Activity report on the project "*Microplastic concentration in sediments and waters of Matagorda and San Antonio Bays: Initial assessment and mitigation plans*"

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Period: July 1st 2022 to September 30th 2022 – Laboratory separation and construction of maps with microplastics sediment concentration.

During the quarter of July to September 2022, we continued the work on separation of microplastics from sediments and reviewed the filtered samples to identify the different type of microplastic particles.

The microplastics study laboratory at MSI employed a new column device designed for microplastics density separation (Figure 1) used on 7 selected sediment samples after a filtration on 20 μm and 8 μm filters were analyzed with FTIR. The microplastics abundance was also compared with distribution map from all grab samples.

The 8 μm membrane filter paper were inspected under a wide field microscope to view any larger identifiable plastic particles. Filters were then analyzed by choosing ten squares at random on the gridded filter.

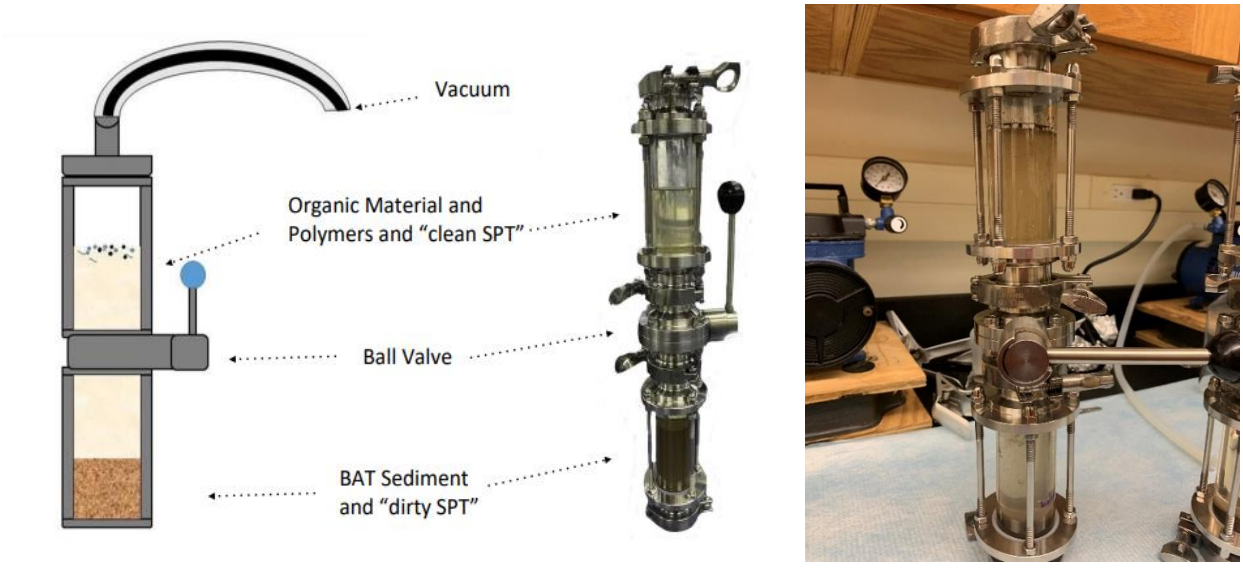

Figure 1. Density separation device (DSD) schematic (left) and during the lab separation(right) (after Löder et al., 2015).

From there, under 15x view, any suspected MP particles were analyzed using microscope-Fourier transform infrared spectroscopy (FTIR, Shimadzu AIM-9000) to identify the polymer composition of plastics. Particles that returned a plastic polymer type with a score >600 were considered for further analysis (Figure 2). FTIR data was then analyzed using RStudio.

