frontiers | Frontiers in Marine Science

TYPE Editorial
PUBLISHED 13 February 2024
DOI 10.3389/fmars.2024.1372876

OPEN ACCESS

EDITED AND REVIEWED BY
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RECEIVED 18 January 2024
ACCEPTED 29 January 2024
PUBLISHED 13 February 2024

CITATION
Ehlers SM, Ellrich JA and Gestoso I (2024) Editorial: New plastic pollution types and novel sources of microplastic pollution in marine systems.
Front. Mar. Sci. 11:1372876.
doi: 10.3389/fmars.2024.1372876

Editorial: New plastic pollution types and novel sources of microplastic pollution in marine systems

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KEYWORDS

plastiglomerate, pyroplastic, plasticrust, paint chips, polymer based paints, plastitar

Editorial on the Research Topic
New plastic pollution types and novel sources of microplastic pollution in marine systems

Plastic pollution has been extensively studied over the past decades. For instance, it is well known that animals get entangled in discarded plastic (Afonso and Fidelis, 2023) and consume microplastics (plastic particles < 5 mm) while foraging (Ehlers et al., 2021). Examples of microplastic sources comprise everyday single-use items such as plastic packaging material (Tziourrou et al., 2021), lost or discarded plastic fishing gear (Wu et al., 2023), and tire wear (Goßmann et al., 2021). However, novel microplastic sources, such as weathering polymer-based paints, have only recently been identified (Figure 1A). Even though paints are used in various applications on a regular basis, this source has been largely neglected in the past (Gaylarde et al., 2021).

Furthermore, reports on novel plastic forms, including plasticrusts (plastic encrusting coastal rocks; Figure 1B), pyroplastic (melted plastic with a stone-like appearance; Figure 1C), and plastitar (plastic embedded in crude oil residues; Figure 1D), that derive from geophysical or geochemical interactions are steadily increasing. Such plastic forms differ from regular plastic debris in appearance, chemical composition, and environmental fate (Ellrich et al., 2023).

The aims of this Research Topic were to increase the awareness of the distribution and abundance of such novel plastic pollution sources and, if possible, their potential environmental effects. By doing so, these sources can be characterized and incorporated into mitigation measures. Further aims were to find out more about the distribution of novel plastic forms and to collect information about their potential sources worldwide.

This Research Topic contains three publications focusing on microplastics in deep-sea geomorphological units in the northern South China Sea (Zhang et al.), mechanisms of microplastic release from ship coatings (Tamburri et al.), and the worldwide distribution of

