

The Role of Organic Matter in Fine-Grained Marine Sediments

By Casper Hui

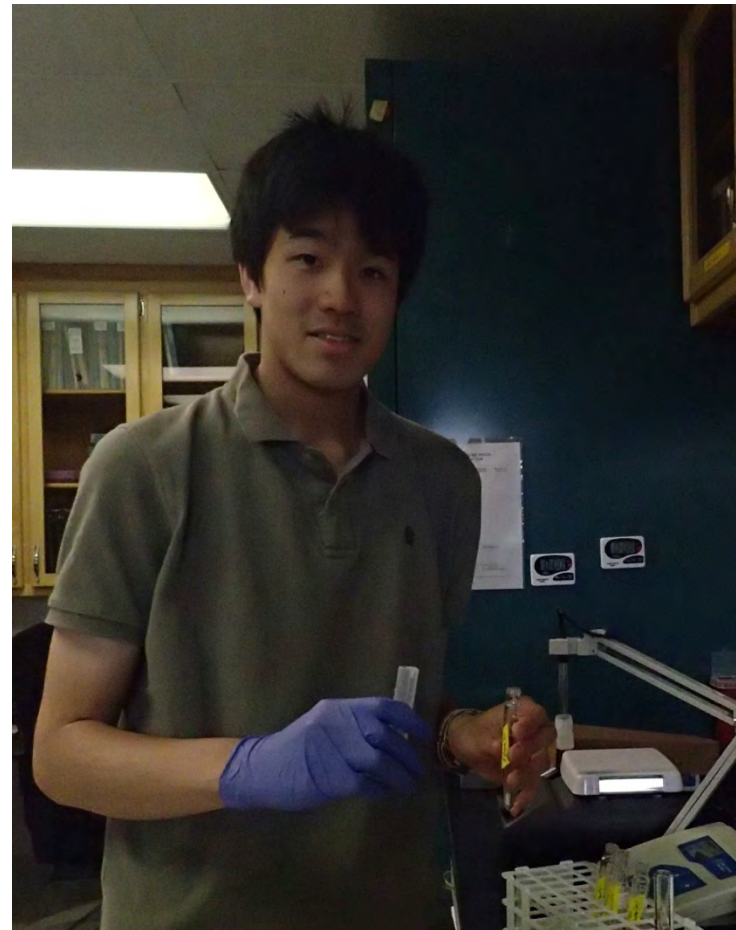
**Mentor: Dr. Kelly Dorgan
Dauphin Island Sea Lab**

**NOAA-NGI Diversity Internship
Program 2014**



About Me: Casper Hui

- Hometown: Hong Kong
S.A.R., China
- The Pennsylvania State
University
 - Expected graduation: Spring
2015
- B.Sc. Earth Science
(Climatology Option)
 - Minors in Geographic
Information Science (G.I.S.),
Geography



Mentor at DISL: Dr. Kelly Dorgan

- PhD., 2007, University of Maine
- Senior marine scientist at the Sea Lab
 - Specialization: Burrowing forces, polychaetes, benthic ecology





Project Background: Why Care About Sediment?

- **70% of Earth's surface = Marine sediment!**
 - **Burial of carbon**
 - **Ecologically important**

Types of Sediment: Mud vs Sand

MUD

- Higher OM content
- Smaller grains (<63 microns)
 - Higher porosity
- Cohesive, 'gelled' physical structure


SAND

- Lower OM content
 - Larger grains
 - Lower porosity (higher permeability)
- Granular (loosely consolidated)



Organic Matter in Sediment

- Preliminary data: Organic matter controls mechanical properties of muds.
- Not all organic matter controls structure
- Total organic matter: Measured via organic carbon, nitrogen

- 
- **EPS (extracellular polymeric substances)**
 - Secreted by microorganisms
 - Stabilizes sediments, decreases erosion
 - Components: **Colloidal, Bound**



Project Hypothesis

**EPS controls the mechanical
properties of muds.**

Bound EPS, not colloidal EPS,
controls stiffness in muds.



