

# ANALYSIS OF MICROPLASTICS IN BOTTOM SEDIMENTS FROM USA 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  $\mu\text{m}$ -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.
- 3) Bioaccumulation potential increases with decreasing size = widespread risk of exposure.
- 4) Many studies have shown marine organisms have been affected by microplastics.



# 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 the USA and world.



**n=11**

# EXTRACTION METHODS

Extraction of microplastics using density separation followed by wet peroxide



**homogenize**

5 min in  
glass  
specimen  
bowl



**sieve**

50 g wet  
sediment  
thru 2 mm  
sieve



**density separation**

zinc chloride  
 $1.4 \text{ g/cm}^3$   
2 extracts



**filter**

Carefully  
filter and  
rinse



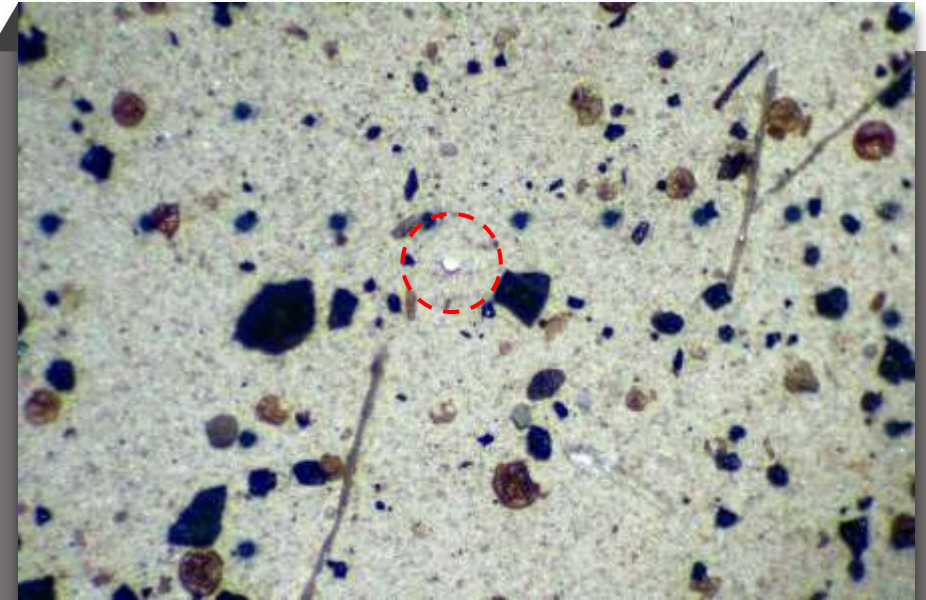
**wet peroxide**

$\text{H}_2\text{O}_2 + \text{FeSO}_4$   
reduce  
organics

# METHODS

## PLASTIC IDENTIFICATION

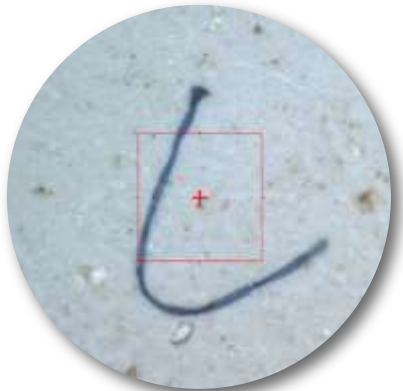
- Microplastics were identified under the stereo microscope (x40)
- Physical properties (e.g., texture, flexibility)
- Visual inspection by low-powered microscopy accepted



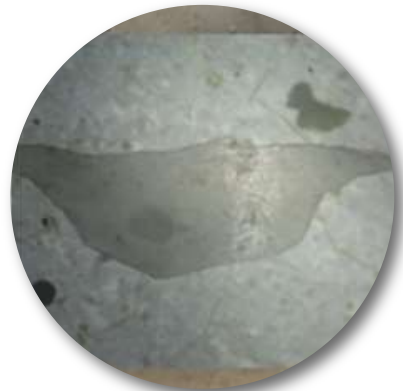


# METHODS

Microplastics can be categorized into broad categories including:  
fibers, films, foams, fragments, spheres



