

## Biofilms on plastic, metabolically fantastic: functional dynamics of the microbial plastisphere

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In the last decades, plastic pollution in marine ecosystems has become an environmental issue of increasing global concern. Disposed plastic items ending up in the ocean serve as a new habitat, harbouring diverse and structured microbial communities, and named “plastisphere”. Some studies have focused on the microbial plastisphere and the environmental drivers shaping its structure; instead, its functional role in biogeochemical cycles has received less attention, also due to methodological issues. To assess the metabolic potential of the microbial plastisphere, we incubated 1×0.5 cm plastic pieces of five different polymers (HDPE, LDPE, PET, PP, and PS) in flow-through containers under *in situ* conditions in two Mediterranean sites (Gulf of Trieste and Gulf of Naples). The 60-day-long incubation experiments, sampled at four time points, were carried out in winter and summer to investigate prokaryotic biofilm formation through confocal imagery and omic techniques, as well as its metabolic potential, employing specific stains to detect metabolically active cells. Biofilm-specific organic matter degradation rates were assessed through fluorogenic substrate assays. Biofilm developing on HDPE, LDPE and PP consistently showed higher organic matter degradation rates and higher prokaryotic abundances compared to PET and PS. Generally, carbohydrate degradation rates peaked after 15-30 incubation days, whereas proteinase activity increased only at the last time points. Noteworthy, after long-term observations, biofilm forming on 1 cm<sup>2</sup> of plastic displayed organic matter degradation rates comparable to those measured in 1 L of seawater, highlighting the non-negligible biogeochemical role of the microbial plastisphere.