# The Presence of Microplastics in Bottom Sediments from US Waterways

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# WHAT IS A **MICROPLASTIC?**

< 5 mm

**Microplastics are small pieces of plastic < 5 mm**

L — Large microplastics (1-5 mm)

S — Small microplastics (1 µm-1 mm)

Photo by Dustan Woodhouse on Unsplash

# WHAT IS A **MICROPLASTIC?**

01

## Primary microplastics

Specifically engineered for various applications such as personal care products.  Can be in the form of preproduction pellets.

Photo by Parks Canada

02

## Secondary microplastics

Plastics resulting from degradation of macroplastics caused by various reasons (i.e., UV radiation, abrasion, degradation)

Photo by NOAA

# WHY?

1) Microplastics are ‘emerging contaminants’

2) Microplastics are ubiquitous in the environment

3) Bioaccumulation potential increases with decreasing size = widespread risk of exposure

4) Many studies have shown aquatic species affected by microplastics

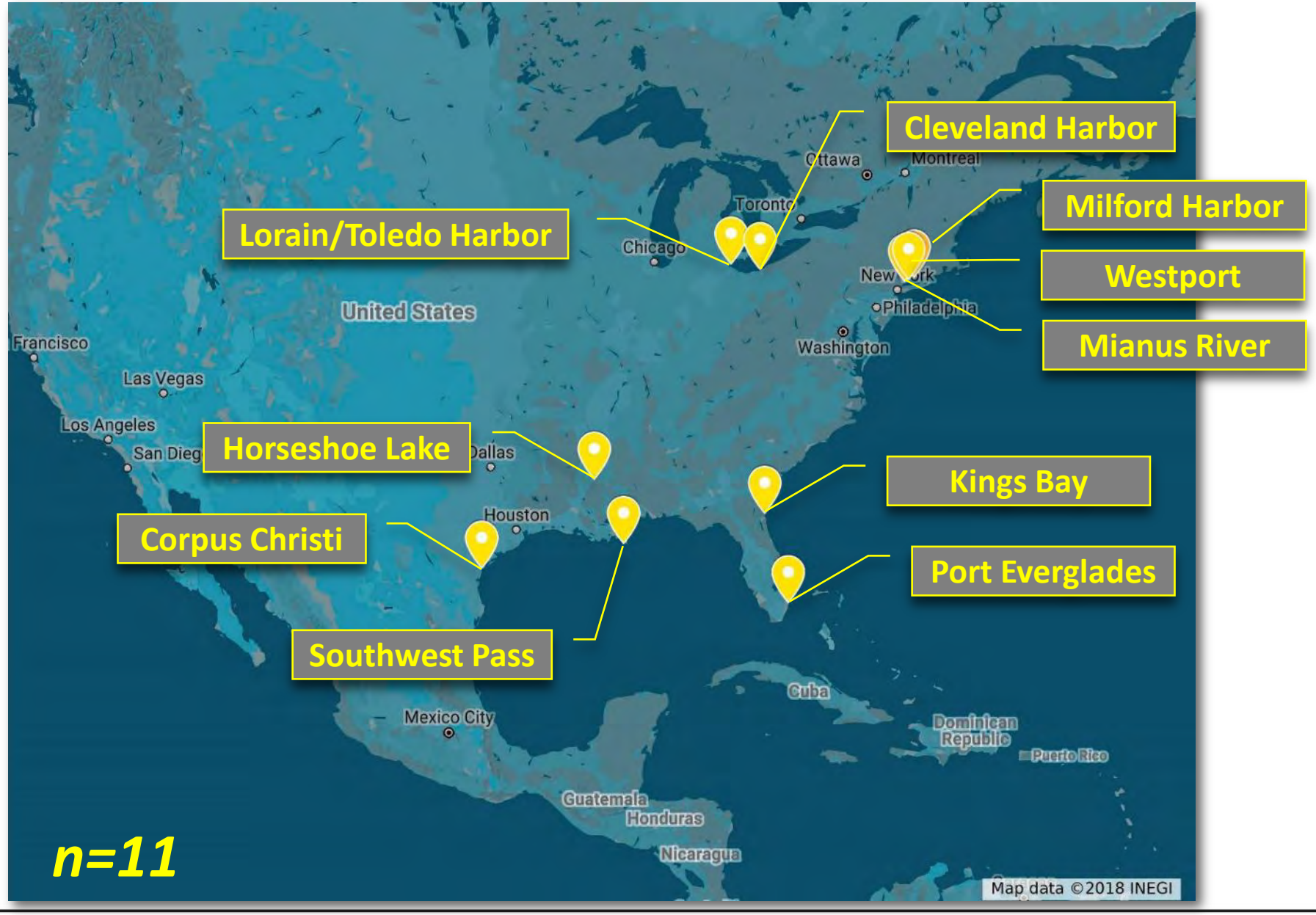
5) Are bottom sediments to be dredged different from other sediments?

