Characterizing Geo-acoustical Properties of the New England Mud Patch

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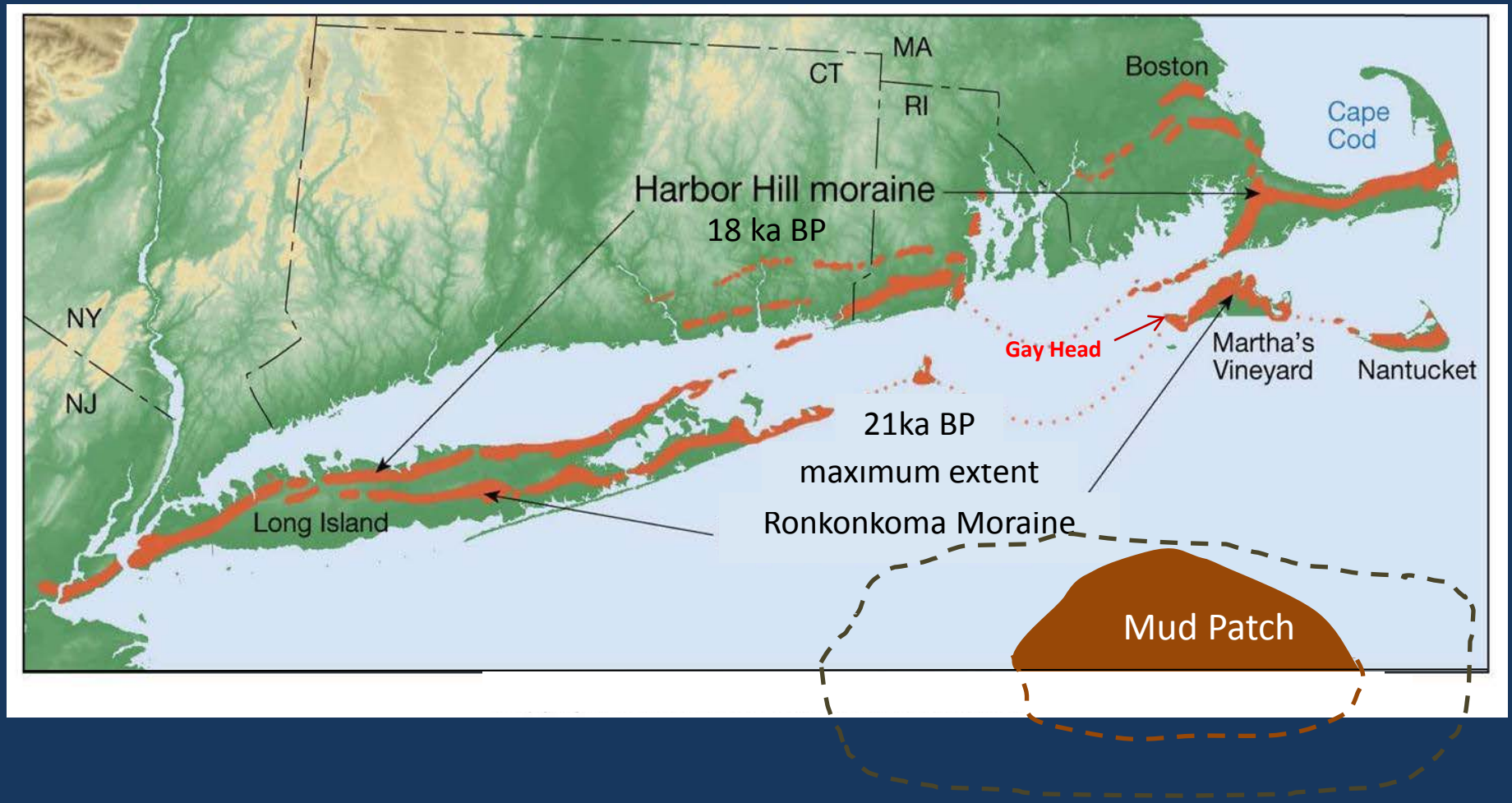
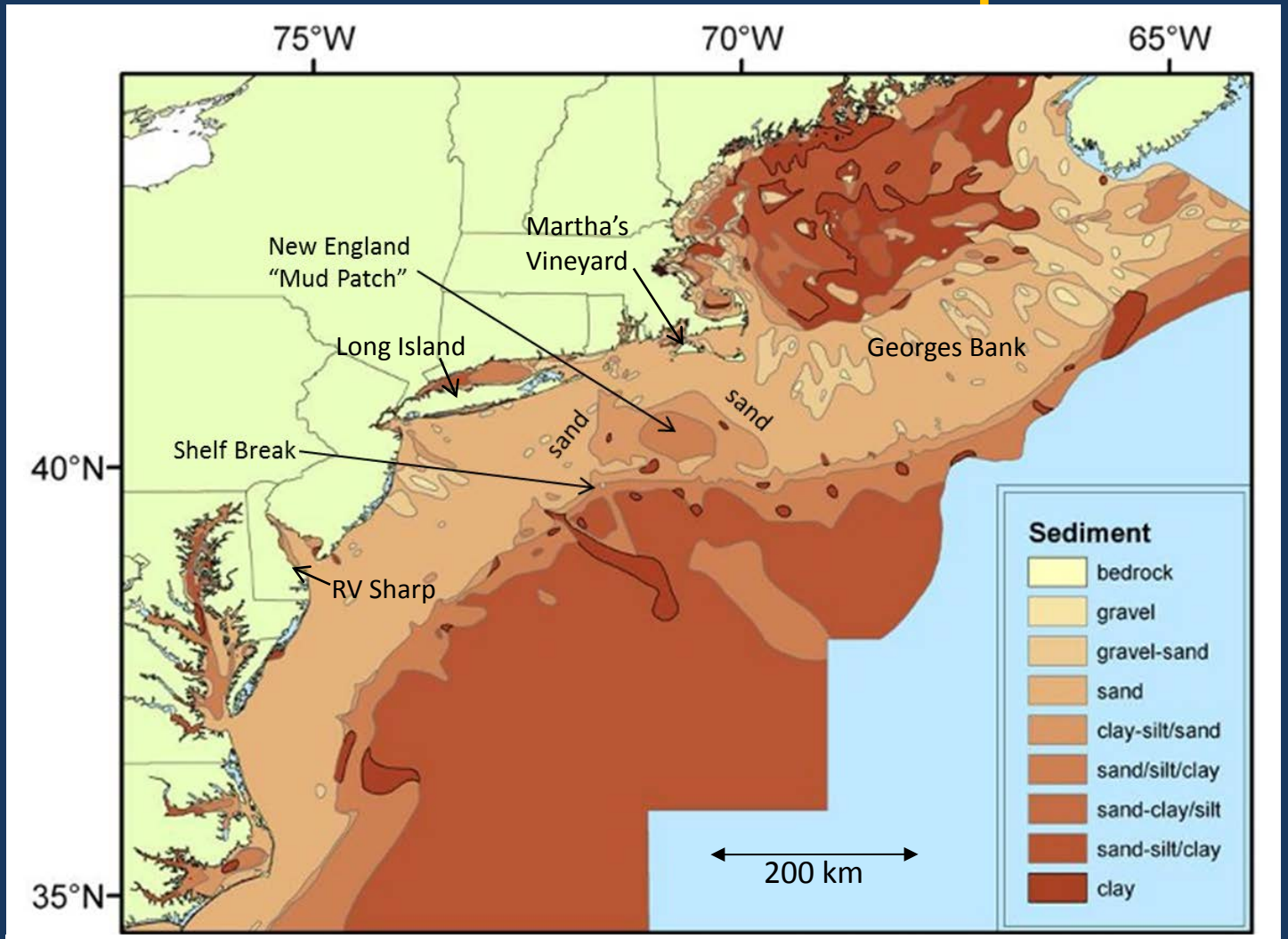
Seafloor Sciences Branch
Naval Research Laboratory
Stennis Space Center MS 39520

