North Carolina Outer Continental Shelf Sand Resource Investigation
Final Full Investigative Report
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1 Introduction

Since 2000, 52 tropical cyclones (23 as hurricanes) have passed within 300 miles of the North Carolina coast (North Carolina Climate Office, 2019). Not all of these storms recorded heavy damage to the shoreline, but storms such as Isabel (2003), Irene (2011), Sandy (2012), Arthur (2014), Matthew (2016), Florence (2018), and Michael (2018) left behind impacts, including erosion to the State's ocean beaches. As a result of these and other storm events (e.g., nor'easters), many communities in NC are looking to beach nourishment as a way to protect their economically valuable beach-dune systems. However, there remains limited knowledge of offshore borrow areas for replenishment projects.

A review of the potential sand resource needs and borrow area knowledge was conducted in 2017 (NCDCM, 2017). The work described in this report builds on that effort, with a specific focus here on the offshore waters south of Cape Lookout where new data are available. Resources are anticipated to be limited, and demand will likely increase with sea-level rise and storm activity. This study examined new seismic data, shallow sediment cores, and sediment surface samples collected as part of the Atlantic Sand Assessment Project (ASAP). Much of the data analysis presented was conducted as part of doctoral research by Ian Conery at East Carolina University (Conery, 2019).

The principal objective of this project is to expand our knowledge of the replenishment resources that might potentially be available to NC coastal communities for future beach nourishment projects. The effort aimed to increase the inventory and database of information available in federal waters of the Outer Continental Shelf (OCS) offshore (3-8 nautical miles) of North Carolina. Specific goals of this report are three-fold: 1) to provide an overview of the need for sand resources and related data offshore of North Carolina, 2) to review and interpret the range of geological and geophysical information and data currently available and 3) to identify and prioritize future research needs in the OCS.

2 Need for Sand Resource Information Offshore of North Carolina

Of the one hundred counties that collectively make up the State of North Carolina twenty are classified as coastal and eight of these are identified as oceanfront (Figure 1). From north to south the oceanfront group consists of the counties: Currituck, Dare, Hyde, Carteret, Onslow, Pender, New Hanover and Brunswick. In addition to the counties, several federally managed properties, including military reservations and state or private conservation areas, are located here. The NC Beach and Inlet Management Plan, drafted in 2011 (NC BIMP, 2011) provides a comprehensive overview of the eight counties and coastal lands, describing coastline and coastal management-related activities in the different regions along with their socio-economic value. While shipping commerce and industry makes a home in select areas of the North Carolina Coast, particularly in the Wilmington and Morehead City areas, the lion's share of the economic activity from Currituck in the north to Brunswick in the south is tourism based. Thus, much of the local and regional economy hinges on preserving the infrastructure and ecosystems (both natural and man-made). In 2017 the State's one hundred counties amassed more than 23 billion USD in visitation revenue (VisitNC, 2017).

The environmental and ecological sustainability of the ocean shoreline is another factor that must be considered for ecosystem services, resources and economic prosperity. For instance, the compatibility of sand placed on the beach is important, not only to ensure the design life of a nourishment project is realized, but also for the ecological health of the beach, backing dunes, interior and fringing marshlands, adjacent estuaries, and the many indigenous species found there. This same interwoven importance is equally applied to the lives and livelihoods of residential and business communities that have grown and evolved in the midst of this natural system (NC BIMP, 2011).

A number of areas in NC have a long history of beach renourishment. Since the first project was conducted along Wrightsville Beach in 1939 more than 250 additional projects have been completed, pouring more than 100 million cubic yards of sand along North Carolina's ocean shorelines (Table 1), at a total

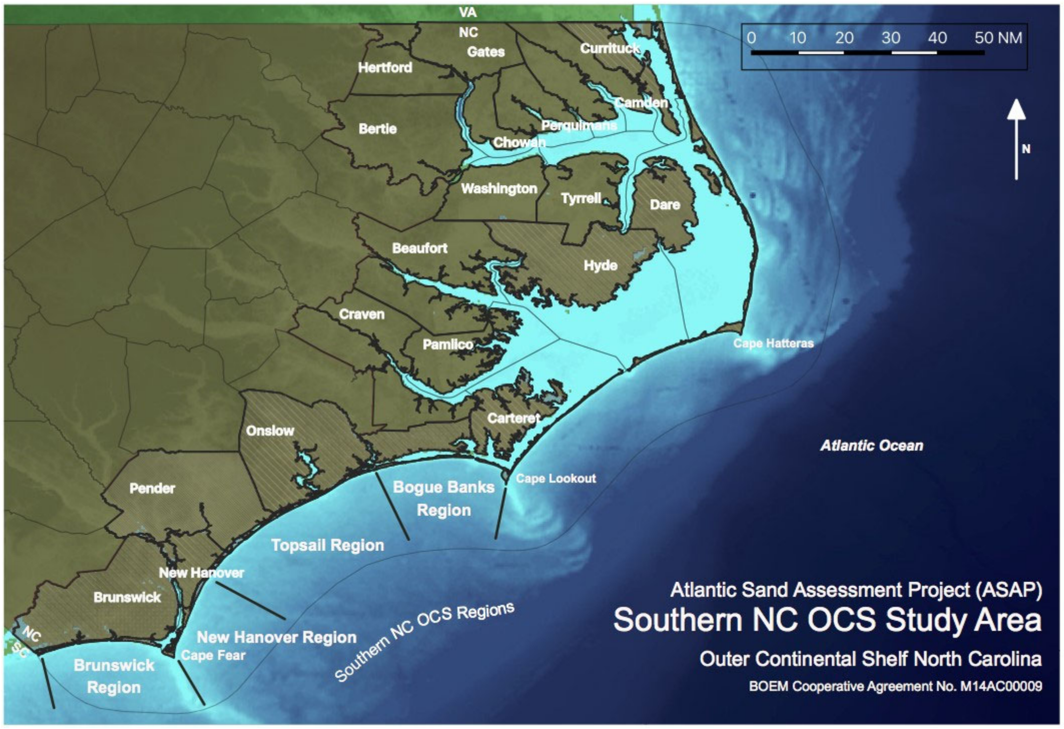


Figure 1: North Carolina's coastal and ocean-fronting counties and the Southern NC OCS Study Area.

cost exceeding a half billion U.S. dollars (WCU, 2018). A complete listing of these projects continues to be compiled by the Program for the Study of Developed Shorelines at Western Carolina University. The beach nourishment database can be accessed online at: http://beachnourishment.wcu.edu. More information focusing on coastal storm damage reduction and associated beach nourishment and recovery can be had from the U.S. Army Corps of Engineers. Interested readers are referred to the Army Corps of Engineers website: http://www.saw.usace.army.mil/Missions/Coastal-Storm-Damage-Reduction/.

This report reviews and discusses offshore sand resources, but data analysis is focused on the continental shelf from 3 nautical miles (3 nm, the State territorial limit) to about 8 nm into federal waters, known as the Outer Continental Shelf. The new data assessment and interpretation in this report is in the southern half of NC, specifically from Cape Lookout southward to the SC border (Figure 2). For discussion this region is partitioned into a series of subregions based on political units (counties, municipalities) or cooperative groupings, where one or more proximal communities have been combined in past nourishment projects (Figure 3). Four subregions, from north to south, are used: Bogue Banks, Topsail Island, New Hanover County, and Brunswick County. Sand resources in the northern part of NC have been described in detail in other previously released reports (Walsh et al., 2016a, Walsh et al., 2016b; NCDCM, 2017). As such, northern coast sand assessments are herein discussed only in brief.

3 Data and Methods

3.1 Data Compilation

Many different entities have conducted seafloor mapping and geological research offshore across the North Carolina continental shelf over the last half century. As a result, a wide variety of spatially-referenced sediment, seismic, and bathymetric datasets with accompanying FGDC-compliant metadata are available from both state and federal sources (NCDCM 2016; Walsh et al., 2016a, Walsh et al., 2016b). The largest data collections (many with large spatial coverage) are available from federal agencies,

Table 1: Beach Nourishment Histories for North Carolina Coastal Communities. **Note that projects in Duck, Kitty Hawk, and Kill Devil Hills completed in 2018 are not included here.

Location	First Year of Record	Number of Times Nourished	Total Volume Nourished (cy)
Atlantic Beach/Fort Macon	1958	14	17,525,228
Bald Head Island	1991	12	11,186,190
Cape Hatteras	1966	3	1,812,000
Cape Lookout	2006	1	75,700
Carolina Beach	1955	36	19,803,048
Caswell Beach	2001	2	256,600
Emerald Isle	1984	19	4,571,214
Figure Eight Island	1977	26	6,113,852
Hatteras Island	1974	7	887,801
Holden Beach	1971	49	4,661,045
Indian Beach/Salter Path	2002	3	1,385,692
Kill Devil Hills	2004	1**	38,016
Kitty Hawk	2004	1**	143,000
Kure Beach	1998	6	5,964,932
Masonboro Island	1986	6	3,234,686
Nags Head	2001	3	4,800,000
Oak Island	1986	9	6,545,287
Ocean Isle Beach	1974	18	4,479,790
Ocracoke Island	1986	5	516,062
Onslow	1990	4	405,829
Pea Island	1990	20	9,673,228
Pine Knoll Shores	2002	6	2,969,185
Rodanthe	2014	1	1,618,083
Topsail Island	1982	20	5,394,479
Wrightsville Beach	1939	26	14,709,157

including NOAA (the National Centers for Environmental Information at https://www.ngdc.noaa.gov/), the U.S. Army Corps of Engineers (e.g., the Corp's Duck North Carolina Field Research Facility; http://www.frf.usace.army.mil/), and the U.S. Geological Survey (USGS) (http://walrus.wr.usgs.gov), including the USGS's usSEABED database, and from a large cooperative study conducted in the 2000s (Reid et al., 2005). Many other data sources come from academic, private, state, and other federal efforts.

3.2 Priority Target Areas and Data Collection

As noted earlier in this report, the need for beach nourishment in North Carolina is becoming increasingly widespread. Many communities have conducted projects in the past, and others are planning future efforts. As the Earth's climate continues to change, and average atmospheric and oceanic temperatures continue to rise, more frequent, higher intensity tropical and extratropical storms in the short (sub decadal) term are likely. Over the longer (multi-decadal) term sea level rise will become an increasingly important factor contributing to changes in the coast that will force most if not all coastal communities in North Carolina to consider nourishment at some point in the future.

To minimize costs, it is usually preferred to use a proximal sediment source (e.g., inlet fill) for beach replenishment; however, in many areas, a sufficiently sized source of compatible sand is lacking. In these cases a more distant offshore, continental shelf site may be the only option. Based on the available data, a prioritization schedule was completed in early 2015 to guide data collection for the BOEM-funded Atlantic Sand Assessment Project (ASAP). Using this guidance, reconnaissance and data collection for the ASAP began in the summer of 2015 along the State's Outer Continental Shelf (OCS) south of Cape Lookout (see Figure 2)-an area sparse in geophysical data coverage as compared to the shelf to the north where coverage is more extensive. In the process the USGS-cooperative project (Thieler et al., 2013; 2014) collected some 317 nautical miles of seismic reflection data to map the sub-bottom and sidescan and nadir-scan sonar for bathymetry, along with 24 vibracores and 14 surface sediment sample grabs (Figure 2).

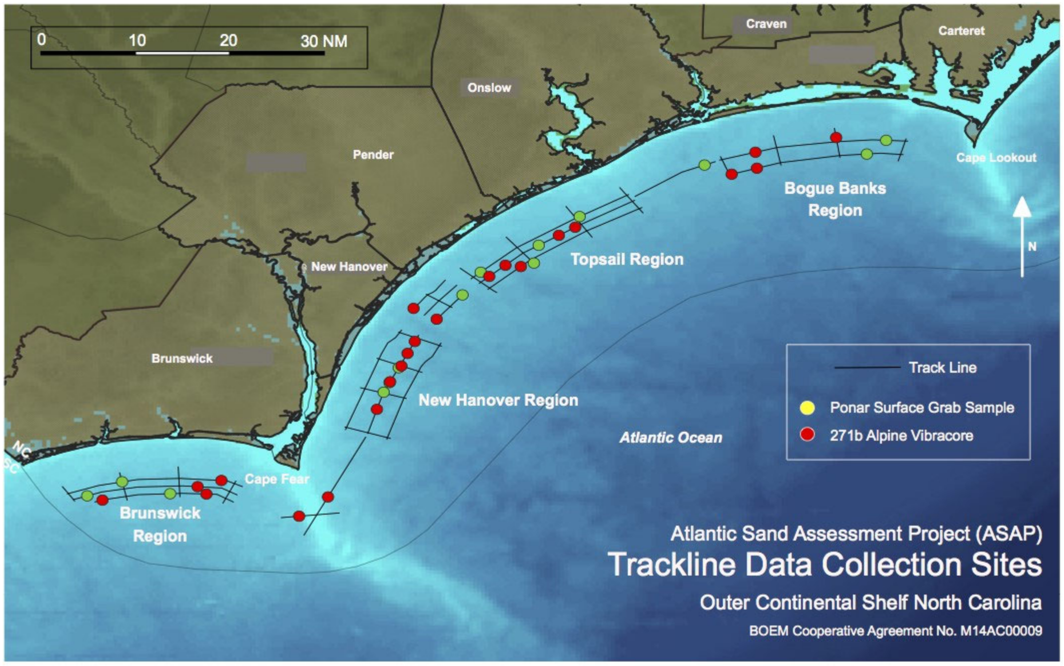


Figure 2: Data collection sites (seismic survey track lines, shallow cores and surface sampling) for 2015 BOEM Atlantic Sand Assessment Project (ASAP) NC OCS Study Area.

3.3 Core Logging and ^{14}C Dating

Sub-bottom cores were collected, logged, and interpreted (e.g., to determine: grain size, mineralogy, sorting, age, and stratigraphy) by CBI and East Carolina University (ECU) research staff. Cores (see Appendix 1) were subsampled either at lithologic boundaries, or at 30 cm minimum intervals. For grain-size analysis, standard wet separation and dry mesh sieving techniques were used. Each core sample was first separated into coarse and fine component fractions by passing the disaggregated sediment/dispersant slurry through a 63 micron sieve. The fine fraction passing through the sieve mesh was captured and further analyzed for percent silt and clay content using standard settling tube techniques (Folk, 1980). The coarse fraction captured in the 63 micron sieve was dried and then passed through an array of 12 sieves ranging in mesh size from -2.25 to 4.0 phi using a Tyler Rotap^{TM} shaker. Grain-size analysis results are provided in Appendix 2. While logging the cores, 29 in situ shells or shell fragments were extracted for ^{14}C dating (Table 2). The open-source software Calib (Stuiver et al., 2019) was used to calibrate age ranges using the radiocarbon age, standard deviation in age, and MARINE13 curve. Two-sigma values are reported.

3.4 Sand Thickness Analysis

Sub-bottom seismic data pre-processing, interpretation, and sand thickness calculations were carried out using SonarWiz software (Chesapeake Technology, 2018). SEG-Y Chirp files were imported and smoothed using the SonarWiz swell filter function. Vibracores and grab samples were added to the smoothed data based on coordinate positions within seismic lines. The seafloor reflector was created using the software's automated bottom-tracker. For the purpose of this work, the interpreted base of reworked Holocene sand (H), the Quaternary Transgression Ravinement surface (QT), the base of Quaternary channels (QC), and hardbottom (R) were interpreted and digitized. Examples of these chosen reflectors are shown and described in Figure 4.

Table 2: ^{14}C Radiocarbon Ages of Shell Artifacts Recovered from ASAP Cores. (Sample depths are measured from the top of the core at the sediment/water interface)

Sample ID	Sample Depth (cm)**	cal y BP (2σ)
VC03	183	6661 - 6831
VC09	144	969 - 1134
VC09	292	8025 - 8196
VC09	436	44979 - 46075
VC09	495	38745 - 39663
VC09	523	33583 - 34001
VC13	140	7833 - 7978
VC15	201	42253 - 42892
VC17	46	5315 - 5519
VC17	61	2980 - 3177
VC17	373	7980 - 8143
VC18	497	10540 - 10735
VC19	124	8185 - 8338
VC23	67	42119 - 42755
VC23	183	45030 - 46134
VC24	30	1529 - 1677
VC24	241	8531 - 8744
VC25	21	4580 - 4795
VC25	247	4415 - 4598
VC25	328	4769 - 4892
VC27	26	20866 - 21268
VC31	26	1710 - 1858
VC31	43	9875 - 10133
VC31	86	9917- 10156
VC31	122	10500 - 10683
VC31	170	34435- 34952
VC31	267	NA
VC32	23	32415- 33268
VC32	27	42274 - 42933
VC32	61	45083- 46351
VC33	30	563 - 668
VC33	117	9078 - 9313
VC33	197	48446- [50000]
VC33	253	NA
VC34	10	NA
VC34	113	NA
VC34	140	45407 - 46737

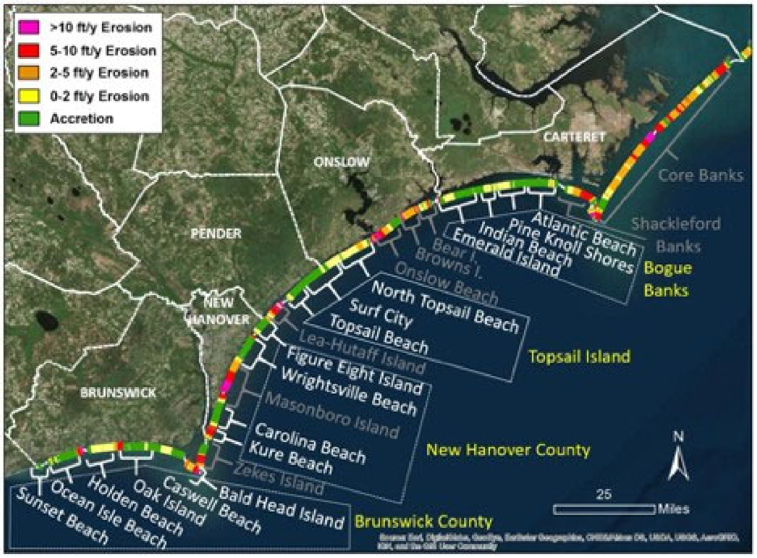


Figure 3: Site map of southern coastal North Carolina and focus areas (labelled yellow). White labels indicate incorporated towns managed with beach nourishment. Gray labels signify undeveloped zones that include state and federal lands unlikely to be nourished. Long-term North Carolina Di- vision of Coastal Management (2017) change (erosion/accretion) rates are superimposed on the shoreline, revealing distribution and variability of change south of Cape Lookout study area.

