

Ocean Floor Sediment Composition in Relation to Offshore Wind Turbines



Cory Caddell, Marci-Ann Smith, Myla Barker,
Advised by Dr. Ben Gutierrez



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Abstract

Offshore wind farms are what coastal communities have been looking into to search for new ways to produce clean energy effectively for communities. Although, offshore wind farms are an ideal concept for energy production, there are environmental concerns that need to be considered such as, severe erosion to the ocean floor. These concerns are necessary for a basic offshore windfarm to maintain a safe and clean environment, while preserving coastal environments and the composition of the ocean floor.

Sedimentology, the study of soil and where it is deposited, plays a pivotal role in the installment of offshore wind farms. It provides a solid foundation for developers, investors, and the biodiversity of communities on the ocean floor. Hence, our research will be an analysis of the ocean floor in Buzzards Bay, MA and Vineyard Sound, MA to determine the best site for offshore wind farming. In this study we use sediment samples collected on the Sea Education Association Sailing School Vessel Corwith Cramer in combination with data collected by the U.S. Geological Survey to evaluate the sites with the best characteristics to support the foundations of wind turbines for an offshore wind farm.

Introduction

"The Offshore Wind Guidance Document: Oceanography and Sediment Stability Version 1", is a document that is designed to guide development of offshore wind site planning, in relation to oceanographic sediment stability assessments. In order to properly assess the sedimentology of the ocean floor, samples were taken from the points C2798-003 and C2798-004 (reference figures 3 and 8 on maps) in Buzzards Bay, MA to compare sediment samples to best determine which location is ideal for an offshore wind farm at a location in Buzzards Bay.

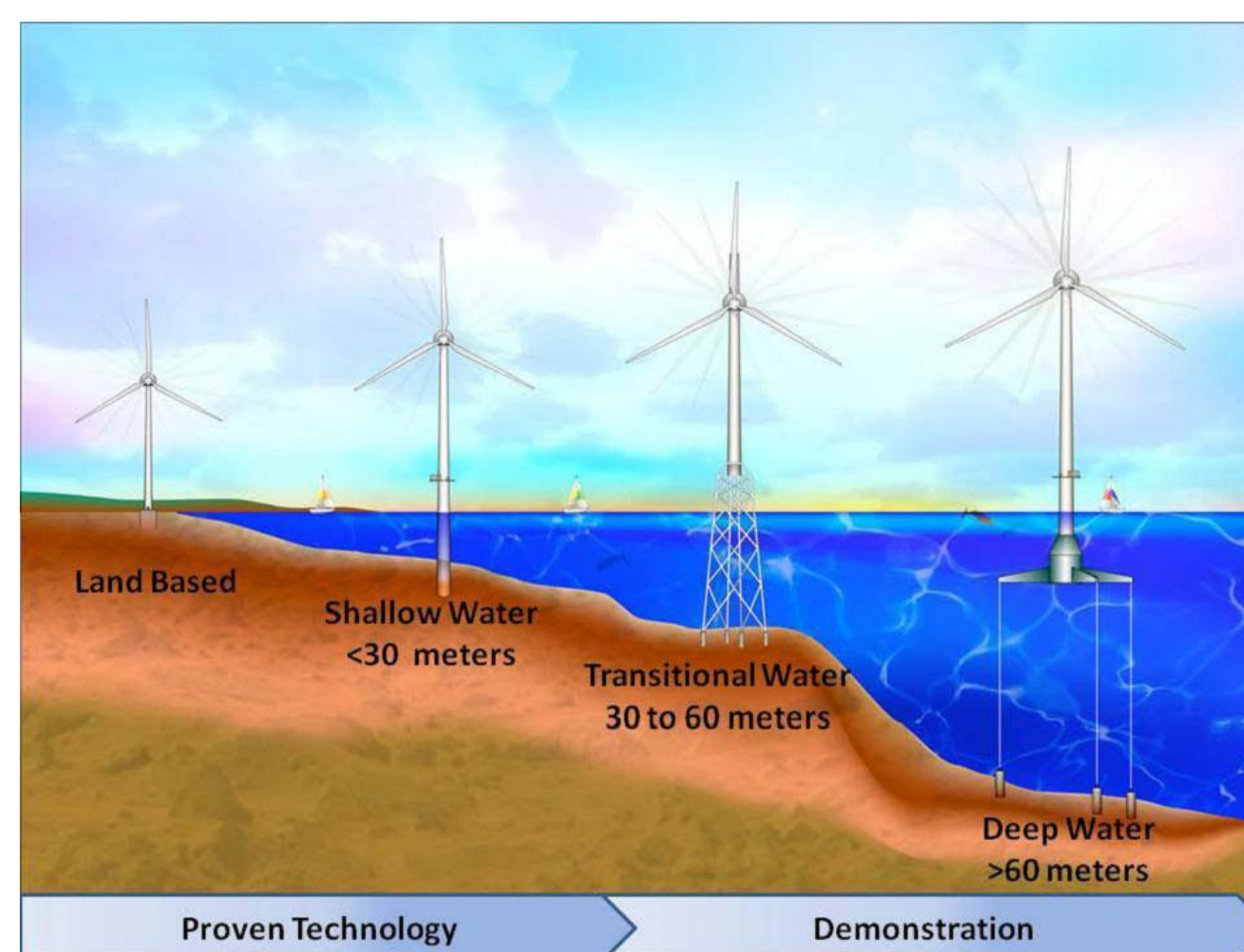


Figure 1: Examples of wind turbine structures based on depth.

