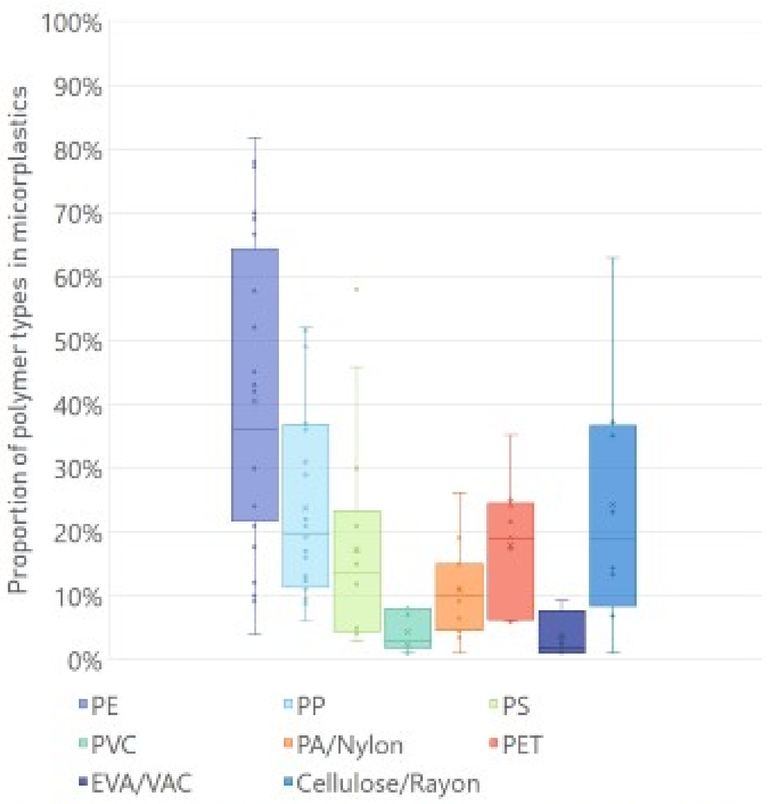

Figure 4. Boxplot of polymer types in microplastics, aquatic and sediments

Conclusion

- While the **quantification** as microplastic density (particles per m³) of marine samples extends across more than eight orders of magnitude, the result of freshwater samples indicates, that no study with freshwater data below a maximum number of one particle per m³ appeared. Hence, no investigated study deals with unpolluted freshwater. In contrast no freshwater samples above the peak category (100,000 n per m³) are found, whereas marine samples include the maximum of 26,000,000 n per m³ in the Arctic Ocean [1].
- The correlation of **mass and size distribution** records a decreasing tendency of particle number with increasing size, as the lower size class accounts for more than a half of all studied particles. In contrast the lower size class makes up only 0.0001% of the total weight [2].
- Regarding the **polymer composition**, PE and PP are most mentioned and account for the highest proportion. The fraction of PE occurrence is highly varying and PP fractions cover a narrower range The mean values of PE (38%) and PP (21%) match the proportion in global consumption statistics [3].

Contact: vasiliki-maria.archodoulaki@tuwien.ac.at

Selected references
[1] Peeken, I., et al., 2018. Artic sea ice is an important temporal sink and means of transport for microplastic in natur communications (2018)9:1505.
[2] Ho, N., and Not, C., 2019. Selective accumulation of plastic debris at the breaking wave area of coastal waters in Environmental Pollution 245 (2019) 702 – 710.
[3] IHS Markit Chemical, Global PE/PP Market Outlook 2019