Project Objectives/Goals

- **Establish a protocol**
- **Quantify Colloidal, Bound EPS**
- **Explore relationship between EPS and mud mechanical properties**

Sampling in the field!

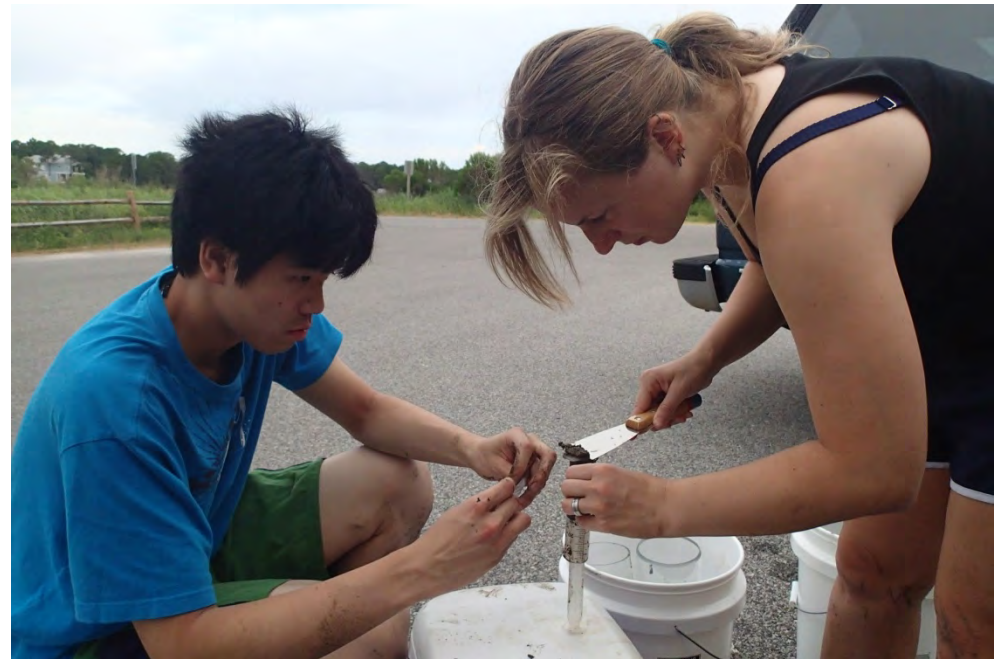
Airport marsh, Dauphin Island, AL



Coring in the field..



Extracting, Sub-Sampling Cores..