# STUDY **QUESTION**

Do microplastics found in federal navigation channel sediments occur at a greater abundance than other similar environments?

## OBJECTIVES:

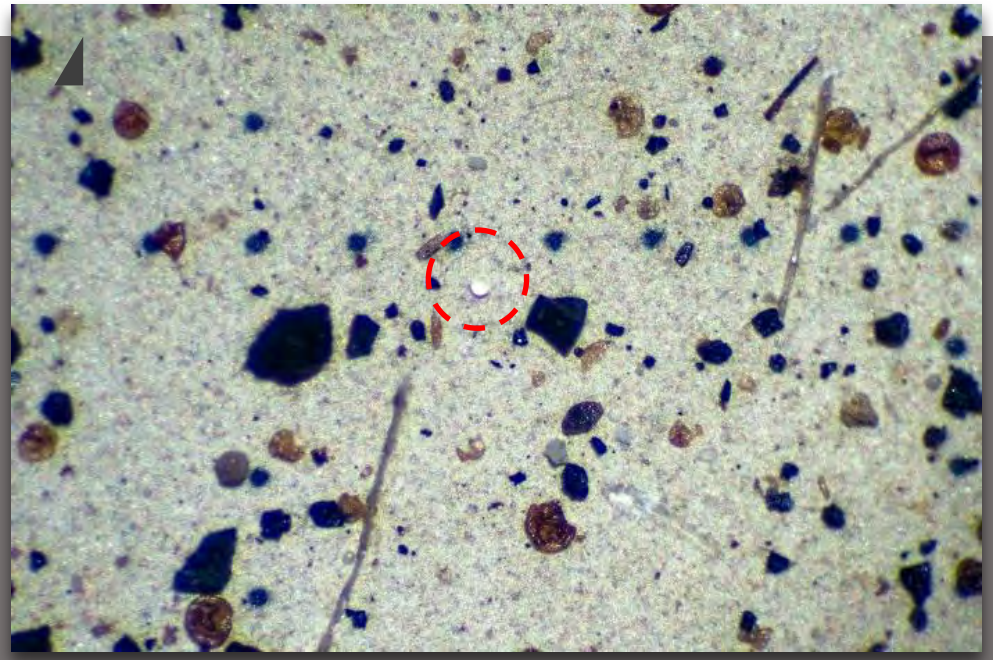
1) To measure the occurrence and abundance of microplastics in sediments collected from several federal navigation channels.
2) To compare the abundance of microplastics in federal navigation channel sediments with the abundance of microplastics found in other sediments in North America and worldwide.


Cleveland Harbor
Milford Harbor
Westport
Mianus River
Lorain/Toledo Harbor
Horseshoe Lake
Kings Bay
Corpus Christi
Port Everglades
Southwest Pass
n=11
Ottawa
Montreal
Toronto
Chicago
United States
Francisco
Las Vegas
Los Angeles
San Dieg
Dallas
Houston
Washington
Philadelphia
Cuba
Dominican Republic
Puerto Rico
Mexico City
Guatemala
Honduras
Nicaragua
Map data ©2018 INEGI

# METHODS

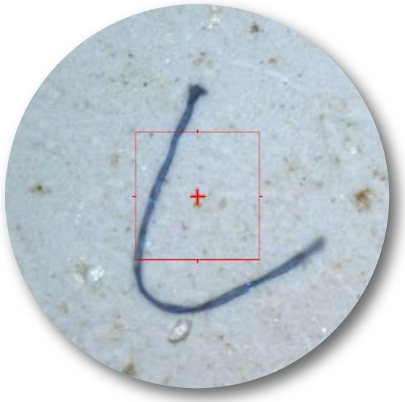
## PLASTIC IDENTIFICATION

- Microplastics were identified under the stereo microscope (x40)
- Physical properties (e.g., texture, flexibility)
- Needle probing; melting with hot needle
- Visual inspection by low-powered microscopy accepted method
- Fourier transform infrared (FTIR) spectrometer analysis