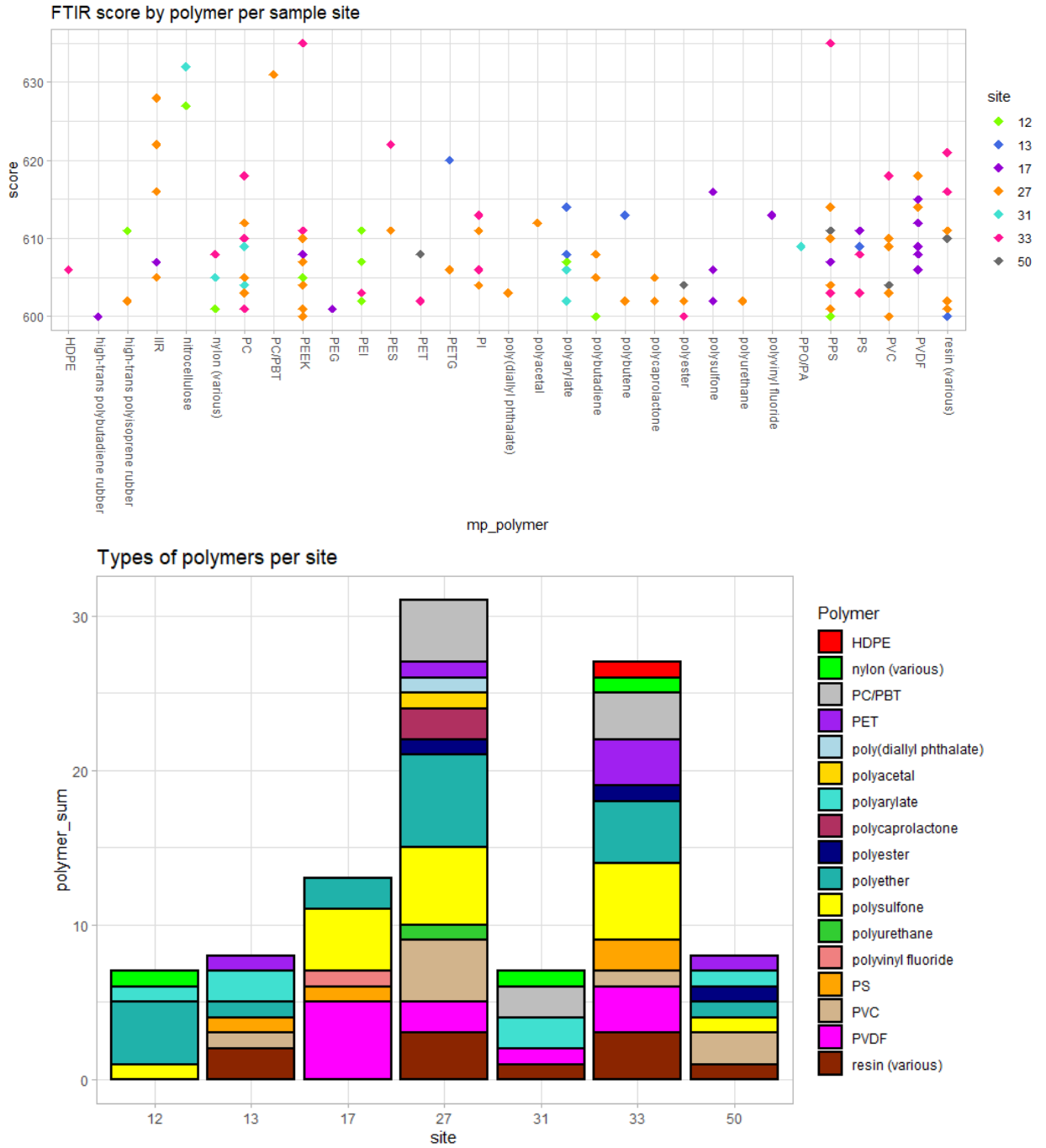

Figure 2. All polymer types identified by FTIR at each site along with their corresponding FTIR score output (top). Amount of common polymer types identified at each site (bottom).

The results of the number of microplastic particles confirmed by FTIR method (Figure 2) are similar with the microscope identification with more particles in sample locations 33 and 27 (Figure 2, lower graph). However, the FTIR analysis allowed the identification of the plastic types that is extremely variable with about 16 identifiable (with a reasonable confidence) plastic polymers. The results obtained so far do not point to a particular trend (areas where a given polymer predominate) and it seems the samples with more microplastic particles also have more polymer types. These observations suggest a depositional environment with a good mix of different sources or an initial heterogenous source.

The microscopy performed during the FTIR analysis confirm the dominance of the previous observed morphologies with fibers and fragment being common (Figure 3).

