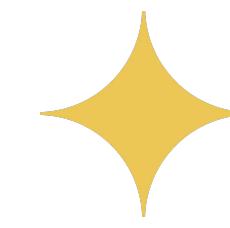


Interactions Between Micro/Nanoplastics and Soil Media: Characterization, Transport, and Implications for Public Health



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INTRODUCTION & OBJECTIVES

Plastics are a growing global contaminant, breaking down into microplastics (MPs) and nanoplastics (MNPs) that interact with soils and water systems. Their movement is shaped not only by the properties of the particles but also by the characteristics of the soils they encounter. Different soil profiles influence whether MPs are trapped near the surface or migrate deeper into the ground, with important implications for groundwater safety and agriculture. These dynamics raise environmental justice concerns, as communities that rely heavily on groundwater often face disproportionate exposure risks.

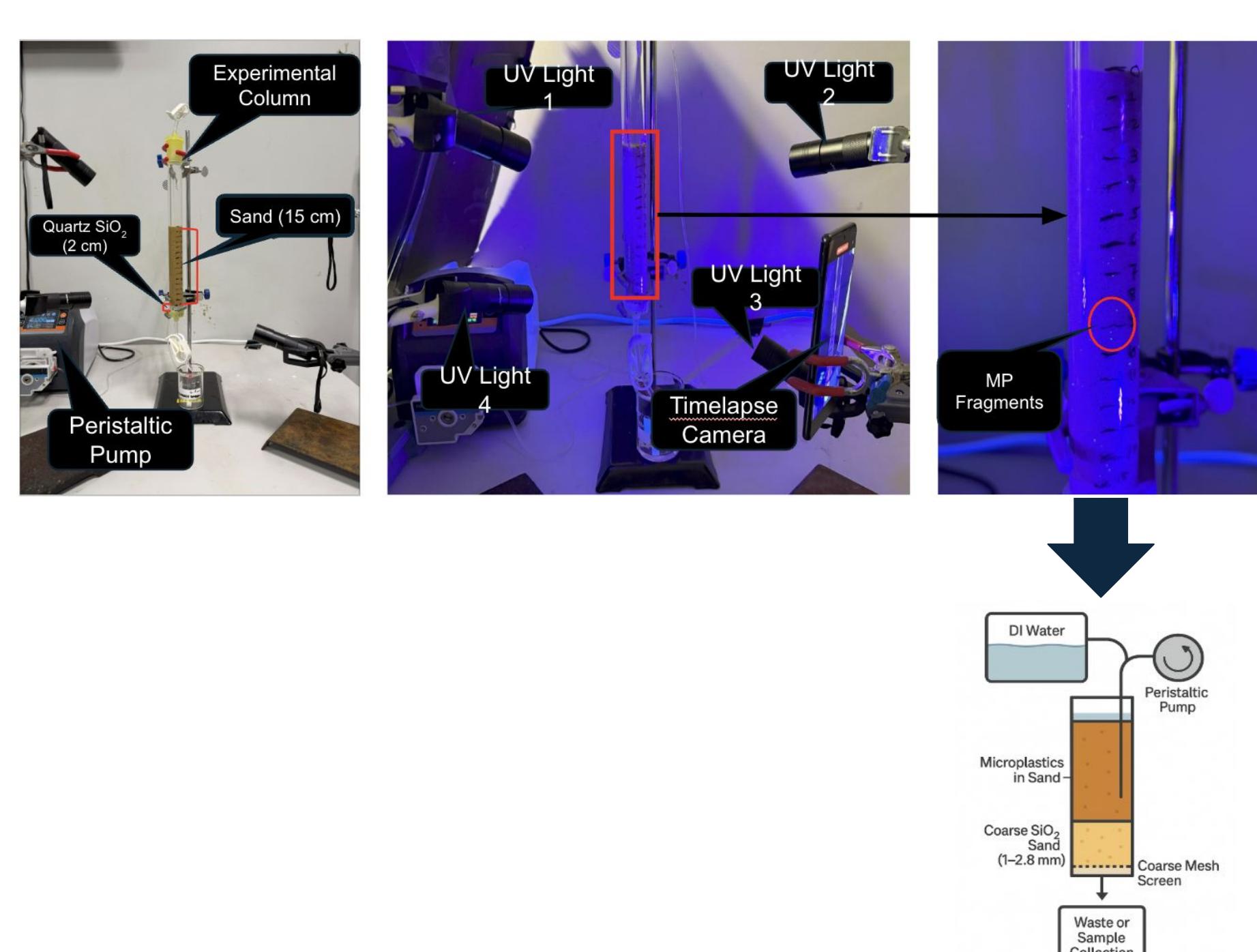
This project investigates how soil profiles influence microplastic retention and mobility, with a focus on identifying key soil properties such as porosity and hydraulic conductivity that shape the depth and speed of transport. It also examines the broader implications of soil-mediated microplastic movement for groundwater contamination and environmental justice.

Hypothesis: Soil variability plays a critical role in the fate of microplastics, with coarser soils promoting deeper migration and greater risks for overburdened communities.

METHODS

Microplastic transport was examined through soil column experiments using different soil media. Known amounts of microplastics were mixed into each medium, and distilled water was applied to simulate natural flow. After each experiment, the columns were frozen, sliced into 1 cm layers, and analyzed to measure particle retention by depth. Results from different soil profiles were then compared and contrasted to evaluate how variations in soil properties influence microplastic mobility and retention.

Experimental Setup



RESULTS & DISCUSSION

Microplastic transport varied across soil media. Sand columns showed the fastest breakthrough and deepest migration, while soils with higher organic content retained more particles near the surface. These findings reflect natural conditions, as sandy soils in the environment promote faster water and contaminant movement compared to denser topsoils, similar to patterns seen in landscapes and rain gardens.

These results demonstrate that soil properties strongly control microplastic fate. Coarser soils allow deeper migration, raising the risk of groundwater contamination, while finer soils enhance retention near the surface. This underscores how soil variability shapes environmental risk and highlights environmental justice concerns for communities relying on vulnerable groundwater sources.

CONCLUSION AND IMPACT

Microplastic transport through soils poses an immediate and invisible threat to public health. As particles migrate into groundwater, they contaminate the very drinking water sources most heavily relied on by rural and marginalized communities. With limited access to advanced treatment systems and healthcare, these populations bear the brunt of exposure. Most water facilities cannot fully filter micro- and nanoplastics, allowing long-term health risks—ranging from chronic inflammation to immune disruption—to persist and compound existing health disparities.

Confronting this crisis demands bold action. Solutions must center environmental justice by cutting plastic production at the source, enforcing stronger regulations, and accelerating innovation in water treatment and green infrastructure that can trap contaminants before they reach aquifers. Protecting overburdened communities with resources for monitoring, remediation, and healthcare access is not optional—it is essential.

This is not just an environmental issue but a moral imperative. Without urgent intervention, microplastic pollution will continue to deepen inequities, silently infiltrating food, water, and bodies. By uniting science, policy, and justice, society has the power to turn the tide—ensuring safe water, resilient ecosystems, and healthier futures for the communities most at risk.

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