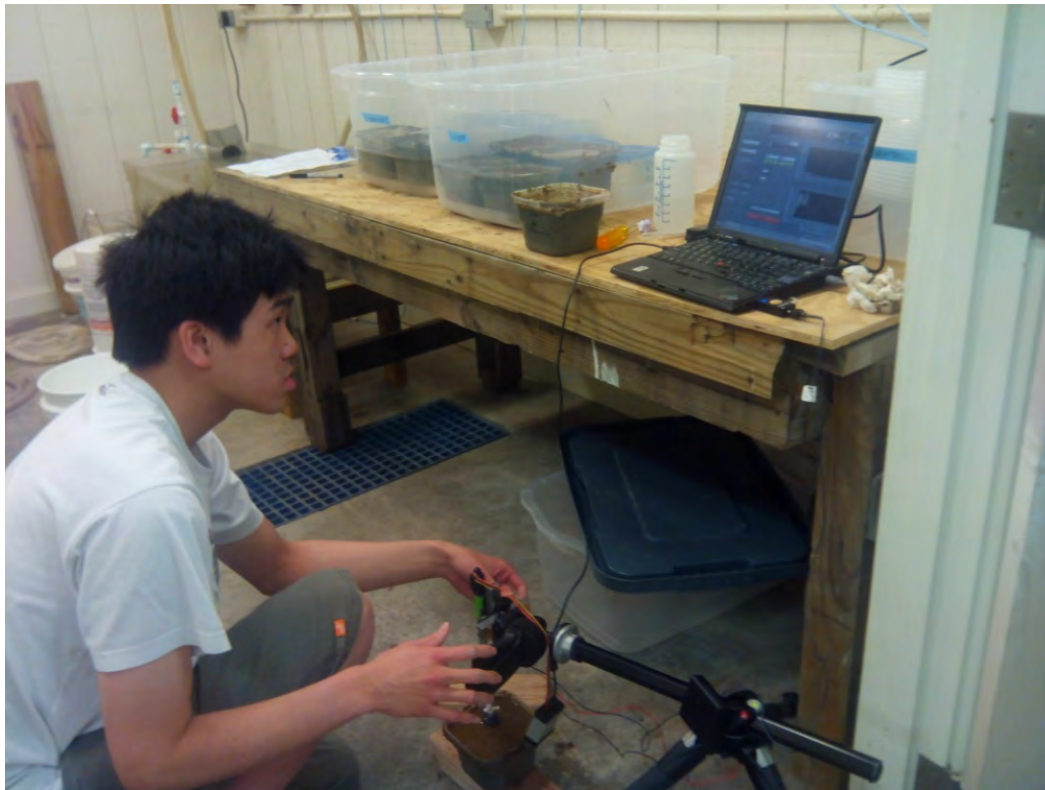
Lab Analysis

Quantifying Organic Matter



- **EPS (carbohydrates)**
 - Colloidal