Ice Extent and Mud Patch

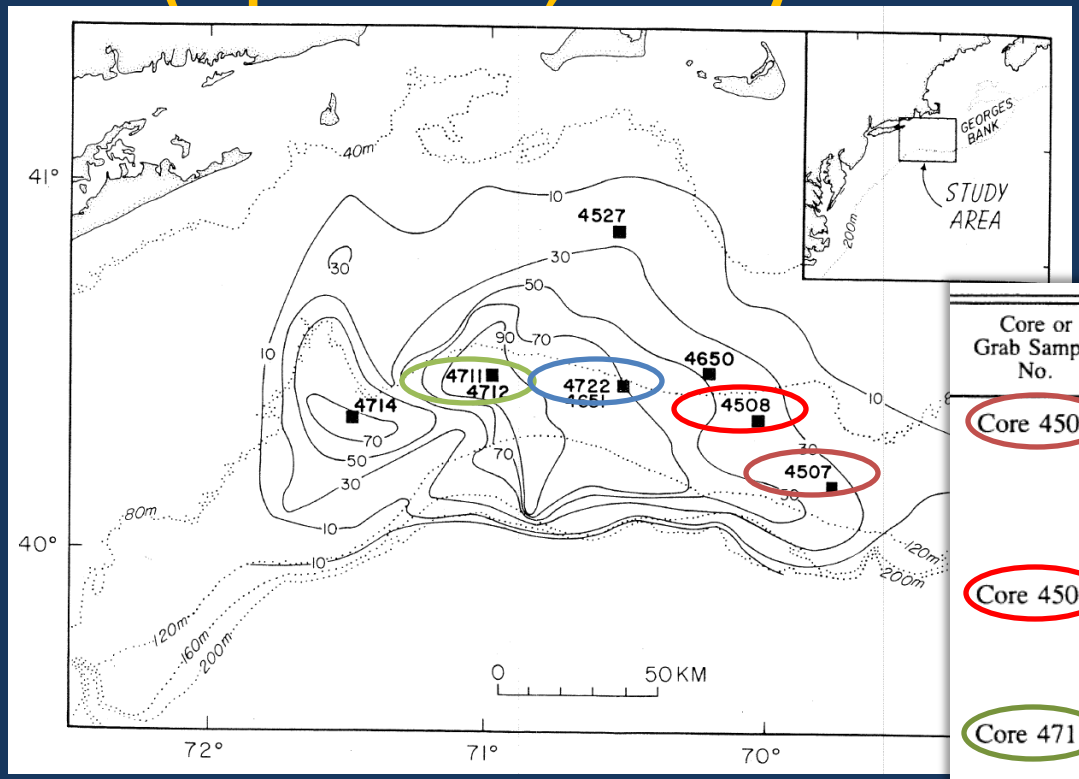


Continental Shelf Deposit



http://www.nefsc.noaa.gov/ecosys/ecology/PhysicalSetting/

Age of Mud – "Recent" (up to 10,000 years before present)



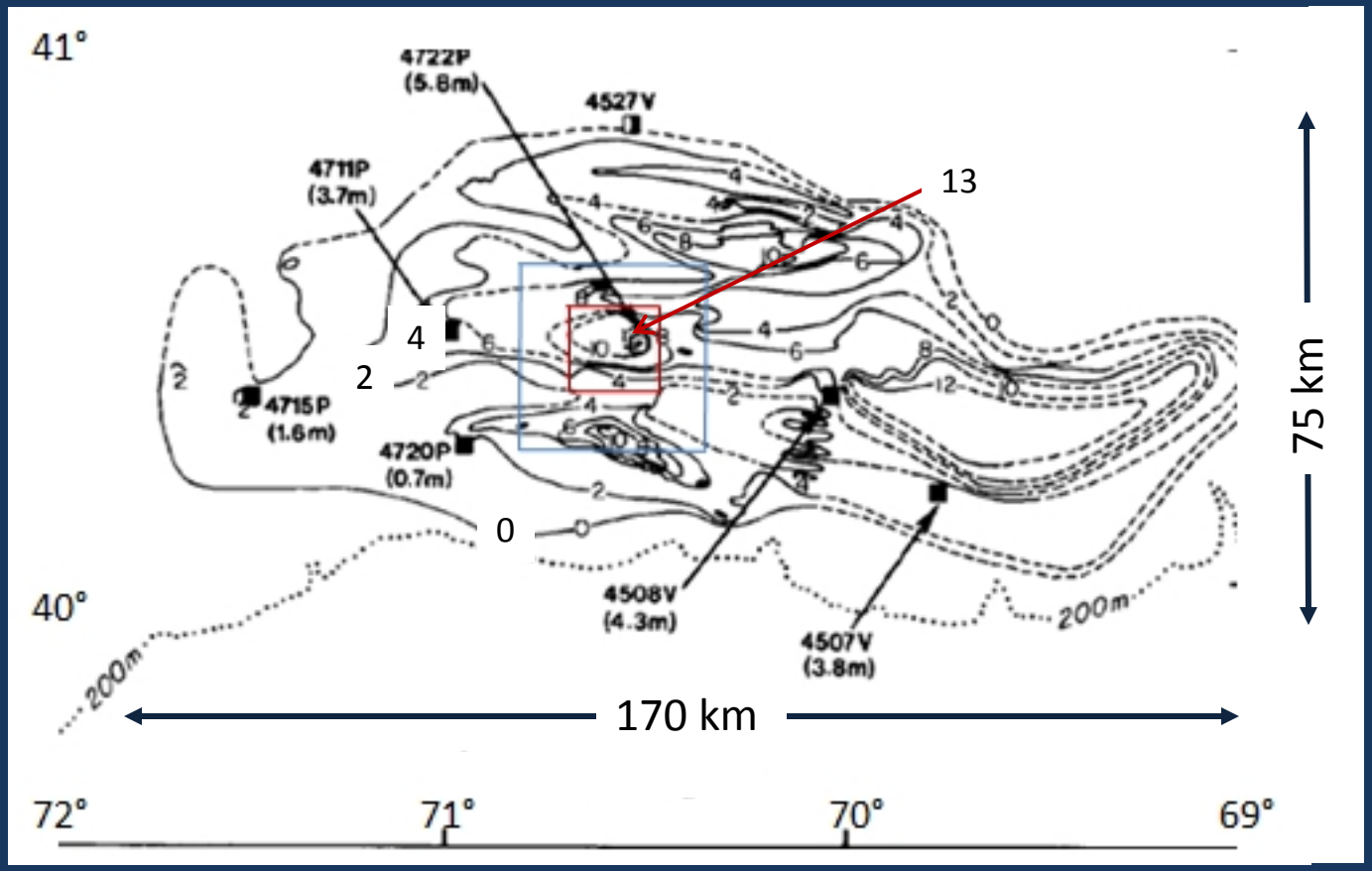
Core locations within the Mud Patch

Carbon 14 dates for depth within cores

Core or Grab Sample No.	Lab. No.	Sediment Depth (cm)	^{14}C age (years B.P.)
Core 4507	W-3932	0–40	1,980 ± 80
	W-4037	93–123	4,050 ± 90
	W-4062	150–180	5,180 ± 60
	W-3906	220–250	6,720 ± 90
	W-3902	323–353	10,070 ± 90
Core 4508	W-3893	0–30	1,820 ± 80
	W-3975	113–143	3,940 ± 80
	W-3973	271–293	7,500 ± 100
	W-3987	419–440	9,400 ± 120
Core 4711	W-4417	0–6[1]	2,020 ± 80
	W-4422	18–22[1]	2,340 ± 60
	W-4088	70–90	5,470 ± 70
	W-4092	200–230	7,630 ± 110
	W-4089	317–337	8,630 ± 100
Core 4722	W-4412	0–12[1]	2,170 ± 80
	W-4420	16–21[1]	2,250 ± 90
	W-4085	69–93	4,200 ± 70
	W-4091	300–320	6,540 ± 90
	W-4087	568–588	8,010 ± 90

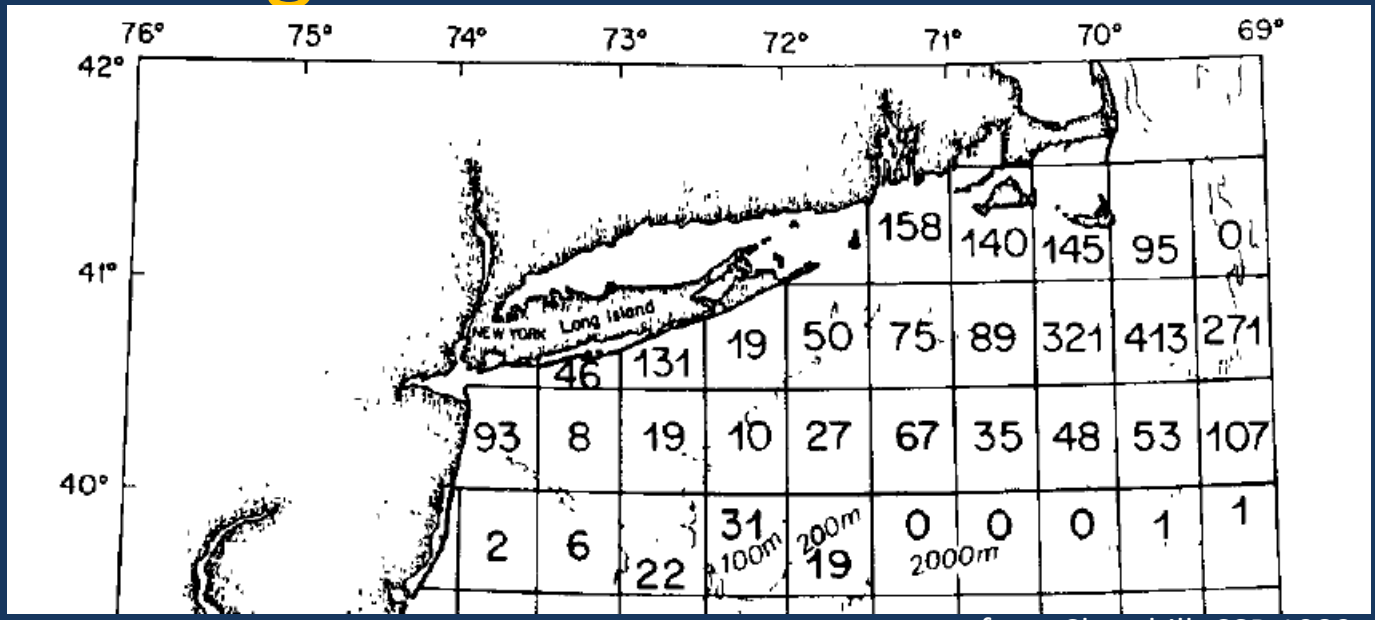
from Bothner et al. JSP, 1981

Mud Patch Variability

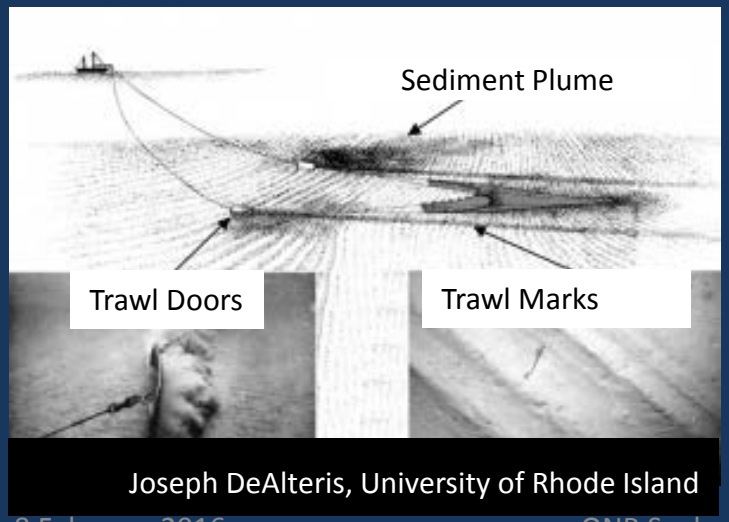


(From Twitchell, 1981)