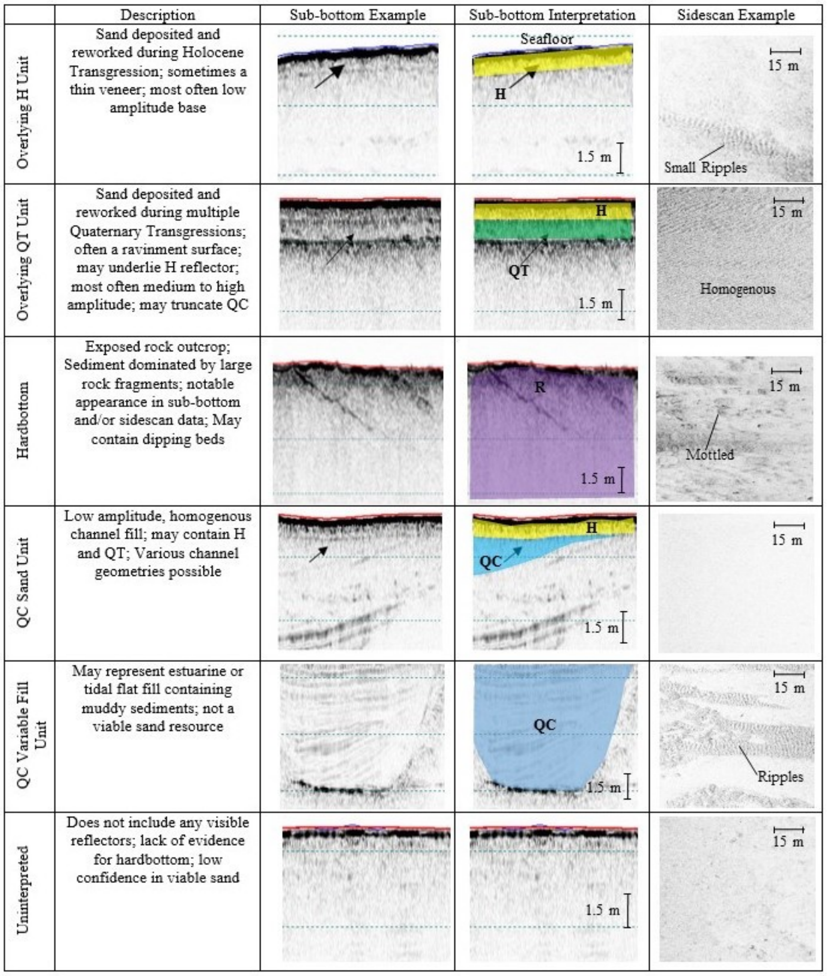
The most suitable units for potential beach sand resources are above the H and QT reflector horizons identified in seismic-reflection data. Channel fill above the QC reflector has proven to be more variable, although sand suitable for nourishment may be found in some paleochannels. After digitization, the reflector thickness calculator in SonarWiz was used to estimate sand thicknesses between the relevant reflectors and the seafloor. These thicknesses were exported as XYZ text files and imported into a GIS as point features.

3.5 Database Development

All of the data collected, either via original survey, or through compilation from external sources was gathered into a single consistently-compliant database to cover the continental shelf, nearshore, and coastline areas for the State of North Carolina. Whenever possible, spatial data were stored as either point, line, or polygon structural types for vector data, and x-y position and cell (pixel) attribute value for integer and floating-point raster data. All spatial data, where applicable, are provided in the U.S. State Plane Coordinate System for the State of North Carolina (FIPS 3200, EPSG 32119). Metadata records are included when available from the source. Some data layers are currently stored in the sand resource database for North Carolina.

4 Framework Geology of the North Carolina Continental Shelf

The East Coast of the United States is a passive continental margin lying within the North American plate which is slowly moving away from Europe as a result of mid-Atlantic Ocean seafloor spreading. The stratigraphy of the margin is complex, but in short, it is largely related to sedimentation and stratigraphic build up over the last 200 million years (Emery, 1966). The North Carolina coast is often described as having two regions, or provinces, one north of Cape Lookout and another south (Riggs et al., 1995). These two regions are distinguished by differences in the geomorphology (e.g., the northern region has large estuaries and long barrier islands), which is controlled by the underlying geology. The differing geology is related to long term basin evolution impacted by tectonics, sea level, and sediment supply. Coastal northern North Carolina has a thicker wedge of Quaternary (less than 3 million years old) strata underlying it (Mallinson et al., 2010; Thieler et al., 2014). Southern North Carolina is characterized by older rock units exposed along much of the seafloor (3 to more than 63 million years old, i.e., Pliocene to Cretaceous; Meisburger et al., 1979; Snyder et al., 1994; Riggs et al., 1995).



	Description	Sub-bottom Example	Sub-bottom Interpretation	Sidescan Example
Overlying H Unit	Sand deposited and reworked during Holocene Transgression; sometimes a thin veneer; most often low amplitude base		Seafloor H 1.5 m	15 m Small Ripples
Overlying QT Unit	Sand deposited and reworked during multiple Quaternary Transgressions; often a ravinment surface; may underlie H reflector; most often medium to high amplitude; may truncate QC		H QT 1.5 m	15 m Homogenous
Hardbottom	Exposed rock outcrop; Sediment dominated by large rock fragments; notable appearance in sub-bottom and/or sidescan data; May contain dipping beds		R 1.5 m	15 m Mottled
QC Sand Unit	Low amplitude, homogenous channel fill; may contain H and QT; Various channel geometries possible		H QC 1.5 m	15 m
QC Variable Fill Unit	May represent estuarine or tidal flat fill containing muddy sediments; not a viable sand resource		QC 1.5 m	15 m Ripples
Uninterpreted	Does not include any visible reflectors; lack of evidence for hardbottom; low confidence in viable sand		1.5 m	15 m

Figure 4: Interpretation guide depicting various seismic unit examples, descriptions, and associated appearances in sub-bottom and sidescan data. Note, this is not all-inclusive and these lithologic units have a variety of geophysical signatures.

Despite its different geological evolution, most of the North Carolina coast is faced with similar issues: i.e., areas of appreciable unconsolidated sand suitable for beach nourishment are limited. In general, suitable deposits are restricted to isolated offshore areas, inlets and estuarine channels. Sediment production from erosion is slow and variable (Riggs et al., 1998), and fluvial transport of sand to the shoreline is minimal. The most voluminous areas of sand are in cape shoals (McNinch and Luettich, 2000; NCDENR, 2011; Thieler et al., 2014). Other areas of thicker sediment are associated with paleo-river valleys and sand ridge and shoal features (see Snyder et al., 1994; Riggs et al., 1995; Mallinson et al., 2010; Thieler et al., 2015 and references therein). River incision during sea-level low stands (e.g., the ice ages) has had a strong influence on the development of the coast today, and several studies have related ongoing changes to seafloor features (McNinch, 2004; Miselis and McNinch, 2006).

4.1 Shoals and Ridge Features

Sand resources in significant quantities exist in a variety of geologic forms, ages and locations. In North Carolina, moderate sand volumes are currently extracted from navigational channels and reused to rebuild nearby shorelines. The work presented here, however, focuses on the shelf, where potential nourishment resources more often take the form of sand shoals and ridges, filled depressions, sediment banks, and/or shoal complexes. Shoals are generally differentiated as either: older or relict shoals (e.g., Oregon or Wimble Shoals; Thieler et al., 2014), cape-associated shoals (Frying Pan Shoals), or sorted bedforms (e.g., Wrightsville Beach; Thieler). On the outer continental shelf of northern North Carolina, the much larger sand supply (relative to that observed in the southern part of the State) has promoted the formation of shoal fields, ranging in size up to several kilometers wide with relief up to 10 meters (e.g., Oregon Shoals; Thieler et al., 2014). In contrast, unconsolidated sediment is less abundant on the shelf south of Cape Lookout NC, and those sources that have been identified are typically smaller in areal extent and thinner than their northern counterparts (Hine and Snyder, 1985; Gutierrez et al., 2005; Thieler et al., 2014).

4.2 Submerged Paleo-channel Features

Fluvial and tidal processes are the primary channel-carving mechanisms (Gutierrez et al., 2003), although glaciofluvial processes also may produce channel-like features like those seen off Long Island, New York (Schwab et al., 2000). Major paleo-river systems on the U.S. East Coast that have been extensively surveyed across the continental shelf include the Hudson (Carey et al., 1998), the Delaware (Fletcher et al., 1992), the Susquehanna/Potomac (Coleman et al., 1990), the Pee Dee/Waccamaw (Baldwin et al., 2007) and the Roanoke/Albemarle Rivers (Riggs et al., 1995; Mallinson et al., 2005). Commonly referred to as incised valleys, these systems generally exhibit dendritic drainage patterns with a large trunk channel. The sediment preservation potential of a paleo-channel is contingent upon four factors: initial channel morphology, tidal enhancement, depth of wave ravinement, and burial (Belknap and Kraft, 1981). The greatest preservation of channel morphology is observed across outer shelf areas where rapid rates of sea level rise during the late Pleistocene/early Holocene, as revealed by seismic data collected along the paleo-Delaware River (Belknap and Kraft, 1981), left little time for waves to erode away these features. As such, the rate of sea-level rise is believed to be critical to the depth of ravinement, and ultimately channel sediment preservation (Belknap and Kraft, 1981).

4.3 Hardbottom Variability

Hardbottom areas are widely viewed as key habitat for various indigenous neritic and benthic species; unfortunately, interpretations of what constitutes a hardbottom and thus their distribution in the nearshore and further out on the continental shelf are highly subjective. To some, the inability to collect a sample using a sediment grab device, or the presence of large gravel on the bottom may imply a hardbottom environment. To others, the geologic hardbottom context is tied to a specific interpretation using seismic or sidescan data. Alternatively, others may require direct observation of an actual rock outcrop to confirm that it is hardbottom. Thus, the definition and classification of hardbottom varies and is inconsistent when synthesizing academic, government, and private work (Riggs et al., 1996). Hardbottom has been defined by Riggs et al., (1996) as “a descriptive term for an indurated surface on the seafloor with no implications of synsedimentary cementation or growth of reef-building organisms; the term refers to all hardgrounds, reefs, and rock outcroppings on the seafloor” (Riggs et al., 1996). If the hardbottom serves as a persistent habitat it is often referred to as live-bottom (Riggs et al., 1996). More recently, Street et al. (2005) gave a more encompassing hardbottom description, “exposed ar- eas of rock or consolidated sediments, distinguished from surrounding unconsolidated sediments, which may or may not be characterized by a thin veneer of live or dead biota, generally located in the ocean rather than in the estuarine system.” Hardbottom may also be called live rock with colonization of algae, sponges, corals and invertebrates (NCDEQ, 2016). According to studies from North Carolina to Florida, hardbottom types include: 1) emergent hard bottom dominated by sponges and gorgonian corals; 2) sand bottom underlain by hard substrate dominated by anthozoans, sponges and polychaetes, with hydroids, bryozoans, and ascidians frequently observed; and 3) softer bottom areas not underlain with hard. (SAFMC 2008a).

Several other terms are often used interchangeably with hardbottom and these may result in confusion. Hardground includes rock surfaces that “show unmistakable evidence (borings, encrustations, marine cementation) of synsedimentary lithification...” (Bromley, 1975), although it has also been hypothesized that these do not exist in Onslow Bay (Riggs et al., 1996). This study has mapped hardbottom using seismic and sidescan interpretation. While this is good for identifying larger areas of no or low sediment cover, the resolution and positioning accuracy can be limited.

The interpretations of ASAP data here thus apply a broader classification of hardbottom (essentially following the definition of Street et al., 2005). This is useful from a habitat and sand resource perspective as it indicates where all forms of hardbottom may provide key habitat and dredging is not viable. Figures 4 and 5 show some of the variety of forms of hardbottom identified through evaluation of the ASAP data. In Figure 5b, hardbottom is mapped based on the presence of large indurated fragments, although the matrix is sand. Distinguishing this hardbottom based solely on the acoustic signature is difficult, showing that a variety of data forms aid in seabed classification (i.e., sidescan and cores). Figure 5e shows a hardbottom classification based on a mixture of surficial gravel, cobble and large shell fragments, which would likely be classified by Riggs et al. (1996) as lag pavement. Although not technically a hardbottom, from a habitat standpoint it is hypothesized that it would be similar to the seabed shown in Figure 5b. In this light, hardbottom classifications might require new considerations that clarify the geological nature of the substrate (e.g., rock vs. unconsolidated coarse sediments).

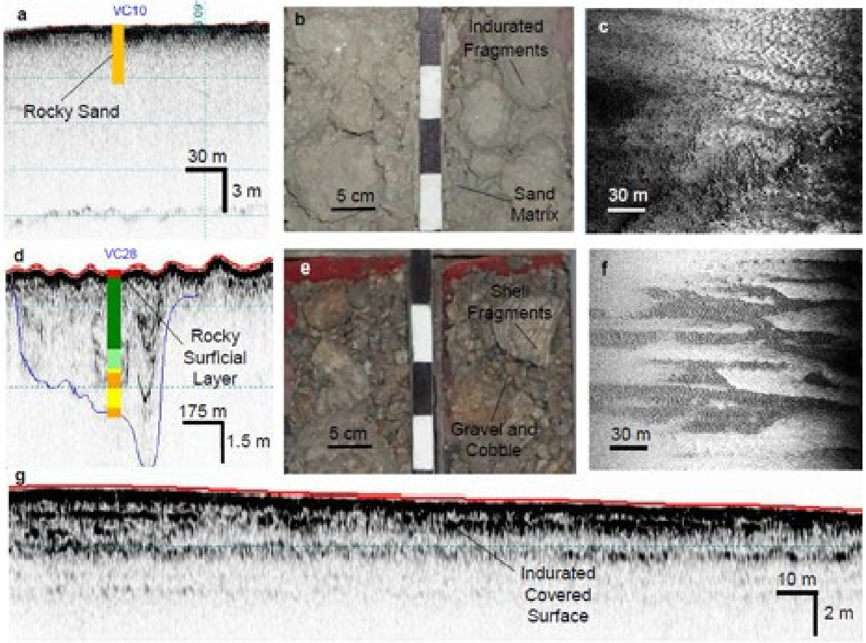


Figure 5: Seafloor examples of New Hanover region hardbottom (a-c) and Topsail Island region non-hardbottom (d-f) areas. Hardbottom interpreted in seismic data from New Hanover and Topsail Island, a and d respectively, with corresponding cores (b,e) and in sidescan data (c,f). Panel G shows the seismic appearance of a hard- bottom buried by < 1 m of sand, commonly observed in Brunswick County.

According to Snyder et al. (1994) and Riggs et al. (1996), hardbottom character and distribution in Onslow Bay is determined by the outcropping of SE-dipping Tertiary indurated sedimentary strata. The morphology of hardbottom is quite variable as a result. Past research has shown hardbottom varies in relief with outcrops up to 10 m in vertical relief (farther offshore) to areas that are relatively flat (Riggs et al., 1996; NCDEQ, 2016). The majority of the ASAP mapped hardbottom is low-relief and shallow sloped. More pronounced outcrops with vertical relief up to a few meters were mapped mostly in the New Hanover region, which is consistent with past studies (e.g., NCDEQ, 2016). Most of the ASAP hardbottom likely falls under the Riggs et al. (1996) classification of flat hardbottoms that are ”smooth to slightly irregular, semi-indurated to indurated surfaces of great extent that form the upper, lower, and in some places middle bounding surfaces of low-relief and high-relief scarped hardbottoms.” In Onslow Bay, flat hardbottoms are generally composed of semi-indurated tertiary muds to muddy sands, are covered by a thin layer of mobile or permanent Holocene surficial sand and “are difficult to recognize by remote sensing” (Riggs et al., 1996; Schmid, 1996).

The distribution of hardbottom is widespread on the southern NC shelf as highlighted by past research and this study, although it is subject to challenges relating to interpretation and definitions described above. From Cape Hatteras to Cape Fear, it is estimated that hardbottom represents 14% (or 500,000 acres) of the seabed between 27 and 101 m water depth (Parker et al., 1983). However, due to the discontinuous and patchy nature of hardbottom, and vastness of the outer continental shelf, more recent efforts have refrained from estimating the overall distribution of hardbottom in NC. Hardbottom distribution is critical to better understand not just from ecological habitat and sand resource perspectives, but because they are an extensive part of the stratigraphic and paleo-oceanographic record on the Atlantic Shelf (Riggs et al., 1996; Riggs et al., 1998). The data from this work suggest hardbottom represents 23% of the seabed in the Bogue region, <1% in the Topsail region, 15% in the Hanover region, and 39% in the Brunswick region, respectively.

Several factors make the delineation of hardbottom in the ASAP dataset challenging. Firstly, these areas contain a variety of hardbottom forms (Figures 4 and 5). Next, in some areas it is difficult to distinguish hardbottom using geophysical signatures alone (i.e. seismic, sidescan) and the sparseness of cores and samples prohibits validation in many cases. Finally, low relief hardbottom areas are subject to ephemeral burial and exposure by moving sand bodies (Cleary et al., 1996; Riggs et al., 1996). This is notable in the ASAP data, as evidenced primarily by sidescan (e.g., Figure 5f). Because the sand veneer covering hardbottom is often thin, the exposure of hardbottom fluctuates as sediments are transported and mobilized during storm events. Ultimately, these data and past research have shown that hardbottom definition, form, and distribution is complex and variable on the NC OCS. Because of these dynamics and interpretation challenges, it is our recommendation that a combination of remote geophysical and physical sampling be used to define hardbottom zones, and that a broad, inclusive definition be employed.

