2025 Analysis of Particle Size and Total Organic Content in Bed Sediments in Puget Sound, WA

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Introduction

The TOC and PSA work done this quarter is part of continuing research done here at the University of Washington, Tacoma for King County's Marine Monitoring Program of Elliot Bay.
All sampling took place throughout June with TOC and PSA protocols taking place in late July and early August of 2025.
This research focuses on the grain size of varying sediment samples (PSA), and the total organic content (TOC) for each sample.

*In the context of our research, there is no distinction between organic and inorganic carbon due to the combustion process

Purpose of Study

Analyzing the TOC and grain size in aquatic sediments give understanding to the environmental health and chemical dynamics inside our aquatic ecosystems. Finer sediments like clays and silts tend to have a higher concentration of the organic content inside; likely due to increased surface area and permeability, which can be one of the several factors leading to anoxic conditions.
Strengthening and understanding the connection between TOC and PSA allows us to know what we can do to help our ecosystems by encouraging safer discharge, removal of Harmful Algae Blooms (HAB's), and reduce Urban Stormwater Runoff

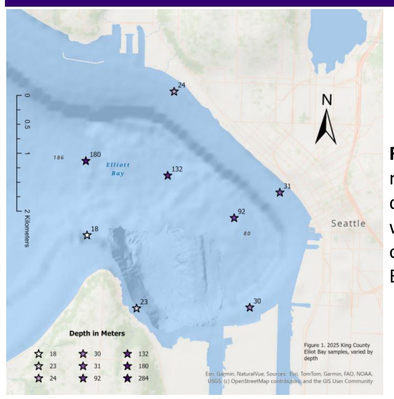

Figure 1. ArcGIS map made showcasing different stations from where samples were obtained from in Elliot Bay (2025)

References

Methods

Total Organic Content (TOC)

- 5 mL of each sediment sample was deposited and weighed in crucibles to calculate wet mass.
- Samples were oven-dried for 5 hours at 105°C, then weighed again after cooling to determine the dry mass
- They were placed in the oven at 650°C for 8 hours to burn organic material, cooled, then weighed a 2nd time to determine the mass of Carbon
- TOC percentages for dry and wet values per sample were calculated by dividing the mass of carbon by the mass of each parameter and multiplied by 100%.

$$\frac{weight\ of\ carbon}{(wet\ or\ dry)\ sample\ weight} \times 100\%$$

Particle Size Analysis (PSA)

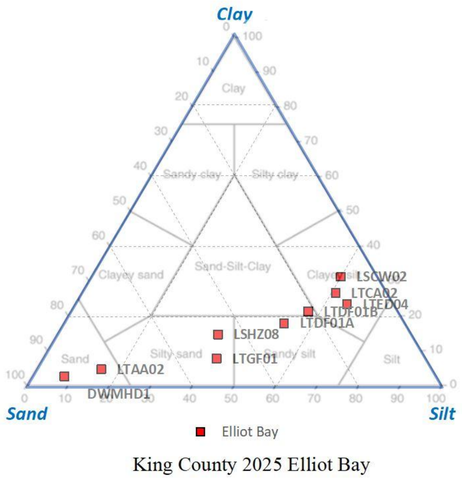

Figure 2. Ternary plot created using 2025 King County Monitoring data from Elliot Bay, overlaid on a previously labeled Shepard classification system (1954).

