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

PIs: Cornel Olariu and Zhanfei Liu, The University of Texas at Austin

PhD students: Will Bailey, Xiangtao Jiang

Postdoctoral scholar: Kaijun Lu

Period: October 1st 2022 to December 31th 2022 – Continuation of laboratory microplastics separation with focus on the sediment cores and construction of maps with microplastics sediment concentration.

During the quarter of October to December 2022, we continued the work on separation of microplastics from sediments by opening more sediment cores collected.

Core numbers 3, 22, 26, and 120 were opened and sediment from top, bottom and middle sampled for microplastics. See Figure 1 for location of the cores which were opened and analyzed. The cores that were collected in aluminum tubes were opened, cut in half, photographed and sampled every 2 to 4 cm. The sediments in the core were in general silty-sandy muds (grainsize analysis will reveal the detail grainsize) with diffuse layering (Figure 2) at some levels abundant reworked shelly material can be observed. The lack of layering in the cores opened so far suggests (1) little variability in the grainsize of the available sediment in the system, or (2) the continuous mixing of the sediment during deposition. As it was already mentioned in a previous report, the microplastics have been found in cores at a depth of 50 cm indicating the presence deep in the sediment deposits (Figure 3). We are not sure yet about the mechanism to emplace the microplastics at 50 cm deep in the sediment below the bay water-sediment interface. There are multiple possibilities to explain the presence of microplastics tens of centimeters deep in the substrate:

1. The sediments were accumulated through time and the deeper buried microplastics represent some of the earlier deposited microplastics, for example deposited 50 years ago (if the sedimentation rate is considered 1 cm per year);
2. There is the possibility of recurrent resuspension and re-deposition of the sediments (microplastics included) through stirring of the unconsolidated sediments through shrimp trawling;
3. Strong storms and hurricanes can also resuspend the sediments due to increase bottom shear stress and locally can form tens of cm deep erosions (i.e., Larm, 1998), the suspended sediments during storm/hurricane events eventually settles depositing the microplastics deeper;
4. Activity of benthic fauna that live on the substrate or burrow in the substrate can bury the microplastics sediments (through infiltration).

We are not sure which of the mentioned mechanisms, or combination of mechanisms are contributing to the burial, 50 cm or more, into the bay sediment. The microplastics burial through sedimentation is the most conservative explanation and is likely to happen especially in areas with high sedimentation rates such as in front of the Colorado River Delta. However, there are studies that documented strong sediments resuspension through anthropic (Palanques_et_al, 2001, Delappena et al., 2006) or natural mechanisms such as hurricanes (Larm, 1988, Bronikowski, 2004) as well as "down migration" of grains through bioturbation (Näkki et al., 2017).