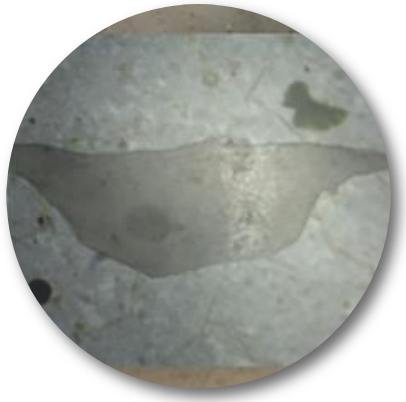


# METHODS

## Microplastics can be categorized as follows:

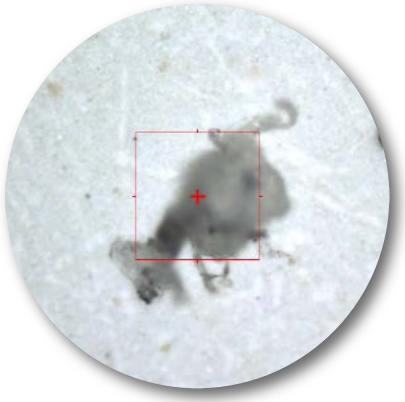


***Fibers***

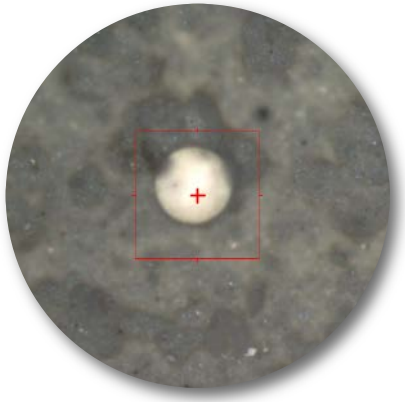


***Films***

***Foams***



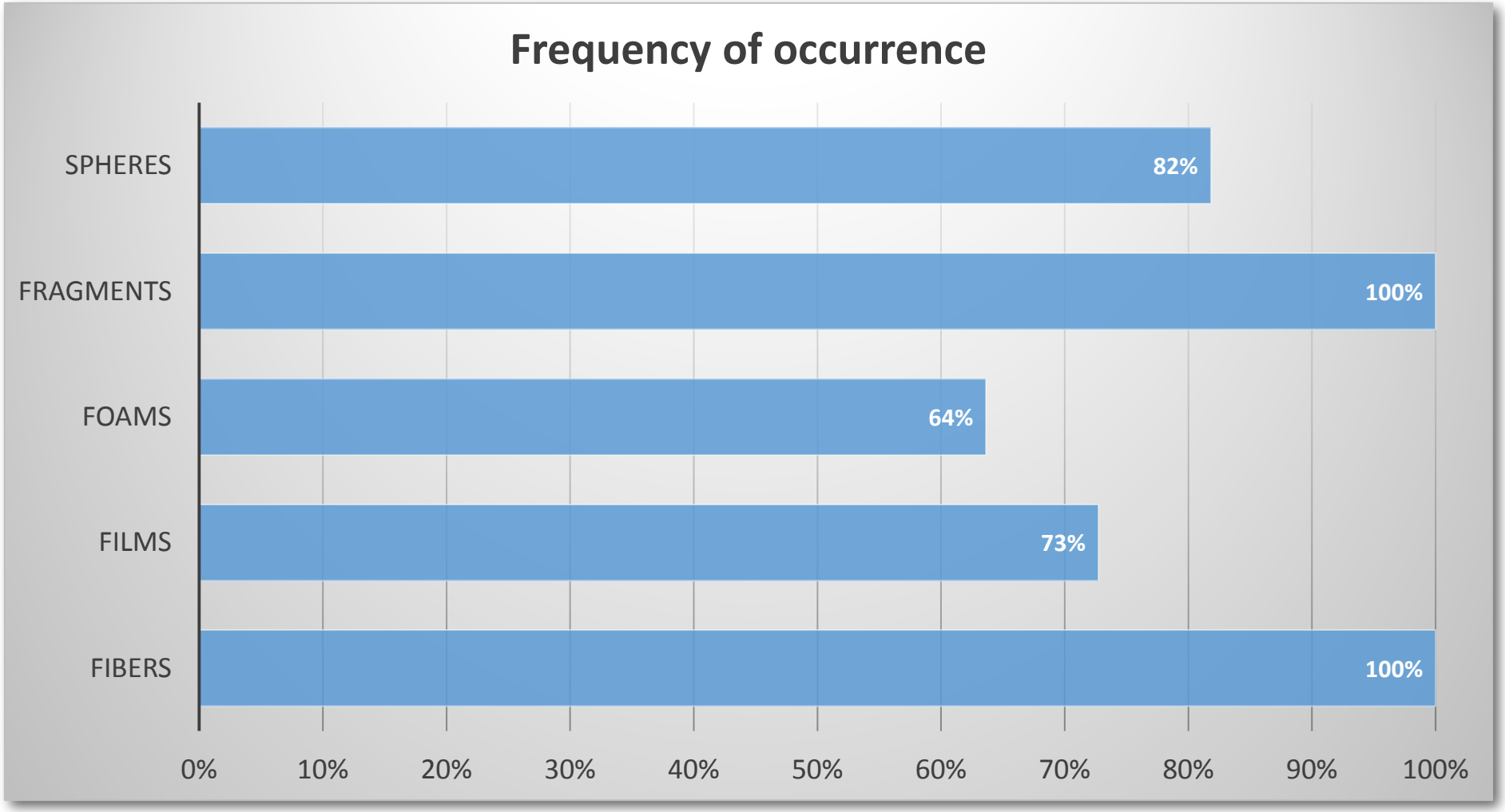
***Fragments***



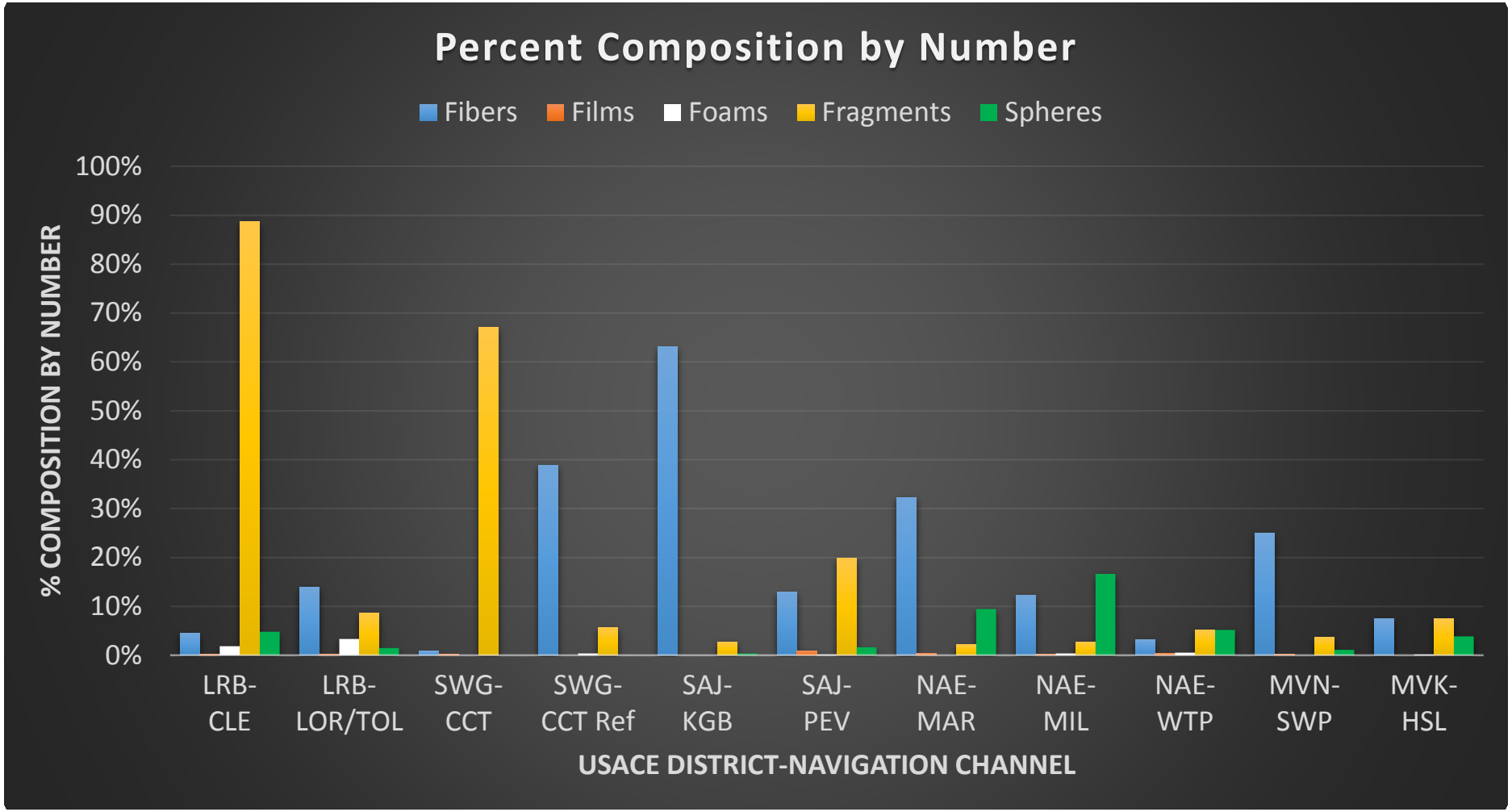
***Spheres***

**Fibers:** short to long, different thickness, variety of colors, bend but don't break
**Films:** usually thin, flexible, transparent, irregular shape
**Foams:** originate from Styrofoam, white to yellow colored, soft, irregular shape
**Fragments:** rigid, thick, sharp crooked edges, irregular, variety of colors
**Spheres/Granules:** round, small (<1 mm diameter), natural colors, transparent