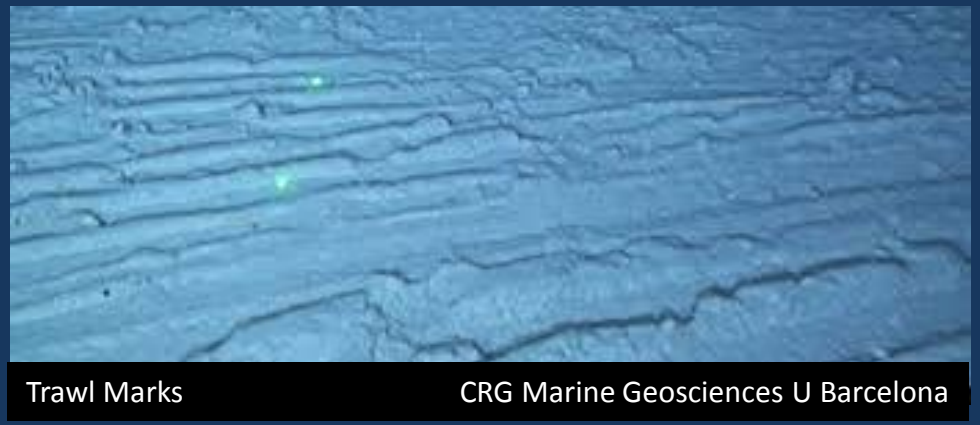
Trawling Surficial Sediment Textures



from Churchill, CSR 1989

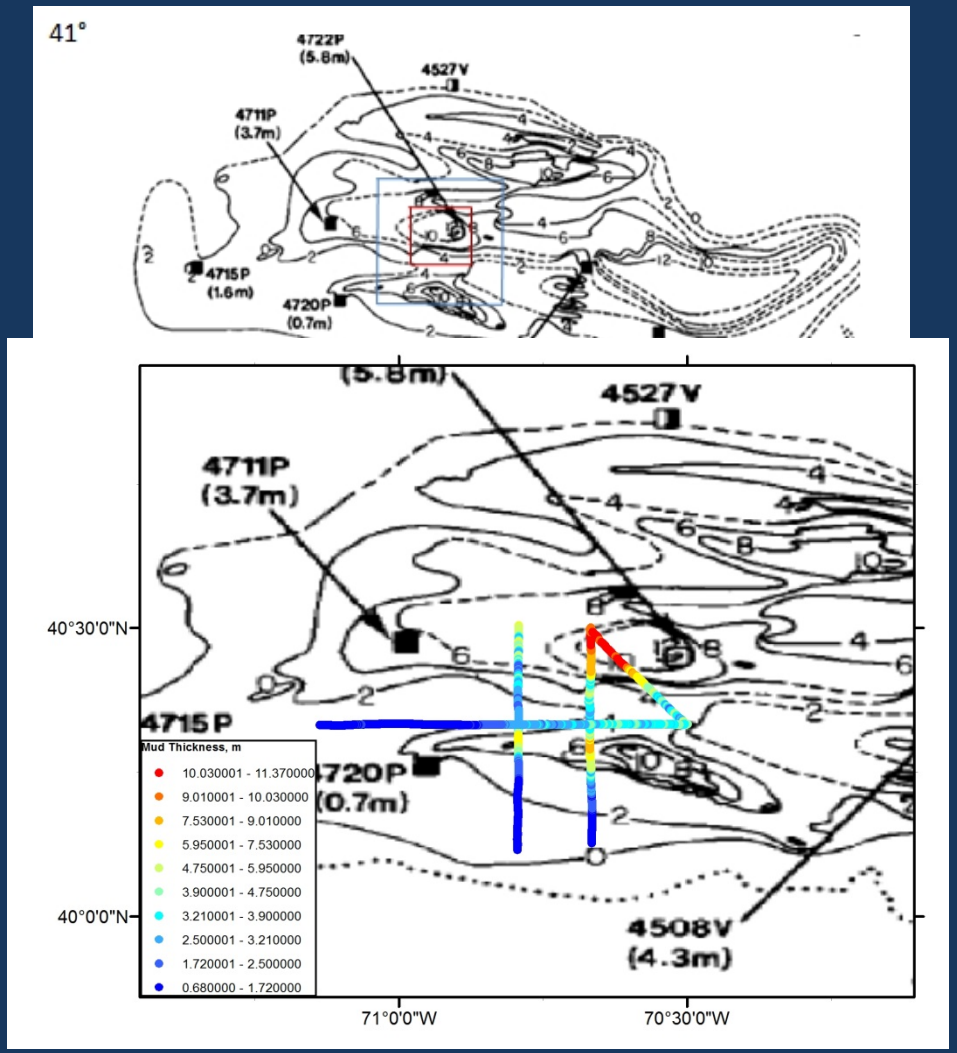


Joseph DeAlteris, University of Rhode Island



Trawl Marks CRG Marine Geosciences U Barcelona

Mud Patch Variability



Heterogeneity

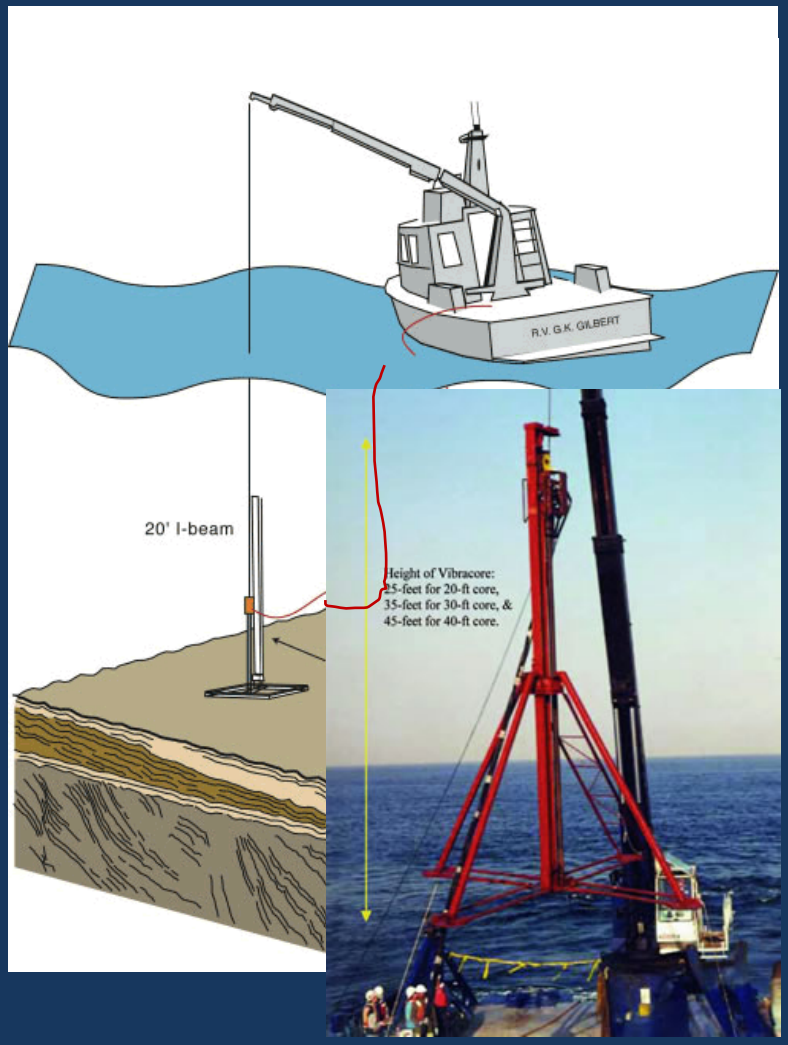
Physical Properties
- density
- porosity
- strata - sand lenses/layers
- clay mineralogy/concentration
- grain size

Surface Roughness
- smooth or planar
- trawled
- burrowed
- rippled or scoured sandbed
- mud-sand interfaces

