

Do Microplastic Contaminants Distort our Understanding of the Ocean's Carbon Cycle?

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Microplastics (MPs) have become an omnipresent component of ocean contaminants. These abundant micro-sized particles (diameters from less than 0.001 to 5 mm) are either derived from breakdown of larger plastic items or are manufactured (e.g., cosmetic microbeads, industrial pellets). Upon entering the ocean, MPs move vertically and laterally along the coast, and circulate into the open ocean. Oceanic MPs are problematic because they can bind toxic chemicals and enter the food chain. They are also unintentionally included in fundamental studies of movement, chemical transformation, and storage of natural carbon in the ocean, all of which are huge concerns in the climate change community. To date, the effects of MPs' on ocean carbon cycling measurements have not been systematically evaluated. Our proposed research will focus on understanding oceanic distributions of MPs, determining the contribution of these synthetic polymers to natural organic particle pools, and characterizing how marine microorganisms interact with MPs. We are currently developing a novel methodology using Raman microspectroscopy (<https://you.stonybrook.edu/nanoraman/>), which has the unique ability to quantify and identify the synthetic MP polymers from environmental samples representing large contamination gradients from coastal NY waters to remote ocean locales (Antarctica, Arctic). An SBU Seed Grant would enable sufficient refinement of this unique methodology and the production of essential preliminary data that are essential for writing several compelling, interdisciplinary, collaborative federal grant proposals. These proposals would address the following issues: i) identity, concentration and distribution of MPs in contrasting ocean settings, ii) the relative contributions of MPs to the ocean's organic carbon pools, iii) mechanisms of MP vertical transport down through the water column, and iv) microbiological degradation of MPs in the ocean. Our goals are to: i) compute more realistic estimates of MP abundances to derive a mass balance of oceanic MPs, ii) evaluate how unintentional inclusion of MPs in carbon cycling measurements might distort our models of how the ocean processes natural carbon, iii) establish the mechanisms of horizontal and vertical MP transport, and iv) determine if any bacteria or fungi degrade plastics in situ. These objectives are crucial to understanding how plastic pollution has actually affected the ocean and biased our perceptions of how the ocean processes carbon.