Methods

- The sediment samples were collected on the Corwith Cramer from three different sites within the Buzzards Bay and Vineyard Sound areas.
- Each sediment was collected using a Shipek grab sampler. The Shipek was also attached to a Hydro-wire or Winch and a J-Frame that were mechanically operated to assist in lowering the Shipek into the water.
- Used a 3.5 kHz Knudsen 3260 Chirp Echosounder System to map the profile of the sea-floor at the locations where we took samples from.
- Ocean floor maps and the acoustic backscatter map from the interferometric sonar were obtained from the U.S. Geological Survey (see reference below to Foster et al., 2014 as well as Ackerman et al., 2014).
- The sediments were placed in glass jars and brought back to the lab to be preserved and analyzed using a microscope.
- Compared samples to stations that were previously tested in the area that showed the same sediment characteristics from the USGS website.
- It was determined which area, or sediment, would be most suitable for coastal wind turbines.

Data Analysis

PEP Cruise Map

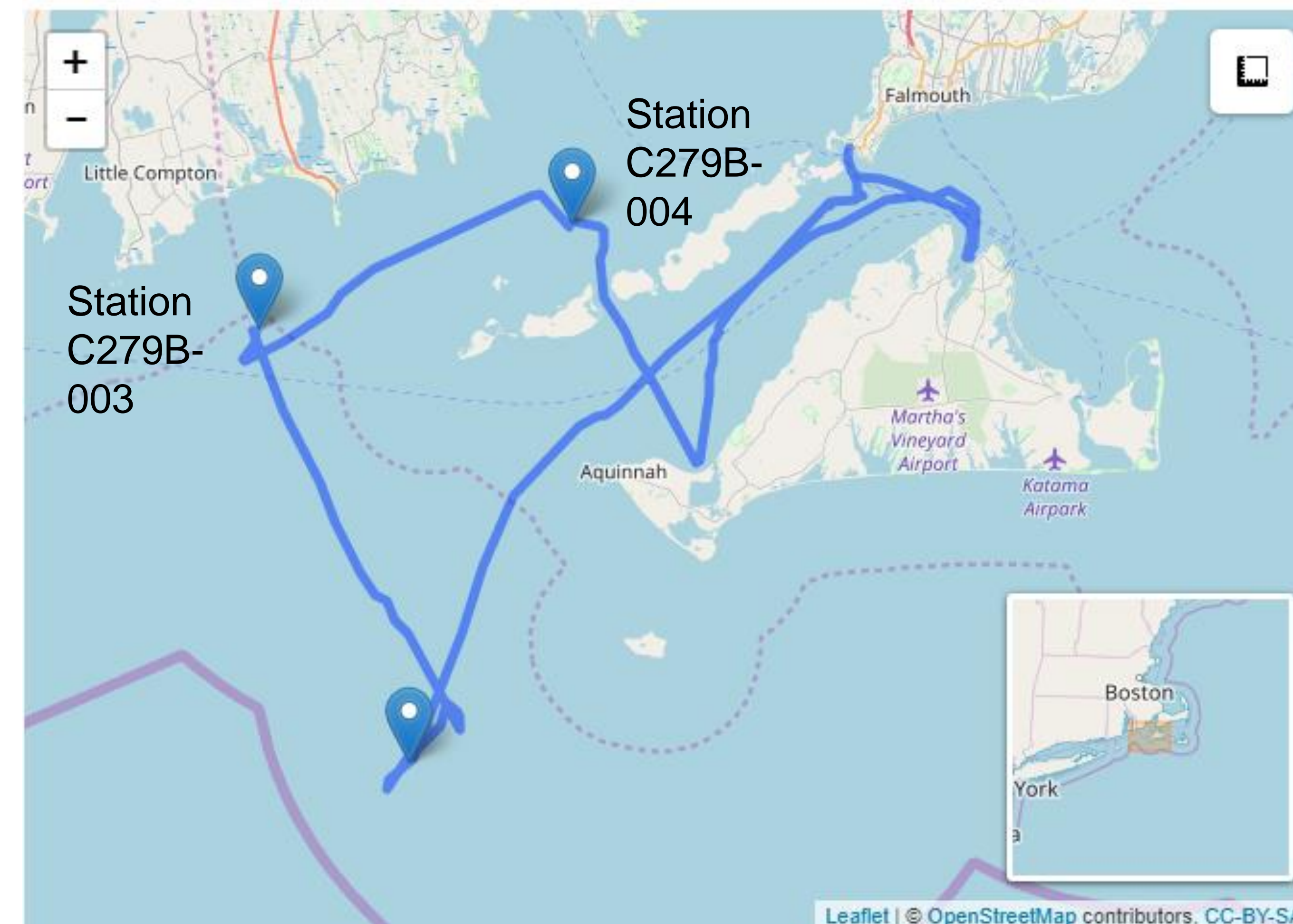


Figure 2: Map of the locations where we took sediment samples.