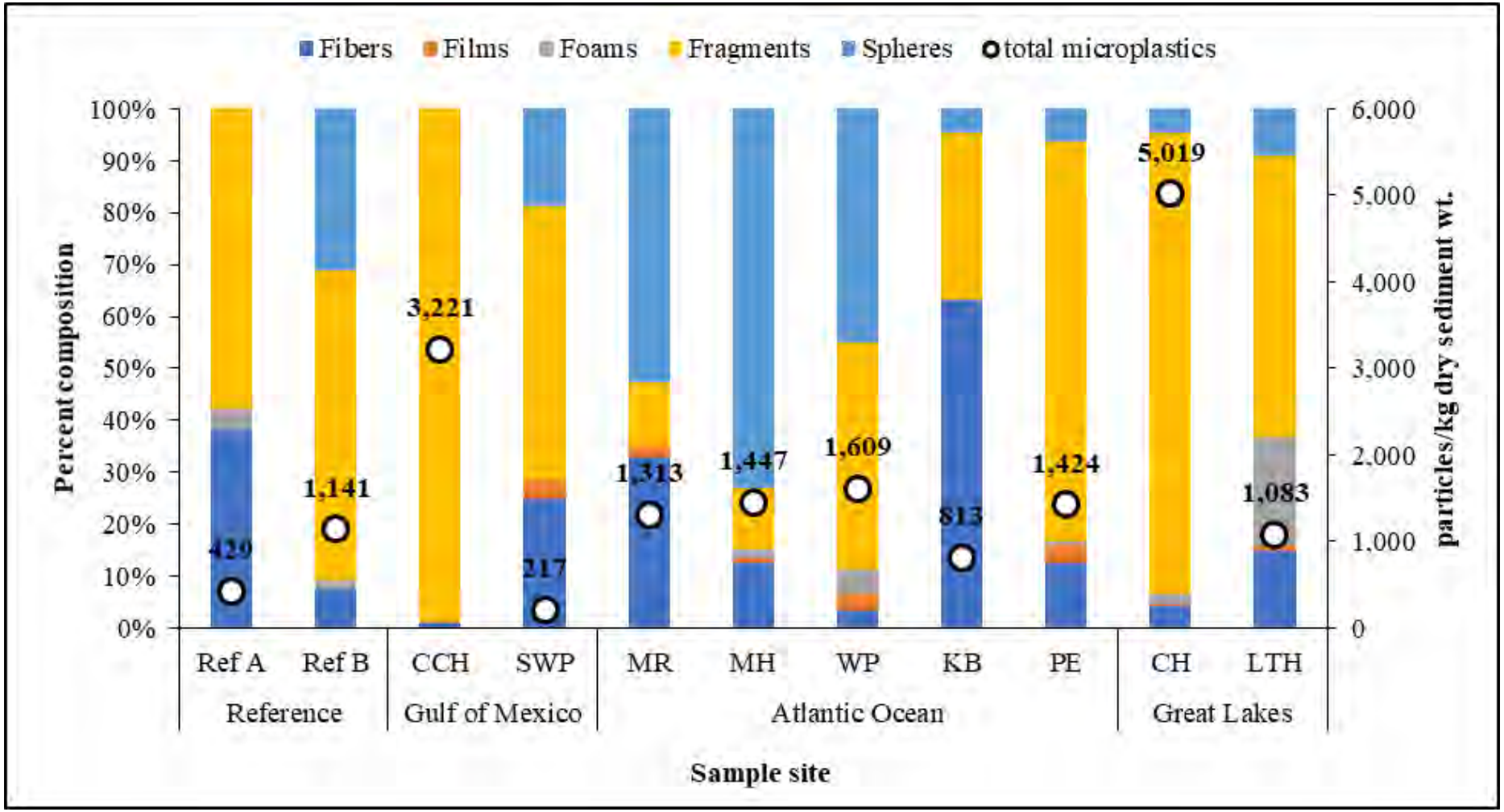
# RESULTS


Frequency of occurrence
SPHERES
FRAGMENTS
FOAMS
FILMS
FIBERS
82%
100%
64%
73%
100%
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%