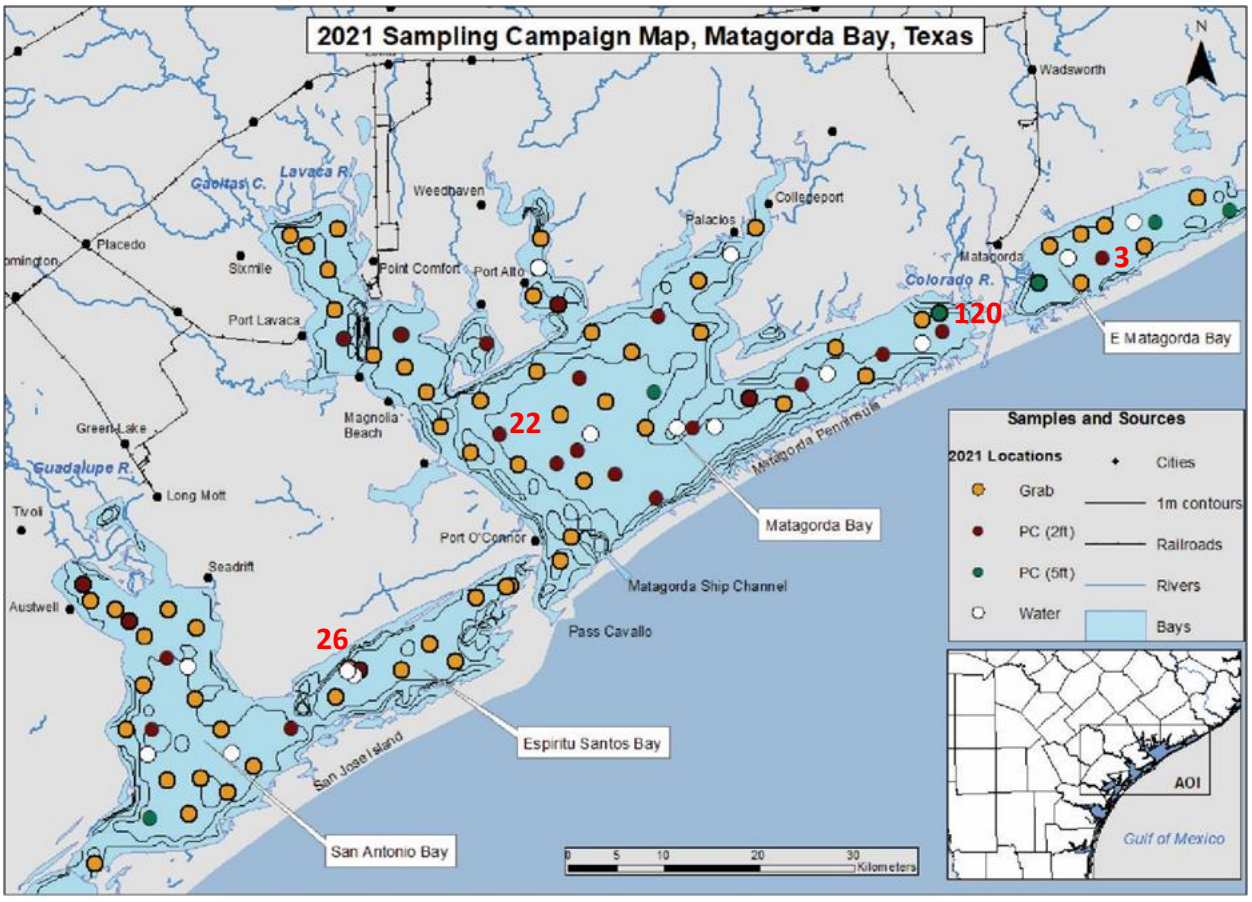

Figure 1. Map of 2021 sampling campaign illustrating locations of sediment grab, push core (PC) and water (Secchi disk, plankton tow, pH, salinity) samples. Rivers, cities, and roads marked to indicate potential MP sources. Black lines represent 1-4m bathymetric contours, where maximum water depth. Note the location of the 4 cores analyzed and with microscope photos shown in the figure 3.