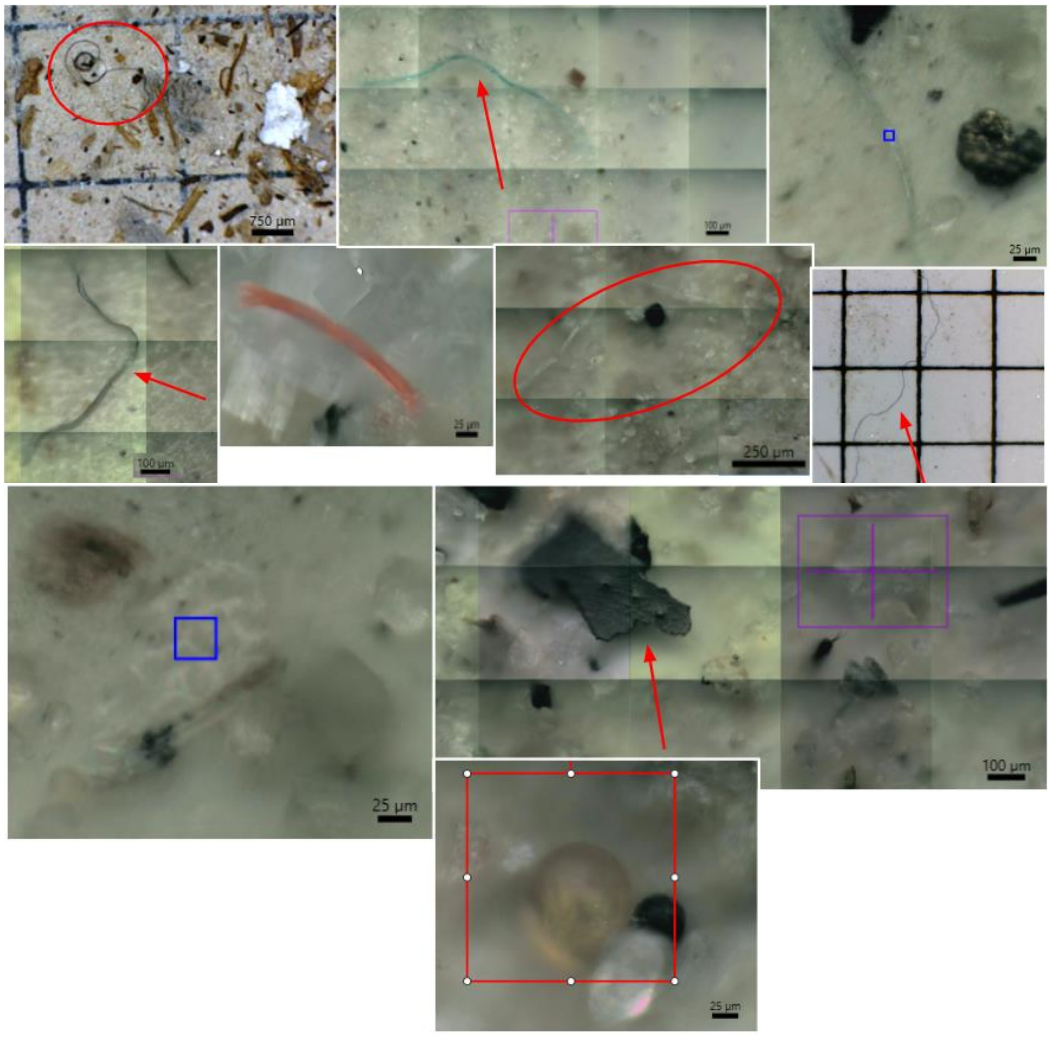

Figure 3. Microplastics morphologies found under inspection of filters including fibers (top) and fragments (bottom) and analyzed with FTIR method.

The previous grab and core samples have been reviewed and the microplastics particle counted again with disregard of the multiple (hundreds) of circular disc morphologies which have been identified as diatom frustules. However, the updated map (Figure 4) indicates some areas with high microplastic content such as Lavaca Bay or inner San Antonio Bay. Microplastics concentration map shows high contents in distal bay areas (behind the barriers) rather than in the central area of the Matagorda and San Antonio bays (Figure 4) where is the deepest water and with lower energy. Increased concentration behind the barriers might be linked with microplastics resuspension and transport or with the particles washed into the bay over the barrier during storms.

The microplastic concentration distribution it is not well correlated with the grainsize distribution in the Matagorda Bay (from late 1970s map, see Figures 4 and 5). We are working on new grainsize analyses for the samples collected and the results will be (1) compared with the grainsize distribution of the 1970s map to understand the mud/sand transport in the bay, and (2) new grainsize map will be checked against microplastics concentrations.

