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First evidence of plastic fallout from the Great Pacific Garbage Patch

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Increasing amounts of plastic debris in the ocean is a global environmental concern. Each year, several million tons of plastic waste enter the ocean from coastal environments. Transported by currents, wind and waves, positively buoyant plastic objects eventually accumulate at the sea surface of subtropical oceanic gyres, forming the so-called ocean garbage patches. To date, the fate of floating plastic debris 'trapped' in the oceanic gyres remains largely unknown. To more accurately assess the persistence of floating plastics accumulating in offshore areas, a better understanding of the plastic inputs and outputs into and from ocean garbage patches is crucial. An important component of this mass balance currently missing is the vertical plastic flux from the sea surface of subtropical waters towards the seabed. Numerical models have major difficulties in constraining the sinking flux of plastic to the ocean interior in these areas since validation against observational data is not possible yet.

Here, we provide the first water column profiles (0-2000m water depth) of plastic particles (>500 μm) in the North Pacific subtropical gyre (Great Pacific Garbage Patch; GP GP). We show that plastic particles in the water column are mostly in the size range of particles that are apparently missing from the ocean surface and that their polymer composition is similar to that of floating debris circulating in the surface waters. Furthermore, water column plastic concentrations increase with higher concentrations at the sea surface and show a power law decline with water depth. These findings strongly suggest that plastics present in the deep sea below the GP GP are small fragments of initially buoyant plastic debris that accumulated at the sea surface. Although the amount of plastic in the GP GP water column is significant compared to the surface accumulation, our results further indicate that the ocean water column is unlikely to harbor a major fraction of the tens of millions of metric tons of missing ocean plastic.