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# Plasticrust generation and degeneration in rocky intertidal habitats contribute to microplastic pollution

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## Abstract

”Plasticrusts” consist of plastic encrusting intertidal rocks and have been reported locally on Madeira island (Atlantic Ocean), on Giglio island (Mediterranean Sea) and in Peru (Pacific Ocean). Therefore, plasticrusts constitute an emerging ”plastic form” (geochemically or -physically altered plastic) and pollutant. However, information on plasticrust sources, generation, degeneration, regional occurrence and fate is still extremely scant. To address these knowledge gaps, we combined plasticrust field surveys, experiments and monitorings along the Yamaguchi Prefecture coastline in Honshu, Japan with macro-, micro- and spectroscopic analyses at the lab in Germany. Our field surveys on the Sea of Japan detected polyethylene (PE) plasticrusts that derived from very common PE containers and polyester (PEST) plasticrusts that resulted from PEST-based paint. We confirmed that plasticrust abundance, cover and distribution were positively related to wave exposure and tidal amplitude. Our field experiments showed that plasticrusts are generated by cobbles scratching across plastic containers, plastic containers being dragged across cobbles during beach clean-ups, and waves abrading plastic containers on intertidal rocks. Our field monitorings found that plasticrust abundance and cover decreased over time and the macro- and microscopic examinations indicated that detached plasticrusts contribute to microplastic pollution (plastics < 5 mm). The field monitorings also suggested that hydrodynamics (wave occurrence, tidal height) and precipitation drive plasticrust degeneration. Finally, floating tests at the lab revealed that low-density (PE) plasticrust fragments float whereas high-density (PEST) plasticrust fragments sink suggesting that polymer type floatability influences the fate of plasticrust fragments in the environment. By tracking the entire lifespan of plasticrusts for the first time, our study contributes the fundamental knowledge of plasticrust generation and degeneration in the rocky intertidal zone and identified plasticrusts as novel microplastic sources.

**Keywords:** plastic forms, emerging pollutants, FTIR, plastic monitoring, plastic field experiments, Sea of Japan

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