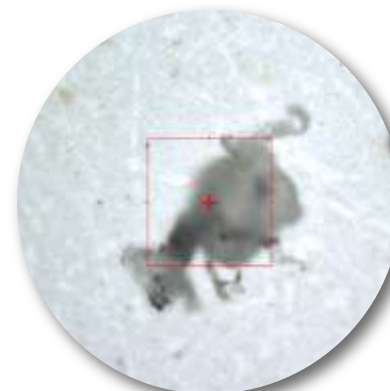
***\*Fibers***



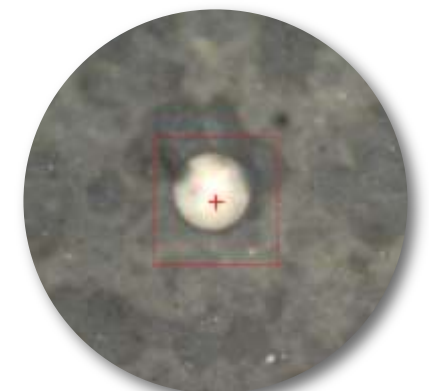
***Films***



***Foams***



***\*Fragments***



***Spheres***

\*most common

# LITERATURE REVIEW

## *Searched*

Articles containing 'microplastics' and 'sediment'.

01

## *Focused*

Microplastics in subtidal zone sediments and inland sediments.

02

## *Excluded*

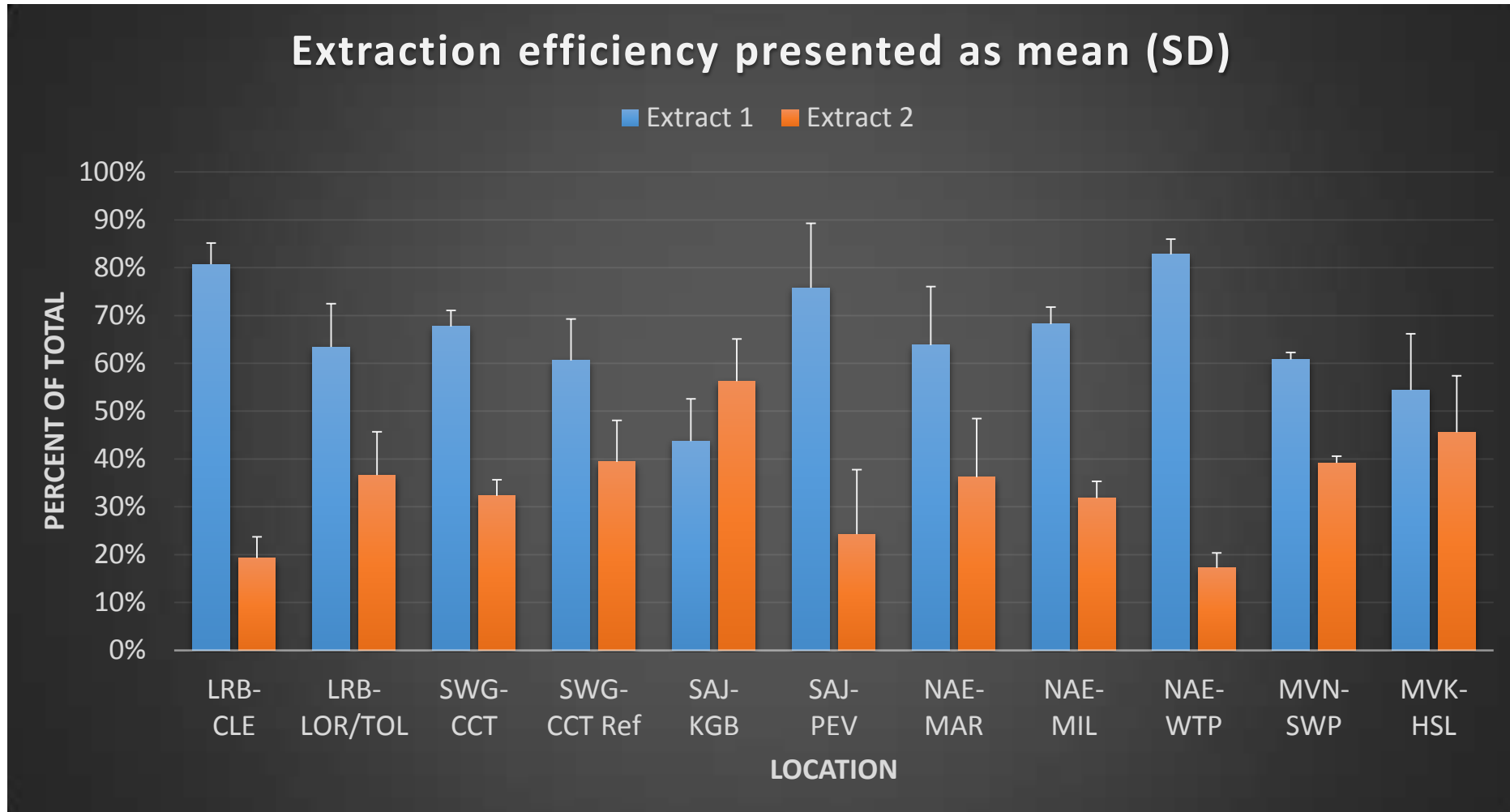
Coastal and inland beach sediments (less representative of dredged sediments).