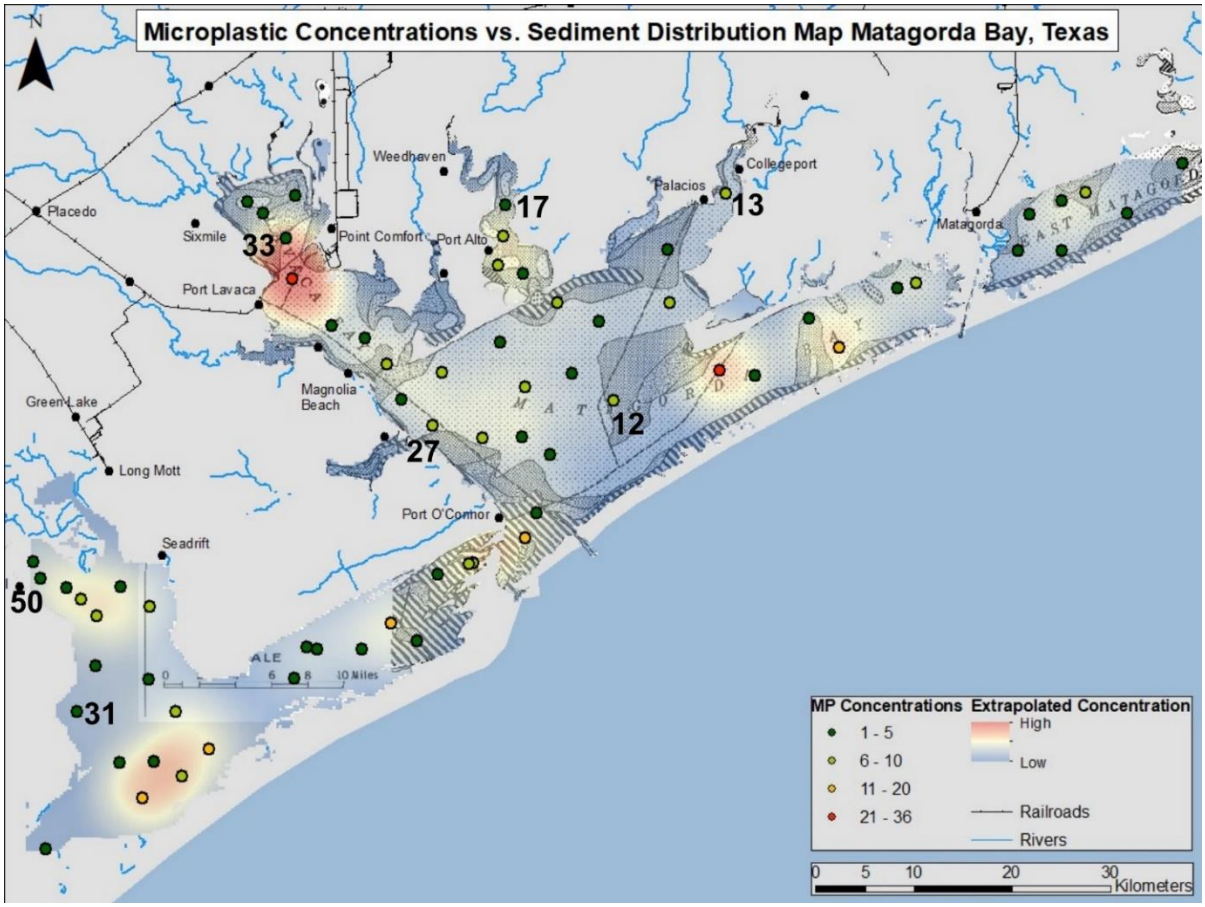

Figure 4. Revised map of microplastics distribution in bottom sediments (~ 10cm thick) in San Antonio and Matagorda bays. The numbers represent microplastics (smaller than 5 mm particles) counts per 100 g of sediments. Larger numbers indicate the locations analyzed with FTIR. Note the colors of the points in legend is related to number of microplastics per sample. The background black and white map represent the bay sediment grainsize from McGowen et al., 1979 (see Figure 5 for legend).

Fibers and fragments of microplastic particles distributions seem to have a pattern on the distribution map (Figure 5) with more fibers in San Antonio Bay, Lavaca Bay, and Matagorda shipping channel, while the central-east part of main Matagorda Bay together with Tres Palacios and Vaes bays have more fragments (Figure 5). While more analyses on the water currents and sediment transport processes is needed, a first observation is that inner San Antonio and Lavaca bays are areas with higher population and industry activity, and microplastic fibers are well known to be sourced from clothing materials or fishing nets.