5 Shelf Habitat

Many sediment features and hardbottom found in North Carolina shelf waters may also serve as important habitat for a variety of neritic fish species and other benthic organisms (NCDEQ, 2016; Rutecki et al., 2014). In order to best manage multi-use conflicts, an understanding of the effects of dredging on those habitats is crucial. Moreover, where multiple borrow sources are viable, knowing where these habitats and potential borrow sites coincide beforehand will allow for the informed selection of the least impactful option. For shelf mineral resource extraction, BOEM policies comply with National Oceanic and Atmospheric Administration (NOAA's) National Marine Fisheries Service and U.S. Department of the Interior's Fish and Wildlife Service guidelines as outlined in the Endangered Species Act (ESA) and Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) to preserve and protect sensitive marine habitat environments. Submerged ridge and swale features and cape-associated shoals–both potential renourishment sand resources–have been defined as essential fish habitat by NOAA.

Sand dredging has been shown to have several short- and long-term physical and biological impacts that can adversely affect marine habitats (Rutecki et al., 2014). Physical effects include alteration of sediment grain size, changes in sediment transport behavior, wave and current patterns, and water- column turbidity, all of which can result in one or more direct or indirect biological impacts to a habitat (Hayes and Nairn 2004). Direct biological impacts include alteration or outright removal of one or more benthic epifaunal and infaunal communities from an environment. Indirect impacts consider the effect of the direct impact on associated species and linkages at other habitation and trophic levels (Hayes and Nairn, 2004). Spatially compiling both the biotic and abiotic aspects for potential borrow areas as comprehensively as possible is critical for long-term, sustainable management of multi-use shelf resources.

6 Regional Interpretations

Much of the work documented in this report focuses on the area of the North Carolina continental shelf south of Cape Lookout. This is a region whose geology and geomorphology has been shown to differ, sometimes markedly, from that observed north of the Cape. The relatively abundant sand resources seen in the north along the Outer Banks are conspicuous for their absence throughout much of the southern portion. Nevertheless, research has also shown that there are potential sand resources here, they are just more scattered. The following discussions detail results from a series of seismic (chirp) and shallow coring (vibracore) surveys performed by CB&I, Coastal Planning and Engineering, Inc. and American Vibracore Services, Inc. in the summer of 2015. The area south of Cape Lookout is partitioned into 4 regions and the discussion follows this geographic format from north to south.

6.1 Bogue Banks Region

The Bogue Banks Region shoreline is oriented predominantly E-W and is bordered by Cape Lookout to the east. The survey lines are relatively shore parallel, contain four north-south shore-perpendicular crossing lines, and are between 7.4 and 15.0 km offshore (Figure 6). Water depths range from 15.0 m (closest to shore) to 19.0 m at the seaward edge of the survey area. The shelf in this region exhibits a gently seaward dipping seafloor. Seafloor gradients vary in the region and the shallowest slopes of 0.2 m/km occur to the east (seaward of the 17 m isobath). The steepest slopes of 2.5 m/1 km occur toward the center of the region (seaward of the 18 m isobath). The seafloor is generally low relief and the highest relief of up to 1.5 m occurs at a ridge and depression in the SE quadrant. The eastern half of the region contains three small-scale, shore-detached ridges that extend NW-SE and are approximately 1 m high and 0.5 km wide, range in length from 2.0 to 3.4 km, and have little to no asymmetry. The ASAP Bogue Banks Region contains an extensive modern sand layer mapped in 49% of the total survey distance with unit thicknesses reaching up to 3.59 m in the northern and southeastern portions (mean = 1.06 m). These observations are consistent with Hine and Snyder (1985) who also note the patchy presence of a 1-2 m Holocene veneer on the inner shelf, although extensive Holocene deposits are not evident due to the migrating shoreface in response to sea level fluctuations, which removed much of the sedimentary record in Onslow Bay. Consequently, Tertiary rocks and sediments outcrop at the seafloor in many locations (Hine and Snyder, 1985; Freeman et al., 2012).

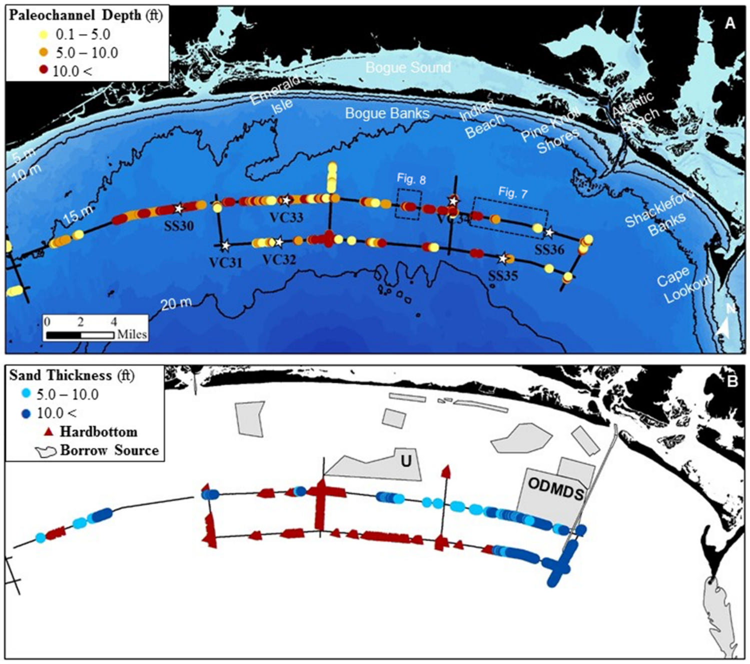


Figure 6: Bogue Banks Region ASAP interpretations. Borrow sources U and ODMS are discussed in text.

The deeper QT reflector is visible in the eastern third of this region—covering some 20 percent of the area mapped and contains thicker sands up to 4.7 m (mean = 2.5 m). Paleochannels and hardbottom are frequently observed in the central region (Figure 7), and are present in 31% and 23%, respectively, of

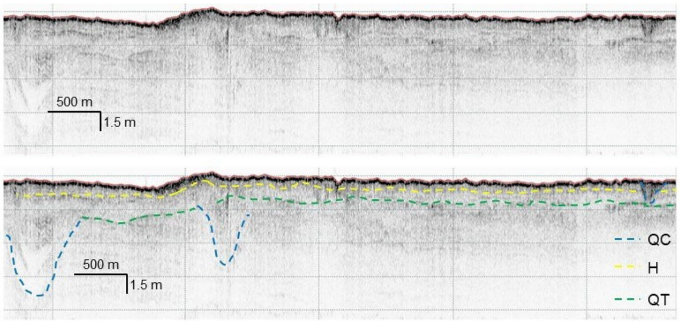


Figure 7: Example seismic line and interpretations from Bogue Region. Location indicated by black dashed box in upper-panel of Figure 6.

the total mapped distance. When ASAP interpretations are overlain on Hine and Snyder (1985), numerous areas of mapped channels align that are interpreted as relict tidal inlets/lower coastal plain streams, which can be identified by truncation in the Tertiary seismic stratigraphy (Figure 8). ^{14}C ages from four cores within paleochannels show two channels contain surficial Holocene sand overlying variable Pleistocene fill (VC31 and VC33; ref. Table 2, Figure 6, and Appendix 1 whereas the other two channels are filled with Pleistocene or reworked sediments (0.3 - 1.5 m depth) (VC32 and VC34; Table 2, Figure 6 and Appendix 1). The infilling of the paleochannels is variable and complex, and mostly appears to be representative of estuarine and fluvial fill (i.e., sands interbedded with muds and clay and gravel base) (Hine and Snyder, 1985). While some buried channels may be suitable for nourishment, more core validation is needed. Hine and Snyder (1985) show areas of especially thick (10 - 20m) quaternary sediments within channels which are corroborated by ASAP data (see black box focus area in Figures 6 and 8).

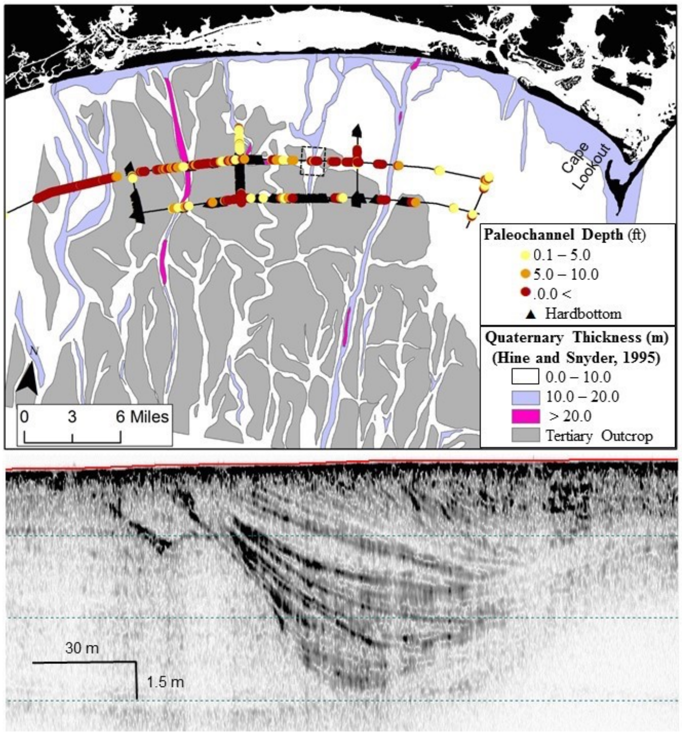


Figure 8: ASAP results draped over geo-rectified interpretations from Hine and Snyder (1985). Areas of thick Quaternary sediments as interpreted by Hine and Snyder (1985) often are corroborated by ASAP results. A channel ex- ample is shown (location is indicated by black box in top panel) where Hine and Snyder mapped particularly thick (10-20 m) Quaternary sediments.

Several areas of ASAP data are adjacent to previously identified borrow sources. USACE (2014) describe the "U" borrow source which lies closely to the central ASAP section and contains an estimated 8.9 Mcy of beach compatible sand. In addition, the Ocean Dredged Material Disposal Site (ODMDS) is near the eastern portion of the region that also appears to have similar sand thicknesses, estimated at 6.7 Mcy (Figure 6). At the ODMS site, dredge spoil sand (up to 4.9 m thick) overlies fine and silty sand that is stratified as much as 9.2 m below the seafloor, although its base is not continuous throughout the Bogue region (Freeman et al., 2012).

Reconnaissance-level data acquired during the ASAP project helped to identify several potential high volume resource areas of likely beach compatible sand, located in reasonable proximity to existing project areas (Table 1). Based on expected continued demand for sand (NCDCM, 2016) these new areas may be viable supplemental resources.

6.2 Topsail Island Region

The Topsail Island Region shoreline is oriented NE-SW. The survey lines are shore-parallel and contain five shore-perpendicular crossing lines (Figure 9). Water depths range from 13 m closest to shore (5.4 km offshore) to 17 m at the seaward edge (14.8 km offshore). The NE half exhibits a gently dipping seafloor (0.45 m/ 1 km slope) seaward of the 13 m isobath. The southern half of the region contains a low valley-like feature with sidewalls up to 4 m/ 1 km in slope. The southern section of the region is characterized by a bathymetric fabric produced by a series of shore-detached, shore-oblique small-scale ridges approximately 1 m high, approximately1 km wide and ranging in length from 3.8 to 4.4 km. The highest local relief is 2.2 m. These ridge features become more pronounced seaward of the survey lines at the -16 m isobath.

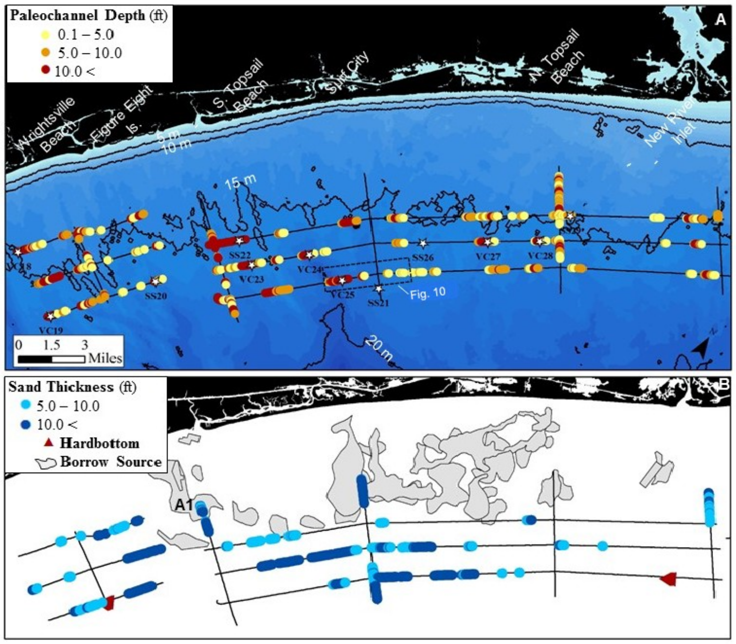


Figure 9: Topsail Island Region ASAP interpretations. Borrow source area A1 is referenced—see discussion in text below.

Most of the Topsail Island Region contains a modern lens of sand (mean thickness = 1.0 m) reaching up to 2 m and visible in 73% of the total mapped linear distance (Figure 9). However, this modern sand unit is discontinuous and quite thin in most areas, making resource extraction (i.e. dredging) potentially challenging. OSI (2004) and Snyder et al. (1988) indicated much of the region landward of the survey area is characterized by low relief Oligocene limestone and siltstone hardbottom overlain by a thin, patchy veneer of Quaternary sands and gravels and numerous Quaternary channel-fill sequences. The QT reflector is interpreted in 29% of the total linear survey distance (mean QT unit thickness = 2.6 m, range 0.2 to 6.4 m), and appears to be thicker in the central section where many areas exceed 4 m (Figure 10).

Paleochannels also are widespread (31% of mapped distance) and are most common in central areas (Figure 10). ASAP core data indicate some may contain usable sand, yet others are more heterogeneous and indicative of variable estuarine fill (i.e., silts and clays), also noted by OSI (2004). ^{14}C ages from

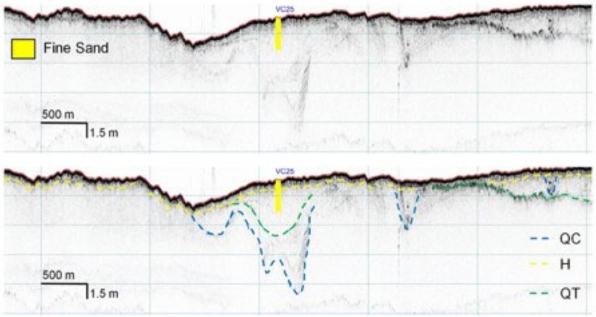


Figure 10: Example seismic line and interpretations from Topsail Region. Location indicated by black dashed box in Figure 9.

cores within four separate channels indicate two channels (VC23 and VC27; Figure 9 and Appendix 1; Table 2) are filled with shallow (<2 m) Pleistocene (or reworked) sediments, whereas the other two channels are filled with Holocene sediments overlying the interpreted QT reflector (VC24 and VC25; Figure 9 and Appendix 1; Table 2). The Holocene channel fill is composed of a homogenous fine sand, while the Pleistocene channel fill consisted of variable estuarine lithofacies.

Mapped hardbottom is minimal (1%) (Figure 9). Extensive low to high-relief hard bottom outcrops have been mapped nearshore of Surf City and New River Inlet, although a thin layer of sand covers much of the low relief hardbottom (Crowson, 1980). Using sidescan, multibeam, and diver ground truth data, HDR (2003) reported an irregular exposure pattern of hardbottom in this region extending from the 9.1 m contour to 8 km offshore. Much of the complexity of the exposure is likely due to the intermittent burial of low relief hardbottom areas by sands.

The closest previously identified borrow sources were recently considered by CPE for use in nourishment ofTopsail Beach. CPE conducted design level surveys in USACE delineated potential borrow area A1, yet stopped at the 3 nm boundary. A1 contains an estimated 0.87 km^2 and 1.99 Mcy of potentially beach compatible sand, although the town opted for a closer, less-expensive, inlet-derived borrow source. The ASAP data continues the extent of coverage into federal waters.

6.3 New Hanover County Region

The New Hanover County region shoreline is oriented N/NE-S/SW (see top panel of Figure 11). The survey lines are between 5.6 and 15.8 km offshore and are near shore-parallel with four shore crossing lines. Water depths range from 8 m around Frying Pan Shoals (southern extent) to 18 m at the seaward survey extent.

This region exhibits the most diverse and variable bathymetry of all the regions. Survey lines cross Frying Pan Shoals which contain ridges up to 1.9 m relief that show moderate asymmetry. Multiple well-developed, shore attached ridges are evident landward of the survey region. Most of the survey coverage is seaward of the 14 m isobath where ridges appear to be shore-detached and are mostly approximately 1-2 m in relief. These wide ridges and platforms have slopes up to 10.0 m/ 1.0 km, are up to 4 km long and approximately 1 km wide. Localized shoals in the central and north sections are up to 3.1 m in relief and 2.2 m relief hardbottom outcrop is visible in the southern extent.