 - Bound (EDTA-extractable)
- Total Organic Carbon, Nitrogen

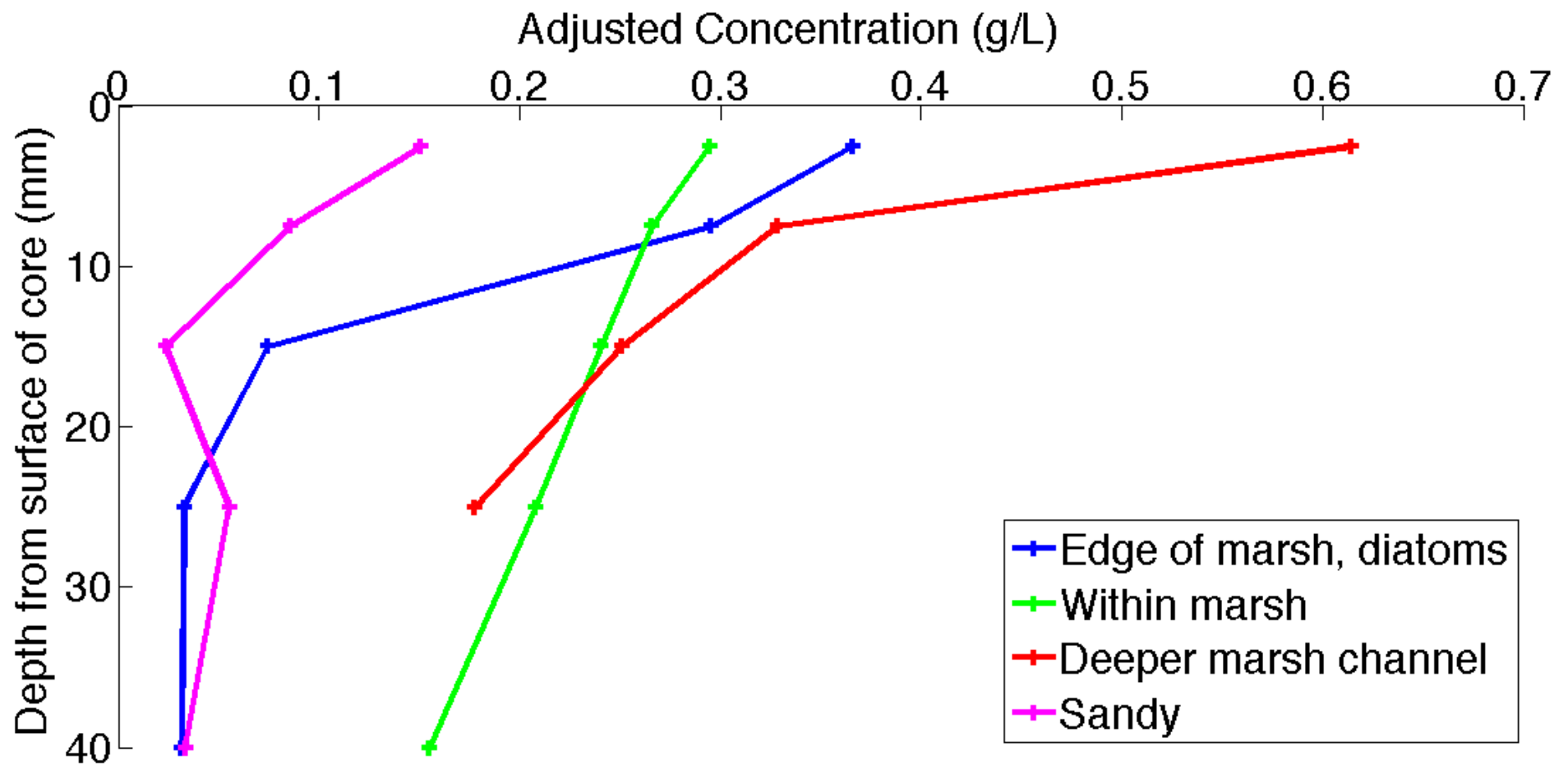
(More) Analysis...