Internal Factors
- sediment strata
- burrows, shells
- gas bubbles

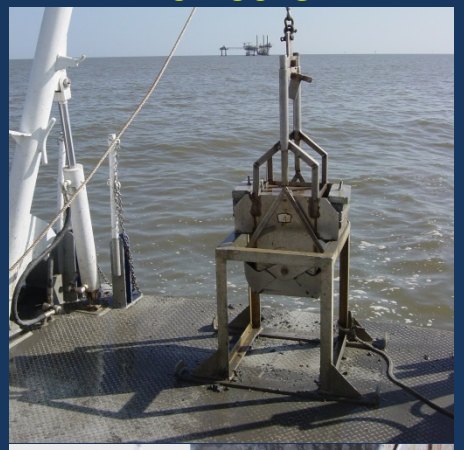
Multi-pronged Coring Approach

Vibracorer

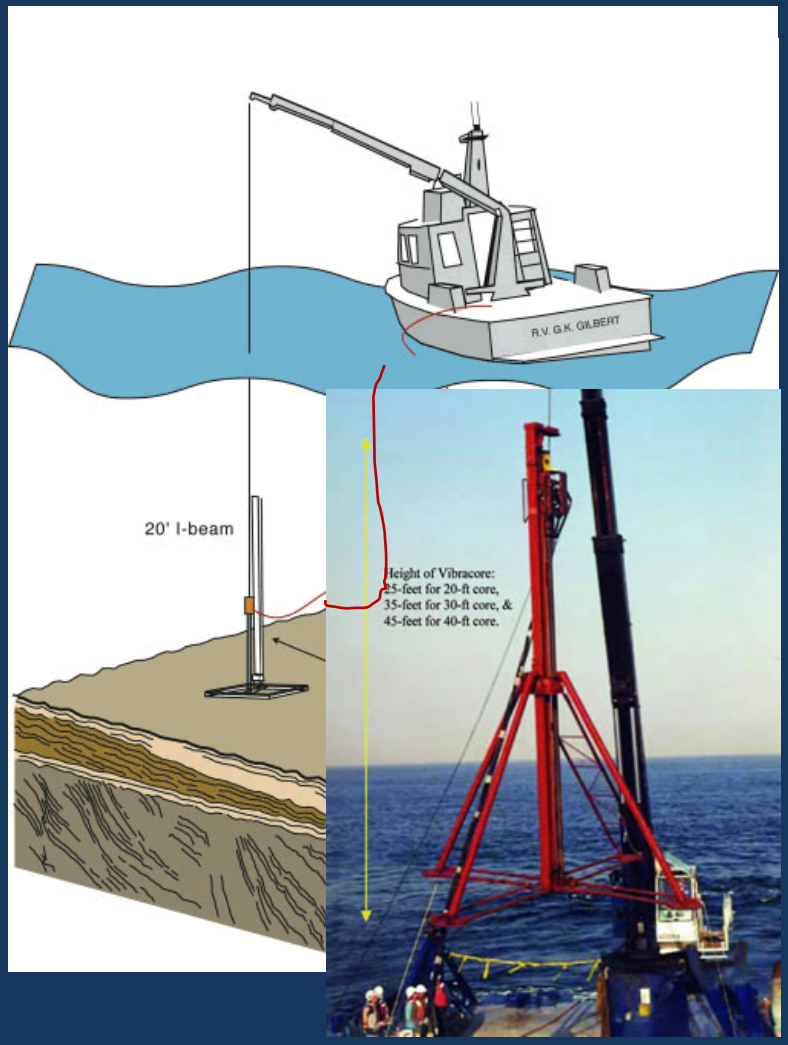


Multi-Corer

Box Corer



Vibracoring



Core Analysis

Deepest Penetration (meters)

Mud thickness & depth to sand

Sand lenses within mud

Mud-sand cores or sand cores

Physical Properties

- density
- sound speed
- porosity
- magnetic susceptibility
- strata - sand lenses/layers
- grain size

Mineralogy

Geochronology or sediment age

Multi-Corer

Core Analysis

Shallow Penetration (~0.5 m)

Physical Properties

- density, P-wave velocity, porosity
- magnetic susceptibility
- strata - sand lenses/layers
- grain size

Geotechnical Properties

- shear strength, bearing strength

Discrete Scatterers

- burrows, shells, gas bubbles

Surface Roughness (to some extent)

- burrows, ripples, trawl marks (sidescan needed)

Mineralogy, clay fabric (“House of Cards”)

Box Coring

Core Analysis

Shallow Penetration (0.4 m)

Physical Properties

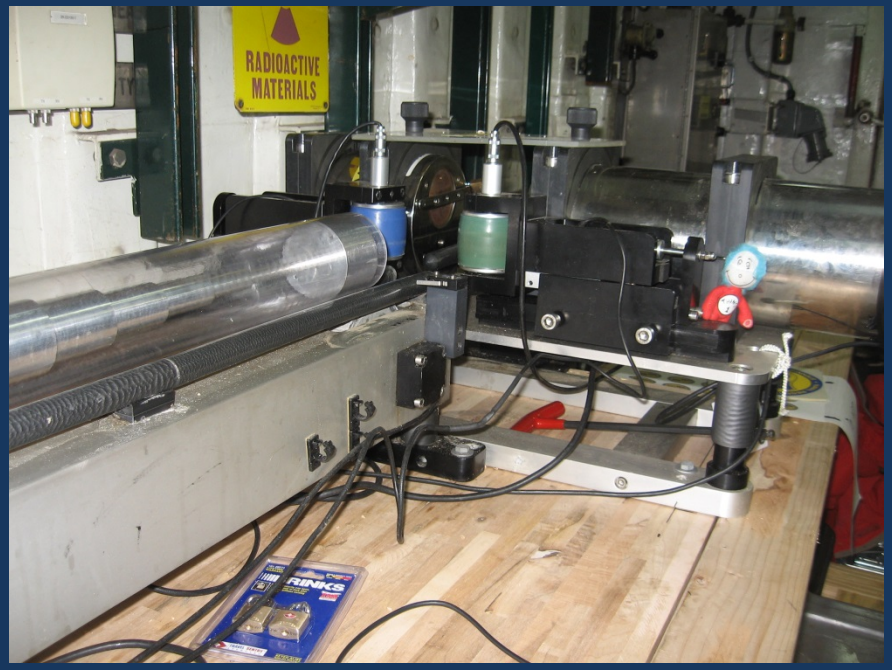
- Density
- P-wave velocity
- Porosity

Primary Purpose of Collection

Laboratory Based Mud Studies (reconstituted mud)

- Shear wave velocity
- Scholte wave study
- Other interests?

GeoTek Multi-Sensor Core Logger

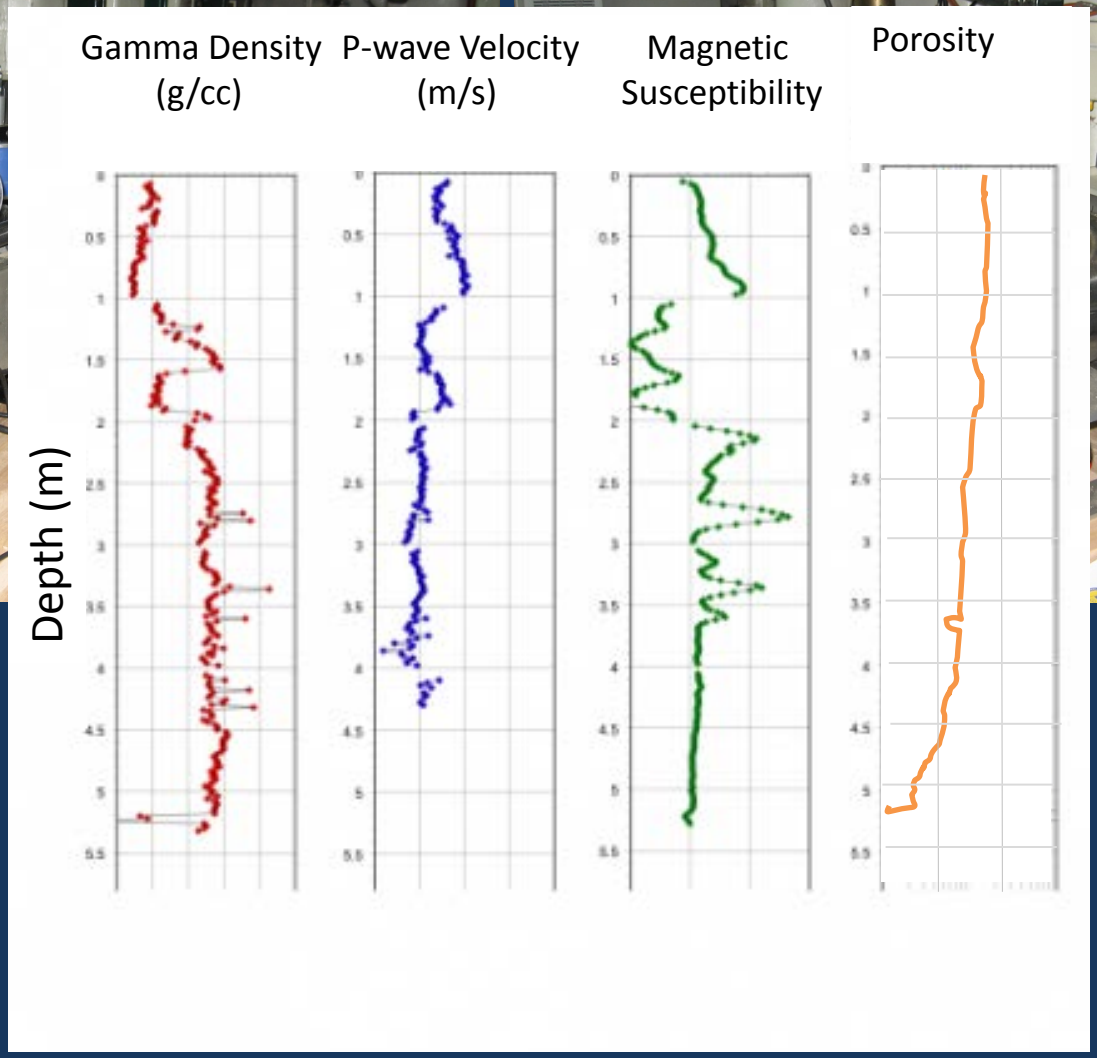


Physical Properties (During Cruise and on board ship)

