

Title: Optimizing density separation methods for microplastics extraction from marine sediments

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Abstract:

Many different techniques are used to extract microplastics (MPs) from sediment samples of variable composition and grain size. The lack of uniform methodology makes it challenging to compare results across studies and to select methods appropriate to local sedimentary conditions. This study (a) evaluates the separation efficiency, yield, and contamination (blank) of settling compared centrifugation density separation, and (b) examines the distribution of MP across successive separation phases (interstitial water, organic matter, sediment). Two different density-separation dependent extraction methods were tested with tropical marine sediments from the US Virgin Islands with variable grain size and composition: (1) suspension within a settling column, and (2): centrifugation. The samples were processed under a laminar flow hood using published best practices to minimize contamination. The two separation techniques produced similar MP yields (85-100%), which were calculated by tracing polyethylene microspheres. However, processing in the settling column sometimes produced incomplete settling of fine organic matter and took a significantly longer time (week vs. minutes) than did separation via centrifugation. Analytical blanks (contamination) were also slightly greater using a settling column (avg: 5.3 ± 1.1) vs the centrifuge (avg: 3.6 ± 0.9). However, the most important reason why the centrifugation is preferable is that it allows for the complete removal of separatory solutions via compaction of the sediment. This allows phased separation of MPs through sequential interstitial water removal, hydrogen peroxide treatment and removal (to target organic matter bound MP), and density separation phases. Our experiments showed that a significant portion of the total MP in the samples were potentially located in the interstitial water phase ($16 \pm 12\%$) and the following hydrogen peroxide phase ($25 \pm 20\%$). In the literature, intermediate treatment solutions are often discarded, resulting in an underestimation of total MP in the sediments. In summary, we found that the most effective method of MP extraction from organic rich or fine-grained sediments is a phased centrifugation process which includes counting MP from all phases.