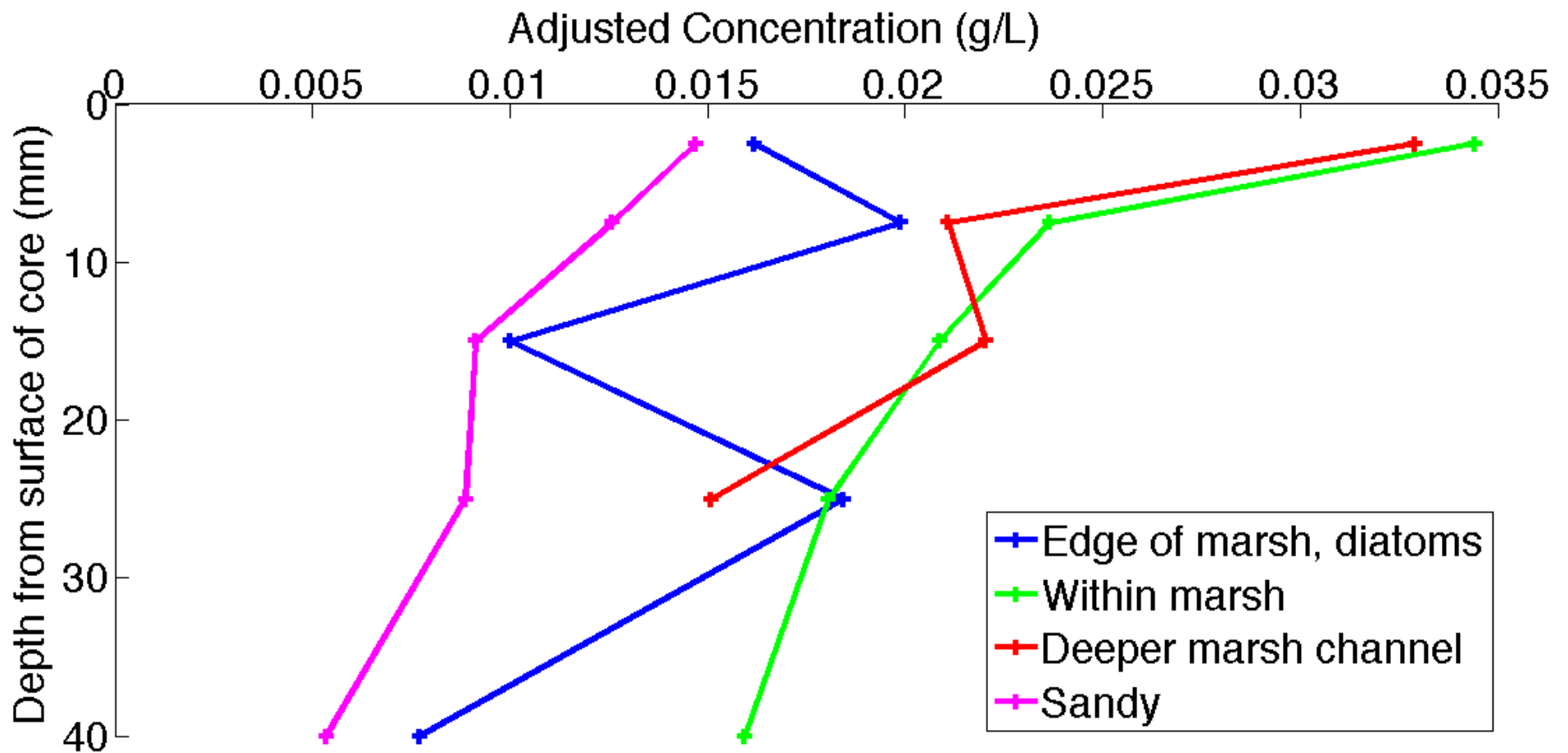
- Stiffness (Force-Displacement)
- Porosity



