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Evaluating settling velocities of microplastics-sediment mixtures under laboratory conditions

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Microplastics (MPs) may be an important component of suspended particulate matter (SPM) in aquatic environments. These particles can be transported independently or as part of larger aggregates (flocs). Recent studies have highlighted that small microplastics (<160 µm) are predominantly transported within flocs across various aquatic systems. Flocculation notably affects the transport dynamics of MPs, particularly by modifying their settling velocities. This process is especially pronounced in estuarine environments, where salinity gradients, turbulence, high suspended sediment concentrations, and organic matter, creates unique conditions for floc formation and movement. This study investigates the settling behavior of small MPs (50-125 µm) and their mixtures with fine cohesive sediment under laboratory conditions. An optical settling column (System of Characterisation of Agregates and Flocs SCAF) was used to measure the settling velocities of MPs with varying characteristics (shape, size and density), both in clear water and when mixed with fine suspended sediments at concentrations representative of turbid estuaries, under previously agitated and no-agitated conditions. The results reveal that regular-shaped MPs exhibit higher settling velocities compared to irregular ones among larger particles (90–125 µm) with similar density, while no such difference was observed for smaller particles (50–90 µm), highlighting the varying influence of particle shape with size. As expected, high-density particles settle faster, while larger particles also exhibit increased settling velocities due to reduced drag relative to their mass. The presence of fine sediments further enhances the settling velocities of smaller (50-90 µm) regular-shaped MPs and both smaller and larger (50-125 µm) fragmented MPs, particularly under previously agitated conditions, suggesting the occurrence of aggregation. A preliminary evaluation of several settling velocity models based on the calculation of drag coefficients, suggests that, unlike large microplastics, models conceived for natural particles align closely with observed data.