- 2-3 cm sediment layers collected with Van Veen, classified by coords then bagged/jarred and stored in a cold-dark place simulating similar environment
- Mixtures were stirred until evenly suspended
- Sample was slowly dropped in LS13 320 Particle Size Analyzer until obscuration reached 8-12%
- Procedure repeated twice minimum per sample

Results

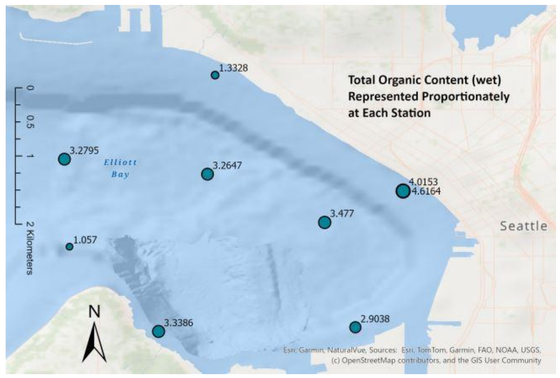

Figure 3. TOC wet, with values ranging between 2.0% – 5.0%

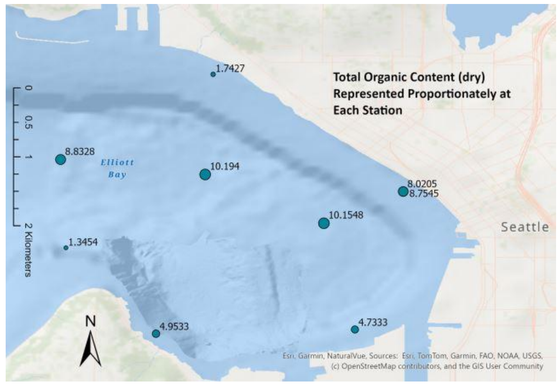

Figure 4. TOC dry, with values ranging between 2.0% – 14.0%.

Results

- Most samples contained a larger amount of Silt compared to their sand/clay counterparts
- Median grain-size of samples ranged between 15 µm - 290 µm with the average around 80 µm
- TOC (wet) % ranged from 1.05 – 4.61%
- TOC (dry) % ranged from 1.34 – 10.19%
- Median grain size vs TOC (wet) analysis: R^2 = 0.5133, moderate correlation
- Median grain size vs TOC (dry) analysis: R^2 = 0.5486, moderatie correlation

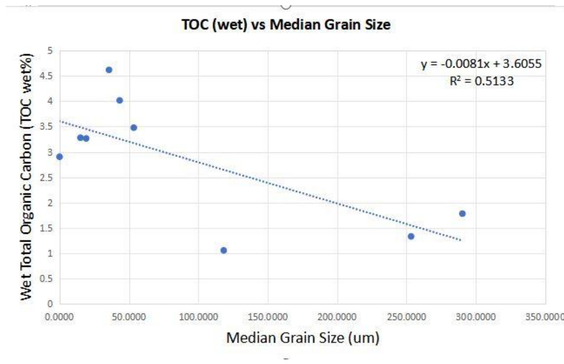

Figure 5. Median grain size (µm) versus TOC_{wet} %

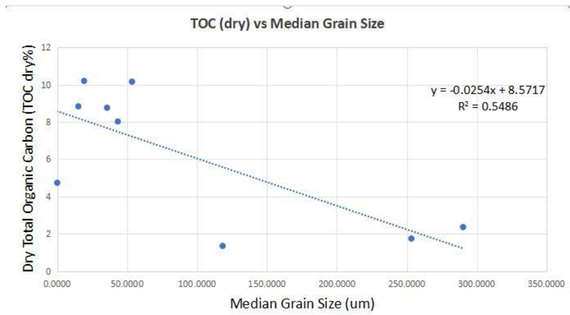

Figure 6. Median grain size (µm) versus TOC_{dry}%

Research Significance

Elliot Bay is perhaps the most important local waterway for King County because of its vital ecological and economical impacts it has on Seattle and the surrounding landscape.
Other researchers have also found that smaller particle sizes had the highest total organic carbon percentages (Arunachalam et al. 2022).
By expanding sampling to additional stations acrross the Elliot Bay will strengthen and by taking more consistent samples at different times of the year, it will hint at episodic events and improve statistical power for future funding.
Research into King Counties heavy human activities and events are needed to help determine recent effects from human impact on different sediments.

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