Proceedings of the 9th World Congress on Civil, Structural, and Environmental Engineering (CSEE 2024)
London, United Kingdom – April 14-16, 2024
Paper No. ICEPTP 124
DOI: 10.11159/iceptp24.124

Monitoring Long-term Microplastics Contamination and Influential Factors in Freshwater Sediment Cores in Pennsylvania, USA

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Extended Abstract

Microplastic (MP) contamination in freshwater environments has become a significant concern because it is the major source of microplastics observed in the ocean, terrestrial ecosystems, and a potential route of human exposure [1], [2]. MPs, defined by their particle size ranging from 1 μm to 5 mm, can originate from plastic products as small particles or result from the degradation of macro-plastic pollution [3]. While many studies have reported MP contamination in surface water and its impact on biota, it has been unclear how MPs transport from point sources (e.g., urban areas) to the ultimate reservoir, the ocean. Additionally, few studies have reported changes in MP exposure over time which is essential for comprehending MP accumulation and the impact of this contaminant on ecosystems [4]. Studying sediment cores can reveal an understanding of long-term contamination in the environment. Freshwater sediment traps pollutants depending on their physico-chemical properties and could record changes in pollutants over time.

This study aimed to quantify historical MP contamination in freshwater sediment depositional environments and correlate MP accumulation with human activities such as land use within the watershed. We collected sediment cores from three different locations in Pennsylvania, USA, that represent a range of land use and population densities. Sample locations include Blacklick Creek, Raystown Lake, and Darby Creek. These samples were sectioned into 1 cm intervals, dried, and ^{210}Pb and ^{137}Cs quantified using a Broad Energy Germanium detector to create an age model and calculate the sedimentation rate. MPs were isolated by organic matter digestion and density separation prior to identification and quantification using a stereomicroscope. MPs were characterized based on their morphology either fiber, fragment, foam, or film. Suspected particles were confirmed with the hot tip of a thin needle, resulting in melting or curling [5].

Sediment cores in Raystown Lake and Darby Creek collected sediment from the present to the pre-1950s, whereas Blacklick Creek showed a much higher sedimentation rate, capturing only younger sediment. Surprisingly, the core collected from a relatively rural area, Raystown, had the highest total microplastic concentration along the core, followed by Darby Creek and Blacklick Creek with the lowest concentration of MP. Distinct patterns of MP types were observed with fragments being the most abundant in Darby Creek and Blacklick Creek, while Raystown Lake was predominately fibers. These variations could indicate localized influence (e.g., septic tank effluent) on MP contamination in the Raystown environment. All cores showed general lower concentrations of MPs before the 1950s and higher concentrations in more recent sediment. Our data, combined with data from previous studies, indicated that MP concentrations negatively correlate with sediment accumulation rate, but showed no correlation with population density or developed area within the watershed.

Here we demonstrate long-term persistence of MP in freshwater sediment, furthering our understanding of MP accumulation, fate, and transport.

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