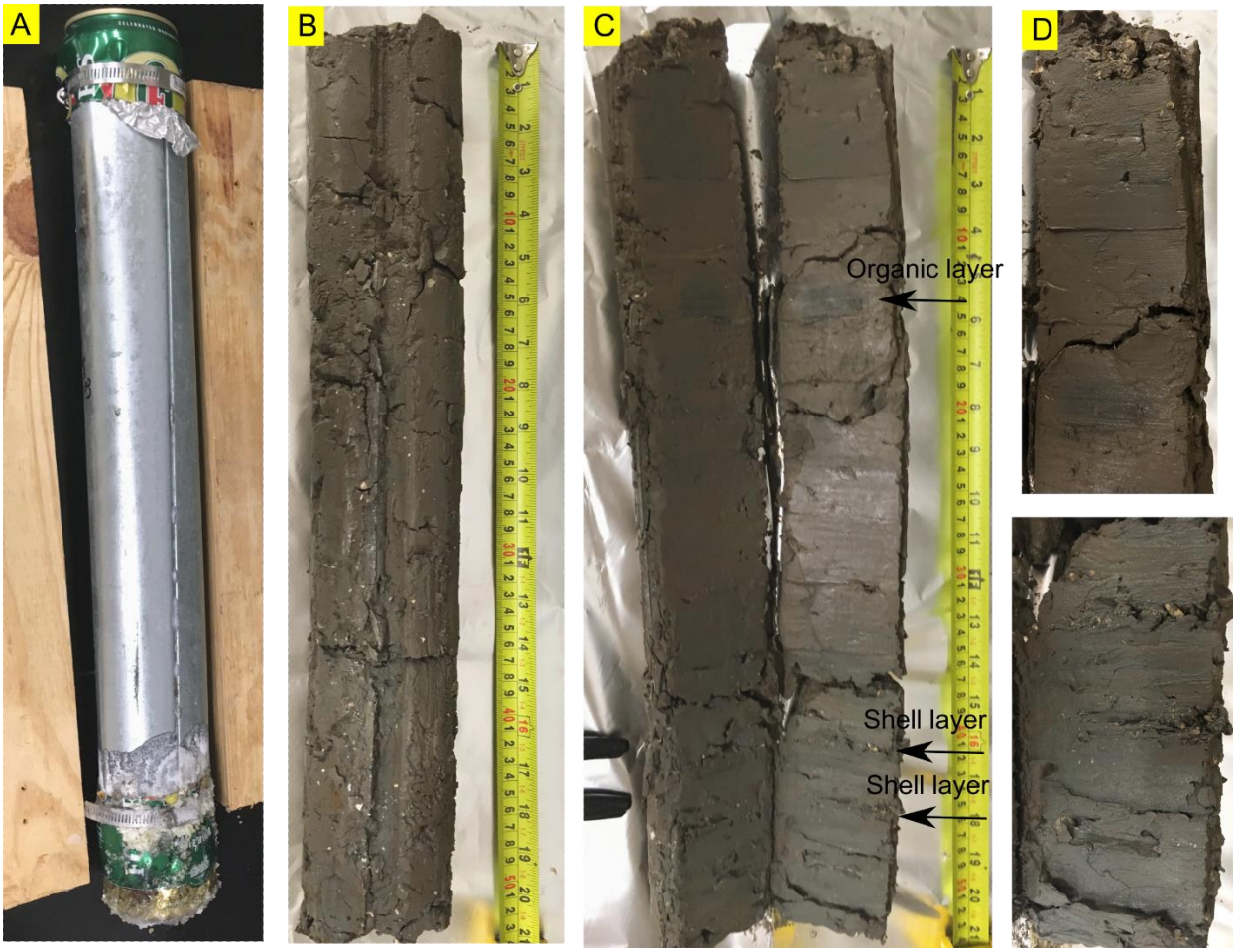

Figure 2. Documenting the pushcore 22 form Matagorda Bay. A - Left is the core in the metal sleeve. B – Unsliced core. C - Sliced core notice that arrows are pointing to the organic rich and shell rich layers, D – Close up photos of the shell layers. Note that deposits have an overall structureless appearance, without lamination or other sedimentary structures.

