Sediment surface elevation change of sediments collected from the Northern Gulf of Mexico following laboratory resuspension at the Dauphin Island Sea Lab in 2020

Website: https://www.bco-dmo.org/dataset/875514
Data Type: experimental, Other Field Results
Version: 1
Version Date: 2025-08-25

Project
» CAREER: Mechanisms of bioturbation and ecosystem engineering by benthic infauna (Bioturbation and Ecosystem Engineering)

Contributors	Affiliation	Role
Dorgan, Kelly	Dauphin Island Sea Lab (DISL)	Principal Investigator
Clemo, William Cyrus	Dauphin Island Sea Lab (DISL)	Contact
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
This dataset represents the sediment surface elevation change of sediments collected from the Northern Gulf of Mexico following laboratory resuspension at the Dauphin Island Sea Lab.

Table of Contents

- Coverage
- Dataset Description
  - Methods & Sampling
  - Data Processing Description
  - BCO-DMO Processing Description
- Data Files
- Related Publications
- Related Datasets
- Parameters
- Instruments
- Project Information
- Funding

Coverage

Spatial Extent: **Lat**:30.22222 **Lon**:-88.13913
Temporal Extent: 2020-01-28 - 2020-02-27

Methods & Sampling

Sediment cores were collected from 10 meters (m) depth in the northern Gulf of Mexico offshore of Dauphin Island, Alabama, in cohesive muddy sediment on January 26, 2020 (30° 13.333' N, 88° 8.348' W). Cores were collected from a Dauphin Island Sea Lab vessel, the R/V Alabama Discovery. Polycarbonate sediment cores (9.6 centimeter (cm) inner diameter x 60 cm height) were collected using an MC-400 multicorer (Ocean Instruments, Fall City, WA).

We resuspended the surface 5 cm of natural muddy sediment cores in the lab and compared temporal changes in sediment compaction to changes in surface and subsurface cohesion over 30 days post resuspension. Sediment-water interface (SWI) height and acoustic sound speed through sediment, which depends on bulk density, provided continuous and nondestructive metrics of compaction, and sediment porosity and grain size were measured destructively to characterize sediment physical structure. We determined surface cohesion by measuring both eroded mass and turbidity resulting from increasing shear stress. Subsurface cohesion was determined from the force required for sediments to fail in tension. We compared surface and subsurface exopolymeric substance (EPS) concentrations to surface and subsurface cohesion measurements. We differentiated between water-soluble (colloidal) and sediment-bound EPS as we expected bound EPS to contribute more to sediment-organic matrix development and thus cohesion because they are directly bound to sediment grains rather than dissolved in porewater.

These data include repeated measurements of sediment-water interface height. A summary of data collected on cores processed over time points 0 days (no resuspension), then 1, 2, 3, 7, 14, and 30 days post-resuspension is given in a related dataset. Detailed data on erosion measurements, as well as repeated non-destructive measurements of sound speed on cores processed on day 30 are provided in separate datasets.

To quantify short- and long-term sediment compaction continuously and non-destructively, we measured post-disturbance sediment-water interface height above the core base 16 times over 30 days following disturbance. For each core, the pre-disturbance sediment-water interface height was subtracted from the sediment-water interface heights at each timepoint to provide sediment-water interface height above or below the undisturbed height. Sediment-water interface heights higher than the undisturbed height indicated less compact sediment.

We performed acoustic measurements following methods from Dorgan et al. (2020). Within a seawater tank, a 400 kHz three-cycle sinusoidal tone burst was transmitted horizontally through sediment cores to a receiver at 3 depths below the sediment surface (2.5, 5, 10 cm) (see Fig. 1 in Dorgan et al., 2020). To account for sound speed differences due to temporal variability in temperature and salinity, sound speed through sediment was normalized by the sound speed in seawater to obtain sound speed ratio (SSR). Each day, we also performed acoustic measurements on cores filled with seawater and with no core present. Sound speed in seawater and the lag time between the transmitted and received signals (time of flight) through sediment and seawater cores were used to calculate sound speed in sediment (νp):

ν_p=c_w/(1-(c_w * Δt/d_s)

where cw is sound speed in water, Δt is the difference in time of flight between seawater core (tw) and sediment core (ts), and ds is the inner diameter of the core (Jackson and Richardson, 2007; Dorgan et al., 2020). SSR was then calculated by dividing νp by cw, where a higher SSR indicates more compact sediment.