- P-wave velocity (green-blue transducers)
- Density (Gamma attenuation)
- Porosity (Resistivity)
- strata - sand lenses/layers (Magnetic susceptibility)

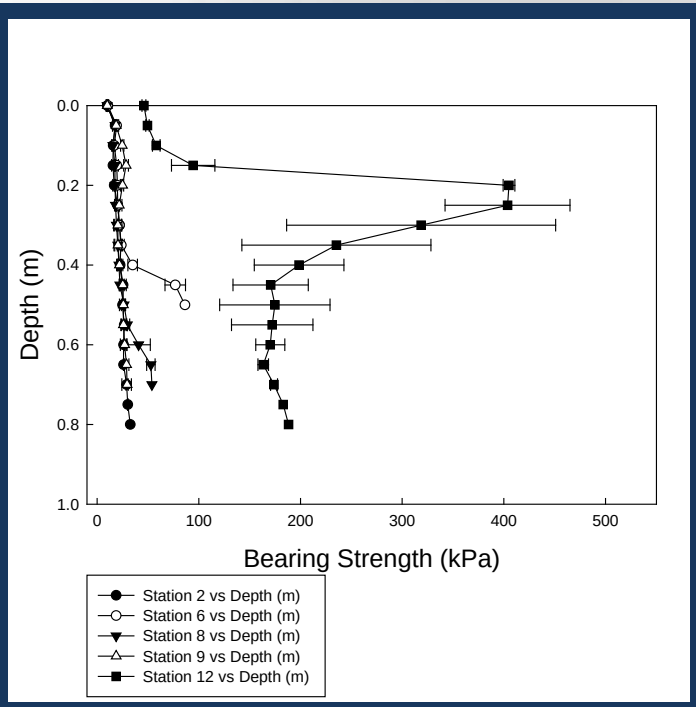
Grain size (Laboratory analysis)

GeoTek Multi-Sensor Core Logger

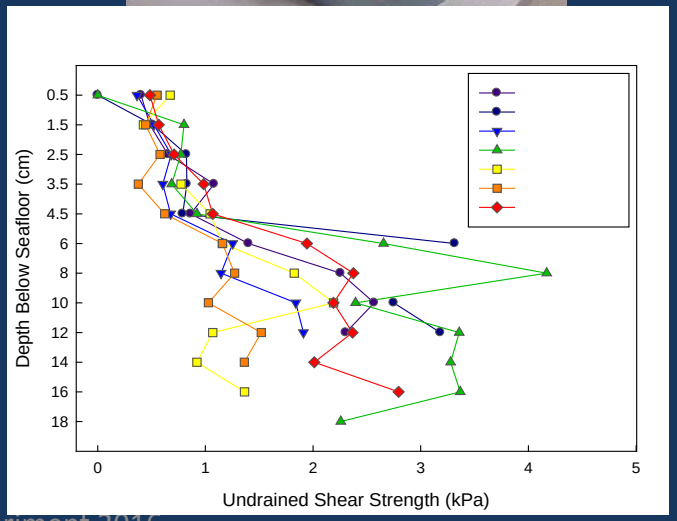


Geotechnical Measurements

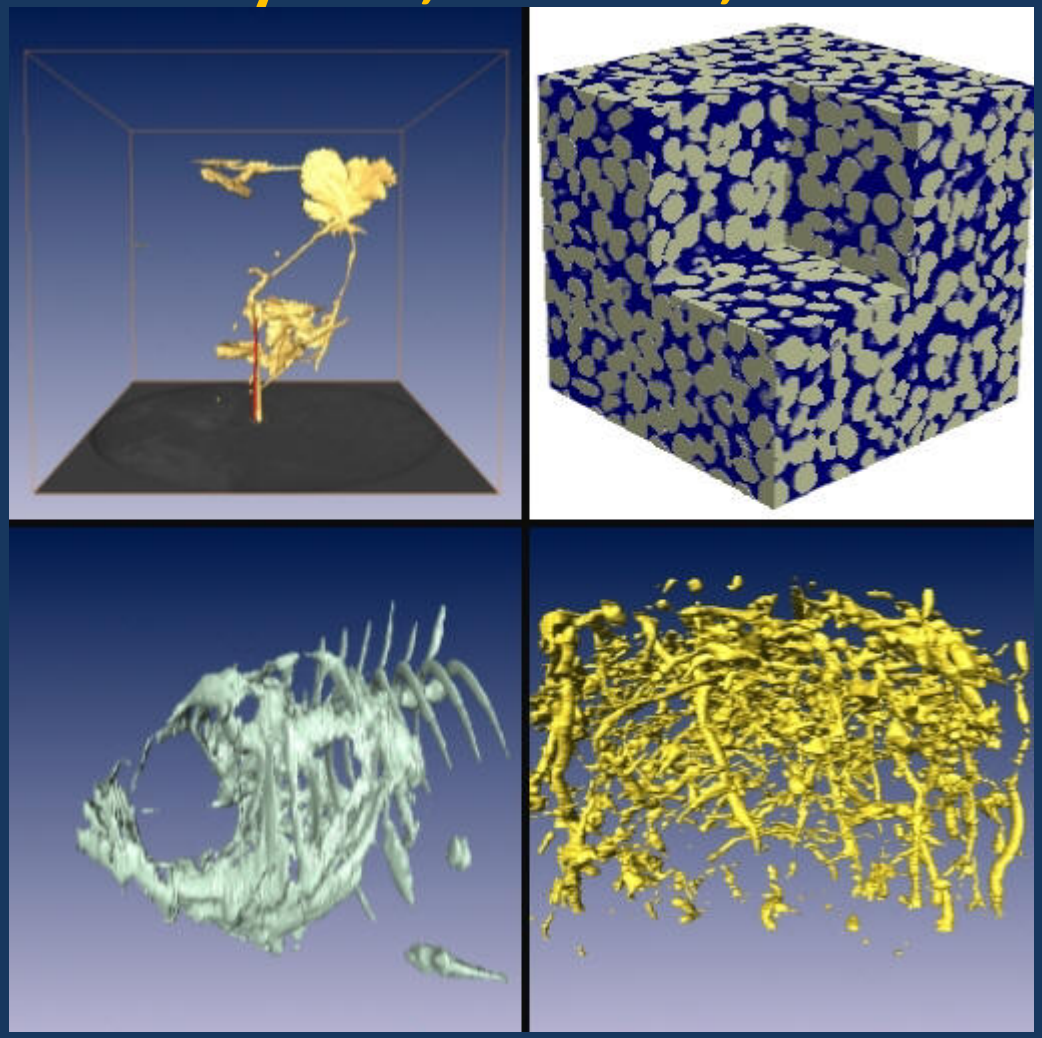
Penetrometer Tests (in situ)



Shear Vane (in lab)



Presence of Gas Bubbles, Sand Layers, Shells, Burrows

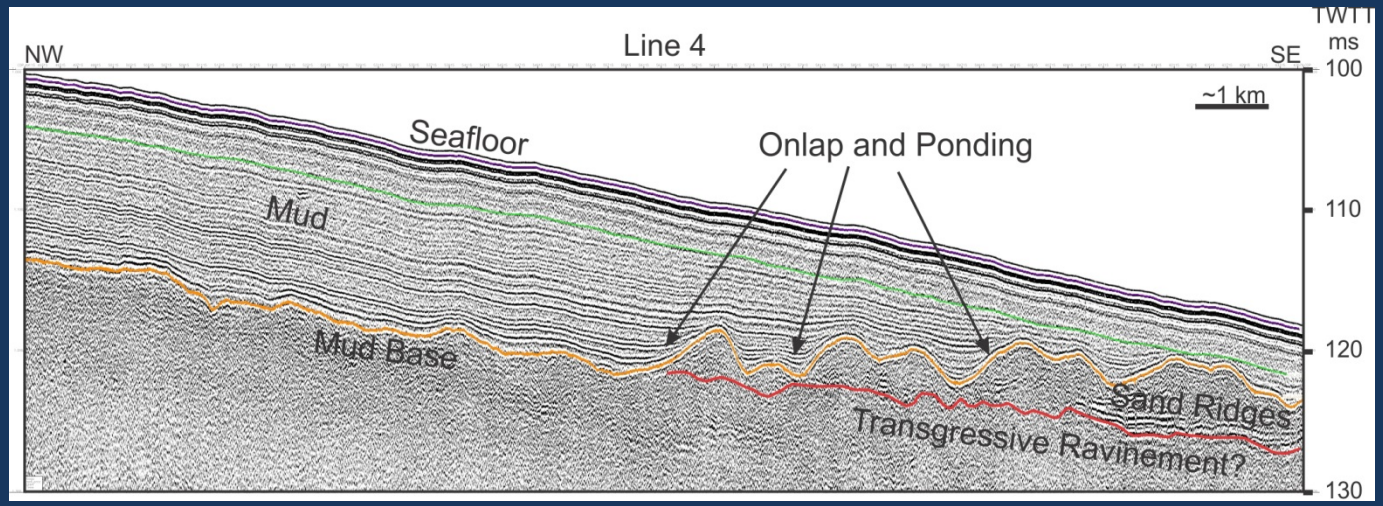


Comments?