The modern sand unit in this region has a mean thickness of 1.0 m with thicknesses up to 3.6 m (Figure 11). The H reflector is extensive in the region and visible in 71% of total mapped distance (Figure 12). ^{14}C ages from two cores verify Holocene ages of the surficial modern sand (VC13 and VC17) (Figure 11 and Appendix 1; Table 2). Compared to other regions, this region has the most mapped QT (61%) at a mean unit thickness of 1.7 m and reaching up to 5.3 m (Figure 11). The QT unit generally appears to thicken to the north. A ^{14}C age from a shell just below the QT reflector has a Pleistocene age (42,253 to 42,892 cal y BP; Table 2) (VC15; Figure 7 and 10). Core VC8 contains Pleistocene-aged surficial (approximately 1 m depth) sand based on a shell fragment (36346 to 37361 cal y BP; Table 2; Appendix 1). The New Hanover County Region contains a lesser distribution of paleochannels (25%) and hardbottom (15%) than

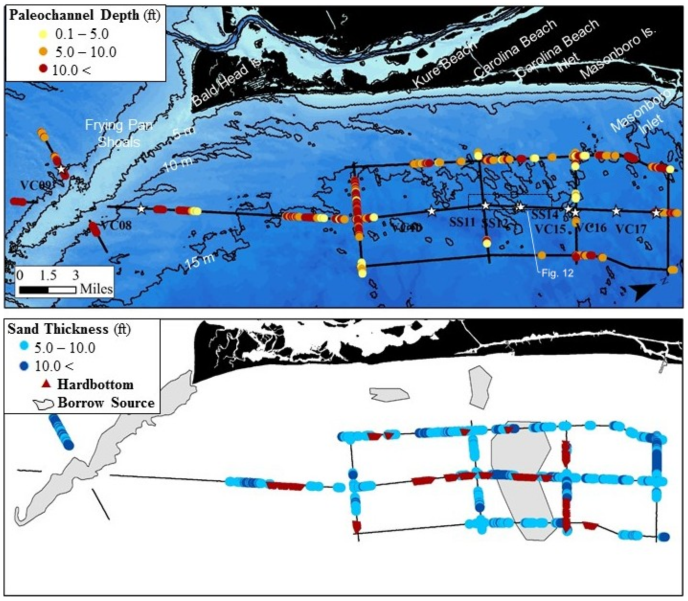


Figure 11: New Hanover Region ASAP (only) interpretations. Note location of Figure 12 is shown by the dashed rectangle in top panel.

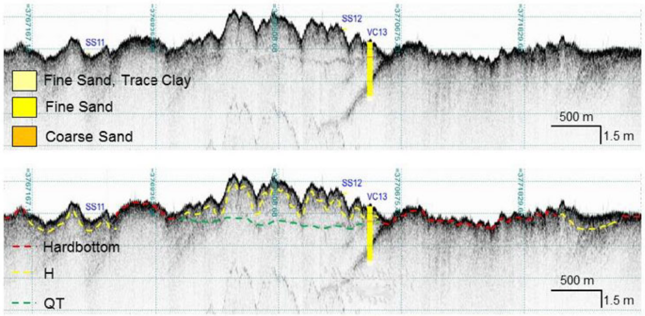


Figure 12: Example seismic line and interpretations from New Hanover Region. Location indicated by black dashed box on Figure 11.

most of the other regions (Figure 11). A channel sampled by core VC09 estimated a shell fragment dated to the Pleistocene (44,979 to 46,075 cal y BP; Table 2; Figure 11). Another channel (VC17) contained a shell fragment dated to the Holocene (5315 to 5519 cal y BP; Table 2; Figure 11 and Appendix 1).

According to the NCBIMP (2011), few offshore sand sources have been identified in this region and most replenishment projects have used nearby inlet derived material. However, the USGS seabed database indicates a region of possible beach compatible sand (large polygon intersecting with ASAP lines), although it is poorly characterized. ASAP data help to corroborate this possibility, showing extensive high relief shoal features with thicknesses exceeding 3 m in areas (Figures 11 & 12). The shoals contain both the H and QT reflectors and are often laterally bound by hardbottom outcrop (Figures 11 & 12).

This region borders work conducted by several researchers (i.e., Meisburger, 1979; Hoffman et al., 1991; Zarra, 1991) and several areas of ASAP sands intersect the lithosomes interpreted as lower shoreface lithosome (LSL), the Inner Shelf Sand Shoal (ISSS), and Linear Shoreface Attached Shoal (LSAS), in addition to the Plio-Pleistocene Valley Fill and Sequence Orb-A (Snyder et al., 1994)(Figure 13). These lithosomes represent a variety of depositional settings including barrier, backbarrier, estuarine and fluvial environments that are now subject to erosion at the seafloor (Wren and Leonard, 2005). Prior work, consistent with ASAP observations, has noted the presence of linear shoal features extending up to kilometers in length, hundreds of meters wide, and up to 5 m of relief that are likely ”erosional remnants of partially preserved Pleistocene sections deposited during successive Quaternary sea-level fluctuations” (Snyder et al., 1994).

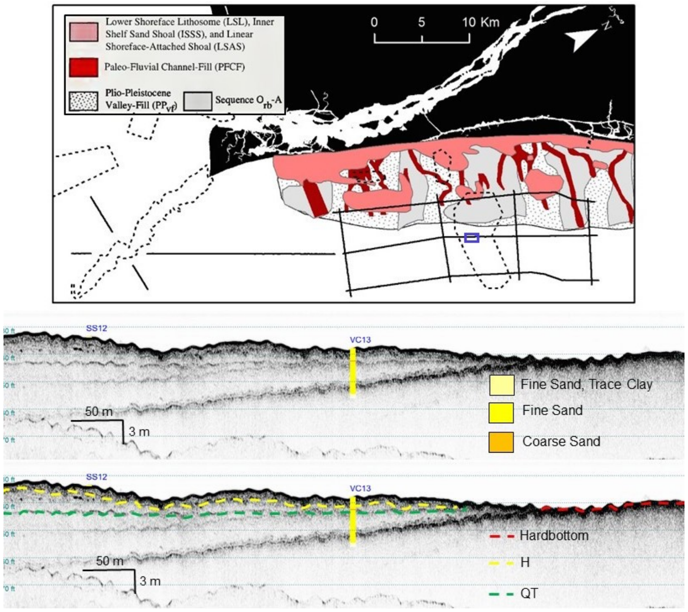


Figure 13: New Hanover Region ASAP interpretations relative to geo- rectified facies from Snyder et al. (1994). The extent of the seismic line is indicated by the black box and is also noted in Figure 8. Note, this area lies within a formerly identified potential borrow source and contains thick shoal deposits that align with high rugosity values. A ^{14}C age date from a shell fragment just above the QT reflector is shown in the black box on the seismic line.

6.4 Brunswick County Region

The Brunswick County Region shoreline is E-W oriented and bounded by Cape Fear to the east and Little River Inlet and the NC/SC state line to the west. Survey lines run shore-parallel with four shore-perpendicular crossing lines (Figure 14). The water depths range from 12 m (7.8 km offshore) to 16 m (15.8 km offshore). The shelf in this region exhibits low-relief, gently seaward dipping seafloor (0.5 m/1 km slope) with the most uniform bathymetry of all the regions (i.e. aligned isobaths). The eastern portion contains the highest relief with ridges up to 1.4 m relief showing little to no asymmetry.

Half (50%) of the Brunswick County Region has a visible H reflector, which is most frequently mapped in the eastern section (Figure 15). While the H thickness is also 1.0 m, the range is smaller (0.2 to 1.8 m) (Figure 15). The deeper QT reflector is not noted because of the thinness and in most lines it is difficult to discern two reflectors. Hardbottom is widespread (39%) on the Western segments and is interwoven with paleochannels (20%) (Figure 14). Core and sub-bottom data suggest the presence of sand in the surficial layers of many paleochannel features, although the fill is variable (Figure 15) displays a good representation of the paleochannel and hardbottom appearance. A core sample (VC03) at approximately 2m depth and below the H reflector shows a ^{14}C age of cal BP 6661 - 6831 (Figure 14 and Appendix 1), yet this age may not be representative of all channels in the region. Extensive hardbottom interpreted in the ASAP data is consistent with NCDEQ (2016), which notes a ”thin veneer of sand over relatively flat hard bottom” in this region with some hardbottom areas up to 22 acres.

The ASAP data is near sand resource areas containing an estimated 5.3 Mcy of sand (ATM, 2010). ATM (2010) reports four sites (Figure 11; 1-4 borrow source labels) that range in sand veneer thickness from 0.3 to 1.2 m with pockets up to 1.8 m. Due to the widespread presence of hardbottom as also noted by other studies in the vicinity (e.g., NCDEQ, 2016), these additional sources may be an efficient and viable option to coastal communities. The ASAP data help to fill in previous knowledge gaps and provide potential targets for further investigation.

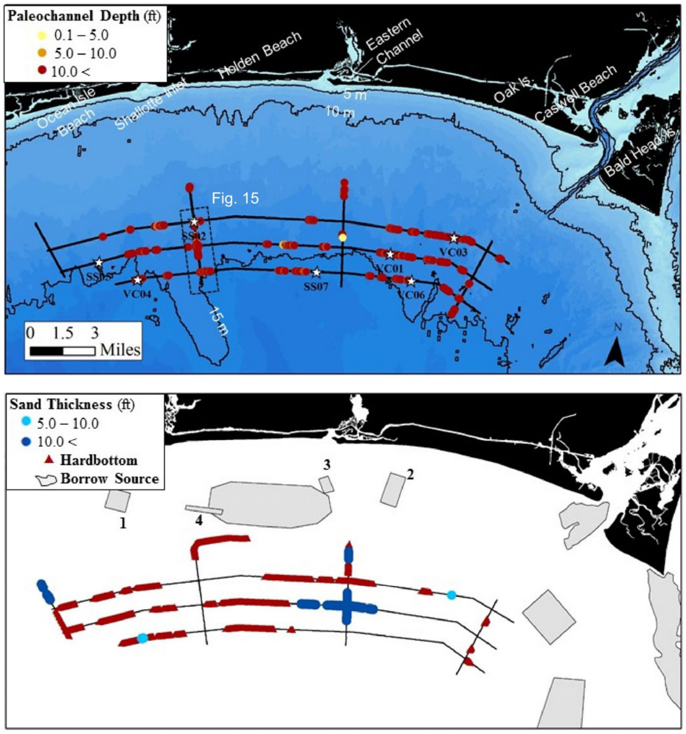


Figure 14: Brunswick County ASAP interpretations. Note location of Figure 15 indicated by dashed rectangle in top panel).

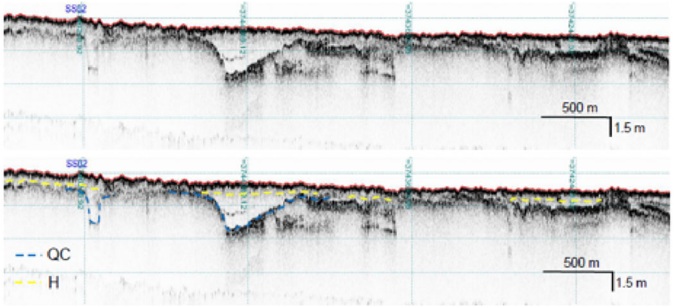


Figure 15: Example seismic line and interpretations from Brunswick County Region. Location indicated by black dashed box on Figure 14.

6.5 Subsurface Paleochannels

Buried channels on the NC continental shelf reflect a complex variety of transgressive and regressive physical processes (Oertel et al., 1991). Due to the lack of fluvial sedimentation coupled with deep shoreface scour during transgression, preserved channels may often be the only depositional record of transgression in the region (Kraft et al., 1987; Oertel et al., 1991). Because inlet channels would be prone to removal by wave beveling during transgression in the wave-dominated system, most large, buried channels found within this region are hypothesized to be paleostream valleys (Hine and Snyder, 1985; Oertel et al., 1991), similar to the inner shelf adjacent to the Cape Henlopen headland of Delaware (Belknap and Kraft, 1985). In other tidal-dominated (as opposed to wave-dominated) shelf regions like in South Carolina, Georgia and Virginia, buried channels may be more reflective of lagoonal and inlet drainage patterns, in addition to paleostream valleys (Henry et al., 1981; Oertel et al., 1991). Tidal-inlet channels are typically discontinuous and have rounded bases (Belknap and Kraft, 1981; Oertel et al., 1991; Riggs et al., 1995). According to Harris et al. (2005), however, tidal channels incising into less-resistant Holocene and Pleistocene sediments exhibit V-shapes with low width-to-depth ratios. On the contrary, U-shaped channels with flat bottoms and high width-to-depth ratios are characteristic of channels in Tertiary strata or compacted Pleistocene muds (Harris et al., 2005).

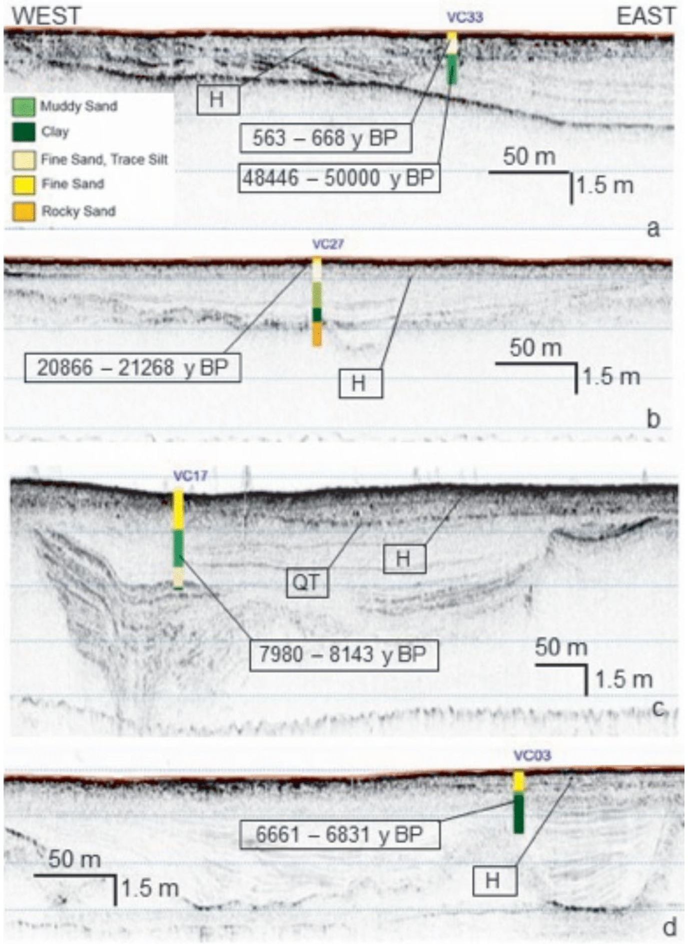


Figure 16: Channel examples, core logs and associated ^{14}C ages. Panel A is from Bogue Banks Focus Area, B is from Topsail Island Focus Area, C is from New Hanover Focus Area and D is from Brunswick Focus Area. Dimensions, fill architecture and geometry are highly variable and described in the text.

Hundreds of channels were delineated across the ASAP regions with high variability in form and in-filling. While characterizing each individual channel is beyond the scope of this work, Figure 16 provides examples of channels characteristic to each region. The Bogue Banks Region contains extensive mapped buried channels that may be associated with the paleo-New River Valley (Cleary et al., 1996). The deepest channels are concentrated to the west and may be related to the antecedent bathymetric depressions extending from the highly irregular 15 m isobath. The prevalence of hardbottom in the central region (Figure 6) appears to influence channel shape (i.e., more flat bottom forms evident) and limit channel distribution, as noted by (Hine and Snyder, 1985). Figure 16a shows an example of a Bogue channel with an asymmetrical rounded bottom, and complex fill, representing multiple episodes of cut and fill implying tidal influence. Below an approximately1.25 m thick sand layer, the heterolithic (i.e., shelly and muddy fluvial and estuarine) fill as indicated by the core would not be ideal for beach nourishment (Appendix 1; VC33). The western portion of the channel contains the highest amplitude reflections suggestive of lateral infill and reworking (Oertel et al., 1991). Toward the eastern edge, there is acoustically transparent fill and low amplitude reflections that show bedding planes of upbuilding and constricting strata from flow inhibition (Oertel et al., 1991). A Holocene sand cap, as seen in many studies (e.g., Nordfjord et al., 2006), is verified by a ^{14}C date (Table 2; Figure 16a). Many channels in the region are similar in incision depth (6 to 10 m) to the Folly and Kiawah rivers in SC (Harris et al., 2005).

The Topsail Region contains numerous mapped buried channels (Figure 9) that may also be associated with a paleo-pathway of the New River Valley (Cleary et al., 1996). To the west, the channels are deepest (>5 m), with low width-to-depth ratios, and exhibit angular bottoms (Figure 9). The western-central area of the subregion also exhibits a deep incisional channel network possibly related to the valley-like feature apparent in the bathymetry to the south (Figures 9 and 10). Toward the east, the channels are generally shallower and wider suggesting incision into more resistant strata. High amplitude channel bases are also evident toward the east possibly indicating a coarse fluvial lag (Chaumillion et al., 2007). Sediment facies in VC27, VC33 and VC03 from the region are indicative of estuarine fill and are not ideal for nourishment (Figure 16b and Appendices 1 and 2).

The Brunswick County region contains a number of shallow (< 5 m) channels as highlighted in Figures 14 and 15. Most channels are mapped on the eastern portion of the region and are likely related to the Cape Fear Valley (Cleary et al., 1996). These channels are predominantly constrained to areas where there is also a thin modern sand veneer. To the west, more hardbottom is visible, corresponding to a lack of buried paleochannels. Of all the regions, Brunswick County Region likely was subject to the lowest amount of wave scour during transgression, and consequently, the numerous shallow channels (<5 m) are indicative of tidal influence. Similar shallow channels have been mapped in tidally-dominated Georgia (Oertel et al., 1991). Additionally, shallow channel incision in this region may be attributable to the differences in shelf slope and more uniform bathymetry (i.e. steeper slopes may have caused incision of deeper channels). The Brunswick channels also differ from the other ASAP regions and areas such as the New Jersey Outer Continental Shelf (Nordfjord et al., 2006), in that they are less likely to be truncated by a transgressive ravinement surface.

