
Vertical distribution and transport of textile microfibers (MFs) in the Mediterranean water column

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Abstract

Microfibers (MFs) are ubiquitous in natural environments and are considered as an anthropogenic litter that has become a global concern. Approximately 2 million tons of MFs are released into the ocean every year and once in the marine environment, it can be hypothesized that their accumulation and transport are largely controlled by oceanographic processes. We collected water column samples for MFs separation and polymeric characterization at 38 stations located in the Central-Western Mediterranean Sea. The aim of our study was to investigate MFs distribution in different water masses and transport through different Mediterranean basins. MFs were detected in all samples with a median concentration of 3.8MFs/L. Polymeric analysis highlighted cellulosic-based fibers as the dominant polymer (85%) over synthetic fibers (5%) and processed cellulose (8%), while animal fibers were detected occasionally. MF concentration was locally characterized by vertical variations according to water masses, and by changes in size, with surface and deep fibers being longer and larger than mid-water fibers. Mediterranean surface waters showed homogeneous MF content (range 3.0-4.9MFs/L), while intermediate and deep waters were characterized by opposite trends. Intermediate-waters showed decreasing MFs concentration moving from the Eastern to the Western Mediterranean basin (9.6-1.6MFs/L) while MF content increased in deep waters at the same stations (3.7-9.1MFs/L). Along the Sardinia Channel, we estimated a negative MF flux of 6 Trillion MF/day entering the Tyrrhenian Sea at intermediate depths, and a positive flux of 12 Trillion MF/day in the deep-water mass. We also estimate a 10-fold flux of synthetic fibers leaving the Tyrrhenian Sea, compared with the daily inflow. Our findings suggest that: i) there is a predominant MFs input on surface waters by atmospheric deposition; ii) MFs vertical distribution is size-dependent; iii) MFs transport between Mediterranean basins is mediated by Levantine waters; iv) a potential export of MFs to deep waters occurs in the Tyrrhenian Sea.

Keywords: Microfibers, Cellulose fibers, Synthetic fibers, Mediterranean Sea, Water column

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