

Long-Range Transport of Oil by Marine Plastic Debris: An 8500 km Journey

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When oil is spilled into a body of water, weathering processes (such as evaporation, emulsification, dispersion, dissolution, sedimentation, photo-oxidation, biodegradation) typically restrict the distance spilled oil travels to a few hundred kilometers. However, from late May - September 2020, the Friends of Palm Beach (FOPB), a nonprofit organization dedicated to cleaning the coastline of Palm Beach, noticed the arrival of an unusually large quantity of capped glass and plastic bottles partially or fully covered with black residue. The black residues ranged from thin coatings to several millimeters thick. When present and legible, the labels on the bottles were written in Portuguese, Spanish, or English, mainly originating from South America / Caribbean countries. Thus, scientists tested the hypothesis of the unprecedented long-range (thousands of kilometers) trans equatorial transport of oil adhered to marine debris by surface currents.

The appearance of the oil-coated strandings in Florida coincided 2 years after the unexplained appearance of ~500 lb. rubber bails (suspected from *SS Rio Grande*) and 1 year after the mysterious oiling of ~3000 km of Brazil's coastline (the worst in its history). Dispersion modeling backed by historical drift bottle experiments supported the plausibility of the hypothesis, that plastic ocean debris, coated by the mystery offshore oil spill, had found its way to the beaches of South Florida. Molecular forensics by Woods Hole Oceanographic Institution and the FT-ICR MS facility at the National High Magnetic Field Laboratory provided the definitive evidence. The high magnetic field mass spectrometers at the MagLab enabled the positive match of tens of thousands of molecules between the mystery oil spill in Brazil and the residue scraped from the bottles that washed up in Palm Beach, FL.

Facilities and instrumentation used: Ion Cyclotron Resonance Facility, 21T FT-ICR Mass Spectrometer.

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