C279B-004 Results

Station C279B-004

Latitude 41.48167
Longitude -70.87000

Nearest Sediment Sample Info:
• Classification = SANDY SILT
• Distance = 18 meters

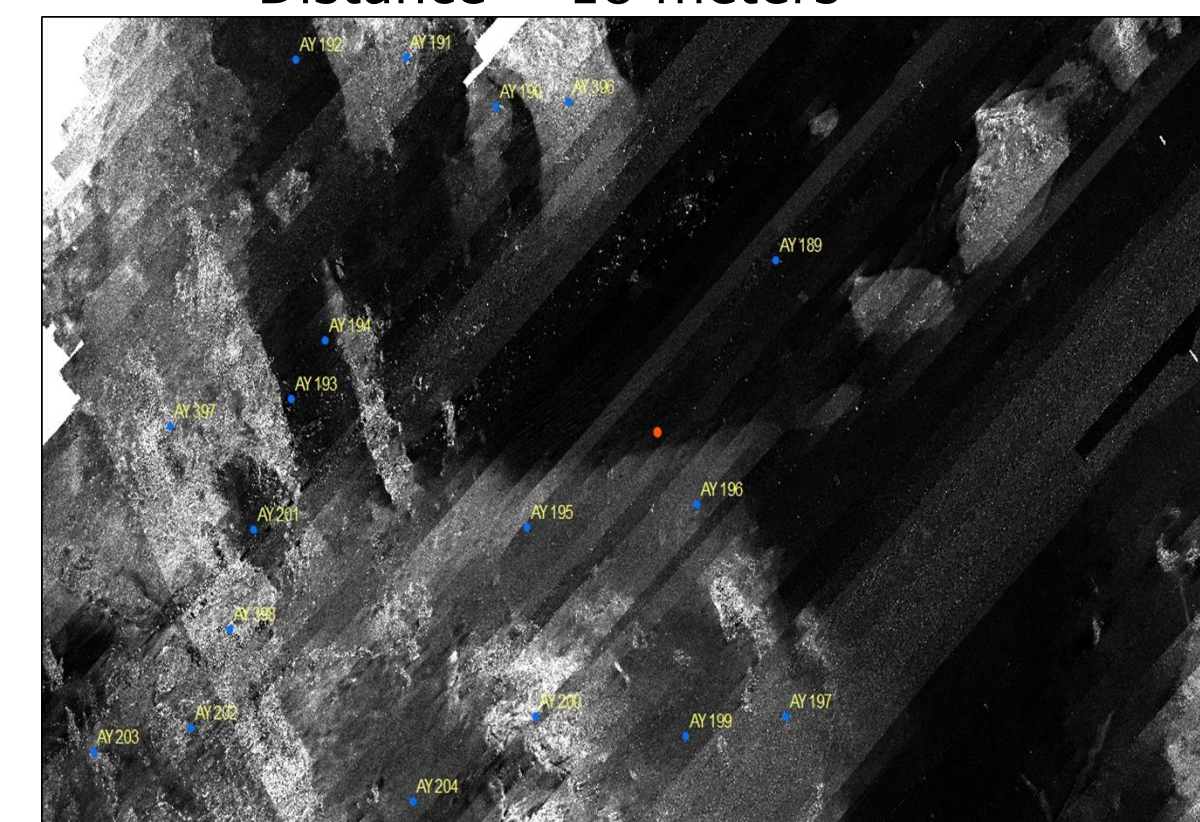


Figure 3: Ocean floor at station 004 using Interferometric Sonar (Foster et al., 2014 as well as Ackerman et al., 2014).



Figure 4: Sample taken from station 004.

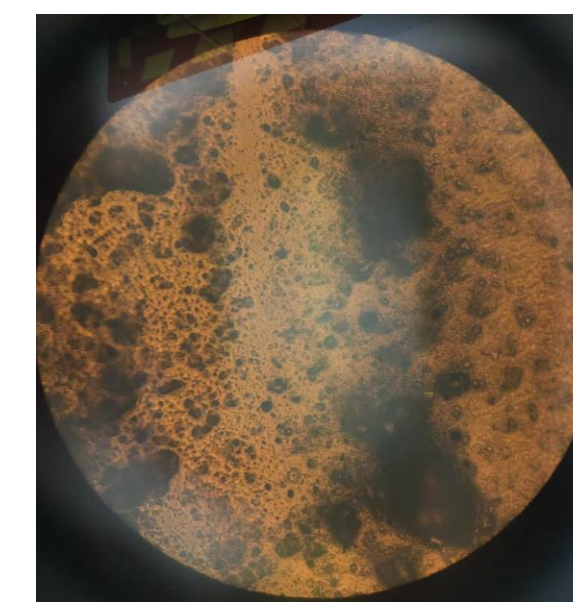


Figure 5: Sample taken from station 004 under microscope.