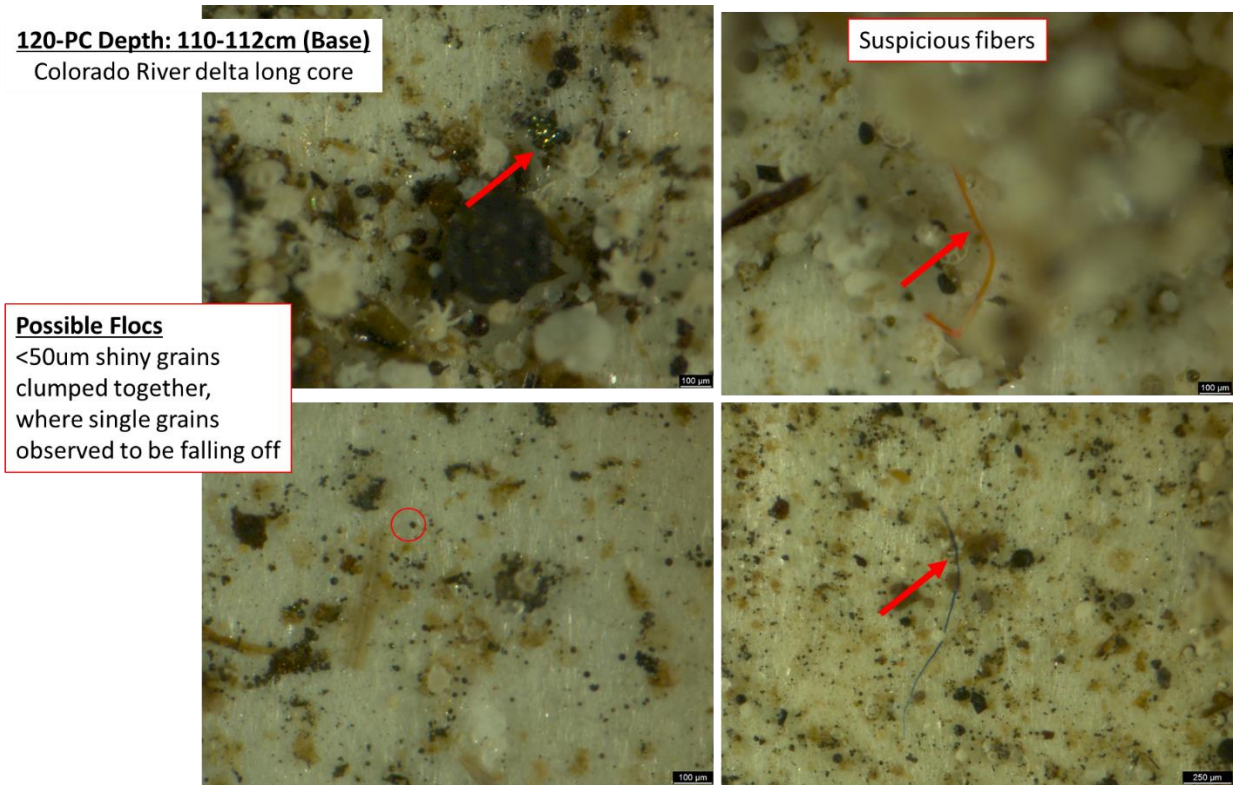

Figure 3. Microscope photographs showing examples microplastics particles at the base of the pushcores 120 located in front of the Colorado River Delta, eastern map of the Matagorda Bay. See figure 1 for the location of the core. The red arrows are pointing to the observed microplastics. Top left and lower left particles forming flocs that might be microplastics. Scale bar on the photos (black line in lower right corner) is 100 microns with the exception of the lower right image which has a 250 microns scalebar.

In November, Will Bailey successfully defended his proposed PhD research titled "The Fate of Microplastics in Texas Bays". The proposed research gravitates around the present research project with an overall objective to provide a sedimentological framework for concentrating microplastic (MPs) deposits within bay environments by understanding mixing of terrestrial and marine sediment sources, and the key processes which govern transport and deposition of microplastics. In addition to mapping the distribution of the microplastics in the bay sediments, Will Bailey's research will also focus on (1) the factors controlling microplastic distribution through assessing the bay sediment transport regime, and (2) use numerical models to investigate sediment (and microplastic) deposition and re-entrainment during normal and extreme hydrodynamic conditions. In preparation for the PhD proposal defense examination and in pursuit a non-destructive "in-situ" method, the Computer Tomography method was tried on some test "made up" sediment cores using Matagorda Bay sediments (Figure 4). The method was successful to reveal the known inserted plastic materials (Figure 4). However, the test core was only 4 cm and the approximate location of the inserted plastic material was known. It is more challenging to use a large 30-50 cm core and with an unknown but low concentration of microplastic particles.