Instruments:
Acoustics measurements were done following Dorgan et al. 2020, JASA.

Data Processing Description

Sound speed was calculated from the lag between sent and received 3-pulse sine waves at 400 kHz using a custom Matlab script (see Dorgan et al. 2020 for details).

BCO-DMO Processing Description

- Imported original file "CLemoResuspensionExperiment2020SedimentElevation.csv" into the BCO-DMO system.
- Renamed fields to comply with BCO-DMO naming conventions.
- Converted date column to YYYY-MM-DD format.
- Rounded numeric columns to 4 decimal places.
- Saved the final file as "875514_v1_sediment_resuspension_elevation.csv".

[table of contents | back to top]

Data Files

File
875514_v1_sediment_resuspension_elevation.csv (Comma Separated Values (.csv), 2.87 KB) MD5:a0a6e8f19fc496d4ae468cd86bfd6036 Primary data file for dataset ID 875514, version 1

[table of contents | back to top]

Related Publications

Clemo, W. C., Giles, K. D., & Dorgan, K. M. (2022). Biological influences on coastal muddy sediment structure following resuspension. Limnology and Oceanography. Portico. https://doi.org/10.1002/lno.12213
Results

Dorgan, K. M., Ballentine, W., Lockridge, G., Kiskaddon, E., Ballard, M. S., Lee, K. M., & Wilson, P. S. (2020). Impacts of simulated infaunal activities on acoustic wave propagation in marine sediments. The Journal of the Acoustical Society of America, 147(2), 812–823. https://doi.org/10.1121/10.0000558
Results

Jackson, D. R., & Richardson, M. D. (2007). High-Frequency Seafloor Acoustics. Springer New York. https://doi.org/10.1007/978-0-387-36945-7
Methods

[table of contents | back to top]

Related Datasets

IsRelatedTo

Dorgan, K., Clemo, W. C. (2025) **Acoustic properties of sediments collected from the Northern Gulf of Mexico following laboratory resuspension at the Dauphin Island Sea Lab in 2020.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2025-08-25 doi:10.26008/1912/bco-dmo.875501.1 [view at BCO-DMO]

Dorgan, K., Clemo, W. C. (2025) **Erodibility of sediments collected from the Northern Gulf of Mexico following laboratory resuspension at the Dauphin Island Sea Lab in 2020.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2025-08-25 doi:10.26008/1912/bco-dmo.875391.1 [view at BCO-DMO]

Dorgan, K., Clemo, W. C. (2025) **Sediment surface elevation, erodibility, and acoustic properties of sediments collected from the Northern Gulf of Mexico following laboratory resuspension at the Dauphin Island Sea Lab in 2020.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2025-08-25 doi:10.26008/1912/bco-dmo.875373.1 [view at BCO-DMO]

[table of contents | back to top]

Parameters

Parameter	Description	Units
coreID	core ID named as "D_samplingday(max30)_replicate(A-E)"	unitless
latitude	latitude of sample site	decimal degrees
longitude	longitude of sample site	decimal degrees
water_depth_m	water depth in meters	meters
date	Date of sample collection	unitless
time_day	time in days since sediment disturbance was performed	days
sedimentsurface_heightchange_cm	change in sediment surface from pre-resuspension level (+ is above)	centimeters (cm)