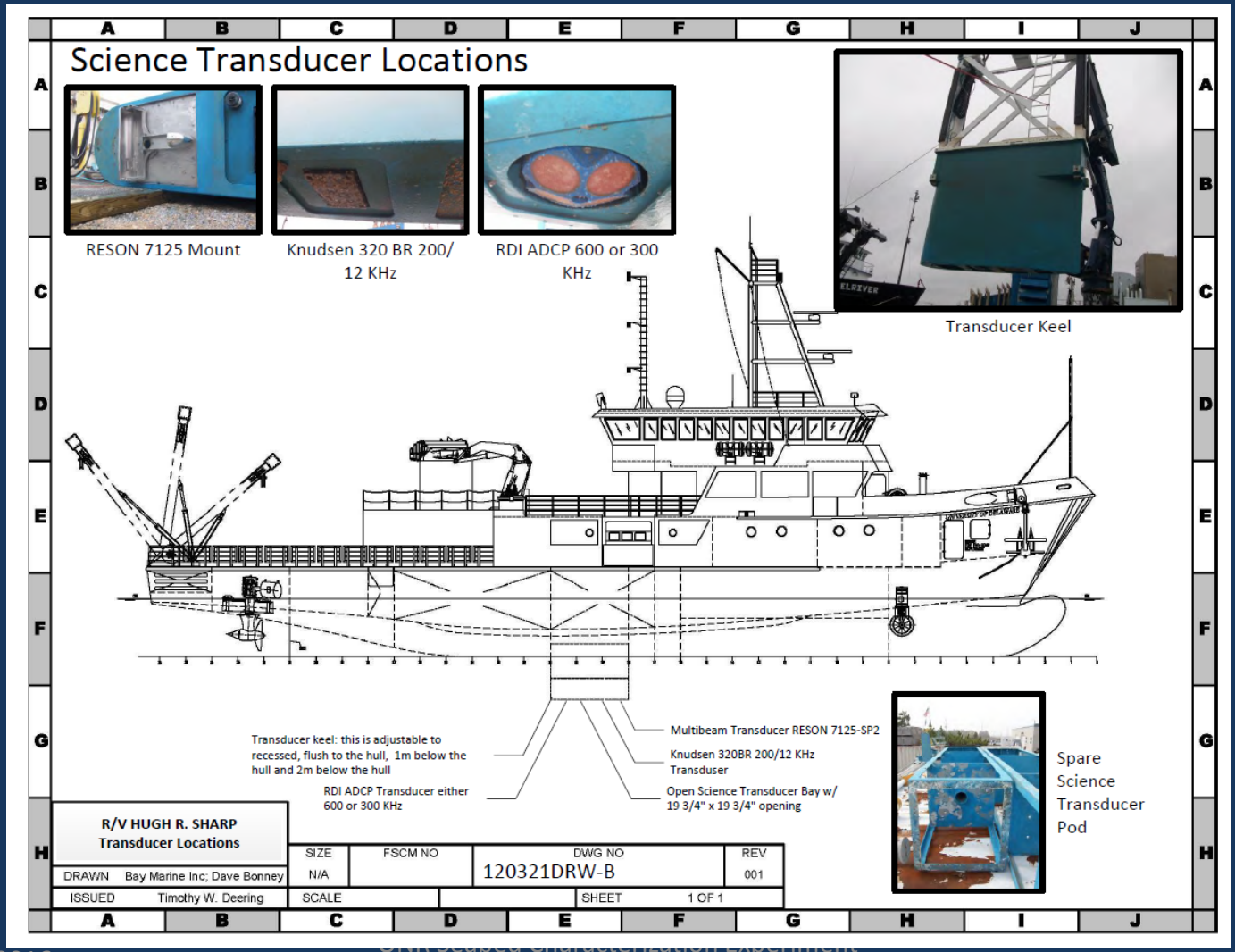
Potential Personnel

- NRL – Seafloor Sciences Branch
- USNA – Dept. of Oceanography
- UMASS-Amherst – geotechnical engineering
- Texas A&M – Dept. of Oceanography
- U. Delaware
- Coring Company – Government Contracting
- Clay mineralogist or clay technician

Rivers?
Transgressive Ravinement?



RV Sharp


Science Transducer Locations
RESON 7125 Mount
Knudsen 320 BR 200/ 12 KHz
RDI ADCP 600 or 300 KHz
Transducer Keel
Transducer keel: this is adjustable to recessed, flush to the hull, 1m below the hull and 2m below the hull
RDI ADCP Transducer either 600 or 300 KHz
Multibeam Transducer RESON 7125-SP2
Knudsen 320BR 200/12 KHz Transduser
Open Science Transducer Bay w/ 19 3/4" x 19 3/4" opening
Spare Science Transducer Pod
R/V HUGH R. SHARP
Transducer Locations
DRAWN Bay Marine Inc; Dave Bonney
ISSUED Timothy W. Deering
SIZE N/A
FSCM NO
DWG NO 120321DRW-B
REV 001
SCALE
SHEET 1 OF 1

R/V HUGH R. SHARP
University of Delaware
2014

GENERAL DESCRIPTION:
The R/V *HUGH R. SHARP* is an acoustically quiet, state of the art, general-purpose coastal research vessel operated by the University of Delaware as part of the University-National Oceanographic Laboratory System (UNOLS) fleet. The ship's normal operating area is the Delaware and Chesapeake Bays and adjacent coastal waters out to 200 nautical miles. However, work is periodically conducted as far north as the Gulf of Maine, as far south as the Gulf of Mexico and as far offshore as Bermuda. The vessel is outfitted with a full range of oceanographic equipment and instrumentation as listed below, all of which are available for use when the vessel is chartered. The Sharp is designed to meet ICES 209 sound emission standards and has an acoustically quiet mode as well as Sound Guards self monitoring hydrophones.

COMMUNICATIONS:
Voice, FAX, and Internet/e-mail via: INMARSAT Fleet-55 and cellular, Fleet Broadband, Marine VHF and GMDSS compliant

MANEUVERING AND POSITIONING
Kongsberg Green DP System, Twin Shottel Z-Drives, Tunnel Bow Thruster

ELECTRICAL POWER:
480 Vac (3Φ), 208 Vac (1Φ and 3Φ)

SCIENCE HANDLING EQUIPMENT:
Starboard Trawl Winch: DYNACON, 3000m of ½", torque balanced wire rope.
Auto-render, 20,000 LBS Line Pull.
Port Trawl Winch: DYNACON, 2500m .681 fiber optic wire, auto-render.
CTD Handling System: Caley Ocean Systems 6000m 0.322 cable, SWL 6700 LBS
Main Crane: Palfinger 48000 (SWL 15,400 LBS @ 18 ft; 3090 LBS @ 67 ft)
Stern A-Frame: SWL 20,000 LBS @ center overboarding sheave
Clear Height: 20.4 ft Clear Width: 11.8 ft
SWL 12,800 LBS P/S upper "T" extensions
SWL 8000 LBS lower "T" extensions
SWL 4000 LBS on inboard auxiliary padeyes
Crane "crutch" on starboard quarter for towing
Forward Deployment Boom (SWL 1000 LBS)

DYNACON 10010 Portable Deck Winch, 700m of 0.498", 10 conductor cable.
DEME Portable Deck Winch, 1000m of ¼", torque balanced wire.
DEME Portable "Clean" Winch, 1000m of ¼" Kevlar.
JENMAR Portable "Mooring" Deck Winch

LAB AND DECK SPACE:
Main Deck Aft: 1500 sqft
Clear Rail Length (Starboard): 53 ft
Dry Lab: 340 sqft
Wet Lab: 260 sqft
Vans: Two (2) 20-foot van locations P/S on main deck aft.
Isotope Van with Hewlett-Packard LSC
General-Purpose Van
Cold and "Clean" vans available upon request

RETRACTABLE KEEL:
Three (3) 24" x 24" transducer bays for ship and science use. Changeable alongside.

Flush with keel:	2.9 m below mean water line
1.0 m down:	3.9 m below mean water line
2.0 m down:	4.9 m below mean water line

SHIP'S STANDARD INSTUMENTATION:
Sound Guard real time noise monitoring and recording program with hull mounted transducers.

Acoustic Doppler Current Profiler (ADCP): RDI "Workhorse" 600 kHz with a nominal range of 60 meters.

Surface Mapping System (SMS): The SMS records navigation, meteorological and sea surface data every 10 seconds.

CTD System: SeaBird Electronics 911 plus CTD, Rosette is a 12-bottle General Oceanic Model 1015, outfitted with an array of 10 liter bottles.