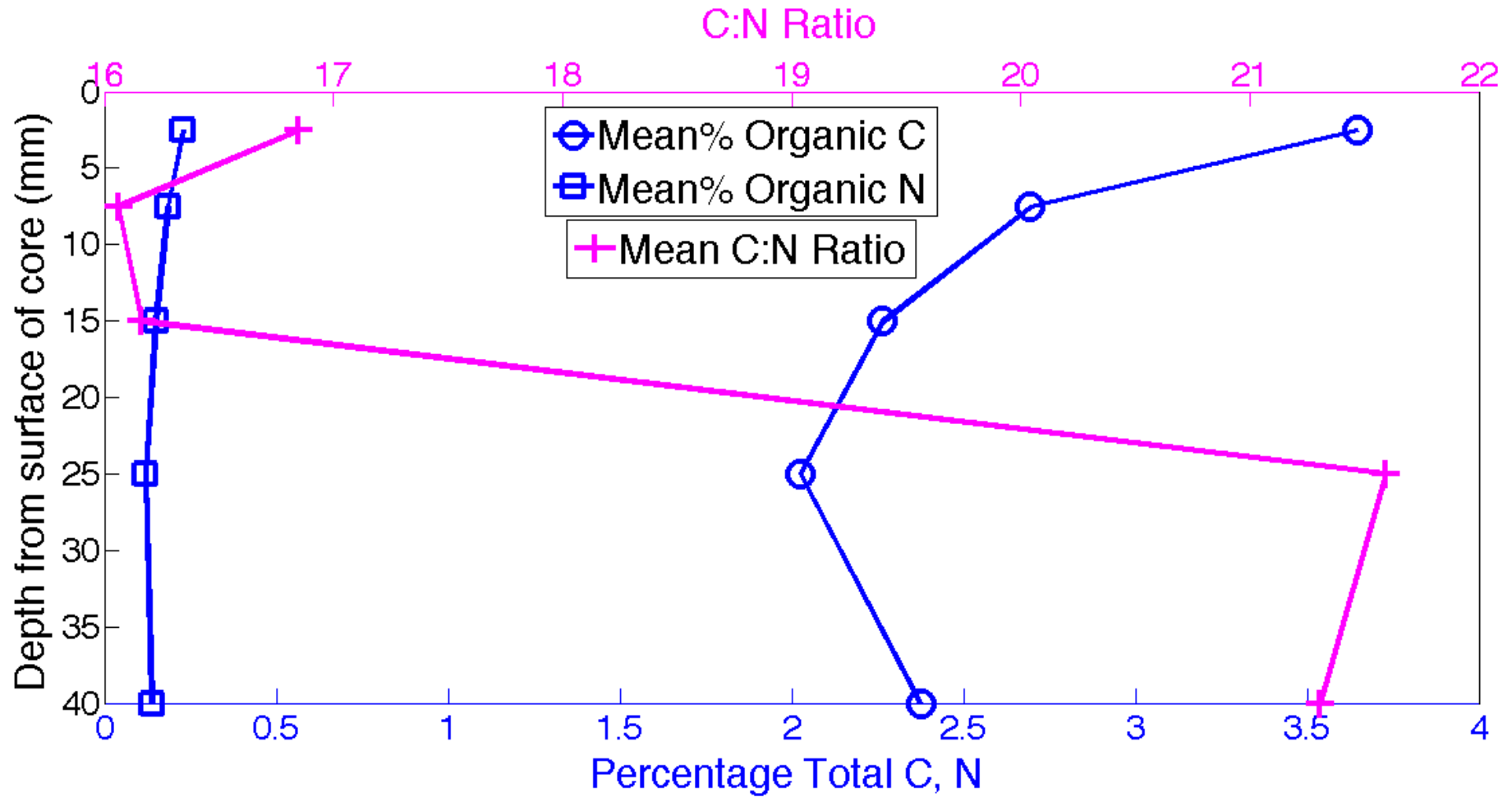
Adjusted Bound Carbohydrate Concentrations vs. Depth of Sediment Core