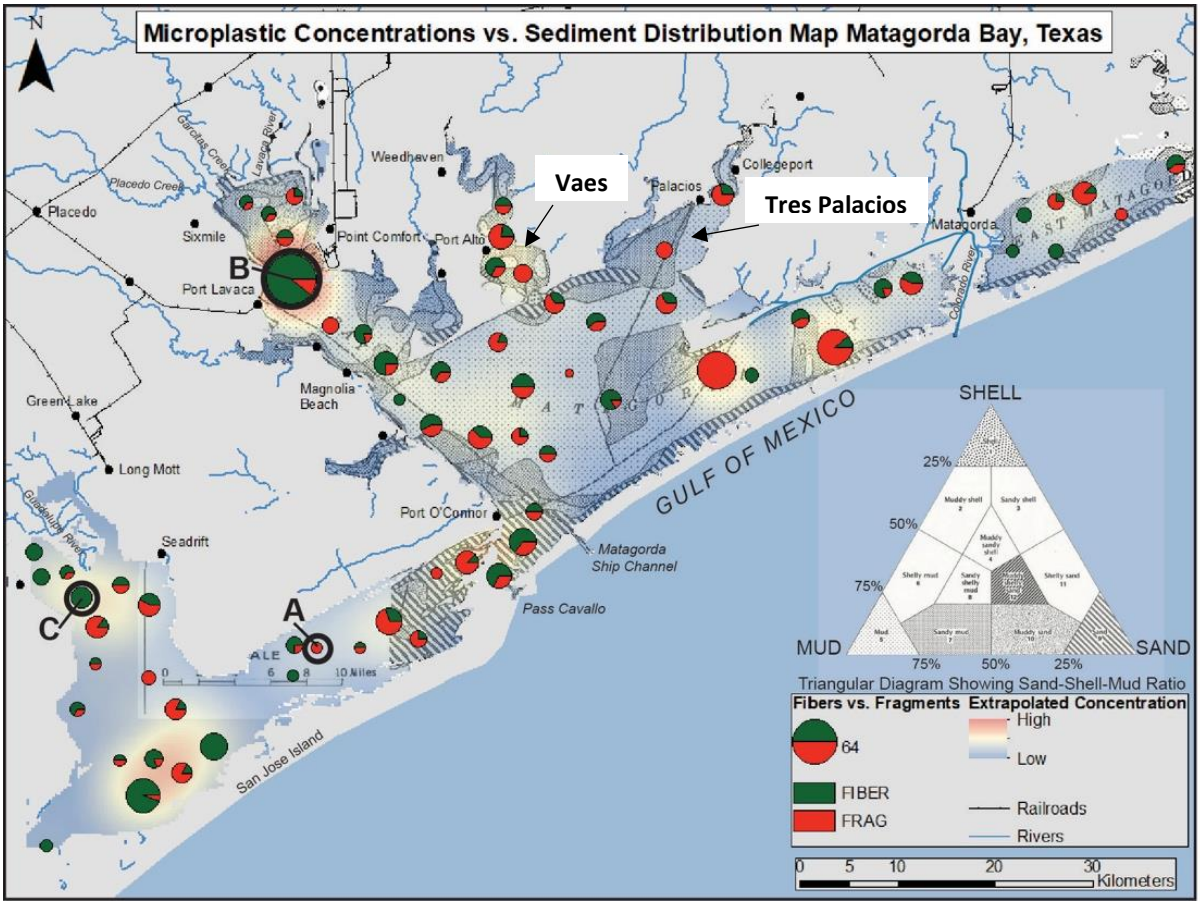

Figure 5. Distribution of microplastics in Matagorda and San Antonio bays sediments separated between fibers (with green) and fragments (with red) morphologies. The background (black and white) pattern shows the grainsize.

The project will continue do add new microplastics concentration from sediment/core samples and FTIR analyses together with new sediment grainsize analyses and observation of bay water circulation.

References

Löder, M. G. J. *et al.* Methodology Used for the Detection and Identification of Microplastics—A Critical Appraisal. *Marine Anthropogenic Litter* 201–227 (2015) doi:10.1007/978-3-319-16510-3_8.

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