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Microplastic transport, deposition and burial in seafloor sediments by turbidity currents

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Plastic pollution of the world's oceans represents a threat to marine eco-systems and human health and has come under increasing scrutiny from the general public. Today the global input of plastic waste into the oceans is in the order of 10 million tons per year and predicted to rise by an order of magnitude by 2025; much of this plastic ends up on the seafloor. Plastics, and microplastics, are known to be concentrated in submarine canyons due to their proximity to terrestrial plastic sources, i.e. rivers. Plastics are transported in canyons by turbidity currents, mixtures of sediment and water which flow down-canyon due to their density; these flows can also 'flush' canyons, eroding and entraining the sediment lining the canyon walls and bottom. A single turbidity current can last for weeks and transport more sediment than the annual flux of all terrestrial rivers combined. Although it is known that these flows play a critical role in delivering terrestrial sediment and organic carbon to the seafloor, their ability to transport and bury plastics is poorly-understood. Using flume experiments we investigate turbidity currents as agents for the transport and burial of microplastic fragments and fibers. Microplastic fragments are focused at the flow base, whereas fibers are more homogeneously distributed throughout the flow. Surprisingly though, the resultant deposits show the opposite trend with fibers having a higher concentration that fragments. We explain this observation with a depositional mechanism whereby fibers are dragged out of suspension by settling sand grains, are trapped in the aggrading sediment bed and are buried in the deposits. Conversely, fragments may remain suspended in the flow and are less likely to be trapped on the bed. Our results suggest that turbidity currents can transport microplastics over long distances across the ocean floor, and that turbidity currents potentially distribute and bury large quantities of microplastics in seafloor sediments.