Adjusted Colloidal Carbohydrate Concentrations vs. Depth of Sediment Core

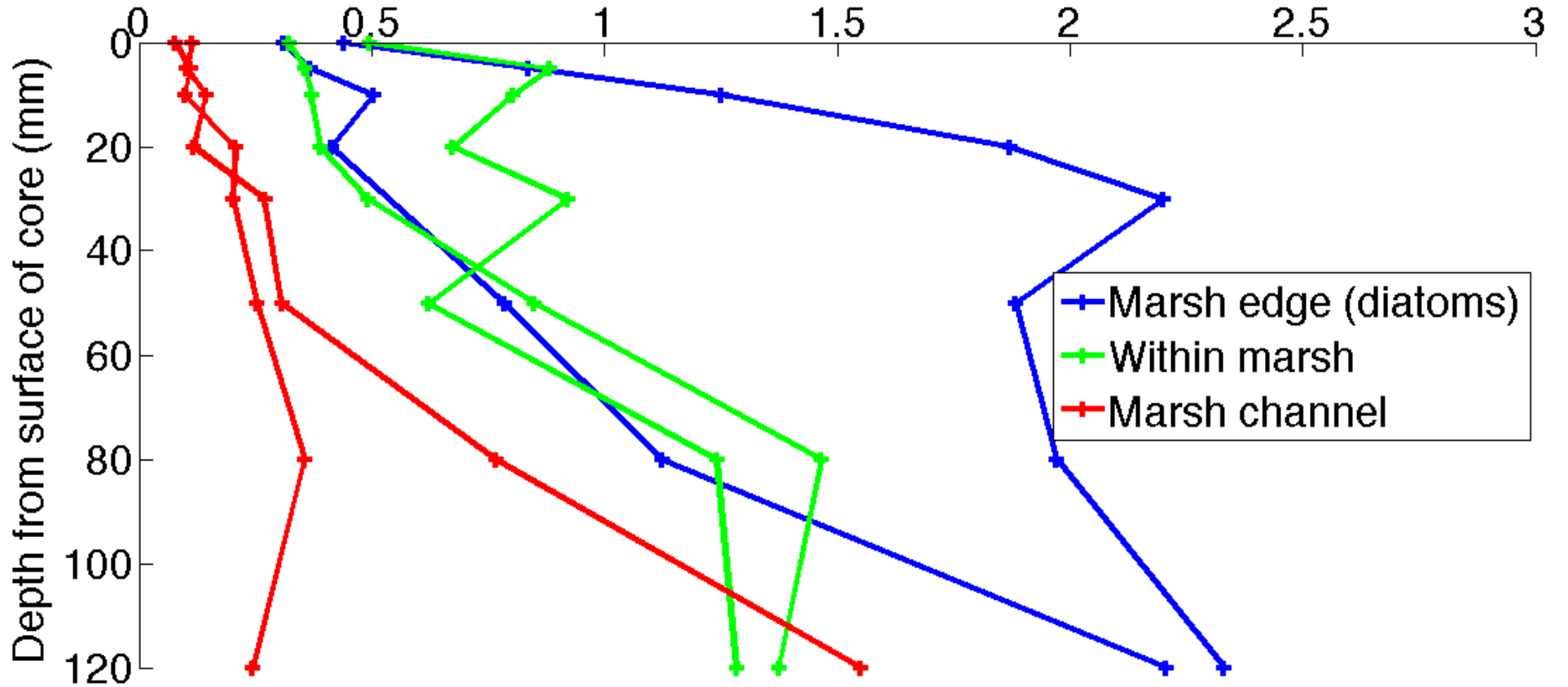


Percentage Total Organic Carbon, Nitrogen; C:N Ratio vs. Depth of Sediment Core

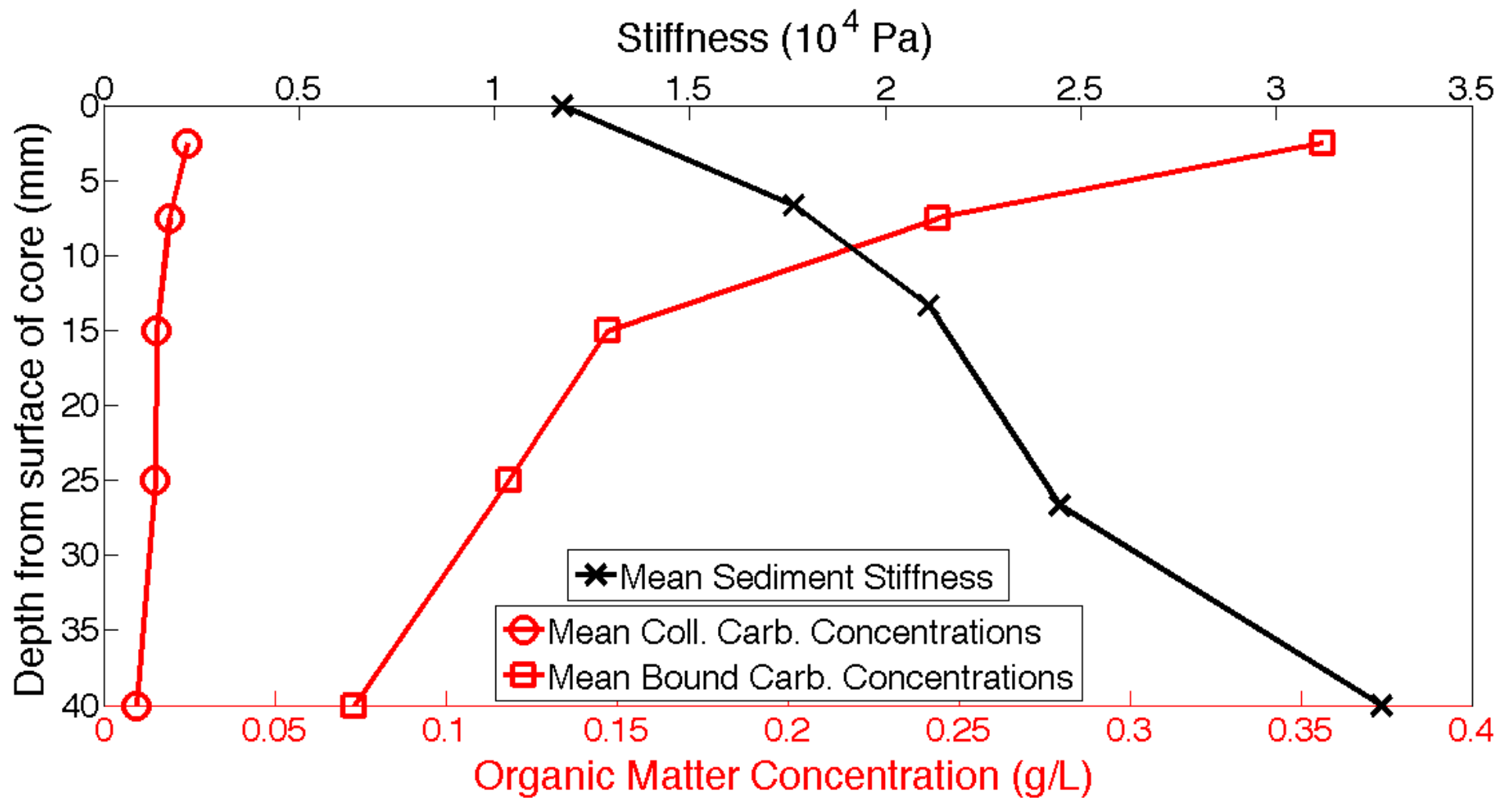


Sediment Stiffness (Stress) vs. Depth of Sediment Core

Stiffness (10^4 Pa)



Sediment Stiffness (Stress), Organic Matter Concentrations vs. Depth

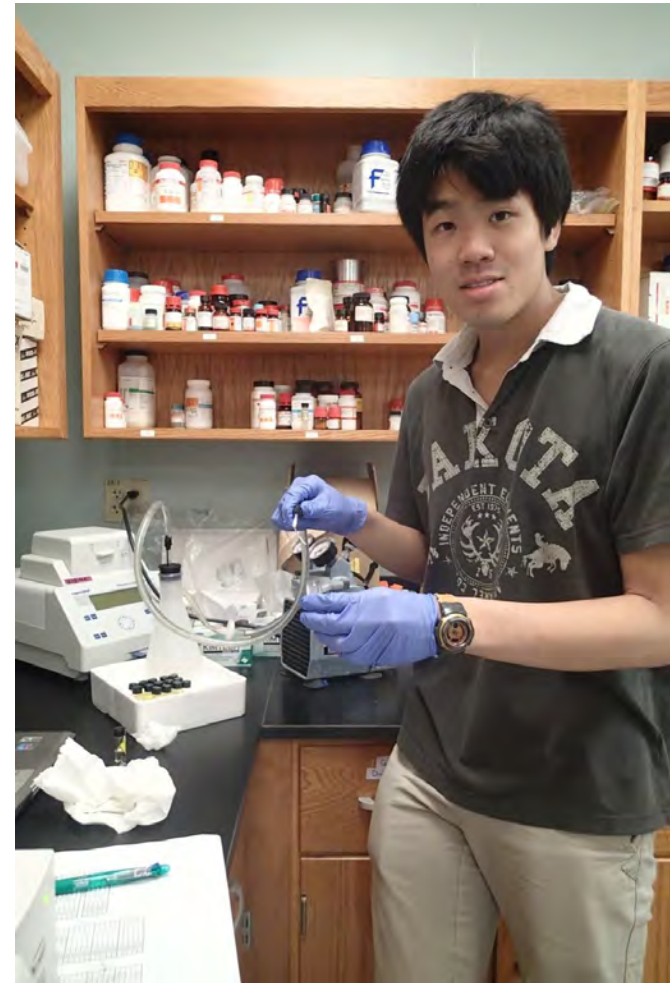


Conclusions

- ***Possible negative correlation between Stiffness and Bound EPS***
 - Less influence from colloidal EPS, total C/N
 - **Data is heavily influenced by depth/porosity**
- Sandy sediment has higher stiffness, lower OM content than muddy sediment
 - Presence of microorganisms (diatoms) impacts EPS quantity

Challenges; What I've Learnt...

- *Identifying key points in scientific literature*
- Being *meticulous and explicit* in developing protocols
- *Muds, sediments, polychaetes!*
- *Professional* work environment
 - Collaborating resources, efforts and knowledge



Acknowledgements



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