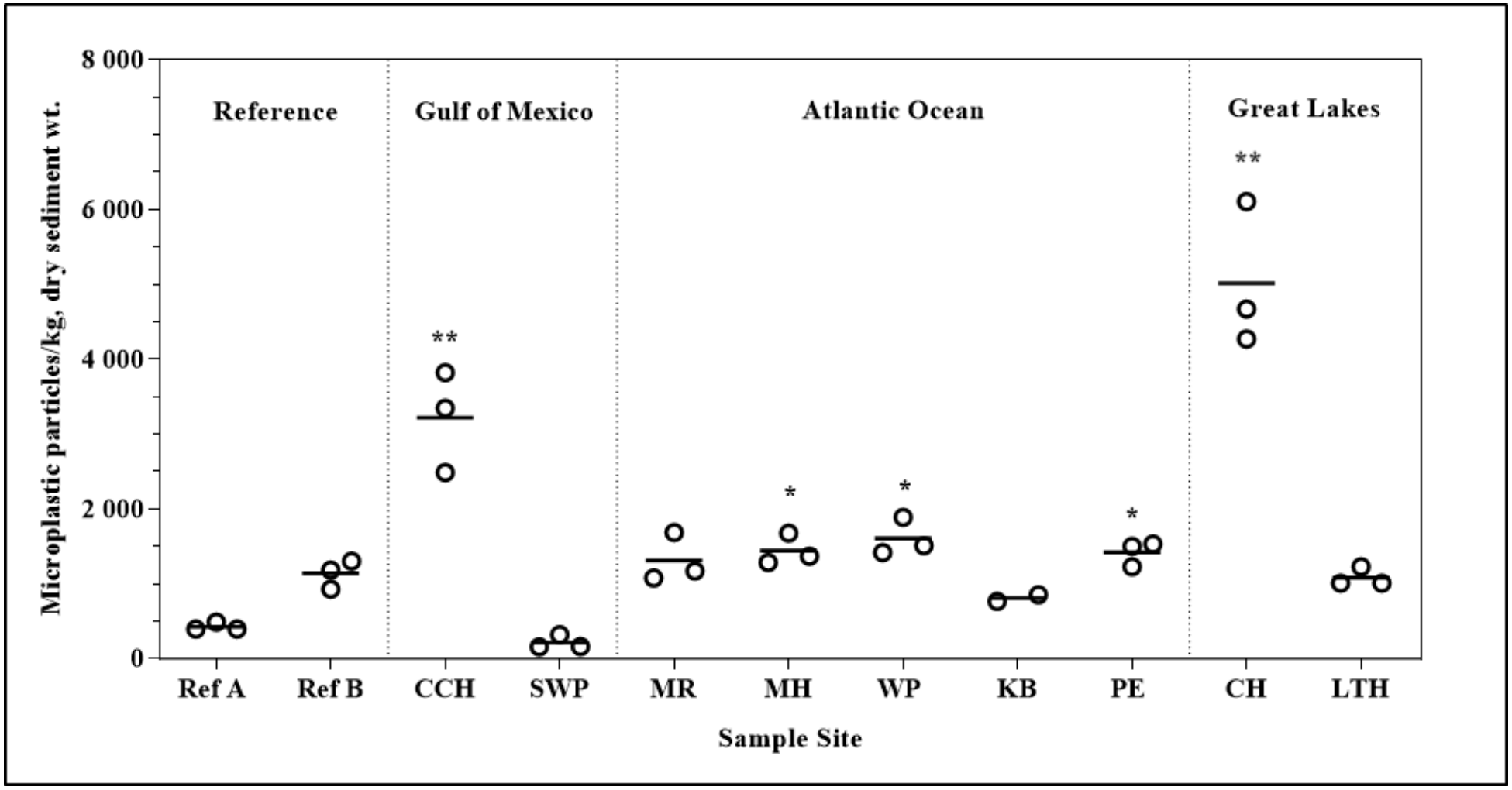
# RESULTS


Percent Composition by Number
Fibers
Films
Foams
Fragments
Spheres
% COMPOSITION BY NUMBER
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
LRB-CLE
LRB-LOR/TOL
SWG-CCT
SWG-CCT Ref
SAJ-KGB
SAJ-PEV
NAE-MAR
NAE-MIL
NAE-WTP
MVN-SWP
MVK-HSL
USACE DISTRICT-NAVIGATION CHANNEL

