

Plastic in the deep sea: Virtually unaltered after a quarter of a century

June 11 2020



Credit: Peter Linke/GEOMAR

Plastic products are durable. On one hand this is a great advantage, but on the other hand, if the plastic enters the environment, this advantage turns into a problem. According to current knowledge, natural

degradation, as with organic matter, does not take place. It can only be estimated, how long plastic debris actually remains in the environment. Corresponding long-term experiments are lacking.

This applies particularly to the [deep sea](#) that is only poorly explored itself. Plastic objects that are found by chance with the help of deep-sea robots or other underwater vehicles are difficult to date. However, during an expedition with the German research vessel SONNE in 2015, researchers from the GEOMAR Helmholtz Centre for Ocean Research Kiel, the Max Planck Institute for Marine Microbiology in Bremen and the Kiel University were able to recover several pieces of waste from the seabed of the Eastern Pacific Ocean in a depth of more than 4000 meters. Conducting a little detective work allowed to constrain the age of deposition quite accurately. For the first time, this offered the opportunity to conduct a long-term study on [plastic](#) degradation in the deep sea. The study was published today in the international journal *Scientific Reports*.

In reality, in 2015 the team was out in the Pacific about 440 nautical miles (815 km) off the coast of Peru to investigate another long-term experiment in the so-called DISCOL area. There, German scientists had plowed a piece of seafloor in 1989 in order to understand the environmental impacts arising from potential future mining of manganese nodules. They visited this site again in 1992, 1996 and in 2015 to study the recovery of the deep-sea ecosystem.

In 2015, the remotely operated deep-sea robot ROV KIEL 6000 observed almost incidentally some waste and recovered it from the seafloor. Among it was a plastic bag containing a Coke can, which was part of a special edition produced for the Davis Cup 1988. "The aluminum can itself would have corroded in the deep sea, if it was not wrapped tightly inside a plastic garbage bag that preserved it. This also indicates that the garbage bag must be of the same age," says Dr.

Matthias Haeckel from GEOMAR, project manager on board back then and now co-author of the study.



Curd box next to manganese nodules at a water depth of more than 4000 metres in the so-called DISCOL area (South-East Pacific). This object was verifiably lying on the seafloor for 20 years. During a detailed analysis, researchers from GEOMAR (Kiel, Germany) found no traces of fragmentation or degradation. Credit: ROV Team/GEOMAR

A second recovered item was a curd box from a German manufacturer. The printed address shows a five-digit postal code. These were not introduced in Germany until 1990. However, the manufacturer was bought by a rival company in 1999, and the brand name disappeared.

"Since the DISCOL area is far away from important shipping routes, the

[plastic bag](#) and the curd box could be attributed to the DISCOL expeditions in 1989 and 1992 or 1996," says Dr. Haeckel. After all, this offered the extremely rare opportunity to examine in detail datable plastic objects from the deep sea. "It turned out that neither the bag nor the curd box showed signs of fragmentation or even degradation," says biochemist Dr. Stefan Krause from GEOMAR, lead author of the study. He led the onshore analyses in the home laboratories.

A scientifically most interesting finding was that the microbial community on the plastic surfaces differed from the one identified in the surrounding seafloor sediments. "All of the species can be found in the deep-sea sediment, but apparently, larger accumulations of plastics could locally cause a shift in the ratio of the predominant species," says Dr. Krause.

Overall, the study provides the first scientifically sound indication of the fate of plastic debris in the deep sea. "This study builds also an important basis for our new project HOTMIC, where we aim to trace the plastic waste entering the ocean from the continents to the large oceanic eddies and further to their final sink, the abyssal seafloor," says Dr. Haeckel.

At the same time, the findings provide a good argument for him to pay even closer attention to compliance with regulations regarding waste on board. "Fortunately, the mentality has changed considerably since the 1990s. Today, both, the crews of the ships and the research teams on board take great care to ensure that no waste is disposed overboard," says Dr. Haeckel.

More information: S. Krause et al, Persistence of plastic debris and its colonization by bacterial communities after two decades on the abyssal seafloor, *Scientific Reports* (2020). [DOI: 10.1038/s41598-020-66361-7](https://doi.org/10.1038/s41598-020-66361-7)

Provided by Helmholtz Association of German Research Centres

Citation: Plastic in the deep sea: Virtually unaltered after a quarter of a century (2020, June 11)
retrieved 20 September 2024 from

<https://phys.org/news/2020-06-plastic-deep-sea-virtually-unaltered.html>

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