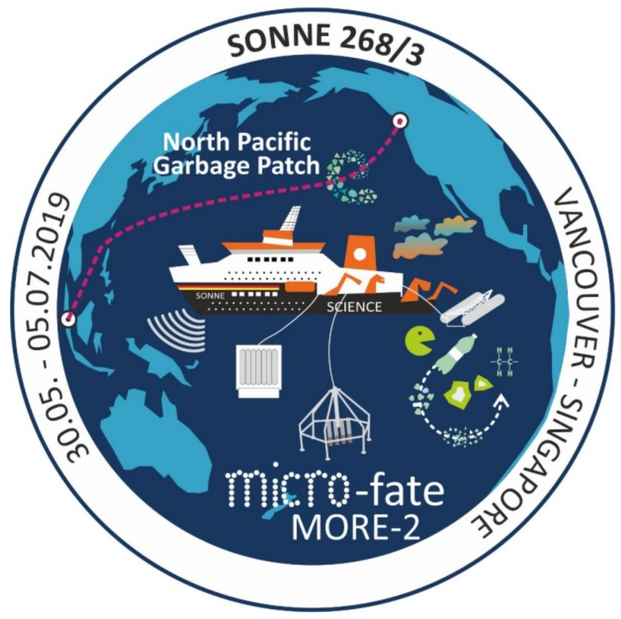
HELMHOLTZ Zentrum für Umweltforschung

Qualitative analysis of the ecocorona on plastic surfaces

Robby Rynek, Oliver Lechtenfeld, Thorsten Reemtsma, Stephan Wagner

Helmholtz Centre for Environmental Research - UFZ, Department of Analytical Chemistry, Germany



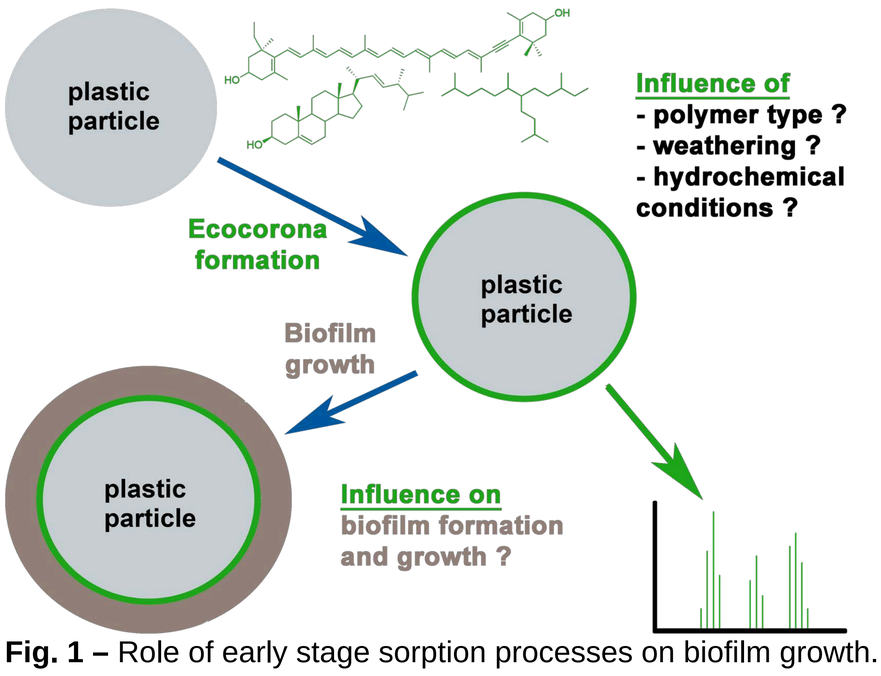


Fig. 1 – Role of early stage sorption processes on biofilm growth.

Motivation and Aims

As micro plastic particles enter the aquatic environment natural organic matter (NOM) molecules attach to the plastic first. This so termed ecocorona is supposed to be the basis for later biofilm formation. Previously it has been demonstrated that biofilm evolution is strongly dependent on the surface chemistry of plastic particles.[1] These findings imply that the ecocorona may has an influence on biofilm growth and may be dependent on the polymer surface.

Our aims are:

1 – Detection and comparison of NOM extracted from polymer surfaces with Fourier-transform ion cyclotron resonance mass spectrometry (FT-ICR-MS).

2 – Evaluation of differences in NOM quality adsorbed to different polymer particles.

3 – Evaluation of the influence of weathering of the polymer surface on the quality of adsorbed NOM.

Key findings

- FT-ICR-MS is a suitable method to detect and qualify the ecocorona on plastic material.
- Marine NOM molecules attach to the surface of different plastic particles and form an ecocorona.
- Preliminary results show differences between various polymer materials and weathering stages.

Methods

- **Incubation** of pristine and artificially UV-weathered plastic particles in sea water from the Pacific Ocean for 1 hour and formation of the ecocorona.
- **Extraction** of adsorbed NOM from the polymer surface and clean-up with solid phase extraction (SPE).
- **FT-ICR-MS** measurement of extracts.
- **Data evaluation** and sample comparison including HCA, O/C and H/C ratios and presence/absence of molecule formulas.

