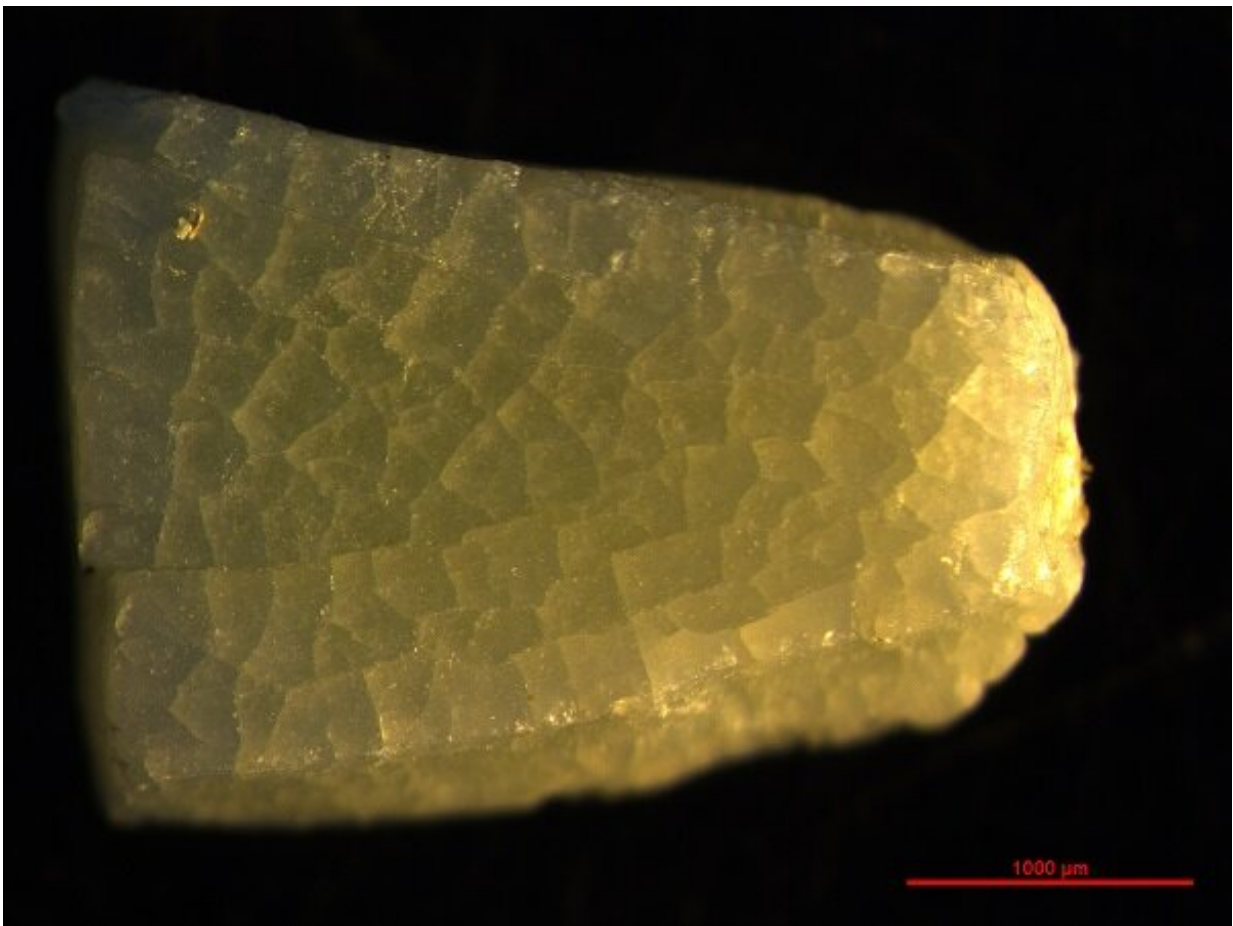


# PE, PP and PS: The most abundant type of microplastics in Mediterranean coastal waters

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The state of the found microplastics could suggest a state of advanced degradation and long permanence in the marine environment. Credit: GRC Marine Geosciences - University of Barcelona

Polyethylene, polypropylene and polystyrene are the most abundant microplastics in the Mediterranean coastal waters, according to a new study published by the journal *Marine Pollution Bulletin* -by the experts Miquel Canals, William P. de Haan, and Anna Sànchez-Vidal, from the Consolidated Research Group on Marine Geosciences of the Faculty of Earth Sciences of the University of Barcelona,.