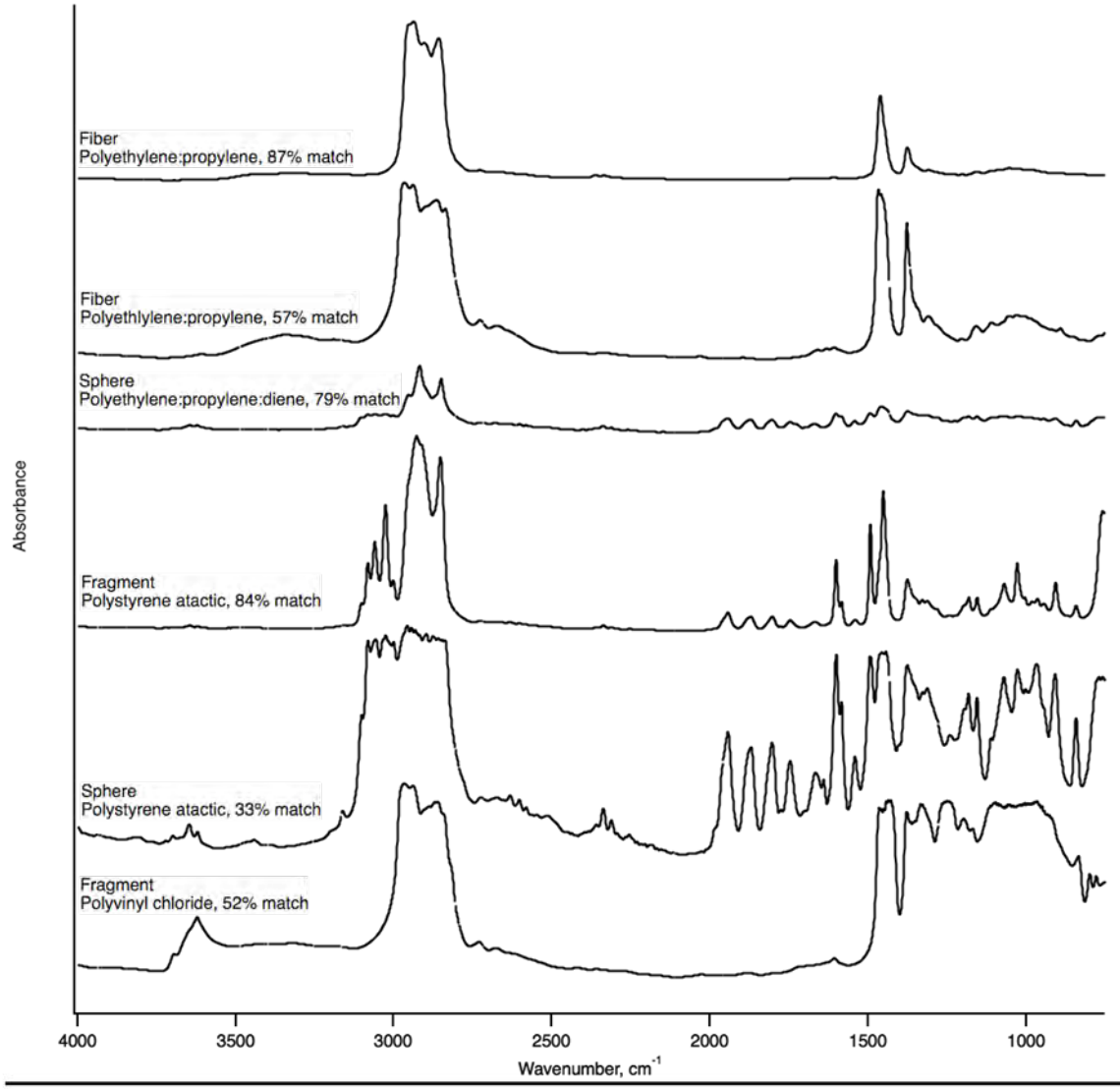
# RESULTS – Abundance



# RESULTS – Sample Comparisons



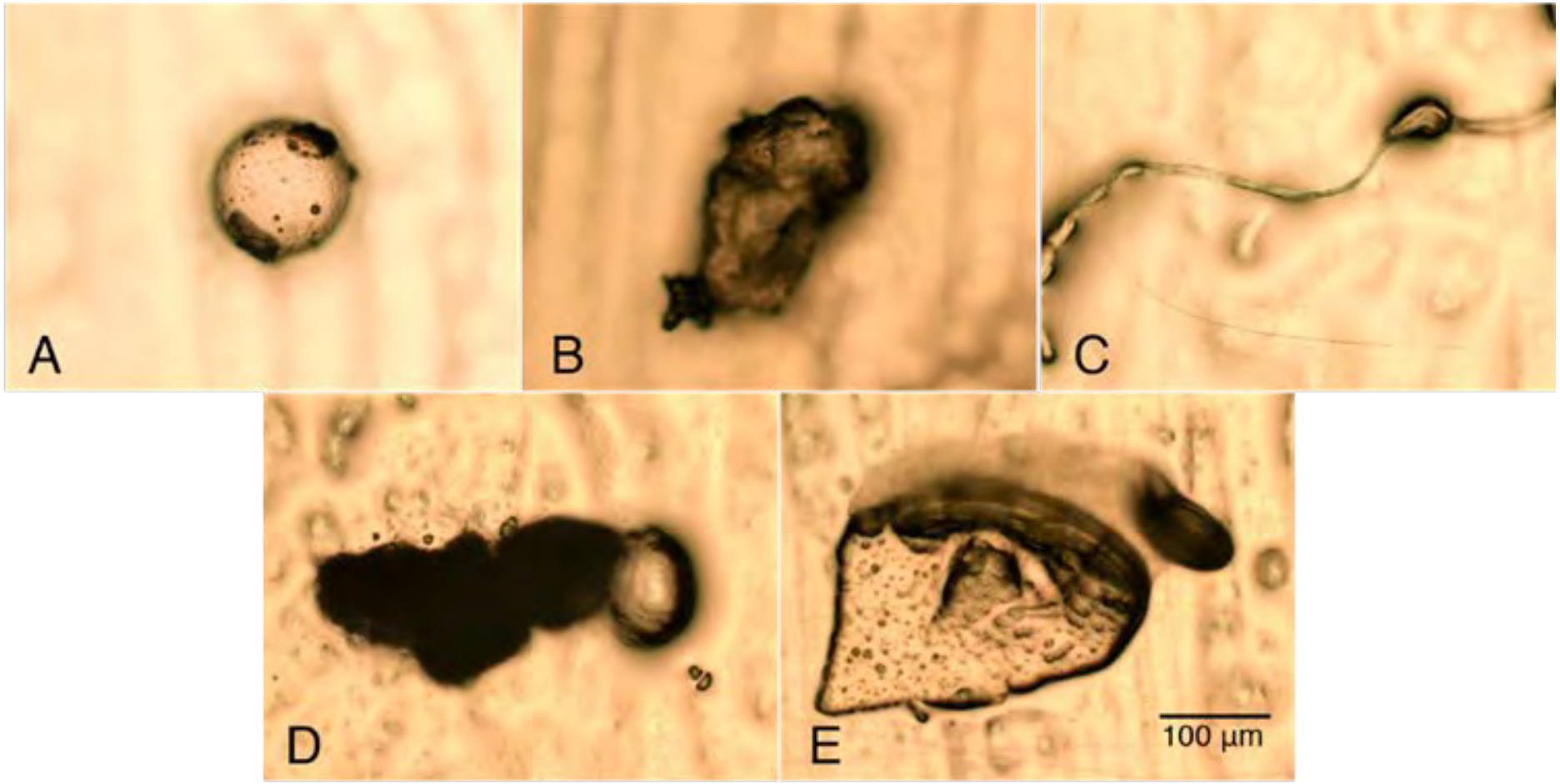
# RESULTS - Composition




**Fourier transform infrared (FTIR) spectrometer analysis:**

- Results yielded 14 polymer types
- Polyethylene:propylene (PEP) particles were most abundant, occurring in 100% of samples examined
- Next most abundant were PS and PS Types: polymethyl methacrylate, polystyrene (PS), polystyrene:4-vinylpyridine (PS type), polystyrene:acrylonitrile:MMA (PS type), and polystyrene:vinylidene chloride (PS type)
- Films (100%), foams (100%), fibers (92%), and fragments (74%) were mainly composed of PEP
- Spheres were composed of mainly PS and PS types (58%)

# RESULTS - Imaging




Images of microplastics extracted from bottom sediment samples: sphere (A), fragment (B), fiber (C), foam (D), and films (E).

# **RESULTS:** Select Studies Reporting Microplastics in Marine and Freshwater Sediments

## World

| Location | Number of particles ($\bar{x}$ ± SD) | Reference |
|---|---|---|
| **Gulf of Cadiz** | 75 ± 98 kg dry | Frias et al. 2016 |
| **Baltic Sea** | 22 ± 5 kg dry | Graca et al. 2017 |
| **Mediterranean Sea** | 270 ± 313 kg dry | Alomar et al 2016 |
| **Bizerte Lagoon, Tunisia** | 7,960 kg dry | Abidli et al. 2017 |
| **Lagoon of Venice** | 1,445 ± 458 kg dry | Vianello et al. 2013 |
| **North Sea** | 167 ± 92 kg dry | Claessens et al. 2011 |
| **Derwent Estuary, Tasmania** | 1,808 kg dry | Ling et al. 2017 |
| **North Sea** | 2,460 ± 1,493 kg dry | Leslie et al. 2017 |
