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Microplastic Occurrence and Transport: The State of the Science

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Abstract

Microplastic (MP) particles have been found in most environments, and their concentrations are expected to rise in the coming decades as synthetic polymer production expands. The expected increase in plastic pollution (including MPs) may increase the risk that these synthetic particles pose to both the environment and human health. The goal of this review is to provide a summary of current knowledge about the occurrence and transport of MPs in and across three of the Earth's subsystems: the lithosphere, atmosphere, and hydrosphere. Evidence is presented that the lithosphere contains significant MP accumulation, the effects of which are unknown.

Keywords: Synthetic • Lithosphere • Hydrosphere • Atmosphere

Introduction

Microplastics have been identified in numerous terrestrial and aquatic ecosystems as a result of the use and production of synthetic polymer (plastic) based products. Primary MPs (small manufactured plastics), meso- and macroplastics (which can degrade into secondary MPs), and nanoplastics are all examples of MP pollution (NPs). Secondary MPs are defined as bits and pieces of larger plastic products. Furthermore, NPs can be defined as plastic particles with colloidal behaviour in the size range of 1-1000 nm, but different definitions of the term NP are common in the literature. MPs and NPs have been identified as a major global pollutant problem and as one of the top environmental challenges identified by the UN Environment Program [1].

MPs were first reported to be transported by air and through the atmosphere in Paris in 2015. While researching MP contamination in urban areas discovered that atmospheric fallout could be a major source of fibres in freshwater ecosystems. However, airborne and atmospheric transport remains a poorly understood MP transport mechanism at the moment. Previous studies found MPs in the atmospheres of urban, suburban, and remote locations (far from source regions), with large quantities varying between study locations [2].

The durability, flexibility, versatility, ease/low cost of production, light weight, and water resistance of synthetic polymers allow for widespread use in many industries worldwide, including (but not limited to) packaging (146 million tonnes per year), building and construction (65 million tonnes per year), textiles (59 million tonnes per year), transportation (27 million tonnes per year), electrical (18 million tonnes per year), and the rising demand for plastics from a variety of industries has resulted in an increase in global plastic production from 1.5 million tonnes in 1950 to 348 million tonnes in 2017 concerning the occurrence and movement of these particles in the environment Researchers, managers, and policymakers will be better equipped to make science-based decisions for future needs as a result. As a result, the primary goal of this literature review was to provide an overview of current knowledge on MPs occurrence and transport in the environment (lithosphere, atmosphere, and hydrosphere) and in organisms that inhabit the environment. This review's outcomes include the identification of current knowledge gaps regarding the occurrence and transport of MPs, as well as recommendations for future research directions [3].

Description

Wind action has been shown to influence the movement of synthetic polymer particles as well as the enrichment of wind-eroded sediments, found that light density microplastics (LDMP) concentrations were higher in wind-eroded sediments (20.27 mg/kg) than in natural soils (6.91 mg/kg) in MP-polluted areas of Iran's Fars Province. Furthermore, the study found an enrichment ratio for LDMP ranging from 2.83 to 7.63, as well as an erosion rate ranging from 0.08 to 1.48 mg m2 min1 . The findings of this study highlight the role of wind erosion in the spread of MPs, which may pose an exposure risk to humans through direct inhalation of the particles less dense MPs accumulate on shorelines and the water surface, while more dense particles accumulate in deeper waters or on the seabed due to density differences. The occurrence and transport of less dense and denser MPs will be discussed separately in the following paragraphs due to the different areas of accumulation. Kane and Clare described the processes that drive the movement and deposition of MPs in deep marine environments. Three primary processes drive MP transport in deep sea environments: 1) gravity-driven transport in sediment-laden flows; 2) biologically driven settling or transport of suspended particles on the surface or in the water column; and 3) transport by thermohaline currents, including settling and reworking of deposited microplastics. Gravity-driven transport occurs when MPs settle via turbidity currents according to their shape and density, with spherical and dense particles having higher settling velocities than platy and low-density particles [4,5].

The lithosphere is distinguished by a lack of MP research and numerous knowledge gaps. The extent to which MPs (e.g., plastic mulch film residue) may affect soil microbial community composition and structure, for example, is largely unknown. This knowledge gap may be exacerbated by the soil micro biome's high degree of diversity and functional redundancy. MPs can introduce new microbial selection pressures, such as the presence of a new carbon source (the polymer itself) or increased pesticide presence, which can lead to niche alteration (changing an organism's position or function in an ecological community). Previous research, however, has been limited to the hydrosphere. Because biphenyl A acts as a reactive agent during temperature sensitive paper moulding, the paper industry is a major supporter of biphenyl a in wastewater. This occurs either during paper making or recycling. Studies

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conducted in over 120 wastewater treatment plants around the world found significant amounts of biphenyl [6].

As with terrestrial environments, particle size, shape, and polymer type can all have an impact on the impact of MPs on marine organisms. Lehtiniemi, for example, reported that size is more important than shape when it comes to MP ingestion by small aquatic predators with average lengths of 3-4 cm. Smaller angular MPs, in general, can be more easily ingested and proliferate more readily throughout an organism's tissues once ingested [7].

Conclusion

The decomposing organisms Although the biodegradative effects of decomposers have recently been reviewed succinctly , a process that is dependent on the biodiversity and abiotic factors of the immediate community, the toxicity of organic pollutants on these pollutants is noteworthy because they serve as vital members of the freshwater trophic cycle and thus indirectly dictate the biodiversity and population dynamics of the aquatic ecosystem.

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Conflict of Interest

There is no conflict of interest by author.

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