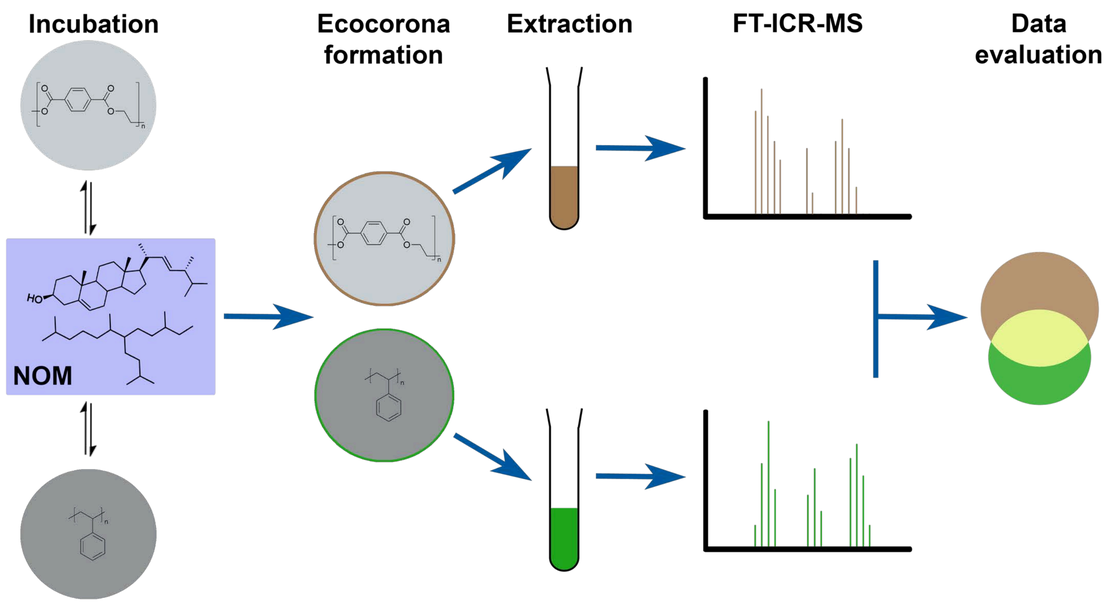


Fig. 2 – Workflow for the qualitative analysis of the ecocorona on plastic surfaces.

Preliminary results

We established a workflow to evaluate the quality of adsorbed NOM on polymer particles and determined the molecular masses, molecule formulas and number of atoms (C, H, N, O, S) of chemical compounds present in ecocorona extracts with FT-ICR-MS. (Fig. 3)

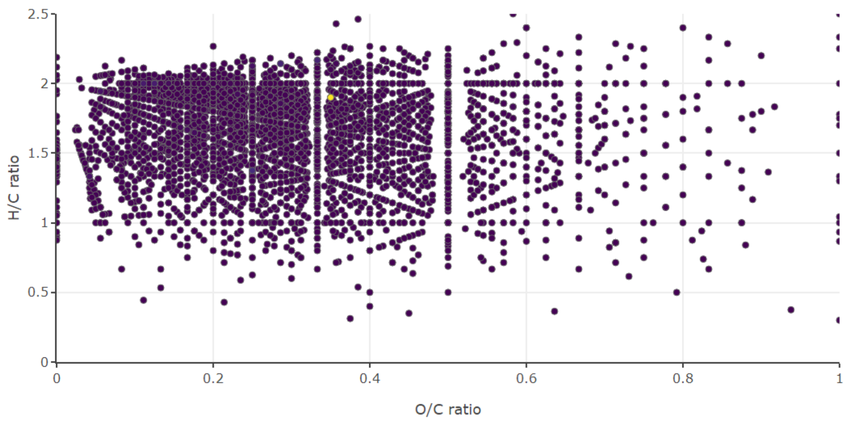


Fig. 3 – van Krevelen plot of an ecocorona sample. Each spot represents a molecule formula present in the sample and its corresponding H/C and O/C ratios.

Here we present some results from our first ecocorona measurements:

1 – A fraction of marine NOM attaches to the polymer surface to form an ecocorona. (Fig. 4 A)

2 – The quality of the ecocorona depends on the type of polymer of the plastic particle. (Fig. 4 B)

3 – Weathering of the polymer surface has and influence on the quality of adsorbed NOM. (Fig. 4 C)

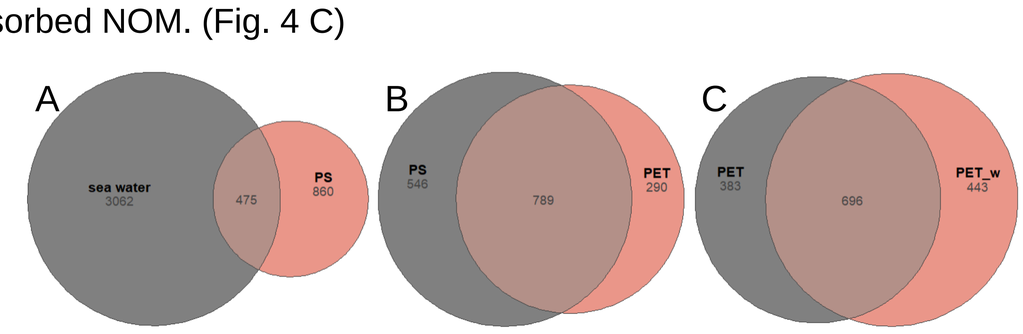


Fig. 4 – Venn plots for the comparison of molecular formulas present in different samples. The overlap represents molecular formulas that were detected in both samples.

References and Acknowledgements

[1] Lorite et al., J. Colloid Interface Sci., 359, 289-295, 2011.

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micro-fate
Characterizing the fate and effects of microplastic particles between hotspots and remote regions in the Pacific Ocean

Contact: robby.rynek@ufz.de