GMI MKII "Scanfish" Undulating Towed CTD with SeaBird Electronics 911 plus CTD installed

Knudsen 320 B/R Deep Water Echo Sounder (12 and 200 kHz). 3.5kH towed body available.
RESON 8101, shallow water Multibeam Survey System

Profiling Light Meter (Biospherical)	Lab-Grade Water Purifier
Ocean Instruments Box Corer (16" x 16")	Gravity Corer (10 Foot)
Smith MacIntyre Bottom Grab	Deck Incubation Tables
Liquid Scintillation Counter (in 20-foot van)	XBT System
Multicorer	

"Clean" Sea Water Supply Available in Labs and Vans from dedicated science sea chest.

17-Foot Semi-Rigid Work Boat (SafeBoats)
Modular Scientific Refrigerators and Freezers
Scientific Bow Tower and Scientific Antenna Mounts on Main Mast

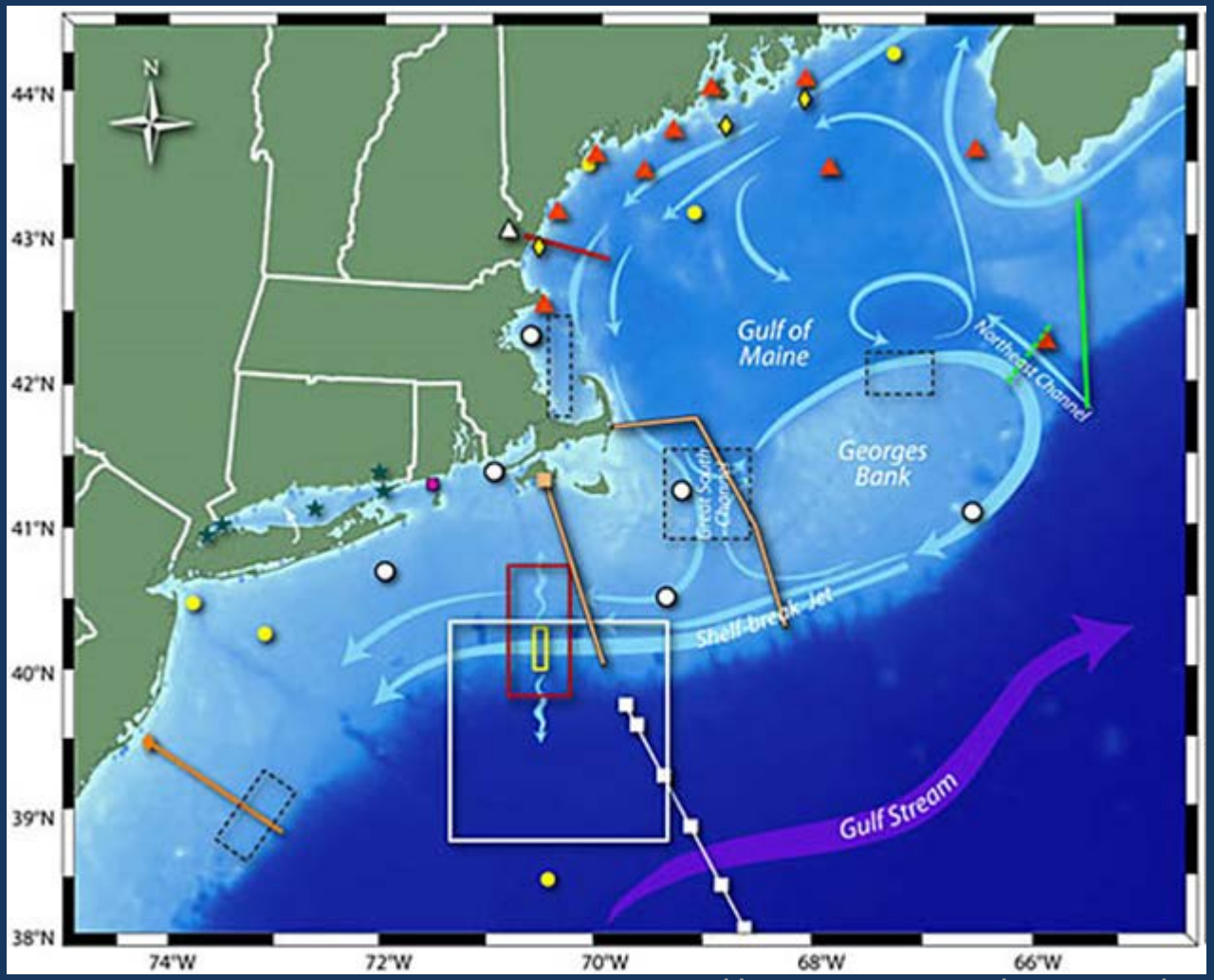
SCHEDULING:
The R/V *HUGH R. SHARP* is scheduled through the UNOLS process. Preliminary schedules for the next calendar year are normally drawn up in July. As the funding decisions for the various proposed projects become known the schedule is finalized. All investigators, regardless of which agency or institution is providing the funding, should submit a Ship Time Request through UNOLS as early as possible (www.unols.org). We are happy to accommodate additional cruises in the current year as the ship's schedule permits. We encourage all investigators to contact Marine Operations early in the planning stages of the project.

CONTACT: Jon Swallow, Director of Marine Operations
Phone: (302) 645-4341 / (302) 396-8565; Fax: (302)645-4006;
e-mail: jswallow@udel.edu

Principle Characteristics
R/V *HUGH R. SHARP*
January 2014

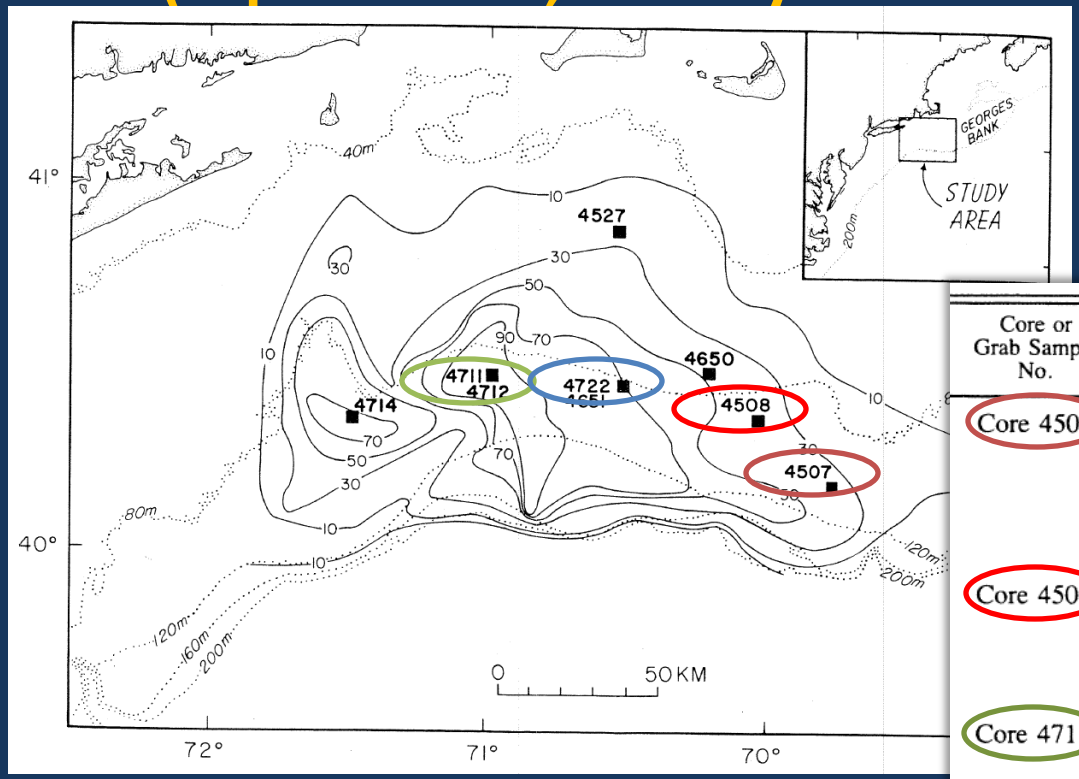
Operating Area	Mid-Atlantic/Coastal Maine to Florida and the Gulf of Mexico
Length Overall	146'(44.5 m)
Length at Waterline	135'
Beam	32'
Draft	9.5'
Freeboard (aft deck)	5'
Maximum Antenna Height (SSB)	75'
International Tonnage (With two 20-foot vans on deck)	495
Domestic Tonnage	256
Displacement Tonnage (Fully Loaded)	598
Cruising Speed	10-11 knots
Range (Average speed 7 knots, 10% reserve)	3500 nm
Endurance (Limiting Factor: Fuel)	~14 days
Propulsion Plant	Diesel-Electric
Main Propulsors:	Schottel Twin Z-drives (5-bladed, fixed pitch)
Bow Thruster:	Schottel Tunnel Thruster
Dynamic Positioning:	Simrad "Green" DP (rated "DPS-0")
US Coast Guard Inspection Status:	Uninspected
ABS Classed	*A1, Maltese Cross, AMS, Circle E
Load Line	Yes
Total Permanent Berths (2-person staterooms)	22
Routine Crew (Including technician)	6-8
Routine Scientific	14
with Conference Room used as berth (2-person):	16
Acoustic Capabilities	Below ICES 209 limits at 8.0 knots
Stack Emissions	"Low" per EPA requirements
Bollard Pull	33,000 lbs
Routine Lifting/Towing	20,000 lbs
Science Payload	45 tons (32 long tonnes)