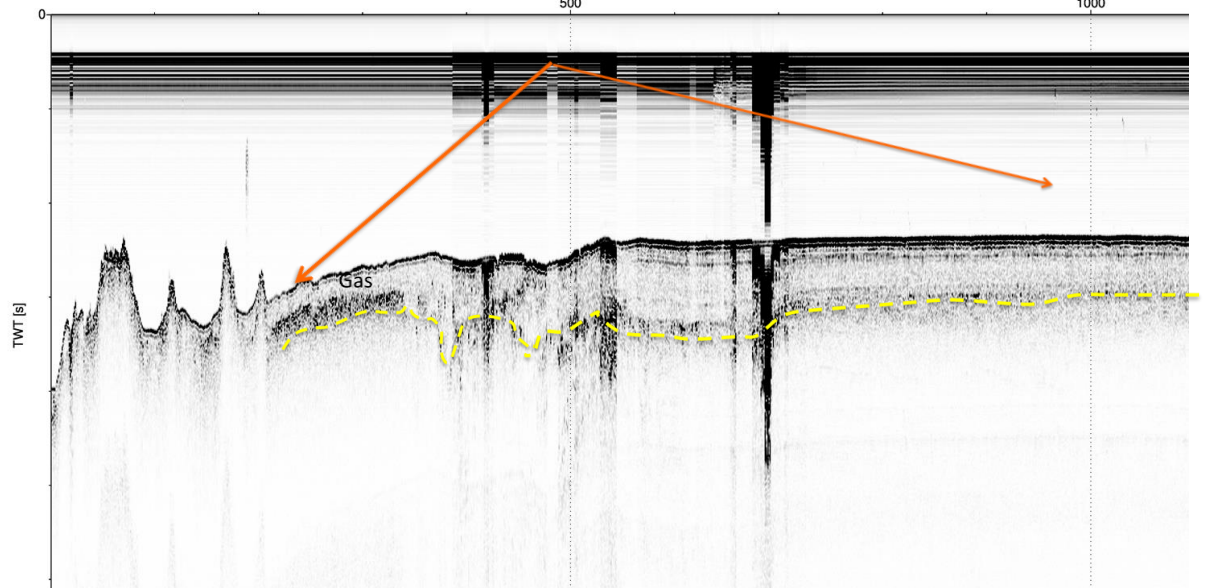
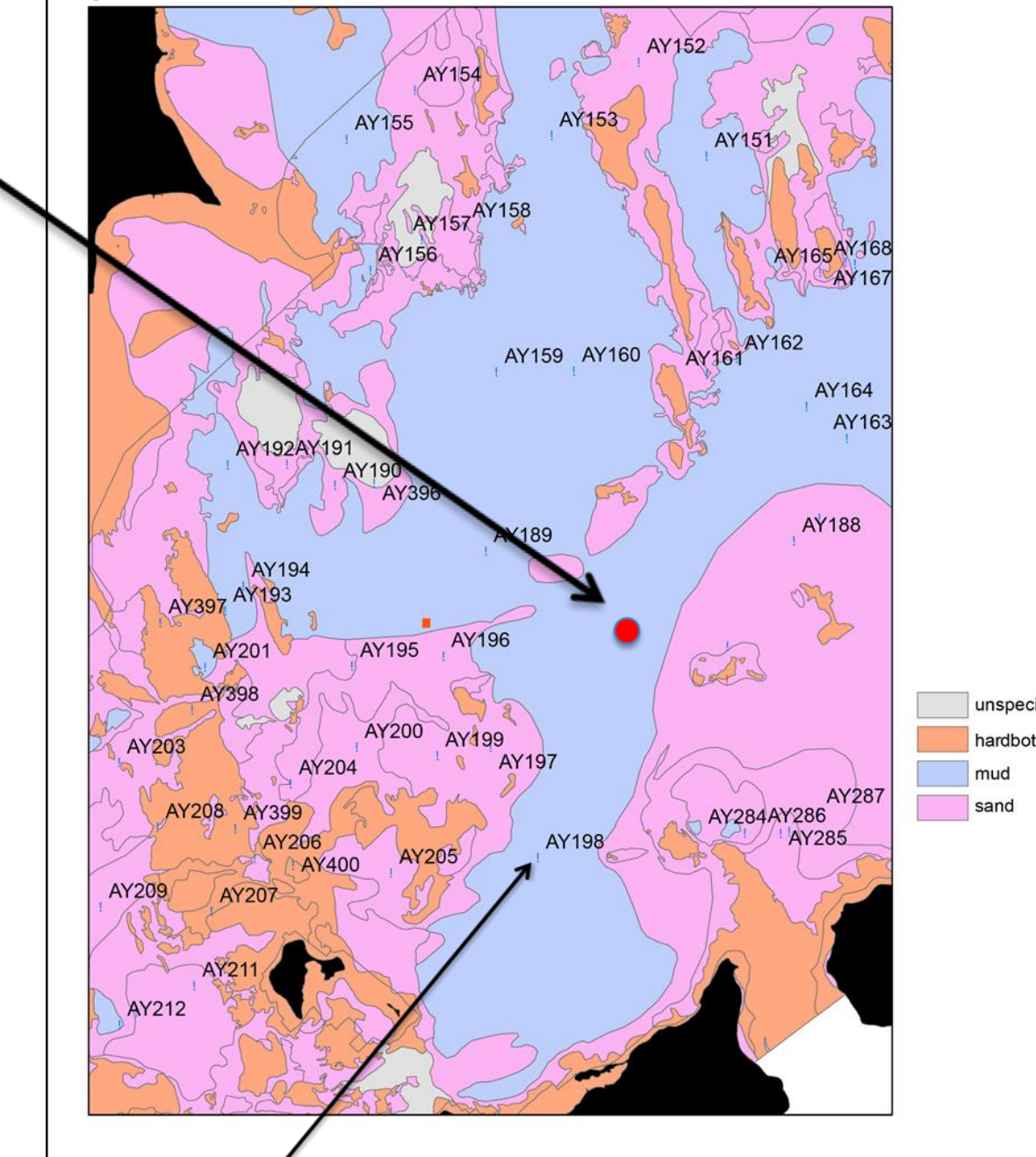


Figure 6: Profile of ocean floor from Chirp system at location 004.