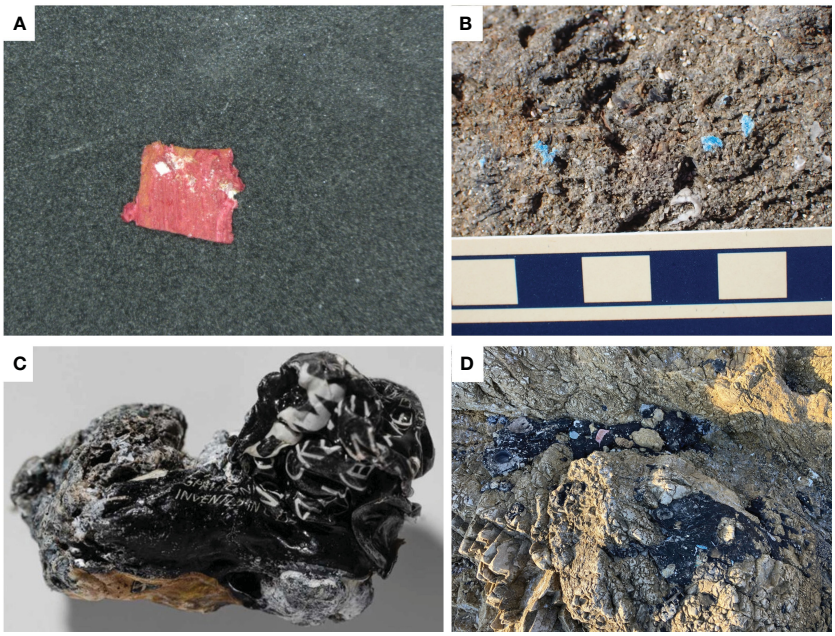

FIGURE 1
(A) A red polyester-based paint chip detected in the rocky Hikoshima island intertidal zone, Yamaguchi Prefecture, Japan (Sea of Japan, picture: Shunji Furukuma). **(B)** Blue plasticrusts covering intertidal rocks in Yoshimo, Yamaguchi Prefecture, Japan (Sea of Japan, picture: Shunji Furukuma). **(C)** Pyroplastic (left side of the object) formation from incompletely melted plastic (right side of the object; picture: Dennis Siering). **(D)** Plastitar found in the rocky intertidal zone in Cala Rajada, Mallorca, Balearic Islands, Spain (Mediterranean Sea; picture: Julius A. Ellrich).

plastitar (Ellrich et al.). It, thereby, contributes to the knowledge of underrepresented microplastic sources in remote locations (Zhang et al.), provides information for guideline development regarding polymer-based paints (Tamburri et al.), and compiles plastitar records made from 1973 to 2023 (Ellrich et al.).

Microplastics in remote deep-sea habitats

While studying the northern South China deep sea for microplastics, Zhang et al. found 19 to 347 microplastic particles/kg sediment, with the majority consisting of polycarbonate, polyethylene, polyester fibers, polyvinyl chloride, and polypropylene. Furthermore, they found an epoxy resin in the Gaoping Canyon sandbar that might have originated from polymer-based paint. It has recently been found in other studies that paint chips can be found in Antarctic deep-sea sediments (Cunningham et al., 2020). These findings, thus, show that paint chips can reach even remote marine locations like the deep sea and that paints are an important source for microplastics in the ocean.

Polymer-based paint from commercial ships as microplastic source

Tamburri et al. looked further into the topic of microplastic release from ship coatings. They emphasize that there are currently no regulations that address this issue. According to their policy brief, polymer binders are the main microplastic source from coatings, and they propose a definition for microplastics originating from ships by saying that any particle with a polymer content of ≥ 10% should be considered microplastic. Furthermore, they identify five situations in which microplastics may be released from ship coatings and suggest how microplastic release can be managed in these situations in which humans are involved, such as maintenance.

Worldwide plastitar distribution: 50 years of plastitar

Plastitar is plastic embedded in crude oil residues that can encrust coastal rocks. Based on recent plastitar findings on the Canary Islands (Atlantic Ocean), plastitar has been defined as a novel plastic form (Domínguez-Hernández et al., 2022). However, since marine plastic and crude oil pollution have been reported for a long time, Ellrich et al. compiled reports on plastic embedded in crude oil residues from the literature. It was found that plastitar has been reported under various names worldwide since 1973. Interestingly, most plastitar records were made along the major oil transportation routes, suggesting that plastitar results from spillage during oil transport. Furthermore, this brief research report provides two additional plastitar records (made in Mallorca, Mediterranean Sea, and Kanda, Sea of Japan) with chemical analyses of plastic and crude oil.

Perspectives

In conclusion, this Research Topic reports on microplastic types from the deep sea that is very difficult to access (Zhang et al.), contributes to finding a regulation for microplastic release by ship coatings (Tamburri et al.), and expands the knowledge of plastitar distribution and composition (Ellrich et al.). The authors used state-of-the-art chemical analyses for microplastic identification and crude oil characterization, thereby assuring the quality of their results.

Author contributions

SE: Conceptualization, Visualization, Writing – original draft, Writing – review & editing. JE: Conceptualization, Visualization, Writing – original draft, Writing – review & editing. IG: Writing – review & editing.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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