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TITLE: Perfluoroalkylated Substances in the Global Tropical and Subtropical Surface Oceans

AUTHOR: ['Belén González-Gaya', 'Jordi Dachs', 'José L. Roscales', 'Gemma Caballero', 'Begoña Jiménez']

ABSTRACT:

In this study, perfluoroalkylated substances (PFASs) were analyzed in 92 surface seawater samples taken during the Malaspina 2010 expedition which covered all the tropical and subtropical Atlantic, Pacific and Indian oceans. Nine ionic PFASs including C6-C10 perfluoroalkyl carboxylic acids (PFCAs), C4 and C6-C8 perfluoroalkyl sulfonic acids (PFASs) and two neutral precursors perfluoroalkyl sulfonamides (PFASAs), were identified and quantified. The Atlantic Ocean presented the broader range in concentrations of total PFASs (131-10900 pg/L, median 645 pg/L, n = 45) compared to the other oceanic basins, probably due to a better spatial coverage. Total concentrations in the Pacific ranged from 344 to 2500 pg/L (median = 527 pg/L, n = 27) and in the Indian Ocean from 176 to 1976 pg/L (median = 329, n = 18). Perfluorooctanesulfonic acid (PFOS) was the most abundant compound, accounting for 33% of the total PFASs globally, followed by perfluorodecanoic acid (PFDA, 22%) and perfluorohexanoic acid (PFHxA, 12%), being the rest of the individual congeners under 10% of total PFASs, even for perfluorooctane carboxylic acid (PFOA, 6%). PFASAs accounted for less than 1% of the total PFASs concentration. This study reports the ubiquitous occurrence of PFCAs, PFASs, and PFASAs in the global ocean, being the first attempt, to our knowledge, to show a comprehensive assessment in surface water samples collected in a single oceanic expedition covering tropical and subtropical oceans. The potential factors affecting their distribution patterns were assessed including the distance to coastal regions, oceanic subtropical gyres, currents and biogeochemical processes. Field evidence of biogeochemical controls on the occurrence of PFASs was tentatively assessed considering environmental variables (solar radiation, temperature, chlorophyll a concentrations among others), and these showed significant correlations with some PFASs, but explaining small to moderate percentages of variability. This suggests that a number of physical and biogeochemical processes collectively drive the oceanic occurrence and fate of PFASs in a complex manner.

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