Figure 7: Map of sediment on the ocean floor with location 004.



Station AY198

Station # 108
Latitude 41.463038
Longitude -70.884302
Time (UTC) 02:27:11

Nearest Sediment Sample Info:
• Classification = SANDY SILT
• Station Number = 108
• Distance = 23.3 meters

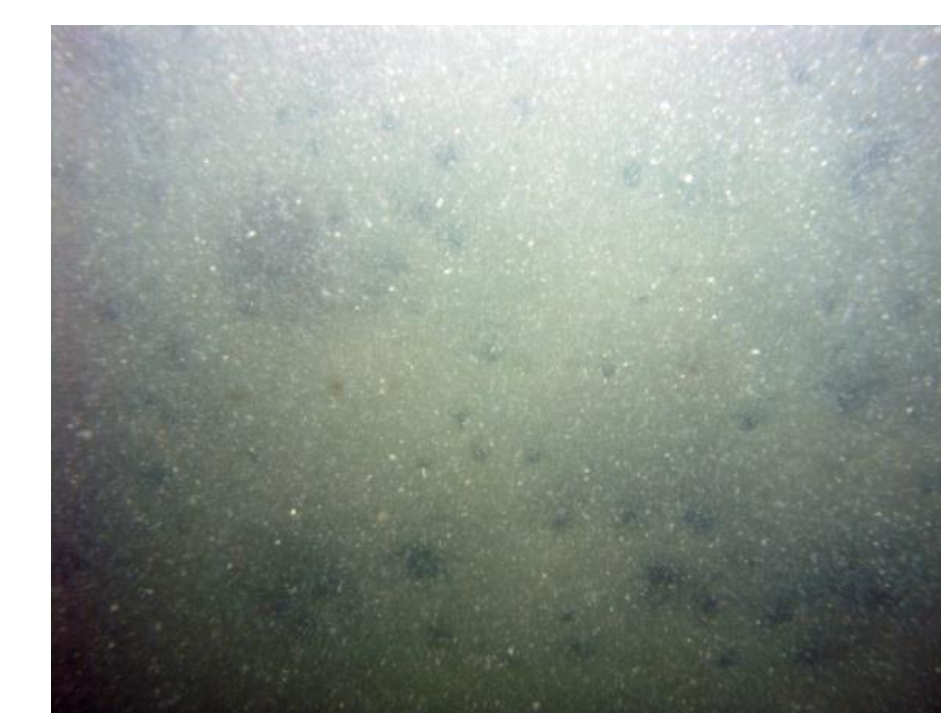


Figure 8: Imagery of ocean floor at station AY198, which was compared to location 004 (Ackerman et al., 2014, as well as Foster et al., 2014).

C279B-003 Results

Station C279B-003

Latitude 41.42500
Longitude -71.09333

Nearest Sediment Sample Info:

- Classification = GRAVELLY SEDIMENT
- Distance = 22 meters

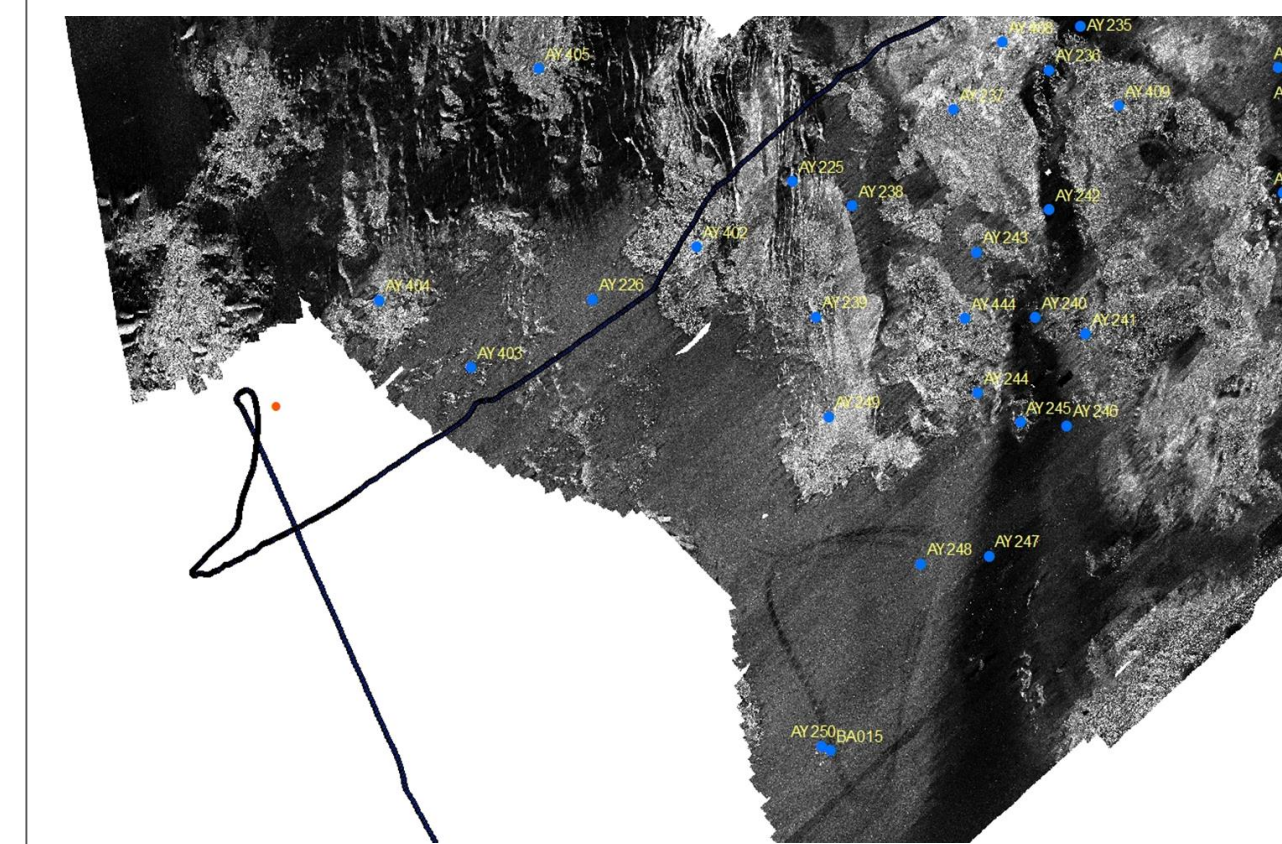


Figure 9: Ocean floor at location 003 using Interferometric Sonar (Foster et al., 2014 as well as Ackerman et al., 2014).



Figure 10: Sample taken from station 003.

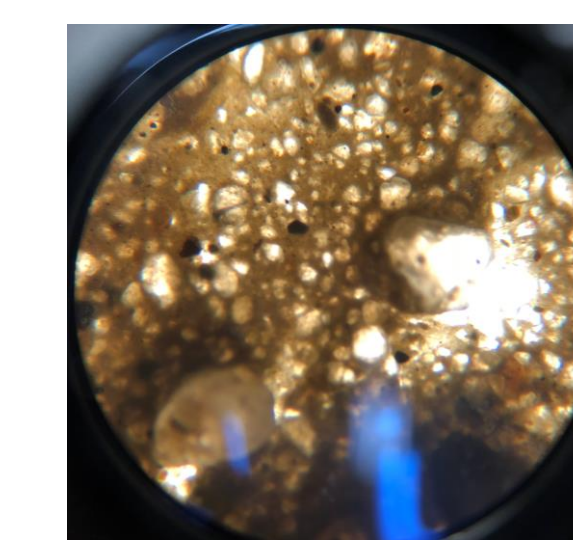


Figure 11: Sample taken from station 004 under microscope.