In general, the channel observations across the SE NC shelf reflect tidal vs. fluvial development (i.e., the distribution of different channel sizes) as well as the underlying geology into which the channels are incised. The shape of the channels is hypothesized to be governed by the geologic strata of Onslow Bay (Hine and Snyder, 1985). However, the fill and preservation is hypothesized to reflect the relationship between fluvial transport capacity, sea-level rise and local geomorphic changes (which are no longer visible due to wave ravinement). These data show that channel-limited areas tend to be hardbottom- rich and the distribution and depth of large channels is related to paleovalley locations (e.g., Figures 7 and 8). It is reemphasized that channels may contain some sand suitable for beach nourishment where acoustically transparent fill and/or the surficial modern sand (H unit) is observed and validated by core data. However, many channels are complex indicating multiple incisions/processes, and are interbedded with heterolithic fill making its use impractical.

7 Sand Resources on the North Carolina Continental Shelf

North Carolina's gently sloping submerged continental shelf and emergent coastal plain display a great deal of spatial variability in their geology and resulting geomorphology. As sea-levels began to rise following the Last Glacial Maximum some 20,000 years ago, ocean shorelines began to retreat landward. The resulting erosion and sediment reworking exposed an array of subsurface sedimentary features (e.g., relict barrier island fragments, tidal deltas and fluvial deposits) (Rutecki et al., 2014) whose characteristics differ, sometimes markedly, from north to south across the North Carolina shelf and outer coastal plain (that portion nearest the ocean shoreline). The State's southern coastline, up to Cape Lookout, is characterized by short barrier islands with many separating tidal inlets and small, narrow back-barrier estuaries. Offshore, the sand veneer covering the shelf is thin, with few thicker sand bodies and numerous older (Pliocene and Cretaceous aged) rocky outcrops dotting the surface along much of the seafloor (Meisburger et al., 1979; Snyder et al., 1994; and Riggs et al., 1995). North of Cape Lookout, on the other hand, the barrier islands are characteristically long and narrow with few tidal inlets (3 at this writing in 2019), and front large, shallow estuaries (Riggs et al., 1995). On the northern North Carolina continental shelf, we find a consistently thicker more spatially continuous overlying sand wedge, made up largely of recent (Quaternary aged) sediments with few or no rocky outcrops (Mallinson et al., 2010; Thieler et al., 2014). Differences in rates of relative sea level rise, sources of new sediments, and regional tectonics are the principal reasons for the variability seen, and are further the principal influences on the long- term erosion/accretion response and ultimately the evolution of the State's modern, largely retreating, coastline (Riggs et al., 1995).

Although the primary focus of this report is on sand resources and associated reconnaissance south of Cape Lookout, for completeness brief discussions are also included on sand resources found north of the Cape.

7.1 Currituck and Northern Dare Counties

In 1994 the Minerals Management Service (MMS), now the Bureau of Ocean Energy Management (BOEM), authorized the North Carolina Geological Survey to acquire marine geophysical data along the outer continental shelf from the town of Duck in Dare County south to Oregon Inlet. These data were used to identify four borrow sources in federal waters offshore of the towns of Nags Head and Kill Devil Hills comprising > 300 Mcy (OCS1-OCS4; Figure 17; Table 3). Due to the spacing of the tracklines (2 nautical miles) and the somewhat limited number of vibracores (56) over such a large area, these volume estimates are relatively coarse but do clearly indicate large volumes of potential sand. For example, OCS3 (Table 2; Figure 19) is only intersected by five tracklines and two vibracores, suggesting the volume estimate of 64.7 Mcy has large associated uncertainty.

As part of early feasibility efforts, the USACE (2000) identified three potential borrow sources. Borrow area S 1 is located within State waters offshore Nags Head and contains an estimated 104.5 Mcy (Table 3; Figure 17). The remaining two sites in State waters offshore, N1 and N2, sit offshore of Southern Kitty Hawk and Northern Kill Devil Hills and are believed to contain approximately 8 Mcy, respectively (Table 3; Figure 17). From the information available, it is believed that all three borrow-area volume estimates were determined based on a combination of seismic-reflection, vibracore and bathymetric data, although data coverage was limited.

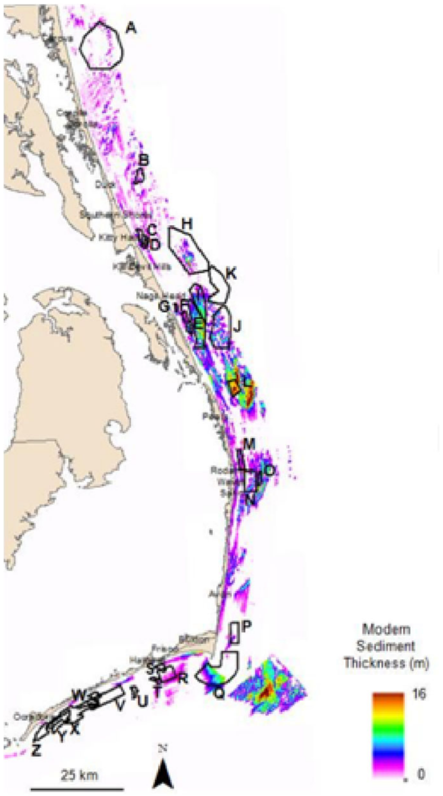


Figure 17: Borrow sources from C&ND and SD&H (See Tables 2 and 3) overlain on sediment thickness isopach map from Thieler et al, (2014). This dataset serves as a good recon- naissance tool for potential sand resources.

Table 3: Borrow Site Sand Resource Assessments–Currituck and Northern Dare Counties

SMFA	**Borrow Area Name**	**Est. Size (Mcy)**	**Estimated Quality(Suitable, Marginal, Unsuitable, Unknown)**	**Data Availability (Limited, Good, Excellent, Not Accessible)**	**Historic Use**	**Planned Use**	**Reference for Volume Estimate**
C&ND	A (Ctk)	N/A	Suitable	Limited	N/A	N/A	BIMP, 2011
C&ND	B (Duck)	2.7	Suitable	Excellent	N/A	Duck 2017	CPE, 2014
C&ND	C (N1)	5.2	Suitable	Good	N/A	N/A	USACE, 2000
C&ND	D (N2)	2.4	Suitable	Good	N/A	N/A	USACE, 2000
C&ND	E (S1)	104.5	Suitable	Excellent in portions	Nags Head 2011	Nags Head 2011	USACE, 2000
C&ND	F (S2)	7.2	Unsuitable	Good	N/A	N/A	USACE, 2000
C&ND	G (S3)	1.4	Unsuitable	Good	N/A		USACE, 2000
C&ND	H (OCS1)	173.5	Suitable	Excellent	North Dare Beaches 2017	N/A	Boss and Hoffman, 2001
C&ND	I (OCS2)	44.9	Suitable	Good	N/A	N/A	Boss and Hoffman, 2001
C&ND	J (OCS3)	64.7	Suitable	Good	N/A	N/A	Boss and Hoffman, 2001
C&ND	K (OCS4)	23.2	Suitable	Good	N/A	N/A	Boss and Hoffman, 2001

From 1999 to 2005, a large-scale, multi-institutional sand availability research effort, with funding from the Outer Banks Task Force and the North Carolina Department of Transportation, was conducted across the inner continental shelf off northeastern North Carolina. The reconnaissance relied on high-resolution single-channel seismic data and 121 vibracores (up to 20 ft in length), and yielded six potential sand resources ranging in volume from 11 to 70 million cubic yards. In all, within shelf waters ranging from the Virginia-North Carolina state line southward down to Oregon Inlet, there are 11 identified potential borrow areas associated with sand ridge and shoal complexes, constituting some 403 Mcy (Table 3; Figure 17) of potential sand.

7.2 Southern Dare and Hyde Counties

Along the North Carolina shelf from Oregon Inlet south to Ocracoke Inlet, 15 potential borrow sources have been identified. A total of 238 Mcy have been estimated for five of these sources (Table 4). According to Boss and Hoffman (2000), Diamond Shoals is a potentially huge borrow source for sand, with approximately 1.6 billion cubic yards of material located in state and federal waters in depths less than 20m. Boss and Hoffman (2000), however, focused their study on only a small section of the shoal located to the east of Cape Hatteras within the 3-mile limit where they estimated reserves to be in excess of 250 Mcy. However, for many of these potential sources, the volume estimates are based on limited data as they were made prior to the USGS surveying (Table 4). For example, some of the potential sources with large estimated volumes like that offshore Ocracoke (70.1 Mcy) are only intersected by 9 seismic tracklines (0.5 mi spacing) and twelve cores (Boss and Hoffman, 2000). Five vibracores and approximately 12 shoal-perimeter seismic track lines (no lines extended across the full width of the shoal) were used to assess the Diamond Shoals resource (Boss and Hoffman, 2000).

Table 4: Borrow Site Sand Resource Assessments–Southern Dare and Hyde Counties

SMFA	Borrow Area Name	Est. Size (Mcy)	Estimated Quality(Suitable, Marginal, Unsuitable, Unknown)	Data Availability (Limited, Good, Excellent, Not Accessible)	Historic Use	Planned Use	Reference for Volume Estimate
SD&H	L (N. Pea Is.)	68.5	Suitable	Good	N/A	N/A	Boss and Hoffman, 2000
SD&H	M	N/A	Suitable	Excellent	N/A	N/A	Geodynamics, 2013
SD&H	N (S. Pea Is.)	55.9	Suitable	Excellent	Rodanthe, 2014	N/A	Boss and Hoffman, 2000
SD&H	O	N/A	Unknown	Limited	N/A	N/A	NCDENR, 2011
SD&H	P (Buxton)	15.5	Suitable	Excellent	Local	Buxton 2017	NCDENR, 2011
SD&H	Q (D. Shoals)	1660	Marginal	Limited	N/A	N/A	NCDENR, 2011
SD&H	R (Hatteras)	28.5	Suitable	Good	Hatteras Nourishments ?		Boss and Hoffman, 2000
SD&H	S	N/A	Unknown	Limited	N/A	N/A	Boss and Hoffman, 2001
SD&H	T	N/A	Unknown	Limited	N/A	N/A	NCDENR, 2011
SD&H	U (Hatt. Inlet)	N/A	Marginal	Limited	Hatteras	N/A	NCBIMP, 2011
SD&H	V (Ocracoke)	70.1	Marginal	Limited	N/A	N/A	Boss and Hoffman, 2001
SD&H	W	N/A	Marginal	Limited	N/A	N/A	NCDENR, 2011
SD&H	X	N/A	Marginal	Limited	N/A	N/A	NCDENR, 2011
SD&H	Y	N/A	Marginal	Limited	N/A	N/A	NCDENR, 2011
SD&H	Z	N/A	Marginal	Limited	N/A	N/A	NCDENR, 2011

7.3 Bogue Banks Region

Several potential borrow sites have been investigated (USACE, 2014; BBBMNP, 2017) to determine the sediment quantity and quality that may be available for placement on Bogue Banks (Figure 18). Initial areas of investigation included the Beaufort Inlet ebb tidal delta, Bogue Inlet, and several sites offshore of Bogue Banks (Figure 18). These locations appeared to cover a significant area and have dredgeable thicknesses (i.e., greater than 2 feet) and remain as active sources. Offshore, environmental concerns or the presence of historic artifacts have eliminated all but three potential borrow sites: only areas Y, U, and the Morehead City Ocean Dredged Material Disposal Site (ODMDS) in Area Q2 remain. (Figure 18). However, it should be noted that the borrow areas eliminated based on findings from a federally-funded Coastal Storm Damage Reduction Study (CSDR) conducted in 2013 (USACOE, 2014) may still be suitable and sizable as beach fill. If future need arises, these areas could be investigated more closely (OSI, 2014).

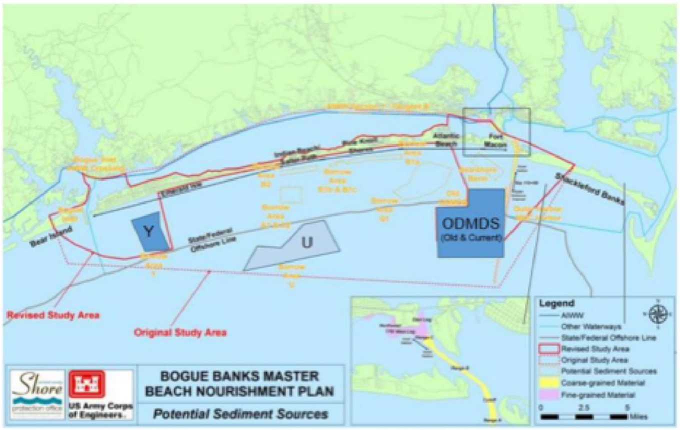


Figure 18: Recommended borrow sites moving forward include Area Y, the Morehead City Harbor navigation channel and associated Old and Current Ocean Dredged Material Disposal Site (ODMDS), Area U, and Bogue Inlet. From the BBBMNP, 2017.

The Bogue Banks Beach Nourishment Master Plan (BBBMNP, 2017) focuses on resources in Area Y and the ODMDS, but omits borrow area U (Figure 18). The field program off Bogue Banks includes additional core and geophysical data collection in Area Y and the ODMDS. More than 50 additional vibracores were collected in these two proposed borrow areas to better define the quality and quantity of the resource. The estimated amount of material in these two borrow areas (ODMDS and Y) total 22,453,557 cy.

7.4 Topsail Island Region

There are several available sand resources that may be used to nourish the shorelines of Topsail Island. Sand from maintenance dredging and channel realignment has been useful and cost- effective in the past (e.g., Phase 1 renourishment for North Topsail Beach). A state-wide evaluation of sediment availability in federal navigation channels has not been conducted to the knowledge of the authors, although the USACE does regularly resurvey and maintain (i.e., dredge) areas of shoaling. Offshore research (Snyder et al., 1982; 1988; Hine and Snyder, 1985; Riggs et al., 1985) has, however, revealed how Paleogene and Neogene marine sedimentary rocks are exposed on the shelf and overlying sediment is generally thin or absent. U.S. Army Corps of Engineers (USACE, 2004) sponsored research was conducted in Spring 2003 in an area between 0.5 and 5 miles offshore. The associated report did not identify specific borrow areas but gave key insights and nicely reviewed earlier studies (USACE, 2004). This research corroborated how unconsolidated sandy sediments offshore are found in isolated areas.

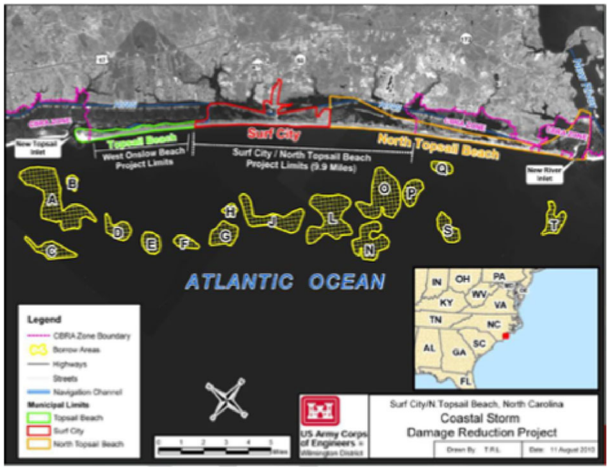


Figure 19: Map of sand management projects and potential offshore borrow areas (from Civil Works Review Board Presentation on USACE, 2017). Note, several previously identified borrow areas (I,K,M,R) were excluded based on sidescan sonar mapping results (USACE, 2010), and Borrow Area X, is not shown as it was identified later.

Based on the data and analysis from the Corps-sponsored study, along with sidescan sonar mapping of the surficial seafloor (USACE, 2004), 16 potential borrow sites were identified holding an estimated total of 50 Mcy (Figure 19; USACE, 2010). Given the spacing of available core and seismic data, these estimates must be viewed as very approximate.

While these reconnaissance data appear to show that there is a considerable volume of sediment offshore for future nourishment projects, it is evident that the available material is not exhaustive and may not be compatible. The Corps of Engineers USACE (2010), for instance points out that borrow areas A, F, L, S, and P did not meet compatibility standards based on their initial evaluation. During PED analysis, borrow areas A, G, H, J, L, O, and P failed to meet state-established grain size and

Figure 20: Borrow areas near New Topsail Inlet. Note Area X is at entrance (USACE, 2017).

mineralogy requirements, although were found to be acceptable according to USACE Wilmington District practices (USACE, 2013). At the moment, it is believed that only reconnaissance-level data exist for the potential borrow areas except A and Q, which was surveyed for Phase 5. Because of the need for a borrow area for Topsail Beach and the determination that area A would not have a sufficient quantity of suitable material, Finkl et al (2008) identified Borrow Area X and estimate that it contains a volume of 2.02 million cubic yards (Figure 20).

7.5 New Hanover Region

Past nourishment projects in New Hanover County SMFA have largely relied on inlet or other navigation channel sands. The one exception to this is Kure Beach, which has utilized an offshore borrow area (Figure 21). The reuse or recycling of inlet fill to rebuild updrift beaches, however, brings with it a two-fold problem. First, the inlet trapped sands must be periodically returned to the updrift beach in order to address losses due to erosion. A sediment budget analysis completed by Jarrett (1978) estimated that 155,000 cy was being trapped annually by the Masonboro Inlet weir jetty system at the southern end of Wrightsville Beach. To account for these losses, an equivalent average annual volume would need to be dredged from the weir depositional basin and put back on Wrightsville Beach. (USACE, 1982). Second, intercepting sediment at the inlet starves the downdrift beaches, potentially (likely) amplifying the erosion problem at these locations. Sustainability of this recovery and recycling approach thus requires additional engineering considerations that make longer-term use problematic, both in terms of project complexity and costs.