This study describes the presence of different types of microplastics in the peninsular coastal Mediterranean, in particular on the coasts of Catalonia, the region of Murcia and Almeria in Spain. According to the results, other abundant types are nylon polymers, polyurethane (PUR), polyethylene terephthalate (PET), ethylene-vinyl acetate (EVA), polyvinyl chloride (PVC), acrylonitrile butadiene styrene (ABS) and fluorocarbon polymer. The experts also identified for the first time signs of plastic materials with marine origins-in particular, particles of ship painting-which were not studied in the Mediterranean basin until now.

## **Diagnosis of the peninsular Mediterranean coast: rounded, small and light microplastics**

Cylinders and small spheres, polyester foam, filaments from fishing gear and many pieces of plastic from varied chemical compositions are among the materials found on Mediterranean coasts. The study has analysed about 2,500 samples of plastic materials taken from different oceanographic campaigns over a north-south axis in every area of study. In all studied areas, the most abundant materials are fragments of polyethylene (54.5 %), polypropylene (16.5 %) and polyester (9.7 %) -the most produced thermoplastic polymer worldwide- which float in marine waters and are likely to come from the continent.

So far, none of the scientific studies could prove the permanence time of plastics in the sea before these deteriorate or are buried. According to

the new study, the microplastics researchers found in the Mediterranean coasts "are round-shaped, and small -about a milimeter- and light-weighted, which could suggest a state of advanced deterioration and therefore, a long permanence in the marine environment", says expert William P. de Haan, member of the research group on Marine Geosciences and first author of the study.

The study identified places in the peninsular coasts which have maximum concentrations up to 500,000 microplastics per square kilometre, over the average, which is 100,000 mp/km<sup>2</sup>. "These results coincide with studies conducted in other regions of the Mediterranean, a marine ecosystem regarded as one of the biggest scuppers of floating [microplastic](#) worldwide", notes William P. de Haan.

## **Microplastics in Catalan coasts: extreme values in Tordera and Besòs**

In the Catalan coasts, the average concentration of microplastics is over 180,000 items per square kilometre. The most extreme levels have been found in the coasts of Tordera (500.000 mp/km<sup>2</sup>) and in Besòs (fins a 110.000 mp/km<sup>2</sup>), which are areas with a notable anthropic pressure due the high density of population, tourism, use of beaches, and marine activities. The most abundant microplastics among those analysed were polyethylene and most were translucent or transparent (65 %).

In these coastal areas, the changes in intensity and the North Current -which moves simultaneously from north to south in the coast- and currents from the littoral, are factors that may affect the distribution of microplastics in the sea. According to previous studies, the North Current could bring up to a thousand million plastic particles per day -weighting up to 86 tons.

## **Murcia and Almeria: currents that come from the Atlantic and greenhouses**

In the [coastal waters](#) of Murcia and Almeria, the variety of polymers is even higher -mainly nylon, polyurethane or polyethylene terephthalate- than the one in Catalan waters and the most predominant ones are dense microplastics which drown easily. Regarding colors, the most abundant ones are matt white (46 % in Murcia and 54 % in Almeria) and dark colors (20 % and 12 % respectively). In these coasts, marine dynamics -with the arrival of surface waters from the Strait of Gibraltar- could favour the emergence of microplastics coming from the Atlantic Ocean.

Moreover, there are extensions of cultivations in greenhouses -such as in Campo de Dalias, in Almeria- that generate uncontrolled dumpings of plastic in areas near the Almeria coast, with a maximum value of 130,000 mp/km<sup>2</sup>. In Murcia, the highest concentration is in Cartagena -140.000 mp/km<sup>2</sup>- but there are other places -such as the Mar Menor lagoon- that are affected by the impact of human activity.