Pioneer Array – Local Currents



http://www.whoi.edu/ooi_cgsn/pioneer-array

Age of Mud – "Recent" (up to 10,000 years before present)



Core locations within the Mud Patch

Carbon 14 dates
2 – 10 ka Before Present

Core or Grab Sample No.	Lab. No.	Sediment Depth (cm)	^{14}C age (years B.P.)
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from Bothner et al. JSP, 1981

Sediment Collection Strategy

- Mud cores, mud sand cores, sand cores
  - vibracores
- Sediment water interface roughness –
  - multi-corer for surficial sediment eval.
  - box corer for surficial sed. eval. and bulk sediment
  - sidescan imagery to assess fish- trawl impacts
- Grab samples w/box core -

Water Data and Measurements

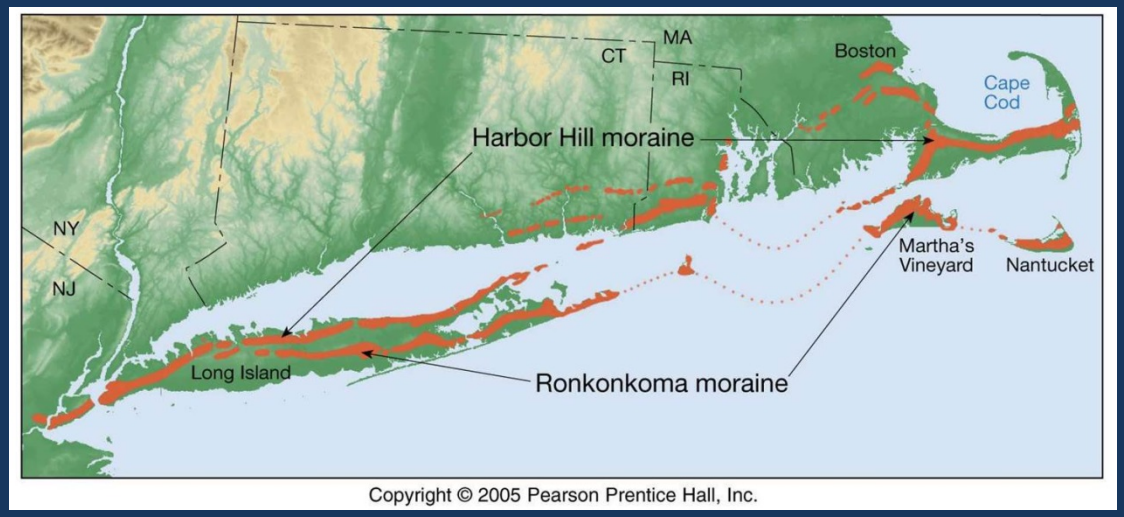
CTD casts for

- Temperature
- Salinity

ADCP

- Currents

Geologic History



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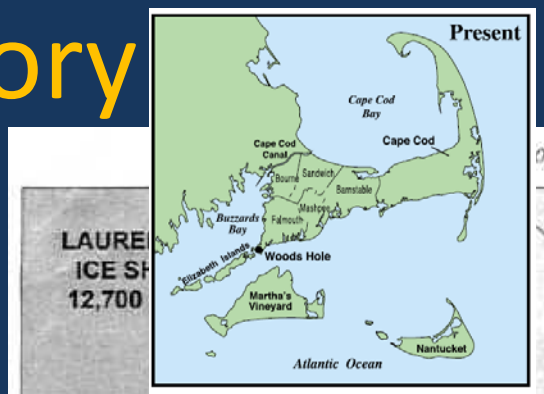
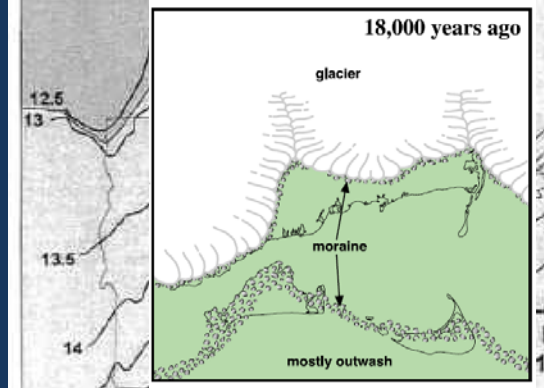
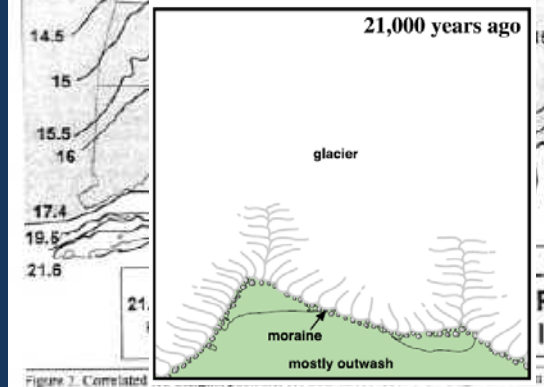
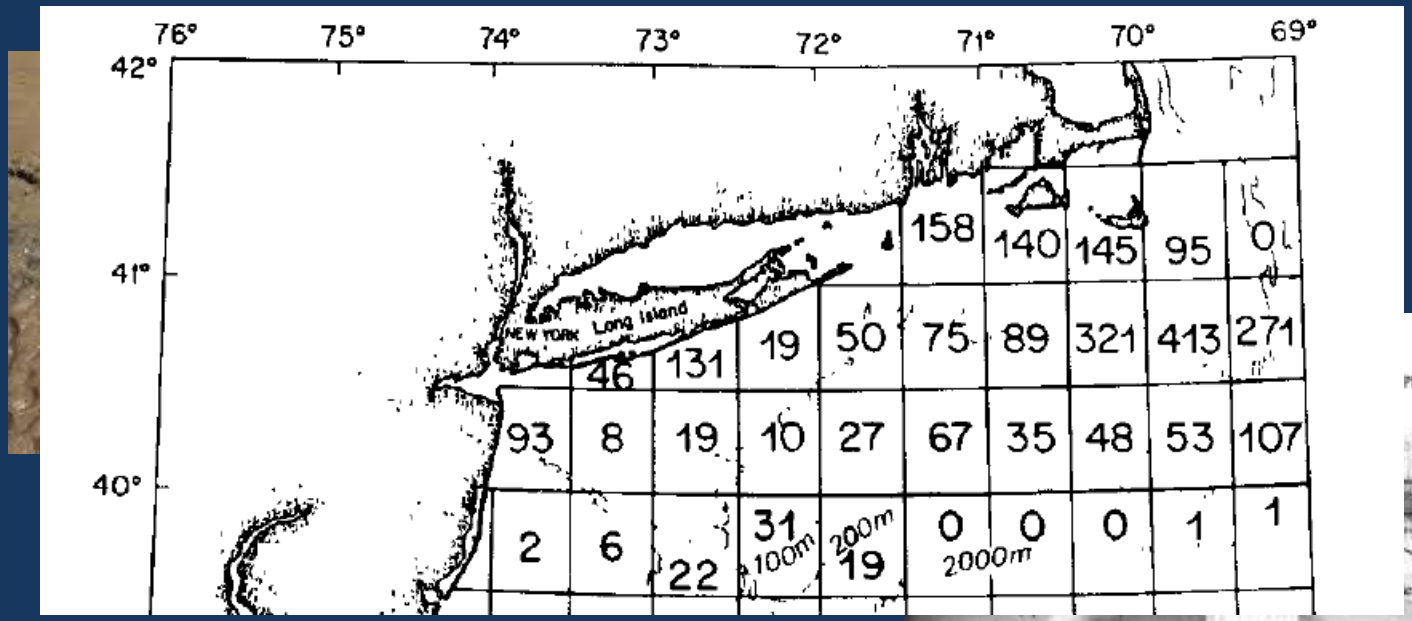
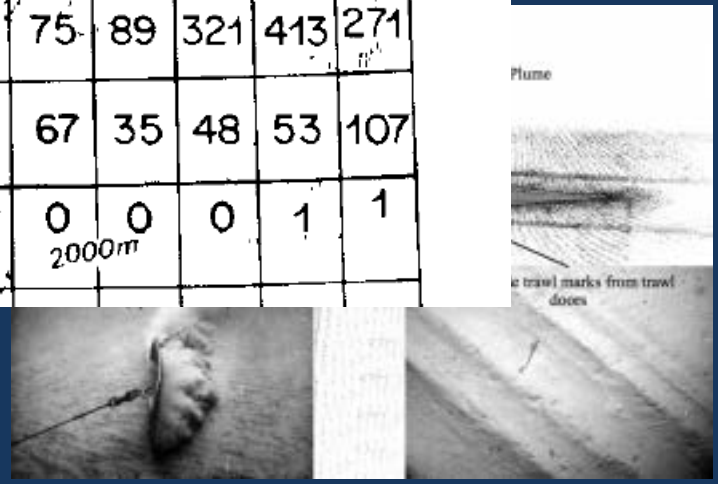






Surficial Sediment Textures





Mud Data

- Physical Property Data
  - Multi-sensor core logger (thru the liner evaluations – underway)
    - Density
    - P-wave velocity (250 kHz)
    - Resisitivity
    - Magnetic susceptibility
  - Geotechnical Properties
    - Shear strength (laboratory)
    - Bearing Capacity (in situ)

- Sediment water interface roughness –
  - Coring with multi-corer for surficial sediment evaluation
  - sidescan might be possible to assess fish- trawl impacts