03

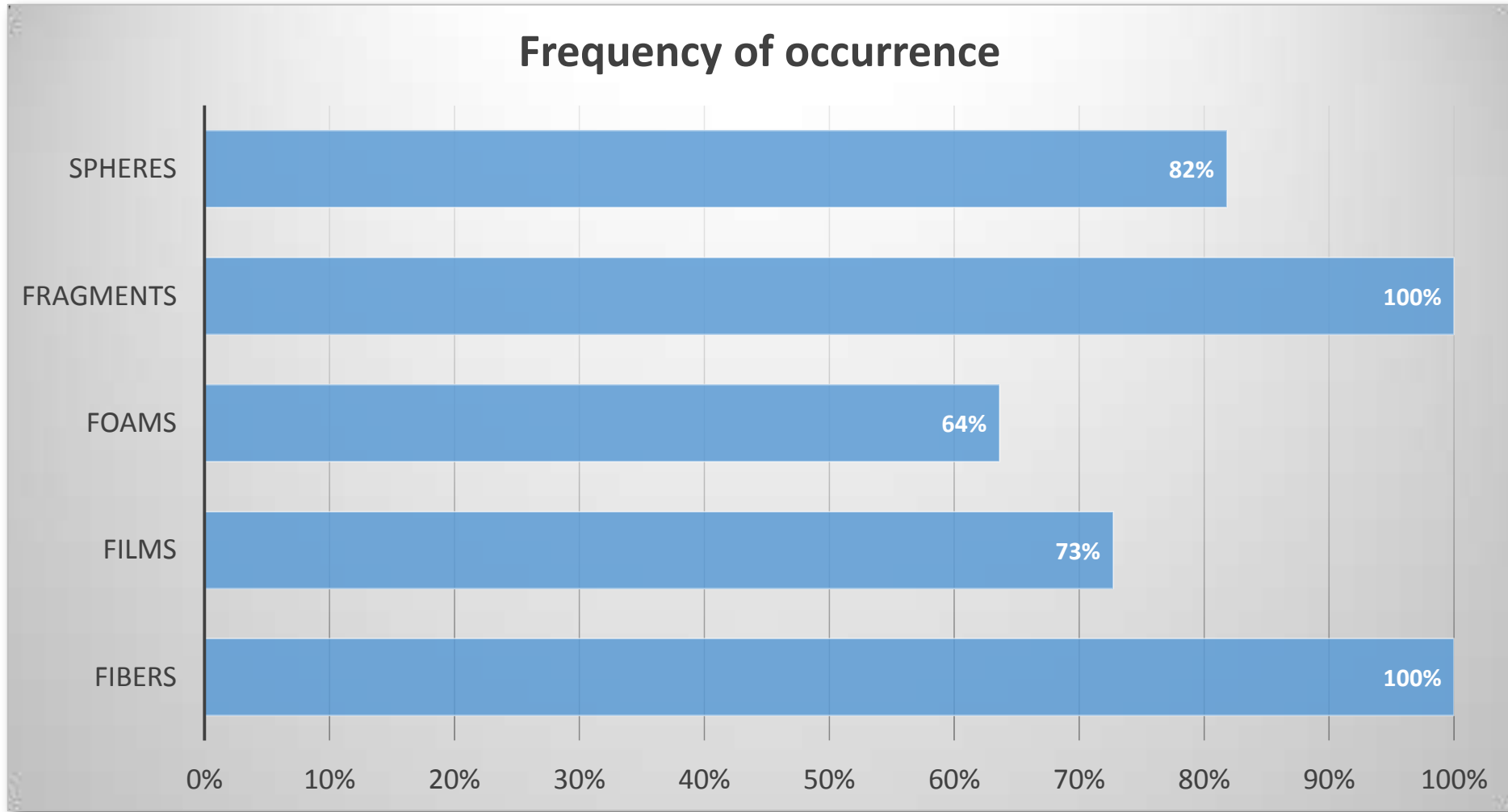


Photo by Javardh on Unsplash

# RESULTS

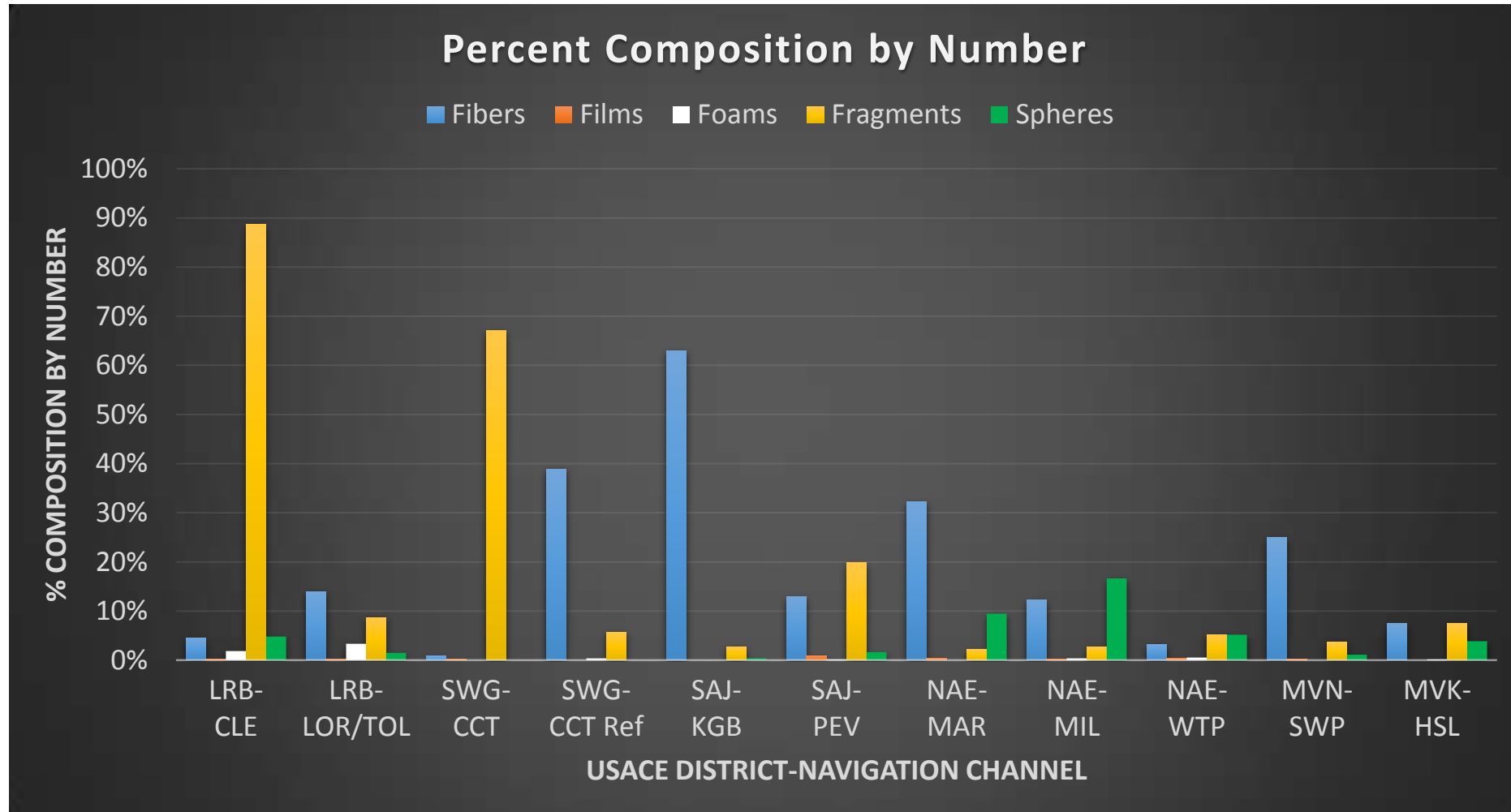


# RESULTS

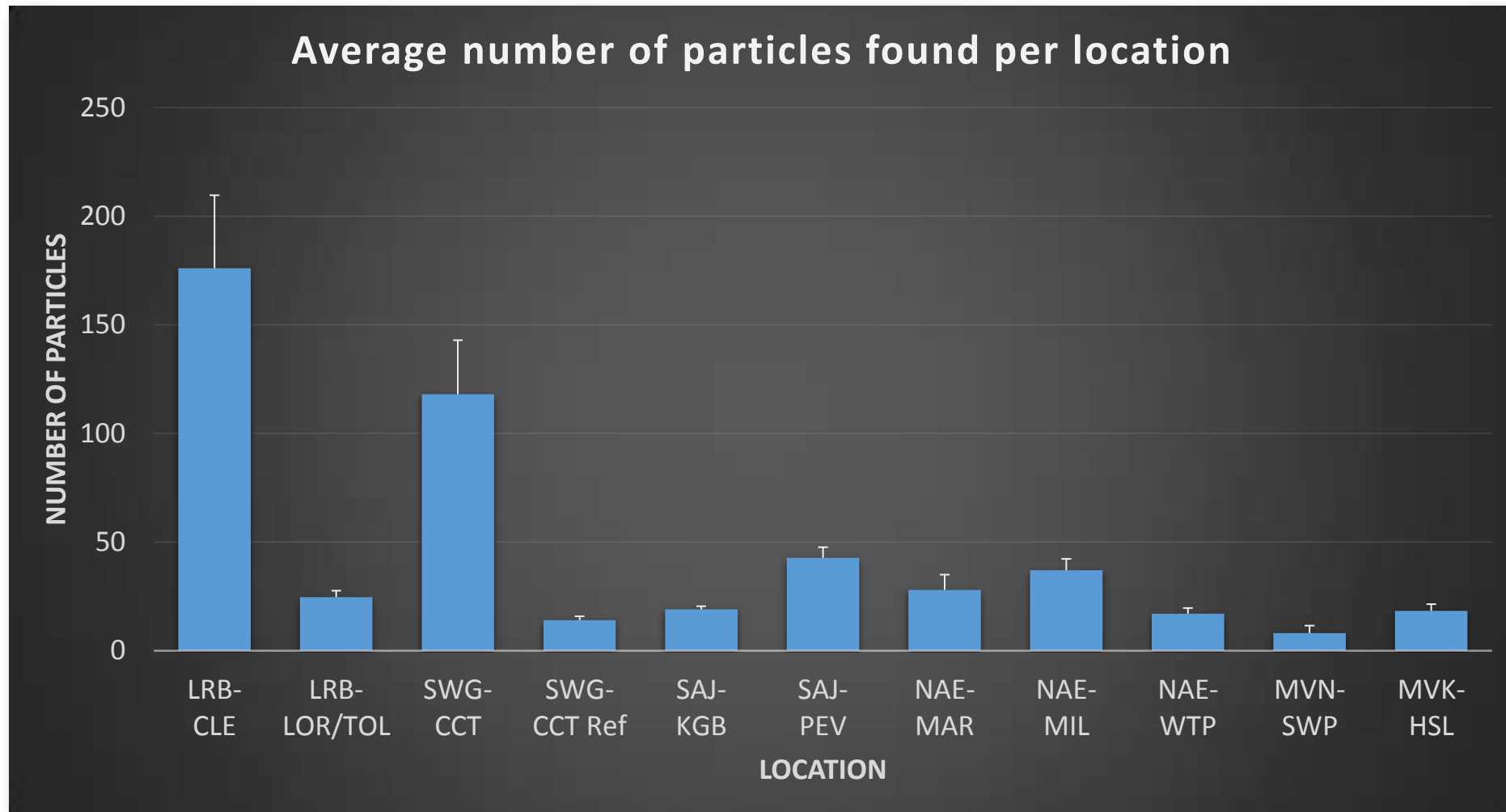




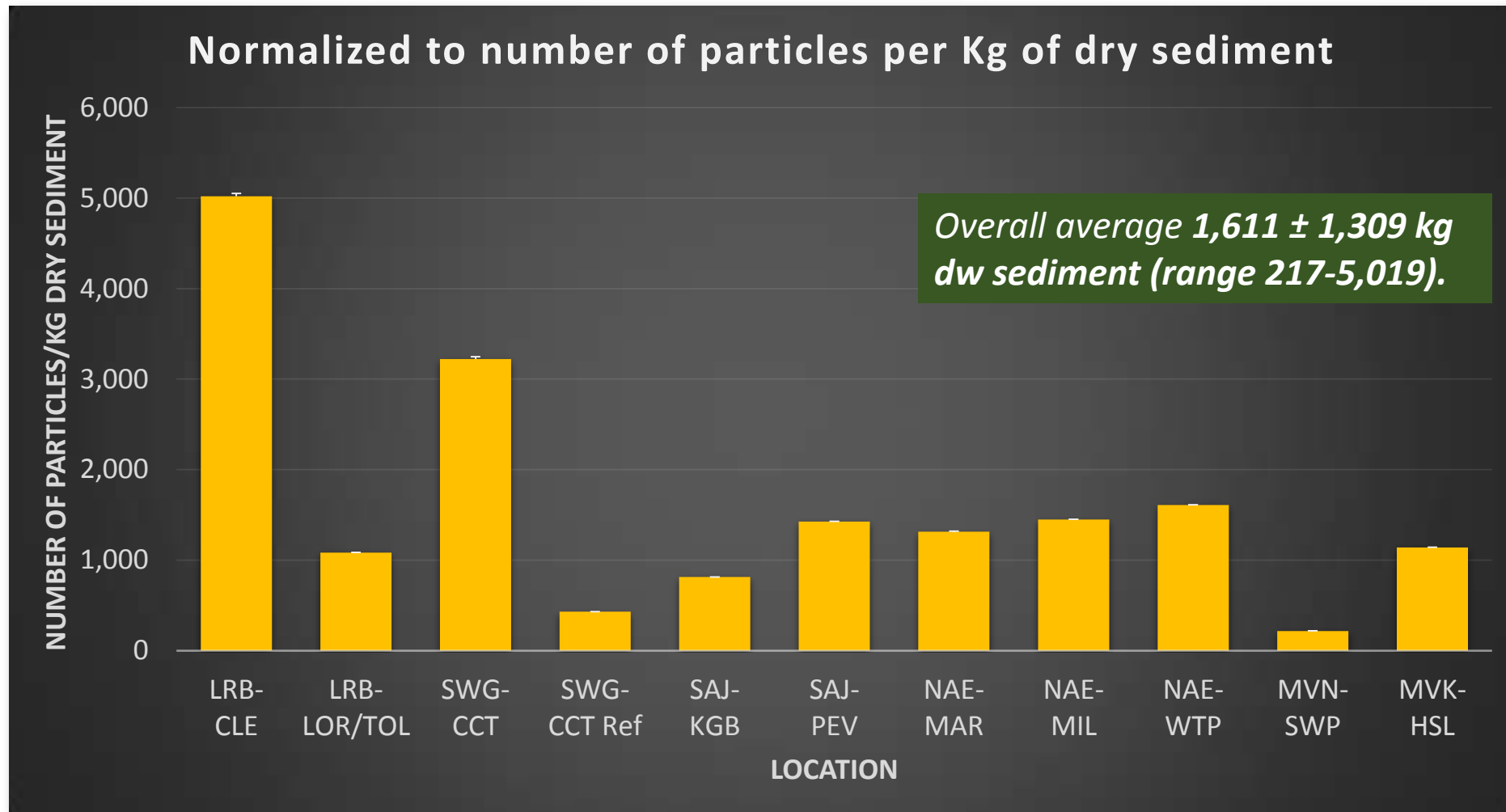
# RESULTS



# RESULTS



# RESULTS



## RESULTS: Selection of microplastics in marine and freshwater sediments.

### Europe

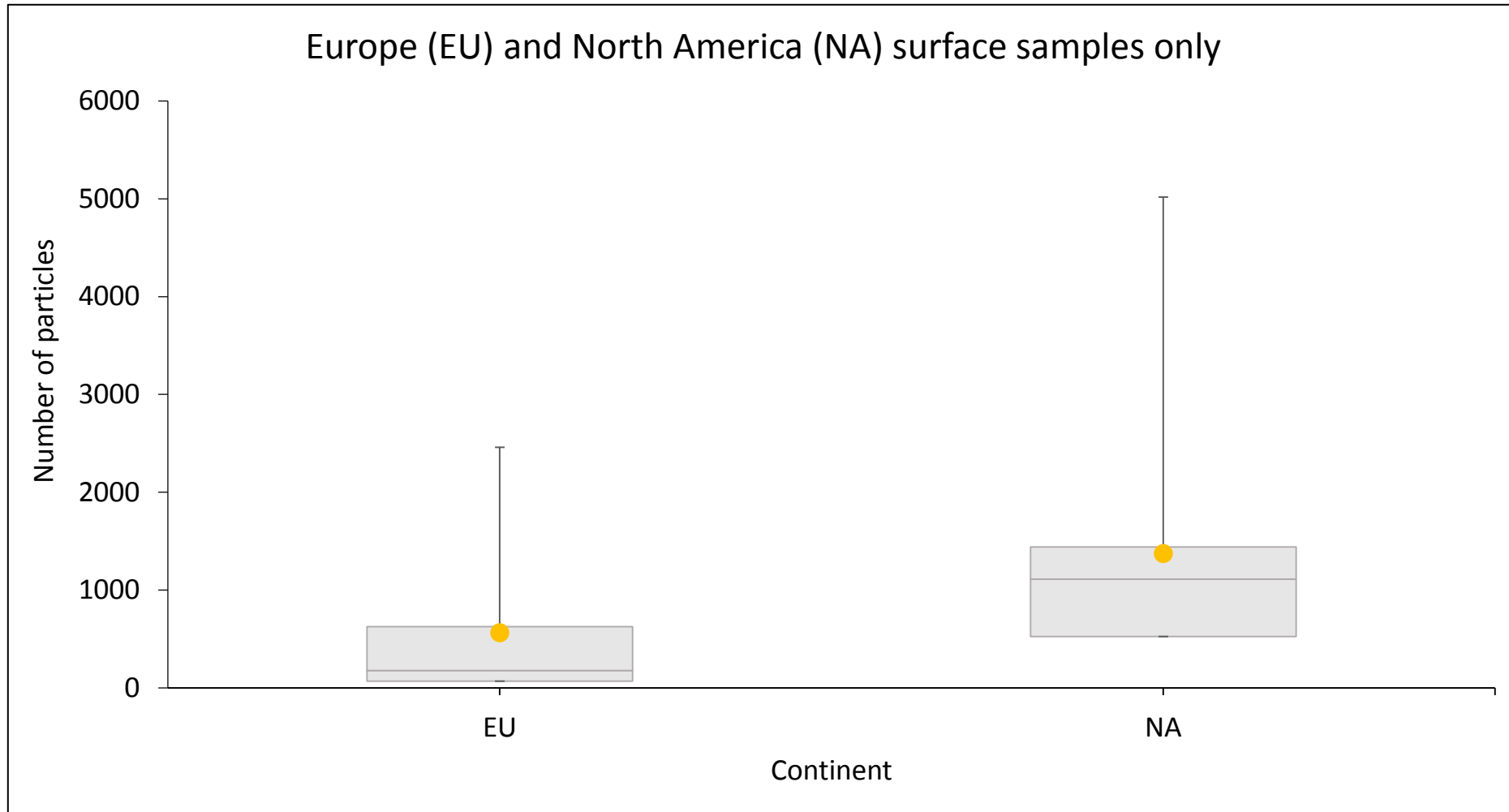
Location	Number of particles ( $\bar{x} \pm SD$ )	Reference