Meisburger et al. (1979) completed a seismic-reflection survey and collected cores across a wide area of the inner continental shelf from Cape Lookout to the SC border (Figure 22). Based on 824 km of seismic-reflection and 139 cores, it was determined that only in a few shoal areas contained sediments that may be beach compatible. Based on 123 km of seismic-reflection data and observations from earlier work, Synder et al. (1994) created an interpretive map of the geology offshore of New Hanover County (Figure 23). The mapped ”Inner Shelf Sand Shoals” are the best areas of potential sand resources (shaded in pink). USACE (2015a) indicates that three possible borrow areas were identified offshore of Figure Eight Island, although no use is planned at the current time (Table 5). To identify borrow source possibilities for Kure Beach, the findings of Meisburger et al. (1979) guided investigations (USACE, 1993). In 1991, a seismic scan was completed (no specifics are given), and 68 vibracores were collected across borrow areas ”A” and ”B”. Based on the available data, volumes were estimated for ”A-North”, ”A-South”, and ”B-West” (Figures 24 and 25; Table 5). Grain-size analysis indicated the sediment in the areas analyzed could be suitable for nourishment, but ”Borrow Area A-South” was not sampled (USACE, 1993).

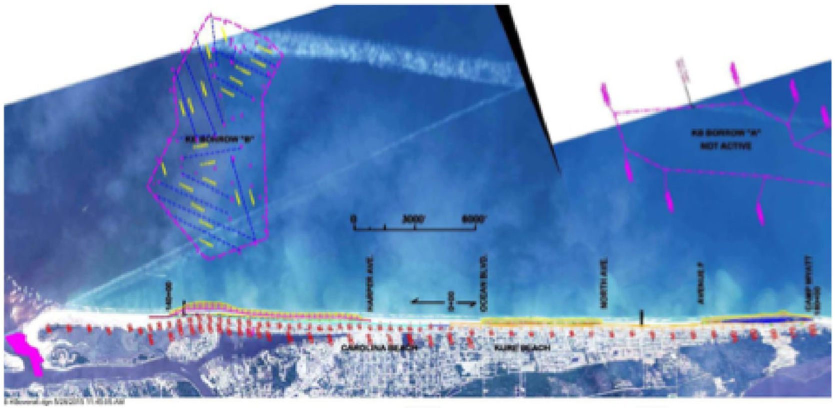


Figure 21: Map of nourishment areas in Carolina Beach and Kure Beach and associated borrow areas for 2016 CSDR cycle. The Carolina Beach nourishment used an inlet borrow area to the north (pink-shaded polygon), and the Kure Beach project used sediment from ”B”. Figure from USACE (2015b).

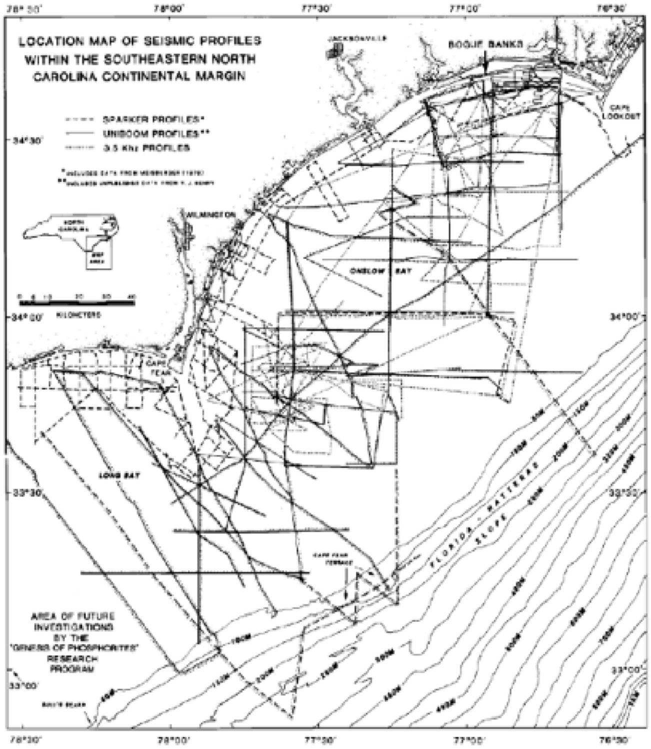


Figure 22: Map of seismic-reflection data in southern NC before 1985. Note the abundance of data near Bogue Banks are from Snyder et al. (1982) while data from Meisberger (1979) cover the inner shelf offshore New Hanover County and Brunswick County. From Riggs et al. (1985).

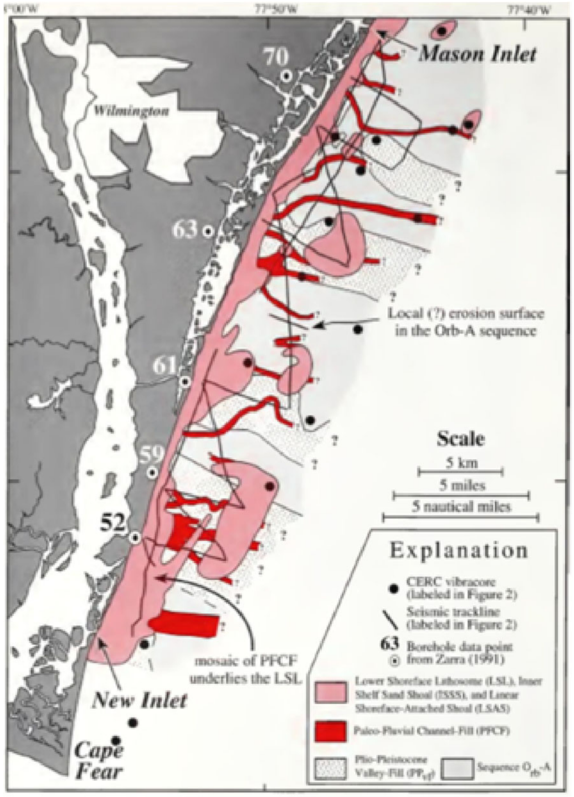


Figure 23: Interpreted surgical geology offshore New Hanover County. Note the single line defining the shoal (pink area) offshore of Borehole 61. From Snyder et al., (1994).

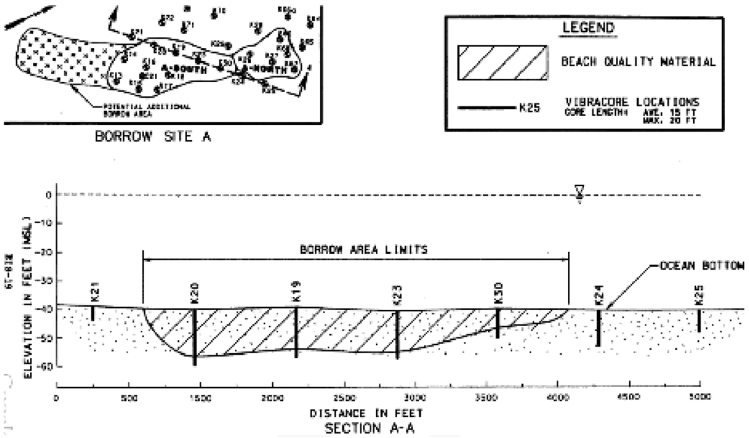


Figure 24: Map and cross-section of Borrow Area A based on USACE cores (USACE, 1993).

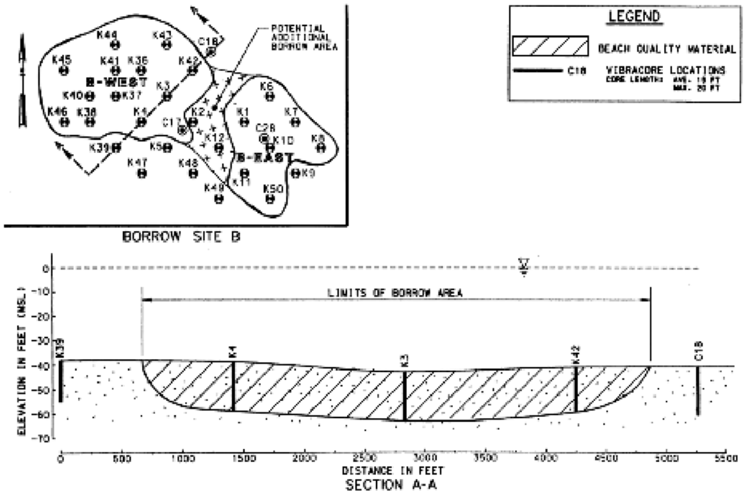


Figure 25: Map and cross-section of Borrow Area B based on USACE cores (USACE, 1993.

Table 5: Borrow Site Sand Resource Assessments–New Hanover County

SMFA	Borrow Area Name	Est. Size (Mcy)	Estimated Qual-ity(Suitable, Marginal, Unsuitable, Unknown)	Data Availability (Limited, Good, Excellent, Not Accessible)	Historic Use	Planned Use	Reference for Volume Estimate
New Hanover	Figure Eight I-III	N/A	Suitable	Limited, N/A	None	None	USACE (2015a)
New Hanover	A-North	8.2	Suitable	Good, N/A	Yes, Kure Beach CSDR	Yes, Kure Beach CSDR	USACE, (1993)
New Hanover	A-South	2.47	Suitable	Good, N/A	Yes, Kure Beach CSDR	Yes, Kure Beach CSDR	USACE, (1993)
New Hanover	B-West	14.54	Marginal	Limited	N/A	N/A	USACE, (1993)
New Hanover	B-East	N/A	Unsuitable	Limited	None	None	USACE, (1993)

7.6 Brunswick County Region

Based on all available data as of this writing, potential sand resources along the Brunswick coast and shelf, not including Cape Fear Shoals, could be as high as 75 – 80 Mcy (Table 6). Cape Fear Shoals represents a vast resource of perhaps an additional several hundred million cubic yards. The addition of the Cape Fear resource could push available reserve estimates to upwards of 240 Mcy (Table 6). Inlet sites, from navigation channel maintenance, are difficult to estimate, but could provide an additional beach compatible sand supply well in excess of 245,000 cy/y (the estimate for Lockwoods Folly Inlet alone). Additional sand resources will also be contributed by future dredging projects for navigation purposes in high trafficked and commercial areas such as Wilmington Harbor channel, Eastern Channel, and the AAIW. These navigation projects have collectively provided approximately 11.3 M cy of beach nourishment material since 1971 (or an average of 235,000cy/yr).

8 Resource Summary and Influence of Geologic Framework

Due to differences in the framework geology along the NC coast, there are regional differences in erosion, historical mitigation efforts, as well as potential sand resources. The NE Region of the state has several sand shoal complexes, as outlined in earlier work (e.g., Boss and Hoffman, 2001; Thieler et al., 2014; NCDCM, 2017). Despite these possibly large holdings of sediment, they are not ubiquitous and may not be proximal to areas of need or of suitable quality. Having less offshore data, ASAP collection efforts focused on the southern half of the State, where need exists and use is likely to increase in the future.

Like other high-energy, passive continental margins, the southern NC shelf and Onslow Bay are considered sediment-starved due to a lack of fluvial input and entrapment of sediment within estuaries (Emery, 1968; Cleary et al., 1996; Riggs et al., 1996; Riggs et al., 1998). Consequently, Onslow Bay is dominated by hardbottoms (Mearns et al., 1988; Cleary et al., 1996; Riggs et al., 1996). Unconsolidated sediments are generally limited to a discontinuous veneer as highlighted by the ASAP data and earlier work (Cleary et al., 1996; Riggs et al., 1996; Riggs et al., 1998). Similarities with the SC shelf are noted (Gayes et al., 2003, Baldwin et al., 2007; Denny et al., 2013). Physical and bioerosion processes are hypothesized to be responsible for creating much of the modern sands in Onslow Bay and into SC, with material reflecting the composition of the Tertiary and Pleistocene hardbottom being eroded (Cleary et al., 1996; Riggs et al., 1998; Gayes et al., 2003; Putney et al., 2004; Baldwin et al., 2007). While the majority of ASAP-delineated sand can be considered a veneer, in several areas H and QT reflectors visible in the sub-bottom data suggest the presence of interspersed thicker sand deposits. In addition, this ASAP effort has mapped numerous channels that may be a viable source of offshore sand in sediment-starved areas.

Table 6: Borrow Site Sand Resource Assessments–Brunswick County

SMFA	**Borrow Area Name**	**Est. Size (Mcy)**	**Estimated Qual-ity(Suitable, Marginal, Unsuitable, Unknown)**	**Data Availability (Limited, Good, Excellent, Not Accessible)**	**Types of Data**	**Historic Use**	**Planned Use**	**Reference for Volume Estimate**
BCB	Jinks Creek Nav Project	0.1	Suitable	Excellent,	Cores, bathymetry	None	Nav Project	M&N 2017b, 2017c (2015a)
BCB	Tubbs Inlet	unknown	Suitable	Good	Cores	None	N/A	OPE, 2015b
BCB	Shallotte Inlet	1.1-1.7	Suitable	Excellent	Cores, bathymetry	OIB	OIB term groin & CSDR	OPE, 2015b; OIB 2016
BCB	Lockwoods Folly Inlet & Eastern Chan.	7	Suitable	Excellent	Cores, bathymetry	Oak Island	HB term groin; OI CSMP	M&N 2016; DCA 2015; ATM 2013
BCB	Offshore Tubbs Inlet	unknown	Suitable	Good	Cores, bathymetry	None	N/A	CPE 2015b
BCB	Offshore Central OIB	0.4	Suitable	Good	Cores, bathymetry	None	N/A	CPE 2015b
BCB	Priority 1 Borrow Area	1.87	Suitable	Good	Cores, seismic	None	N/A	ATM 2010
BCB	Priority 2 Borrow Area	2.16	Suitable	Good	Cores, seismic	None	N/A	ATM 2010
BCB	Priority 3 Borrow Area	0.76	Suitable	Good	Cores, seismic	None	N/A	ATM 2010
BCB	Priority 4 Borrow Area	0.49	Suitable	Good	Cores, seismic	None	N/A	ATM 2010
BCB	USGS R1a	unknown	Suitable	Good	Cores	None	N/A	M&N 2016; DEQ 2003
BCB	Long Bay (1998/2003 surveys)	unknown	Unsuitable	N/A	Cores, seismic	None	N/A	C&C 1999, 2003
BCB	Wilmington Harbor ODMDS	166	Unsuitable	Good	Cores	None	N/A	M&N 2016; NCDENR 2011
BCB	Central Reach	3.3	Suitable	Good	Cores, bathy, seismic	Holden Beach	Central Reach	M&N 2016; DCA 2015
BCB	Jaybird Shoals	50	Suitable	Good	Cores, bathymetry	BHI term groin	N/A	M&N 2016; NCDENR 2011
BCB	Cape Fear Shoals BHI	5.2-8.5	Suitable	Good	Cores, bathy, seismic	None	BHI	BHI 2016
BCB	Cape Fear Shoals (CFA) total	1400	Suitable to Moderate (too fine in areas)	Limited	Cores, seismic	None	BHI	M&N 2016; Meisburger, 1979

The Bogue Banks Region is fortunate to have a diverse range of historic borrow sources, including inlets, dredge spoil sites, and offshore resources (NCDCM, 2017). ASAP data show a thin modern sand veneer is present, although a mean thickness of approximately 3 feet likely makes dredging impractical. However, these data also reveal that the southeast third contains two modern reflectors likely indicative of sand over 5 feet thick, potentially representing a voluminous dredging resource. Toward the western half of the subregion, there are a few stretches that exceed 3 m (10 ft) in thickness, although they are localized. These areas, and multiple mapped channels, would need to be surveyed and sampled further to constrain volumes and extraction costs.

The Topsail Region also contains a variety of historic borrow sources (NCDCM, 2016). While the H unit is widespread, it is often less than a meter (3 ft), making dredging not feasible. The QT unit, however, is also well distributed and thicknesses exceeding 2 m (5 ft) represent a more viable sand source. Multiple mapped channels also may hold viable sand resource thicknesses that would need to be verified with additional studies.

The New Hanover County Region also contains an extensive H unit, however with a mean thickness of only a few feet, resource extraction may not be possible. At a 61% coverage, the QT unit presents a more usable sand resource especially with a mean thickness of 5 ft. These thicker sand layers are believed to be related to a series of shore-detached ridges and relict paleo-cape sediments.

Finally, the Brunswick County Region also contains inlet sources as well as multiple inner shelf borrow sources, which have been effective at sustaining federal nourishment cycles (NCDCM, 2016). Comparatively, this region appears to contain a lesser amount of potential offshore sands, as it is difficult to distinguish a QT reflector and H is quite thin in most areas (less than a few feet). Many channels, however, contain at least a modern sand cap, and many may be composed of more sand at depth as indicated by acoustically transparent fill, making further investigation an option.

9 Management Implications and Future Research

North Carolina's coastline is largely erosive, and this erosion is placing into jeopardy the infrastructure, property and economy of many coastal communities. Beach nourishment is an important tool for coastal communities to manage this erosion, but it requires sand resources which are not widespread and need to be better constrained with additional geological and geophysical data. Nourishment is already being used widely and is likely to increase given the projections for sea-level rise, potential for increased storms, and the State of North Carolina's restrictions on the use of hard-structure controls (e.g., groins, jetties, sand-bags). This report details the exploratory efforts to locate and assess the quantity and quality of offshore sand resources. The results highlight the lack of existing data in some areas, and the work needed to determine the volume and distribution of sand resources along the continental shelf off North Carolina. Where future research should be directed depends upon need and available funding. Information presented in this NC-BOEM study offers insight into this important question.

Sediment thicknesses as described in this and the accompanying Final ASAP Technical reports reflect interpretation of the shallow subsurface sediment layer(s) observed along a series of shallow seismic survey track lines. Based on the data presented herein, future work should focus on areas where mapped sand resource deposits are thick (>5 ft) and more extensive (kilometers wide). For instance, within the Bogue Banks Region (see Figure 26 here or Figure 3 in the ASAP Technical Report), there are four areas that are good candidates for additional investigation. The area south of Beaufort Inlet, the most densely researched of the four areas, appears to suggest the presence of a viable sand resource---a result which further suggests that additional exploration in the other three areas in this region may be justified. Another possible area is the series of almost-overlapping patches seen in Figure 28 (Figure 5 in the ASAP Report) offshore of Topsail Island. Each of Figures 26 and 33 in this report (Figures 3 and 10 in the ASAP Report) depict these potential sites, both as surface and channel-fill sourced sedimentary materials.