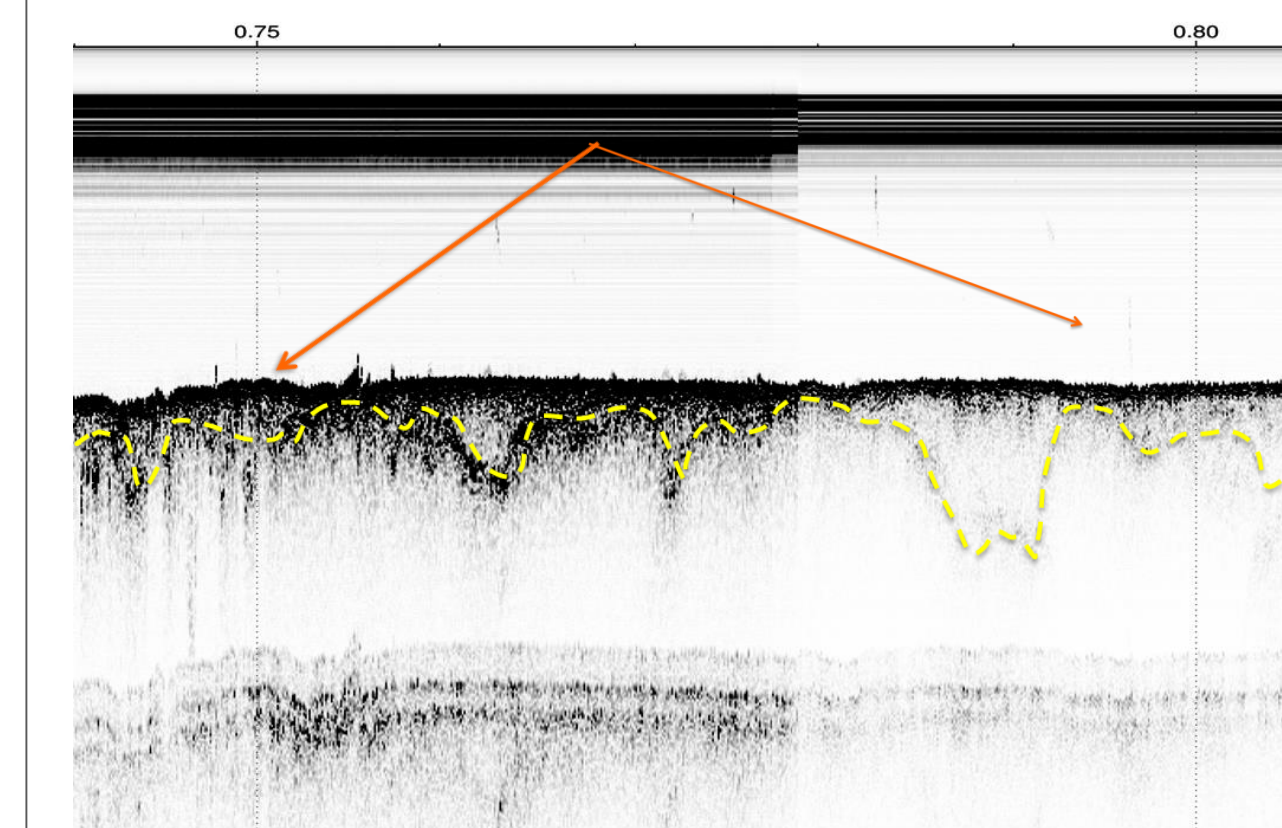
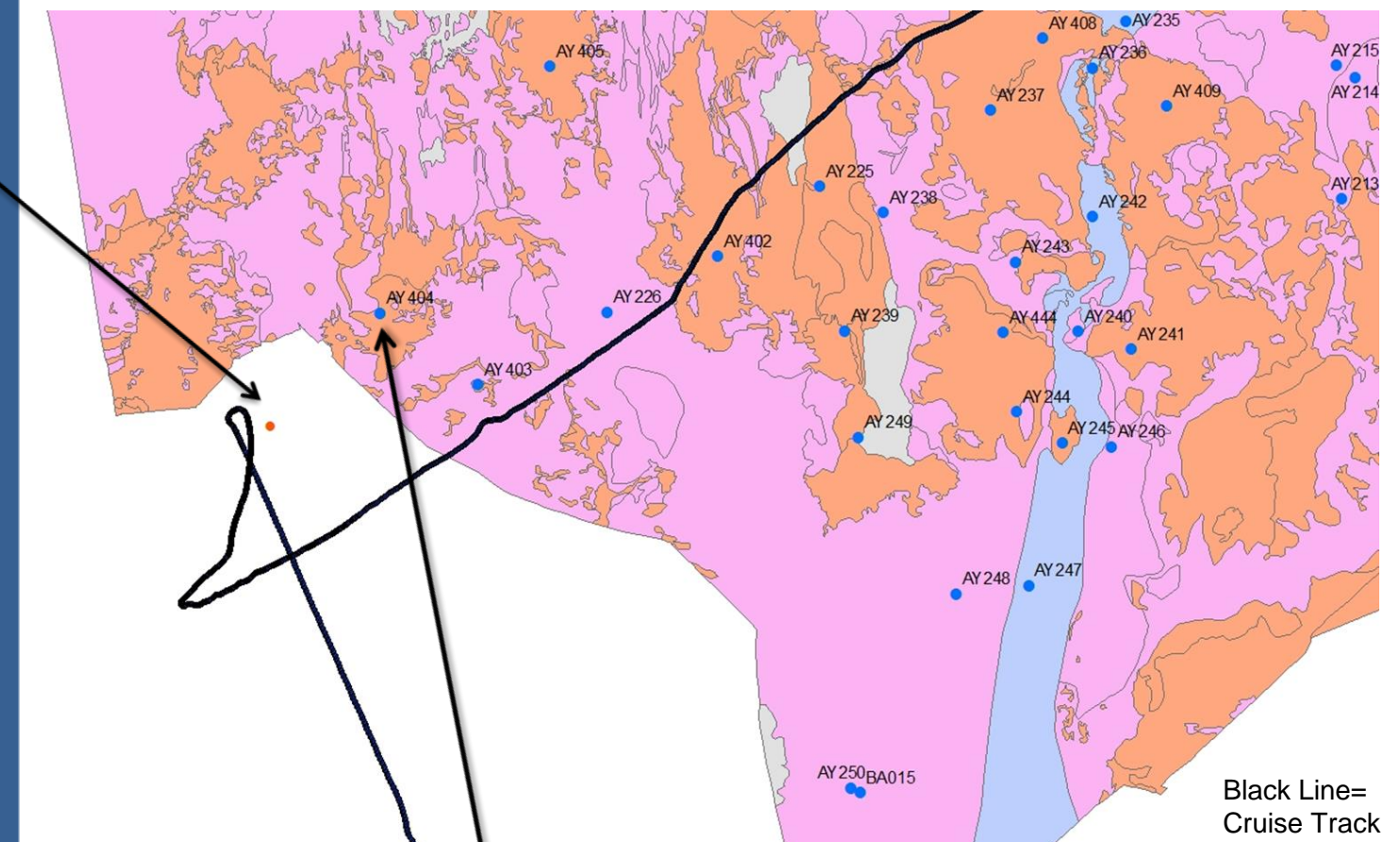


Figure 12: Profile of ocean floor from Chirp system at location 003.

Figure 13: Map of sediment on the ocean floor with location 003.



Station AY404

Station # 143
Latitude 41.435117
Longitude -71.079358
Time (UTC) 14:47:53

Nearest Sediment Sample Info:
• Classification = GRAVEL
• Station Number = 143
• Distance = 34.5 meters