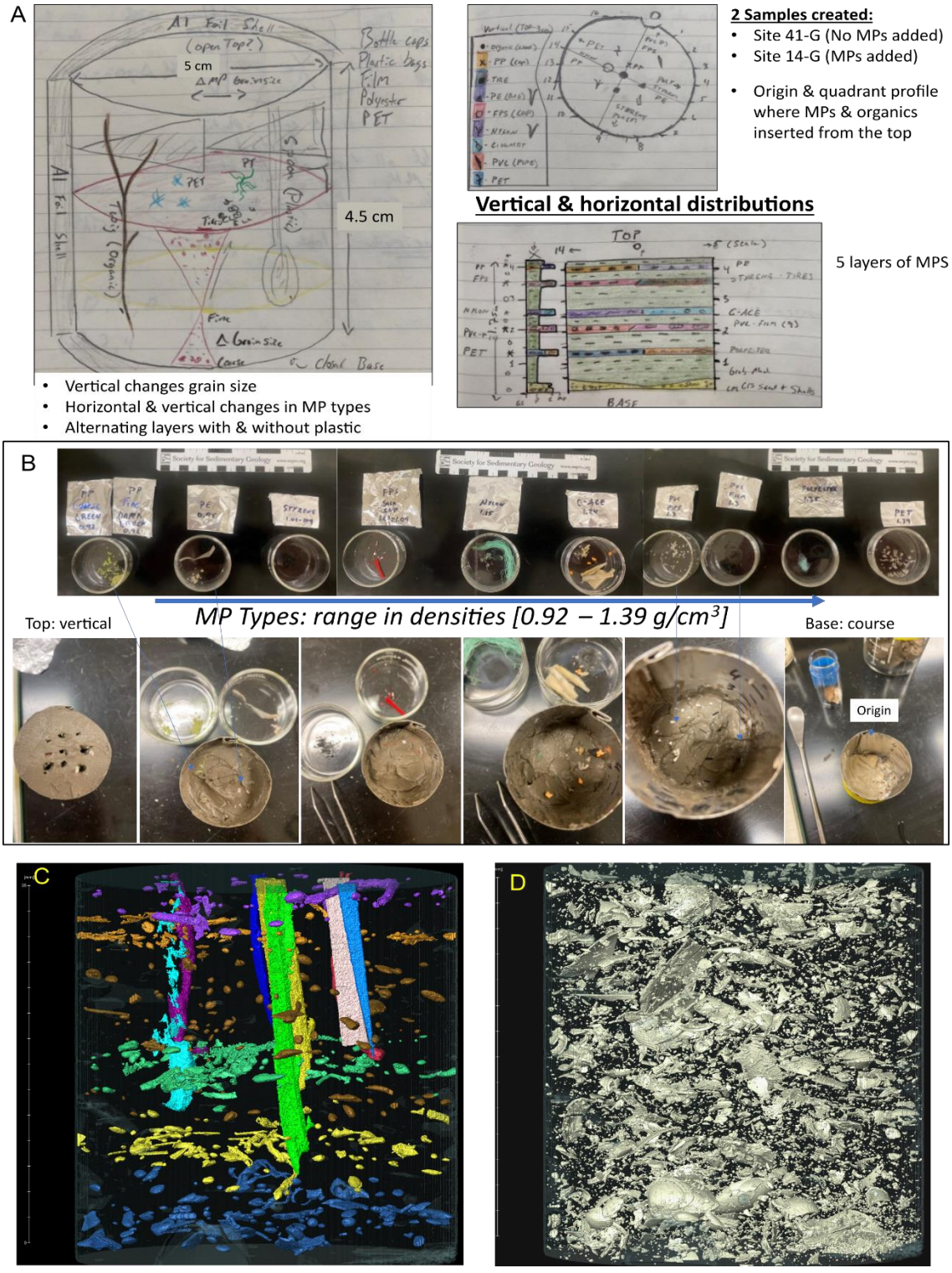

Figure 5. Image of tryout core samples with different plastic types in Matagorda Bay sediments. A- Set up sketch of the plastic material in the core. B- Photos of the different types of plastic used. C- 3-D CT scan image of microplastics. D- 3-D CT scan image of shell fragments.

References

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