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	MC-400 multicorer
Generic Instrument Name	Ocean Instruments MC-400 Multi corer
Dataset-specific Description	Polycarbonate sediment cores (9.6 centimeter (cm) inner diameter x 60 cm height) were collected using an MC-400 multicorer (Ocean Instruments, Fall City, WA).
Generic Instrument Description	The Ocean Instruments MC-400 {Hedrick/Marrs} multi-corer is a sediment multi-corer with a series of cores attached to one deployment frame. This model carries four sample tubes. It is designed to retrieve sediment and water samples in lakes and shelf waters. The sample tubes are sealed with a silicone rubber upper door gasket and a neoprene or carpet lower door seal. Each of the four sample tubes can be removed from the coring unit for immediate processing in the laboratory without exposing their contents to the surface environment. It is designed to recover undisturbed surface sediments and is therefore well-suited to study benthic processes. The multi-corer is disposed on a research vessel and is lowered into the water body by a cable. When the multi-corer touches the sediment the units ballast weight pushes the assembled cores into the substrate. Each of the tubes contains a unique sediment core. The multi-corer uses a unique hydrostatic damping system that slows the penetration rate down to approximately 1 cm/s. Provisions have been made to carry up to two 4-liter water bottles that actuate as the frame legs touch bottom. The overall sample tube length is 58 cm, with a maximum penetration of 34.5 cm. The tube diameter is 10 cm.

[table of contents | back to top]

Project Information

CAREER: Mechanisms of bioturbation and ecosystem engineering by benthic infauna (Bioturbation and Ecosystem Engineering)

Coverage: Dauphin Island Sea Lab, Dauphin Island, AL

NSF Award Abstract:
Marine sediments are important habitats for abundant and diverse communities of organisms that are important as food sources for higher trophic levels, including commercially important species. Through burrowing, constructing tubes, and feeding on sediments, these animals modify their physical and chemical environments to such an extent that they are considered ecosystem engineers. Bioturbation, the mixing of sediments by animals, is important in regenerating nutrients and transporting pollutants and carbon bound to mineral grains. Despite its importance, our ability to predict bioturbation rates and patterns from the community structure is poor, largely due to a lack of understanding of the mechanisms by which animals mix sediments. This project builds on earlier work showing that animals extend burrows through muddy sediments by fracture to test the hypothesis that the mechanical properties of sediments that affect burrowing mechanics also affect sediment mixing. More broadly, this project examines the relative contributions of (i) the functional roles of the organisms in the community, (ii) the mechanical properties of sediments, and (iii) factors that might increase or decrease animal activity such as temperature and food availability to bioturbation rates. Burrowing animals modify the physical properties of sediments, and this project quantifies these changes and tests the hypothesis that these changes are ecologically important and affect community succession following a disturbance. In addition to this scientific broader impact, this project involves development of instrumentation to measure sediment properties and includes a substantial education plan to introduce graduate, undergraduate, and middle school students to the important role that technology plays in marine science.

Through burrowing and feeding activities, benthic infauna mix sediments and modify their physical environments. Bioturbation gates the burial of organic matter, enhances nutrient regeneration, and smears the paleontological and stratigraphic record. However, current understanding of the mechanisms by which infaunal activities mix sediments is insufficient to predict the impacts of changes in infaunal community structure on important sediment ecosystem functions driven by bioturbation. This project tests specific hypotheses relating infaunal communities, bioturbation, and geotechnical properties with the ultimate goal of understanding the dynamic changes and potential feedbacks between infauna and their physical environments. This project integrates field and lab experiments to assess the relative importance of infaunal community structure and activities to bioturbation rates. Additionally, this project builds on recent work showing that muddy sediments are elastic gels through which worms extend burrows by fracture to propose that geotechnical properties of sediments mediate bioturbation by governing the release of particles from the sediment matrix during burrow extension. Finite element modeling determines how the release of particles by fracture during burrowing depends on the fracture toughness (cohesion) and stiffness (compaction) of sediments and complements laboratory experiments characterizing the impact of geotechnical properties on burrowing behaviors. The proposed research also aims to determine whether impacts of infauna on geotechnical properties are ecologically important. Changes in infaunal communities and geotechnical properties following an experimental physical disturbance address the hypothesis that ecosystem engineering of bulk sediment properties facilitates succession.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1844910

[table of contents | back to top]