The maps seen in Figures 26 through 33 show the area along the North Carolina Outer Continental Shelf (OCS) south of Cape Lookout partitioned into the four discrete, non-overlapping assessment regions addressed in this report. The included maps show the seismic survey track lines and sampling locations, along with sand resource thickness measurements at discrete positions along each track line. The maps also include modeled thickness estimates in the immediate vicinity of the track line sample positions. The mapped sand bodies are first grouped by type (channel-fills versus non-channel deposits) and then by thickness, the latter using bins of 0 – 5 feet, 5 – 10 feet, and greater than 10 foot thicknesses. Fill type is represented on separate map graphics. Sediment thickness interpretations for both types (channel and non-channel fills) are presented on the maps using two cartographic visualization strategies. The first uses simple vector point features to mark the locations where seismic observations and interpretations were made along the track-lines during the study. Here, atop the regularly-spaced track lines, sampling locations are represented as points (sample points) encoded to reflect interpreted sediment depths in the three bin ranges. Color differences are used to differentiate two classes: yellow (255:255:0) for depths from 5 to 10 feet, and red (255:0:0) for those that exceed 10 feet. Interpreted thicknesses less than 5 feet are not explicitly identified on the maps. The second strategy used to illustrate sediment bed thickness applies a kernel density function estimator to the observed seismic data to predict thickness at locations within a limited radial distance in the immediate vicinity adjacent to the survey track line sample points. The density function estimators are seen on the maps as "halos" of varying color surrounding the track-line data points where thickness is estimated (by investigator interpretation of the seismic track-line data) to be 5 feet or more. The reader is cautioned that these density estimates are probability-based extrapolations. Their estimation accuracy is highest within the first few 10s of meters adjacent to the data points. Their reliability diminishes with increasing distance away from the point. Bed characteristics are known with certainty only along the track lines (at the sample points) where seismic data was actually collected and assessed.

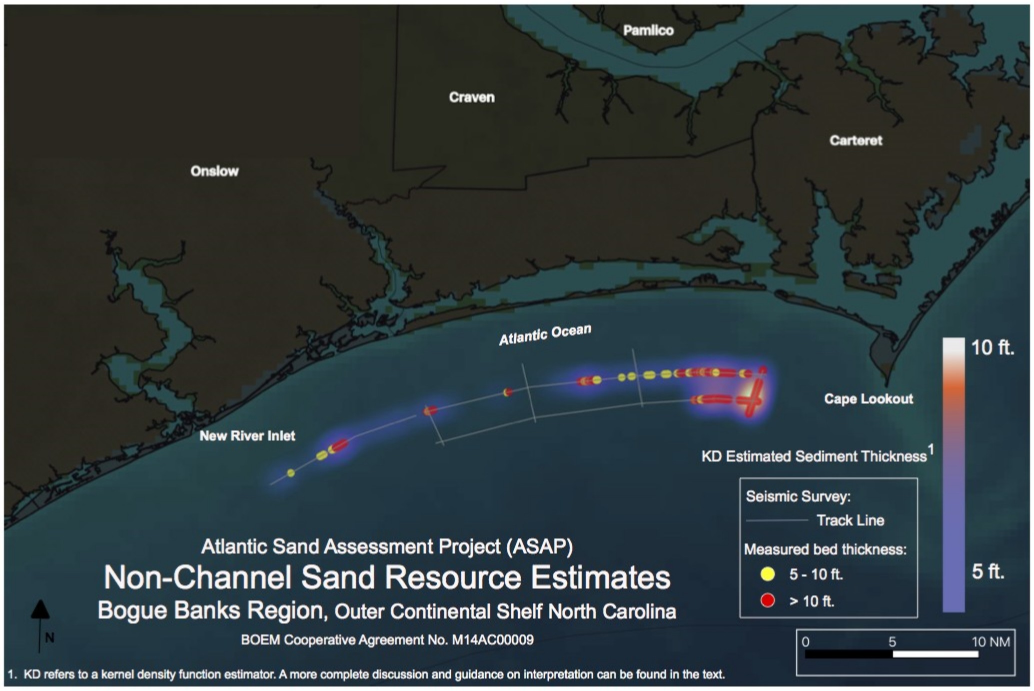


Figure 26: Non-channel sediment resource estimates for the Bogue Banks OCS Region. Identified as Figure 3 in the ASAP Technical Report.

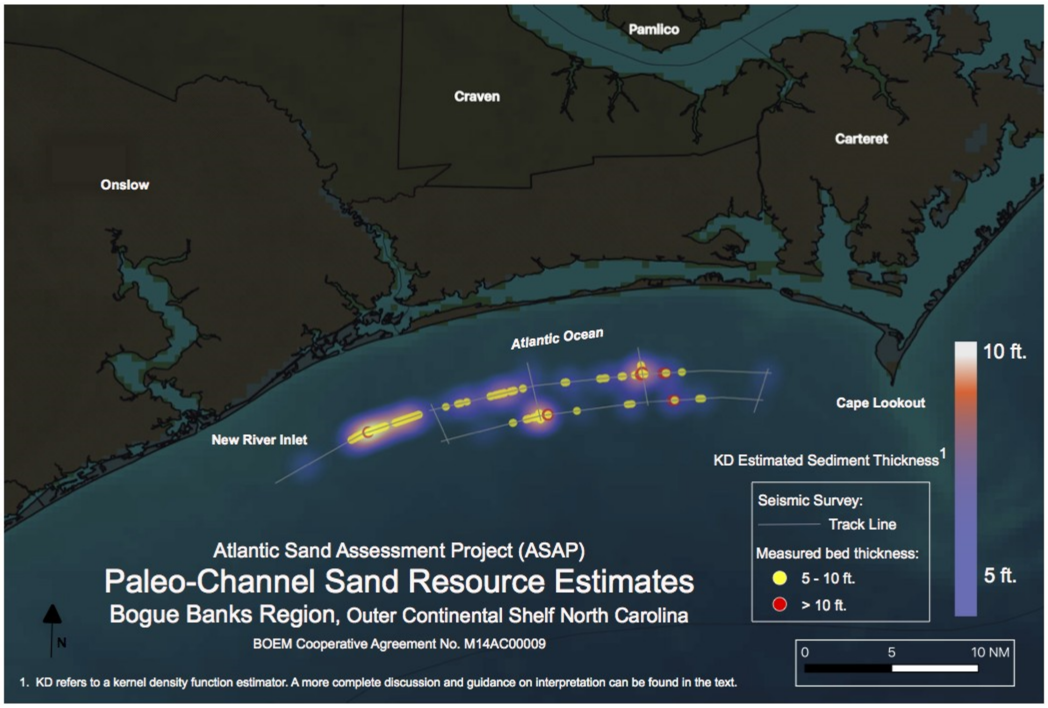


Figure 27: Quaternary channel sediment resource estimates for the Bogue Banks OCS Region. Identified as Figure 4 in the ASAP Technical Report.

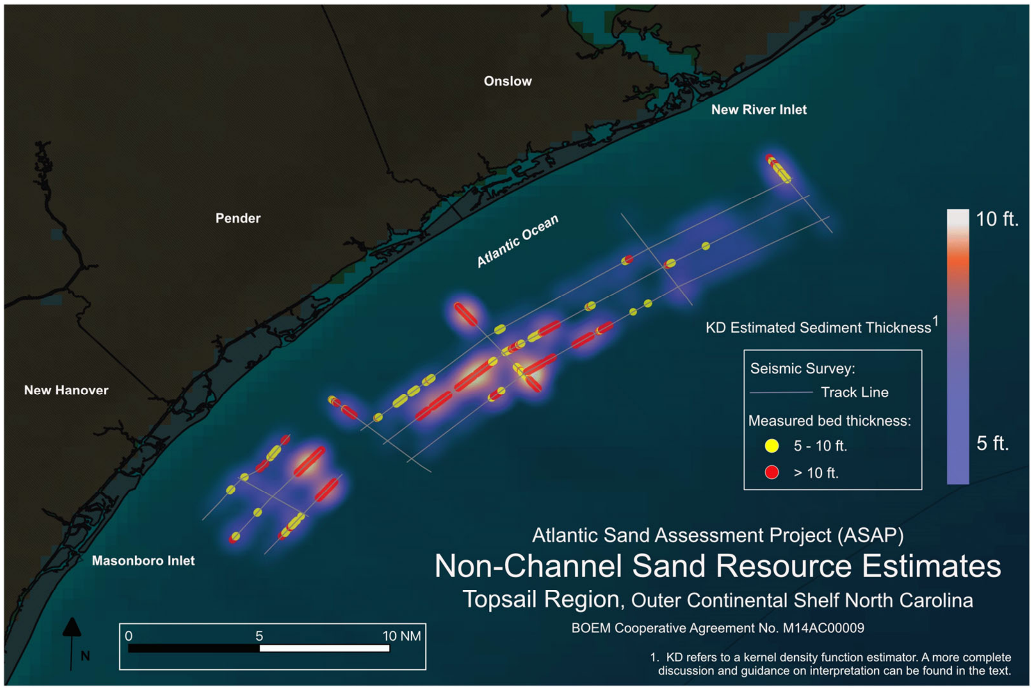


Figure 28: Non-channel sediment resource estimates for the Topsail OCS Region. Identified as Figure 5 in the ASAP Technical Report.

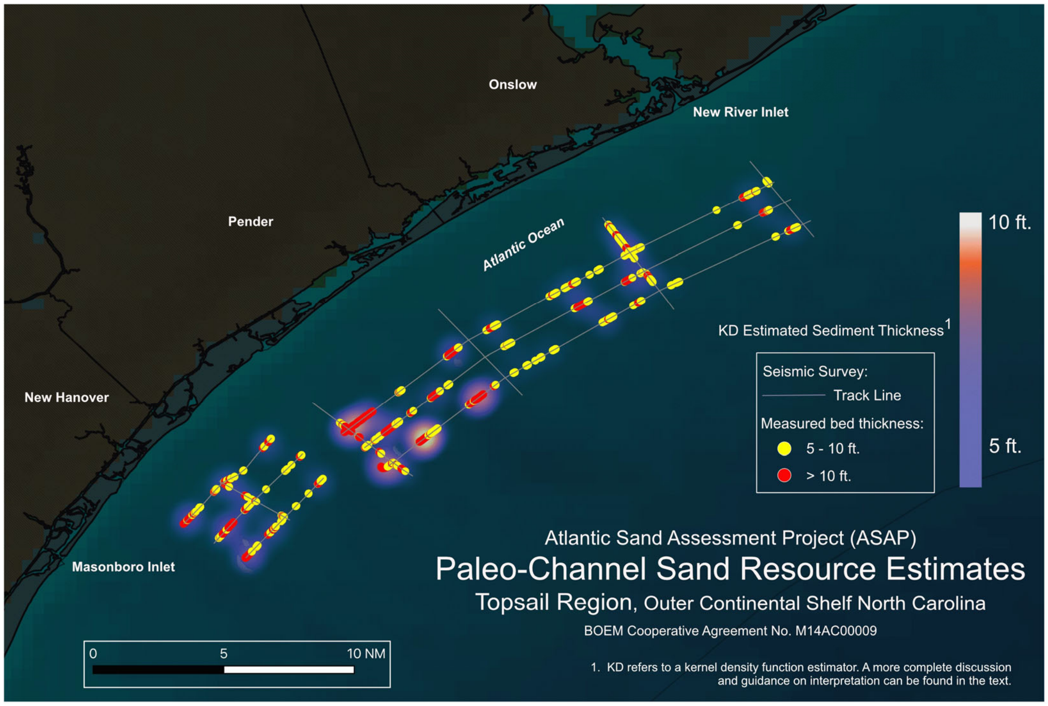


Figure 29: Quaternary channel sediment resource estimates for the Topsail OCS Region. Identified as Figure 6 in the ASAP Technical Report.

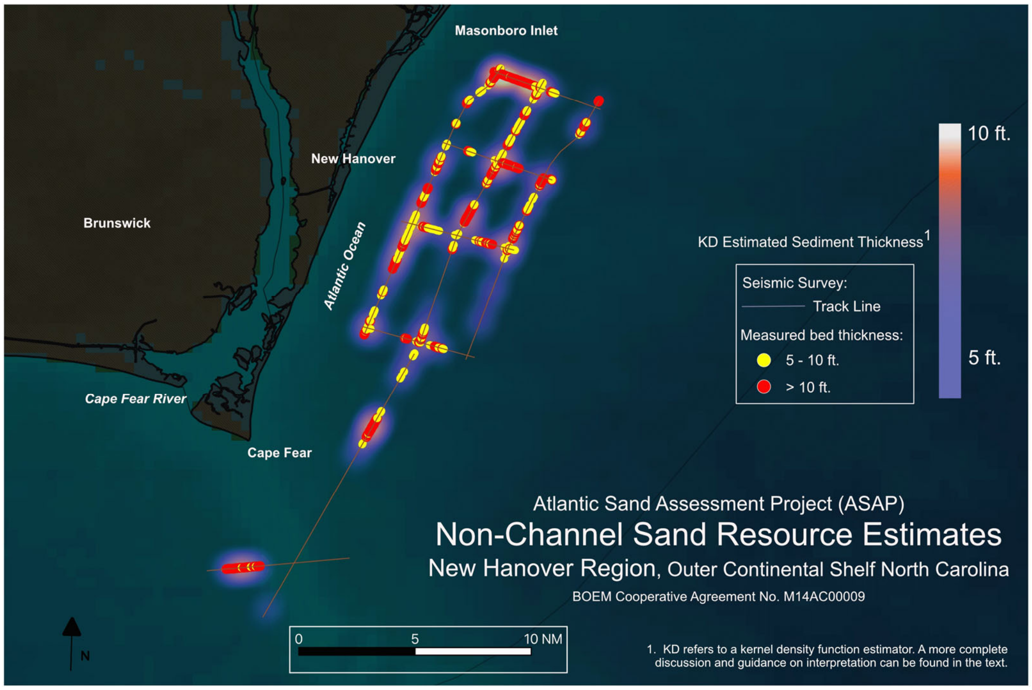


Figure 30: Non-channel sediment resource estimates for the New Hanover OCS Region. Identified as Figure 7 in the ASAP Technical Report.

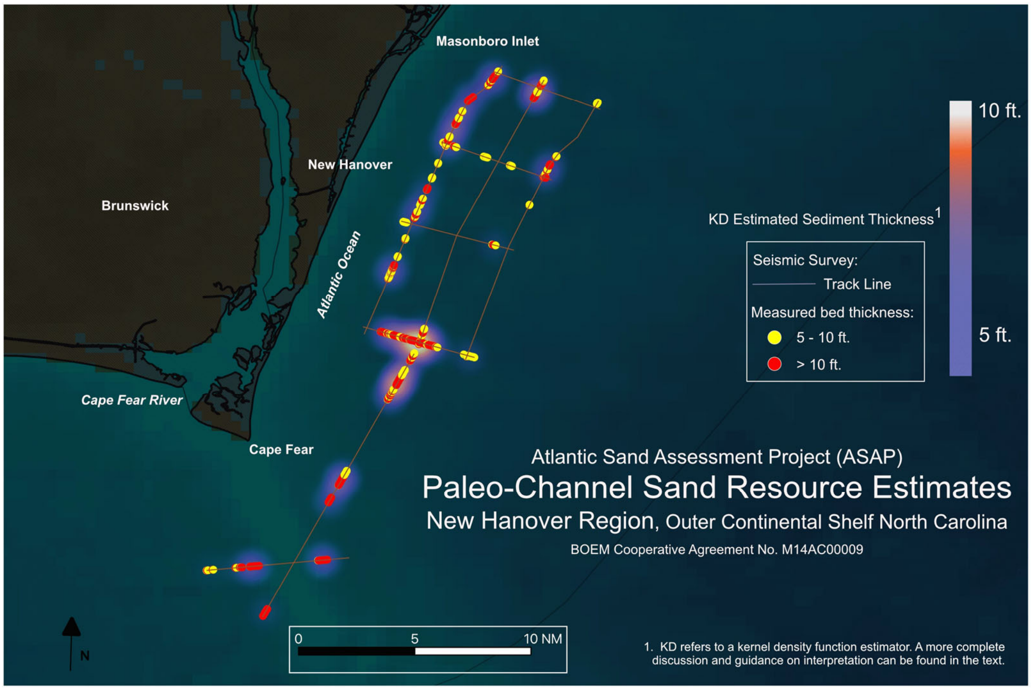


Figure 31: Quaternary channel sediment resource estimates for the New Hanover OCS Region. Identified as Figure 8 in the ASAP Technical Report.