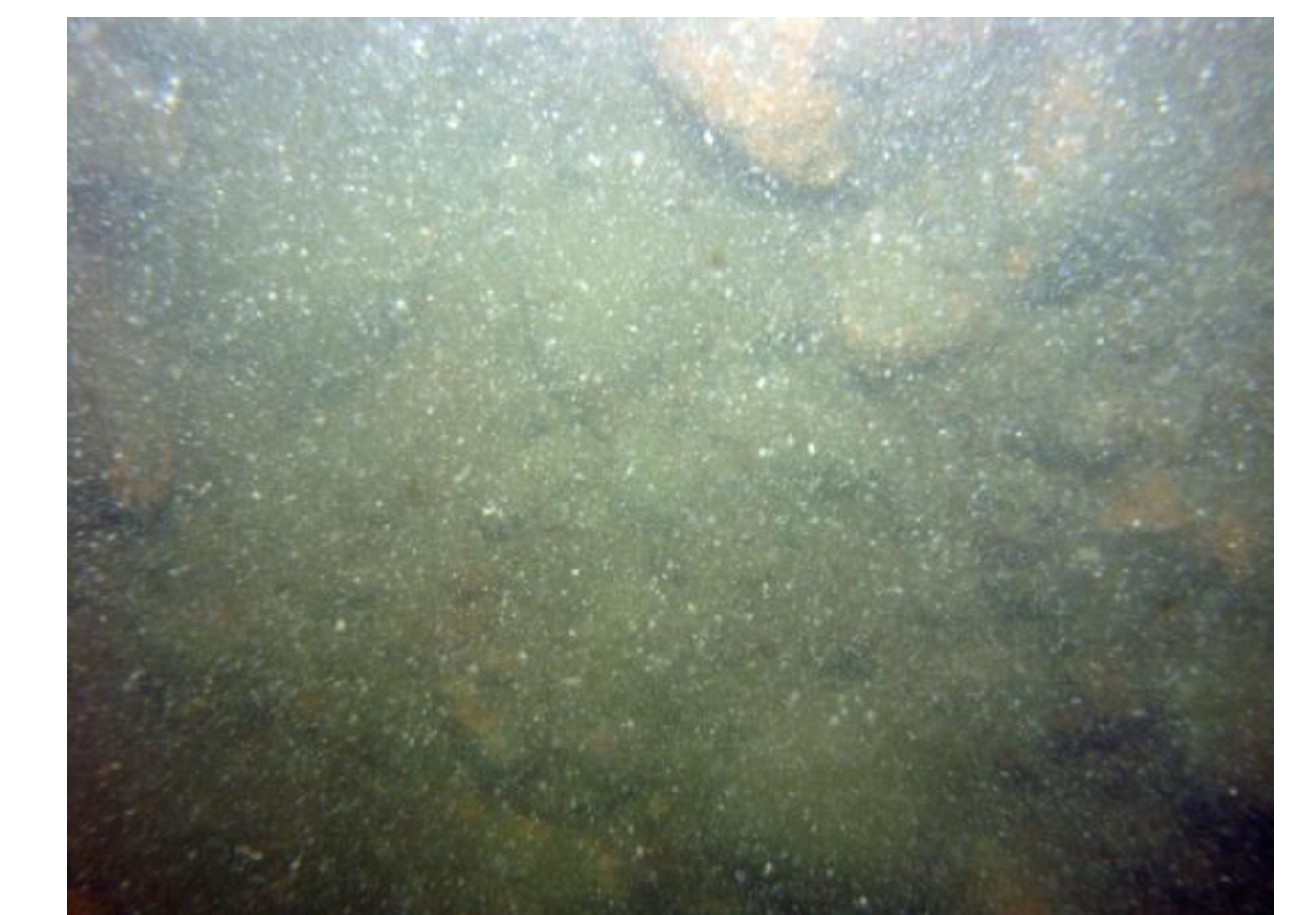


Figure 14: Imagery of ocean floor at station AY404, which was compared to location 003 (Ackerman et al., 2014 as well as Foster et al., 2014).

Conclusion/Discussion

- Station 003 contains gravel sediment and seems to have the best characteristics suitable for installation of wind turbines compared to Station 004, a sandy silt, which resembles mud, a thick mud unit buried beneath the ocean floor. .
- Wind currents should be studied to make sure the location is ideal.
- Buzzards Bay needs to be mapped out completely in order to further analyze sedimentology of the ocean floor.
- Evaluating sedimentology of the ocean floor is considered best practice for installing offshore wind turbines to ensure a stable environment for wind turbine installments.

References

- Ackerman, S.D., Andrews, B.D., Foster, D.S., Baldwin, W.E., and Schwab W.C. 2012, High-resolution geophysical data from the inner continental shelf— Buzzards Bay, Massachusetts: U.S. Geological Survey Open-File Report 2012-1002, <http://pubs.usgs.gov/of/2012/1002/>.
- Jones, Craig; Magalen, Jason; Roberts, Jesse; Offshore Wing Guidance Document: Oceanography and Sediment Stability (Version1) Development of a Conceptual Site Model, Sandia National Laboratories, Albuquerque, New Mexico; Livermore, California; June 2014.
- Foster, D.S., Baldwin, W.E., Barnhardt, W.A., Schwab, W.C., Ackerman, S.D., Andrews, B.D., and Pendleton, E.A., 2014, Shallow geology, sea-floor texture, and physiographic zones of Buzzards Bay, Massachusetts: U.S. Geological Survey Open-File Report, 2014-1220, <http://dx.doi.org/10.3133/ofr20141220>
- Seth D. Ackerman, a. (2018). USGS Open-File Report 2014-1221, Sampling Survey with the USGS SEABed Observation and Sampling System (SEABOSS): Buzzards Bay and Vineyard Sound, Massachusetts, Data Collection and Processing. [online] Pubs.usgs.gov. Available at: https://pubs.usgs.gov/of/2014/1221/html/botphoto_gallery/ofr2014-1221-index_sept13a.html [Accessed 15 Jun. 2018].