
Microplastics and ship paint particles in the Weddell Sea, Southern Ocean: A forensic investigation

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Abstract

Microplastics (MP) are ubiquitous in the marine environment and have even reached the Southern Ocean surrounding Antarctica. In this study, we investigated the occurrence of microplastics in the Weddell Sea, an Antarctic region experiencing particular low human activity. Surface and subsurface water samples were collected during two expeditions on RV *Polarstern*, targeting large microplastics ($> 300\mu\text{m}$). ATR-FTIR measurements revealed MP in 65% of surface and 11.4% of subsurface water samples, with mean concentrations of $0.01 (\pm 0.01 \text{ SD}) \text{ MP m}^{-3}$ and $0.04 (\pm 0.1 \text{ SD}) \text{ MP m}^{-3}$, respectively, being within the range of previously reported values for regions south of the Polar Front. Of all recovered MP, 47% are possibly associated to paints due to their polymer composition, visual characteristics and brittleness. On top of that, particles with same colors as paints from RV *Polarstern* were found ($n=394$) but could mostly not be assigned to a polymer by means of FTIR due to low quality matches with the spectral library. Such particles, with similar FTIR spectra ($n = 101$) to reference paints from RV *Polarstern* were further subjected to micro-x-ray fluorescence spectroscopy (μXRF), to compare their elemental composition, indicating contained pigments and additives. Besides Ti, Ca and Fe, which were found in nearly all particles, heavy metals such as Cu, Pb and Zn were detected. Further, μXRF revealed that 89% of the paint particles with same colors and FTIR spectra as RV *Polarstern* (and 45.5% of all recovered synthetic particles) derived from vessel-induced contamination, while 11% might derive from other sources. This study shows that paint particles might be an important MP source in the Southern Ocean. Further, we demonstrate that differentiation of paint particles based on visual characteristics and FTIR spectroscopy might not be sufficient for accurately determining sample contamination sources.

Keywords: Southern Ocean, Antarctica, Microplastics, Ship Paint, FTIR, μXRF

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