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3D-MICROPLASTICS_SO: THE 3-D DISTRIBUTION AND ORIGIN OF MICROPLASTICS IN THE 'ISOLATED' SOUTHERN OCEAN

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ABSTRACT

The Southern Ocean had been considered as an exception because of limited anthropogenic impacts due to the polar fronts acting as barriers against exchanging floating materials with the lower latitudes. Recent studies prove that microplastics (MP) is common in the Southern Ocean. Yet, the source of MP in the Southern Ocean remains unclear. Furthermore, one of my work in the South Atlantic Gyre found high concentrations of small sized MP (71.1 n m^{-3} , $<100 \mu\text{m}$) accumulating in the North Atlantic Deep Water, which is the deep-water mass entering the Southern Ocean. These small-sized plastics ($<100 \mu\text{m}$) is able to translocate across the biological membranes and result in potential bioaccumulation in the food web, thus leading to unknown consequences. Nevertheless, the information of small sized MP in the Southern Ocean is lacking. Considering the global importance of the Southern Ocean's ecological and biogeochemical processes, it's particularly vital to understand the 3-D distribution, source and fate of plastic debris in this pristine region. In this project, we aim to assess the origin and vertical distribution of MP particles in the Southern Ocean through the view of both chemical and microbial oceanography. The marine particle samples will be collected with multiple techniques from the surface water to the mid water. After analyzing samples with the state-of-art FTIR/Raman imaging and a self-developed automated algorithm for large spectral datasets, we will: 1) disclose the abundances and distribution of plastic particles ($>1 \mu\text{m}$) along the water depth continuum in the Southern Ocean; 2) compare polymer properties that collected from the sea surface to the deep sea (such as particle morphology, polymer composition, extent of degradation); 3) analyze the taxonomic and functional structure of plastic-attached microbial communities to evaluate the potential source of MP. Our project will generate a more holistic picture of MP in the rarely studied Southern Ocean, largely advancing our understanding of plastic pollution in these remote regions. Ultimately our dataset will provide a platform for Earth system models projecting the global impacts of plastic pollution on the biogeochemical cycling and ecosystem health.