Gulf of Cadiz	75 ± 98 kg dry	Frias et al. 2016
Baltic Sea	22 ± 5 kg dry	Graca et al. 2017
Mediterranean Sea	270 ± 313 kg dry	Alomar et al 2016
English Channel	59 ± 36 kg dry	Thompson et al. 2004*
Lagoon of Venice	1,445 ± 458 kg dry	Vianello et al. 2013
North Sea	167 ± 92 kg dry	Claessens et al. 2011
North Sea	48 kg dry	Karlsson et al. 2017
North Sea	2,460 ± 1,493 kg dry	Leslie et al. 2017
Telaščica Bay	178 ± 122 kg dry	Blaskovic et al. 2017
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 ( $\bar{x} \pm SD$ )	Reference
Lake Ontario	352 ± 374 kg dry	Corcoran et al. 2015
Lake Ontario	921 ± 1,072 kg dry	Ballent et al. 2016
Ottawa R.	220 kg dry	Vermaire et al. 2017
St Lawrence R.	13,759 ± 13,685 m <sup>2</sup>	Castañeda et al. 2014
Maine coast	105 Liter	Graham and Thompson 2009
Florida coast (Atl. O.)	214 Liter	Graham and Thompson 2009
Florida coast (Glf. Mex.)	116 Liter	Graham and Thompson 2009



# RESULTS



# SUMMARY

## OBJECTIVE 1: Microplastic abundance

- Overall average number of particles in the federal navigation channels sampled was **1,611 ± 1,309 kg dw sediment (range 217-5,019)**.
- Microplastics occurred in every sample.
- Fibers and fragments were the dominant particle type followed by spheres.

## OBJECTIVE 2: Literature Review

Overall average number of particles....

- coastal waters: **1,098 ± 1,804 (range 22-7,960)**
- inland waters: **1,062 ± 1,941 (range 82-7,228)**
- Several authors have found that abundances of microplastics was highest in harbors as compared to beach sediments and other subtidal areas.

# PRELIMINARY CONCLUSIONS

## MICROPLASTICS IN FEDERAL NAVIGATION CHANNELS

- These data represent the first sediment microplastic concentrations for federal navigation channels. This study provides evidence that microplastics should be expected in dredged sediment.

## PATH FORWARD

- A statistical analysis of microplastics in bottom sediments.
- Fourier-transform infrared (FT-IR) will be used for quality control.
- ERDC has developed capabilities to extract and identify microplastics (< 5mm) to support USACE District dredge projects where microplastics may be of concern.

# ACKNOWLEDGEMENTS

## Thanks to

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