The diversity of microplastics in the sea regarding composition and color, as well as differences in concentration, show different origins and volume depending on the analysed area of the coast, according to the authors.

## **What is the final destination of marine plastics?**

Plastics do not always behave the same way, and that is why it is hard to know generically their final destination in the marine environment. "Size and physical and chemical properties, as well as the conditions of the marine environment, determine the destination of microplastics in water", says researcher Anna Sànchez-Vidal.

"Density of the plastic material is a determining factor regarding big fragments. When talking of a microplastic, dynamics are more complex. Also, density of marine water varies due several factors -temperature, salinity, geographical position, depth- and it affects directly the buoyancy of the microplastics".

The study describes for the first time the aggregate potential of microplastics to integrate into marine organics, formed by organic and mineral-derived particles. This interaction -described so far in the laboratory only- is a phenomenon that occurs naturally in the marine environment, as stated in the new study.

Therefore, 40 % of the microplastics -in quantity- and 25 % -in mass- can create these marine aggregates. This process could ease the drowning and accumulation of light microplastics in marine floors, an environment far from the only agent able to deteriorate them: the solar ultraviolet radiation.

"Around 66 % of the microplastics we found in marine aggregates -[polyethylene](#), [polypropylene](#) and expanded [polystyrene](#)- are low density microplastics in the sea. This hypothesis could explain the presence of low-density microplastics in big marine depths worldwide, and why the abundance of plastics floating in the surface of the ocean is lower than expected", notes Sanchez-Vidal.

## **Marine fauna, threatened by plastic civilization**

Usually, plastics that float in the marine surface are eaten by marine organisms, which may think they are food. Even zooplankton is able to eat microplastics and throw them through faecal pellets. This is a known situation -and not enough studied- in marine ecosystems.

Also, apart from additives they contain per se, microplastics can bring

toxic compounds to the trophic chain in marine waters (metals, organic pollutants, and others). Transported by the marine currents, these plastic materials can become dispersal vehicles for invasive species and pathogenic organisms.

## **Protecting the marine and coastal system in the Mediterranean**

Climate change, fishing industry, maritime transport, prospection and exploitation of hydrocarbon and industrial dumping are some of the big threats to the future of marine and coastal systems in the Mediterranean. Protecting and improving the environmental quality of the Mediterranean Sea is a priority in the environmental scientific and political European agenda.

In this situation of scientific challenges, experts from the research group on Marine Geosciences of the UB have participated in different international studies that warn about the environmental impact of microparticles in the marine environment. At the same time, they take part in scientific projects to improve the preservation of marine ecosystems in the Mediterranean basin, such as the projects Policy-oriented marine Environmental Research in the Southern European Seas (PERSEUS) and Implementation of the MSFD to the DEep Mediterranean Sea (IDEM).

Regarding the Mediterranean, some of the most important resources on environmental protection are the Marine Strategy Framework Directive (MSFD) and the Barcelona Agreement for the Protection of the Mediterranean Sea, signed in 1976 and modified in 1995. According to Professor Miquel Canals, head of the research group on Marine Geosciences of the UB and director of the Department of Earth and Ocean Dynamics of the UB "The Framework Directive considers a

series of initiatives to protect and improve the environmental state of marine ecosystems in Europe. In these lines, it defines a series of indicators that study aspects related to research on marine waste, and in particular, a better knowledge on environmental and biological impacts of microparticles in the [marine environment](#)".

"Also, prevention of any kind of pollution is one of the main objectives of the Barcelona Agreement. In this context, there are initiatives such as Fent front a les deixalles marines a la Mediterrània and Una Mediterrània sense plastics, related to the environmental impact of microplastics", concludes Professor Miquel Canals.

**More information:** William P. de Haan et al, Floating microplastics and aggregate formation in the Western Mediterranean Sea, *Marine Pollution Bulletin* (2019). [DOI: 10.1016/j.marpolbul.2019.01.053](https://doi.org/10.1016/j.marpolbul.2019.01.053)

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