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Flocculation of microplastic and cohesive sediment in natural seawater

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The flocculation of combinations of microplastic particles (MP) and natural cohesive sediment has been investigated in a laboratory setup using unfiltered seawater. The experiments were conducted in order to test the hypothesis that MP may flocculate in estuarine and marine environments with natural organic and inorganic particles. MP particles in the size-range 63 – 125 µm were incubated with suspensions of local untreated seawater and untreated fine-grained sediment (< 20µm) collected from a tidal mudflat. Settling experiments were carried out with both a floc-camera video equipment (PCam) and conventional settling tubes.

Flocculation and sedimentation of MP-particles of PVC have been investigated as well as particles from high density polypropylene which is used in certain fishing gear. The studies have generally confirmed our hypothesis that microplastics are incorporated into aggregates along with other natural particles, thus settling faster than they would as single particles. The exact aggregation mechanisms still remains to be revealed but the general cohesiveness of fine-grained natural particles, organic particles as well as particulate and dissolved organic polymers are believed to be responsible for the flocculation. A strong effect of salt ions was also observed, confirming the classical concept of increased flocculation of fine-grained particles as they are transported from fresh-water to estuarine and marine waters.

The implication of the aggregation is that primary MP from land-based sources are likely to flocculate with other suspended particles, especially as they enter saline waters. The particles are therefore expected to deposit close to the sources, typically rivers. This applies to both micro-plastic particles that are denser than seawater but also to low-density plastic types which should otherwise float. However, secondary MP may be formed by disintegration of plastic anywhere and these MP particles could therefore settle wherever there is plastic present at the sea surface, for example under the ocean gyres where plastic is known to accumulate. Here, too, interaction with other particles in the water column is expected, but the concentration of natural particles is much lower than in coastal waters and it may be that the transport of natural organic and inorganic particles will start to be modified if the concentration of plastic in the marine environment continues to rise.