| **Durban Bay, S.A.** | 1,165 kg dry | Naidoo et al. 2015 |
| **R. Rhine, Main** | 904 ± 1,064 kg dry | Klein et al. 2015 |
| **urban canal** | 2,071 ± 4,146 kg dry | Leslie et al. 2017 |
| **R. Thames trib.** | 350 ± 216 kg dry | Horton et al 2017 |

## North America

| Location | Number of particles ($\bar{x}$ ± SD) | Reference |
|---|---|---|
| **Lake Ontario** | 352 ± 374 kg dry | Corcoran et al. 2015 |
| **Lake Ontario** | 980 ± 1,072 kg dry | Ballent et al. 2016 |
| **Ottawa R.** | 220 kg dry | Vermaire et al. 2017 |
| **Maine & Florida Coasts** | 113 kg dry | Graham and Thompson 2009 |

*USACE Study Mean*

***1,611 ± 1,309 kg dw sediment (range 217-5,019).***

# SUMMARY

## OBJECTIVE 1: Microplastic abundance and characterization

- Microplastics observed in 100% of samples examined
- Overall average number of particles in the federal navigation channels and reference areas sampled was **1,611 ± 1,309 kg dw sediment (range 217-5,019)**
- In order of decreasing occurrence: fragments=fibers>spheres>films>foams

## OBJECTIVE 2: Literature Review

- Investigators found an abundances of microplastics in bottom sediments worldwide
- Microplastics observed in 100% of samples
- In general, microplastics were observed highest in bottom sediments nearer more populated ports and harbors as compared to areas more distant from population centers
- Microplastics appear ubiquitous in bottom sediments

# ACKNOWLEDGEMENTS


## Thanks to

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https://doer.el.erdc.dren.mil/