# Researchers focusing on the fragmentation of plastic waste

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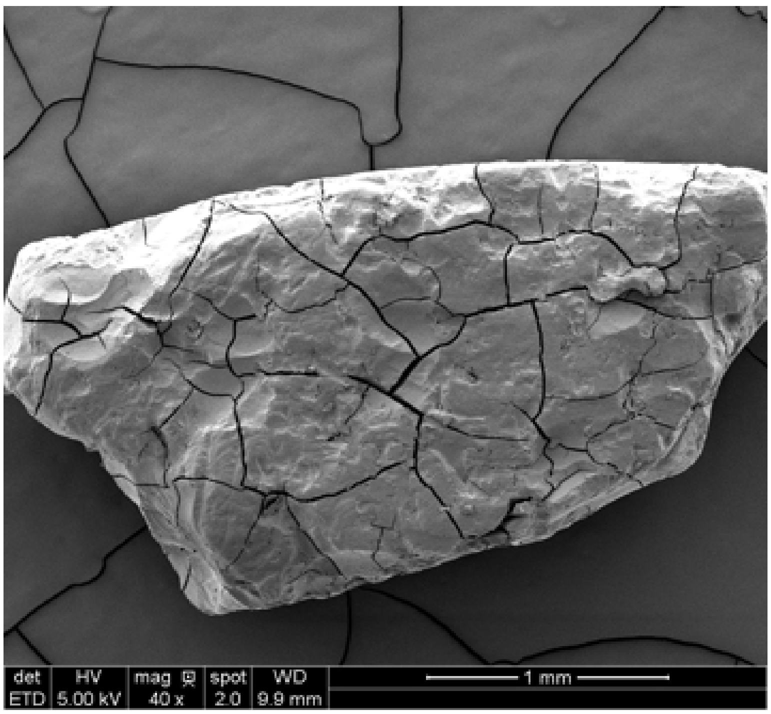


A particle of plastic (around 3 mm long) viewed with a scanning electron microscope. The cracks seen at the surface (face exposed to the sun) are caused by photochemical degradation. They promote the fragmentation of the debris into smaller particles, along the cracks. Credit: IMRCP/CNRS

First discovered by sailors, the masses of plastic debris floating at the center of vast ocean vortices called gyres are today under close scrutiny by scientists. To better understand the fragmentation of microplastics under the effect of light and abrasion by waves, researchers combined physico-chemical analyses with statistical modeling. They were thus able to show that pieces of plastic debris behave in very different ways according to their size. The bigger pieces appear to float flat at the surface of the water, with one face preferentially exposed to sunlight. However, the researchers observed fewer small-sized debris (around 1 mg) than predicted by the mathematical model. Several hypotheses are put forward to explain this lack. The findings were obtained by researchers from CNRS and Université Toulouse III – Paul Sabatier from samples collected during the 7th Continent Expedition. They are published in the journal *Environmental Science: Nano* on 23 May 2016.

Since the 1990s, successive scientific expeditions have studied the composition and behavior of microplastics in the five ocean gyres, at whose centers waste is trapped by circular ocean currents. In May 2014, the 7th Continent Expedition scientific mission enabled researchers to collect samples from the North Atlantic gyre with the aim of better understanding the process of fragmentation of plastic waste. The results of physico-chemical analyses were compared with mathematical modeling.

Microscope and microtomography studies show that the microplastics collected (from 0.3 to 5 mm long) behave in very different ways according to their size. The bigger particles (2 – 5 mm), usually parallelepipeds, float at the surface of the water. The face preferentially exposed to the sun becomes discolored and degrades under the effect of sunlight, while the other face is colonized by microorganisms. The smaller particles (0.3 – 1 mm) are cubic and have identical faces. Their tendency to roll with the waves apparently slows down the development of a biofilm and promotes erosion of the edges.

Collecting particles of plastic on the 7th Continent Expedition.

A distinctive feature of the statistical approach applied to the same samples was that it was based on the distribution of the microplastics according to their mass, unlike more conventional methods based on their distribution by size. The mathematical model predicts, for the lighter particles (under 1 mg), a total mass twenty times greater than that observed in the samples. This lack of lighter particles may mean that the smaller particles, cubic in shape, are fragmented more quickly, giving rise to particles of less than 0.3 mm (or even to nanoparticles) that are not currently detected. Other hypotheses can be put forward: ingestion of the particles by marine organisms and by fish, sinking of the particles, etc.

This discovery should encourage scientists to develop methods for measuring quantities of micrometer- and nanometer-sized particles in natural samples. Indeed, recent laboratory experiments have shown that plastic nanoparticles form under conditions that simulate natural degradation. The issue of the impact of nanoparticles on ecosystems is also raised. Initial studies have already shown that micrometer-sized particles ingested by zooplankton organisms obstruct their digestive tract.

**More information:** Julien Gigault et al. Marine plastic litter: the unanalyzed nano-fraction, *Environ. Sci.: Nano* (2016). DOI: 10.1039/C6EN00008H

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