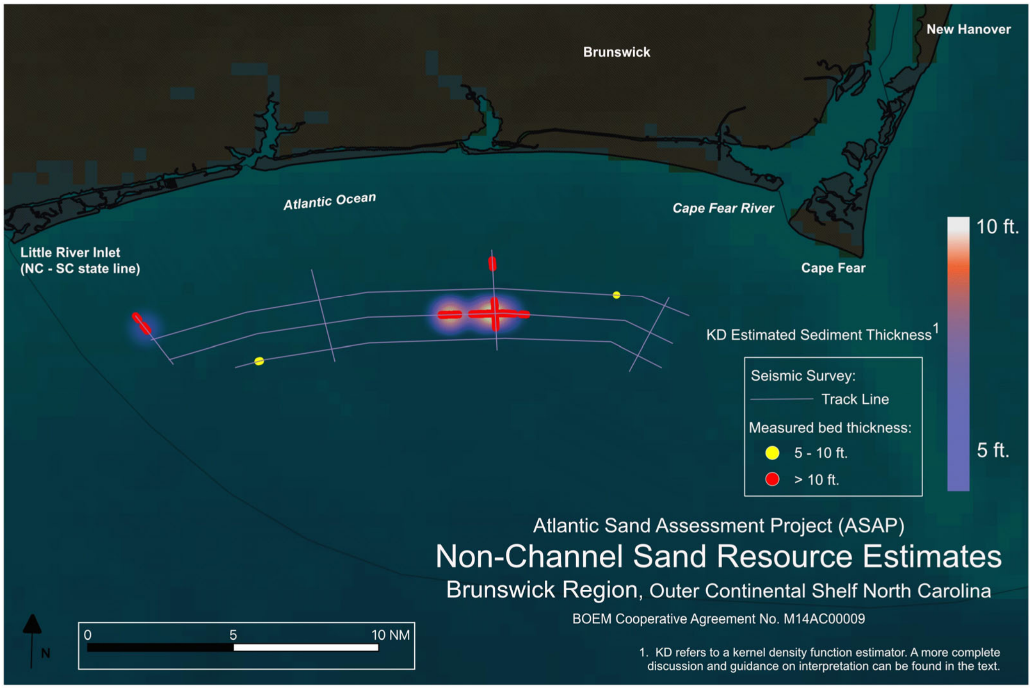


Figure 32: Non-channel sediment resource estimates for the Brunswick OCS Region. Identified as Figure 9 in the ASAP Technical Report.

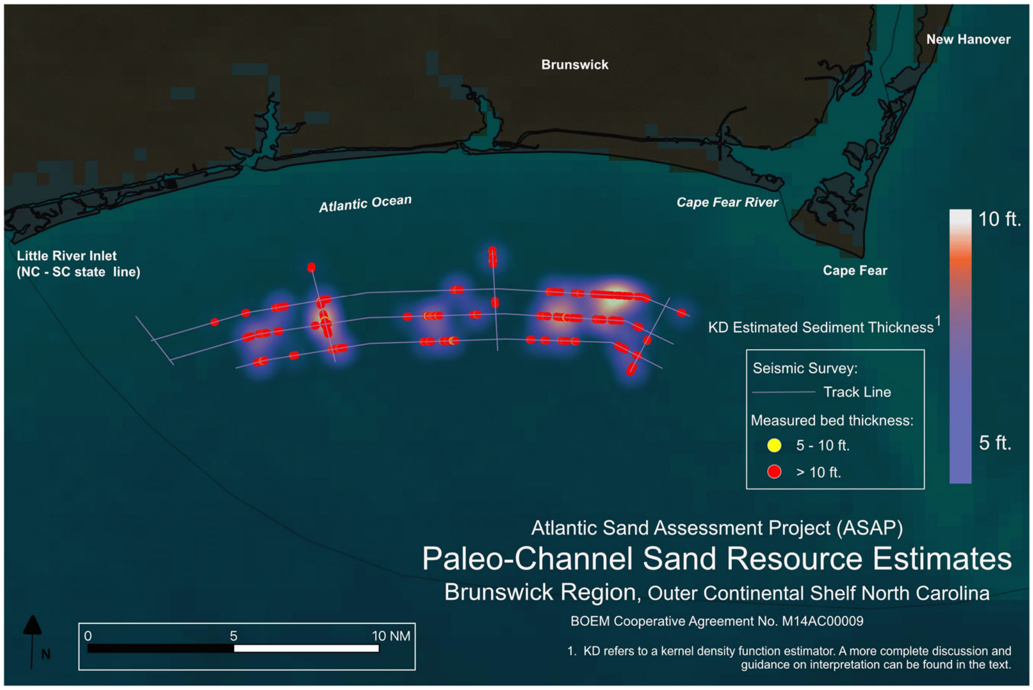


Figure 33: Quaternary channel sediment resource estimates for the Brunswick OCS Region. Identified as Figure 10 in the ASAP Technical Report.

The NC continental shelf is an expansive geographic region, and this report provides a reconnaissance level view of some of the potential sediment resources that exist therein. Additional research is needed regarding the location, quantity and quality of these sediment resources, as well as associated environmental and cultural resource assessments. Although progress has been made, the offshore geology needs more investigation, so a better understanding of the resources and how they are changing due to extraction and ocean reworking can be achieved. Resource evaluation and extraction is expensive and costs will likely rise as sand sources diminish and sources are developed further from project areas. Stakeholders such as the State of NC, BOEM, USACE and local governments should pursue continued resource evaluation with a focus on stewardship to optimize their use and minimize impacts to important habitats or cultural resources. Stakeholders (e.g., coastal communities and counties) should work in partnership with BOEM, State officials, and private industry to better define short- and long-term needs and avoid potential conflicts. The geological research is only one part of a multifaceted issue. Moving forward, more work is needed not only to define the sand resources but also to consider the problem (erosion and resource demand) and how it will change with time. This report provides important progress, especially insight for the southern NC continental shelf resources. A collaborative effort is needed to strategize for the future.

References

American Shore and Beach Preservation Association (ASBPA), 2007. Shore Protection Assessment: Beach Nourishment. http://asbpa.org/wpv2/wp-content/

American Shore and Beach Preservation Association (ASBPA), 2018. Carolina coastline stands up to Florence. http://asbpa.org/2018/09/27/florence-response

ATM (Applied Technology Management, Inc.), 2010. Holden Beach Offshore Seismic Survey Study. Prepared for the Town of Holden Beach, NC. 65 p.

Baldwin, W.E., Morton, R.A., Putney, T.R., Harris, M.S., Gayes, P.T., Driscoll, N.W., Denny, J.F., Schwab, W.C., 2006. Migration of the Pee Dee River system inferred from ancestral paleochannels underlying the South Carolina Grand Strand and Long Bay inner shelf. Geologic Society of America Bulletin 118, 533?549.

Baldwin, W.E., Denny, J.F., Schwab, W.C., Gayes, P.T., Morton, R.A., Driscoll, N.W., 2007. Geologic framework studies of South Carolina's Long Bay from Little River Inlet to Winyah Bay, 1999 to 2003; geospatial data release. U.S. Geological Survey Open-File Report 2005-1346. /http://pubs.usgs.gov/of/2005/1346/S.

Barnes, J. (2013). North Carolina's Hurricane History: updated with a decade of new storms from Isabel to Sandy (4th ed.). Chapel Hill: The University of North Carolina Press.

Beach and Inlet Management Plan (BIMP), 2011. NC Division of Coastal Management. https://deq.nc.gov/about/divisions/coastal-management/coastal-management-oceanfront-shorelines.

BBBMNP (Bogue Banks Beach Master Nourishment Plan), 2017. Information available from http://www.carteretcountync.gov/313/Preservation-Plan.

BBFRP (Bogue Banks Florence Renourishment Plan). 2019. Information available from http://www.carteretcountync.gov/788/Florence-Replenishment-Project-2019

Belknap, D.F., Kraft, J.C., 1985. Preservation potential of transgressive coastal lithosomes on the U.S. Atlantic Shelf. Marine Geology 42: 429-442.

Birkemeier, W.A., 1985. Field data on seaward limit of profile change. Journal of Waterway, Port, Coastal, and Ocean Engineering 111, 598?602.

Boss, S.K., Hoffman, C.W., 2000. Sand resources of the North Carolina Outer Banks, Final Report. Contract Report prepared for the Outer Banks Transportation Task Force and the North Carolina Department of Transportation, 87 p.

Boss, S.K., Hoffman, C.W., 2001. Geologic framework derived from high resolution seismic reflection, side-scan sonar, and vibracore data offshore Oregon Inlet to Duck, Dare County, North Carolina. Prepared for the U.S. Minerals Management Service, International Activities and Marine Minerals Division, 48 p.

Boss, S.K., Hoffman, C.W., Cooper, B., 2002. Influence of fluvial processes on the Quaternary geologic framework of the continental shelf, North Carolina, USA. Marine Geology, 183(1-4), 45-65.

Bromley, R., 1975. Trace fossils at omission surfaces, in Frey, R.W., ed., The Study of Trace Fossils: New York, Springer-Verlag, 399-428.

Carey, J.S., Sheridan, R.E., Ashley, G.M., 1998, Late Quaternary sequence stratigraphy of a slowly subsiding passive margin, New Jersey continental shelf. The American Association of Petroleum Geologist Bulletin 82, 773-791.

Chaumillon, E., Proust, J., Menier, D., Weber, N., 2008. Incised-valley morphologies and sedimentary- fills within the inner shelf of the Bay of Biscay (France): A synthesis. Journal of Marine Systems. 383-396. 10.1016/j.jmarsys.2007.05.014.

Chesapeake Technology. (2018). SonarWiz (Version 6). Chesapeake Technology Inc.

Cleary, W., Riggs, S., Marcy, D., Snyder, S., 1996. The influence of inherited geological framework upon a hardbottom-dominated shoreface on a high energy shelf: Onslow Bay, North Carolina, USA, in: Batist, M. and Jacobs, P. (eds.), Geology of Siliciclastic Shelf Seas. Geological Society Special Publication No. 117, 249-266.

Colman, S.M., Halka, J.P., Hobbs, C.H., III, Mixon, R.B., Foster, D.S., 1990. Ancient channels of the Susquehanna River beneath Chesapeake Bay and the Delmarva Peninsula: Geological Society of America Bulletin, 102, 1268-1279.

Conery, I.W., 2019. From Dunes to Shelf Deposits: A Multidisciplinary Investigation of Coastal Sand Management in North Carolina. Unpublished Ph.D. Thesis. East Carolina University, Greenville, NC. 164 p.

Crowson, R., 1980. Nearshore rock exposures and their relationship to modern shelf sedimentation Onslow Bay North Carolina. Unpublished M.S. Thesis. East Carolina University, Greenville, NC, 66 p.

Denny, J.F., Schwab, W.C., Baldwin, W.E., Barnhardt, W.A., Gayes, P.T., Morton, R.A., Warner, J.C., Driscoll, N.W., Voulgaris, G., 2013. Holocene sediment distribution on the inner continental shelf of northeastern South Carolina: Implications for the regional sediment budget and long-term shoreline response, Continental Shelf Research, 56,56-70. doi: 10.1016/j.csr.2013.02.004.

Dobkowski, A., 1998. Dump trucks Versus Dredges: An Economic Analysis of Sand Sources for Beach Nourishment. Coastal Management 26, 202-214.

Emery, K.O., 1966. Atlantic continental shelf and slope of the United States: Geologic background (No. 529). US Government Printing Office.

Emery, K., 1968. Relict sediments on Continental Shelves of the World. American Association of Petroleum Geologists Bulletin 52., p. 445-464.

Fletcher, C.H., III, Knebel, H.J., Kraft, J.C., 1992. Holocene depocenter migration and sediment accumulation in Delaware Bay: a submerging marginal marine sedimentary basin. Marine Geology 103, 165-183.

Finkl, C.W. and Makowski, C. eds., 2016. Seafloor Mapping Along Continental Shelves: Research and Techniques for Visualizing Benthic Environments (Vol. 13). Springer.

Folk, R. L. 1980. Petrology of Sedimentary Rocks. Austin, TX: Hemphill Publishing Company.

Freeman, C., Bernstein, D., Sumners, B., Hill, J., 2012. Final descriptive report: Sub-bottom and Seafloor surface surveys, Bogue Banks Master Beach Nourishment Plan, Carteret County, North Carolina. Geodynamics and Moffat and Nichol Report.

Gayes, P.T., Schwab, W.C., Driscoll, N.W., Morton, R.A., Baldwin, W.E., Denny, J.F., Wright,E.E., Harris, M.S., Katuna, M.P., Putney, T.R., Johnstone, E., 2003. Sediment dispersal pathways and conceptual sediment budget for a sediment starved embayment; Long Bay, South Carolina. Coastal Sediments '03, 5th Annual Symposium on Coastal Engineering and Science of Coastal Sediment Processes, Clearwater Beach, Florida, May 1823, 2003, Proceedings, 14 p.

Guitierrez, B.T., Voulgaris, G., Thieler, E.R., 2005. Exploring the persistence of sorted bedforms on the innershelf of Wrightsville Beach, North Carolina. Continental Shelf Research 25, 6590.

Gutierrez, B.T., Uchupi, E., Driscoll, N.W., Aubrey, D.G., 2003. Relative sea-level rise and the development of valley-fill and shallow-water sequences in Nantucket Sound, Massachusetts. Marine Geology, 193, 295-314.

Harris, P., Baker, E., 2012. Why map benthic habitats? Chapter in Seafloor Geomorphology as Benthic Habitat, 3-22. doi:10.1016/B978-0-12-385140-6.00001-3.

Harris, M.S., Gayes, P.T., Kindinger, J.L., Flocks, J.G., Krantz, D.W., Donovan, P., 2005. Quaternary geomorphology and modern coastal development in response to and inherent geologic framework: An Example from Charleston, South Carolina. Journal of Coastal Research 21, 4964.

Hayes, M.O., Nairn, R.B., 2004. Natural Maintenance of sand ridges and linear shoals on the U.S. Gulf and Atlantic continental shelves and the potential impacts of dredging. Journal of Coastal Research 20 (1), 138-148.

HDR (HDR Engineering, Inc. of the Carolinas), 2003. Feasibility Report and Final Environmental Impact Statement on Coastal Storm Damage Reduction, Surf City and North Topsail Beach North Carolina. Appendix R Hardbottom Survey Reports.

Henry, V., McCreery, C., Foley, F., Kendall, D., 1981. Ocean bottom survey of the Georgia Bight. In: Environmental Geologic Studies on the Southeastern Atlantic Outer Continental Shelf 1977-1978. (Ed. Popence, P.). p. 1-85. U.S. Geological Survey Open File Report 81-582-A, U.S. Dept. of the Interior, Reston, VA.

Hine, A.C. Snyder, S.W., 1985. Coastal lithosome preservation: evidence from the shoreface and inner continental shelf off Bogue Banks, North Carolina. Marine Geology 63, 307–330.

Hoffman, C.W., Gallagher, P.E., and Zarra, Larry, 1991. Stratigraphic framework and heavy-mineral resource potential of the inner continental shelf, Cape Fear area, North Carolina: first interim progress report: North Carolina Geological Survey Open-File Report 9 1-3, 31 p.

Jarrett, J.T., 1978. Sediment Budget Analysis Wrightsville Beach to Kure Beach, North Carolina (No. CERC-REPRINT-78-3). Coastal Engineering Research Center Fort Belvior, VA, 20 p.

Jones, S., Mangun, W., 2001. Beach nourishment and public policy after Hurricane Floyd: Where do we go from here? Ocean and Coastal Management 44, 207-220.

Kraft, J., Chrzastowski, M., Belknap, D., Toscano, M., Fletcher, C., 1987. The transgressive barrier- lagoon coast of Delaware: morphostratigraphy, sedimentary sequences and responses to relative rise in sea level. Sea-level fluctuation and coastal evolution. 129-143. 10.2110/pec.87.41.0129.

Landry, C.E., Hindsley, P., 2011. Valuing beach quality with hedonic property models. Land Economics 87 (1), 92-108.

Landry, C.E., Keeler, A., Kriesel, W., 2003. An economic evaluation of beach erosion management alternatives. Marine Resource Economics 18, 105-127.

Leatherman, S., 1989. National Assessment of Beach Nourishment Requirements-Associated with Sea-level Rise. U.S. EPA Office of Policy, Planning, and Evaluation Contract No. 68-01-72-89.

Mallinson, D., Riggs, S., Thieler, R., Culver, S., Farrell, K., Foster, D., Corbett, D., Horton, B., Wehmiller, J., 2005. Late Neogene and Quaternary evolution of the northern Albemarle Embayment (mid-Atlantic continental margin, USA). Marine Geology 217, 97?117.

Mallinson, D.J., Culver, S.J., Riggs, S.R., Thieler, E.R., Foster, D., Wehmiller, J., Farrell, K.M., Pierson, J., 2010. Regional seismic stratigraphy and controls on the Quaternary evolution of the Cape Hatteras region of the Atlantic passive margin, USA. Marine Geology 268, 16-33.

McBride, R.A., and Moslow, T.F., 1991. Origin, evolution, and distribution of shoreface sand ridges, Atlantic inner shelf, USA. Marine Geology 97, 57-85.

McNinch, J.E., 2004. Geologic control in the nearshore: shore-oblique sandbars and shoreline erosional hotspots, Mid-Atlantic Bight, USA. Marine Geology 211, 121-141.

McNinch, J.E. and Luettich Jr, R.A., 2000. Physical processes around a cuspate foreland: implications to the evolution and long-term maintenance of a cape-associated shoal. Continental Shelf Research, 20(17), pp.2367-2389.

Mearns, D., Hine, A., and Riggs, S., 1988. Comparison of sonographs taken before and after Hurricane Diana, Onslow Bay, North Carolina. Geology 16, 267-270.

Meisburger, E.P., 1979. Reconnaissance geology of the inner continental shelf, Cape Fear region, North Carolina. U.S. Army Corps of Eng. Coastal. Eng. Res. Cent. Technical Paper 79-3, 135 p.

Miselis, J.L., McNinch, J.E., 2006. Calculating shoreline erosion potential using nearshore stratigraphy and sediment volume: Outer Banks, North Carolina. Journal of Geophysical Research 111.

National Research Council. 1995. Beach Nourishment and Protection. Washington, DC: The National Academies Press. https://doi.org/10.17226/4984.

North Carolina Climate Office, 2019. North Carolina State University, Raleigh, NC.

NC Department of Environment and Natural Resources. (2011). (NC BIMP, 2011) North Carolina Beach and Inlet Management Plan: Final Report (p. 1005). Retrieved from North Carolina Department of Environment and Natural Resources website: http://digital.ncdcr.gov/cdm/ref/collection/p249901coll22/id/396392.

North Carolina Division of Coastal Management (NCDCM), 2016. Coastal Erosion Study. 59 pp. http://deq.nc.gov/about/divisions/coastal-management/coastal-management-hot-topics/reports. North Carolina Division of Coastal Management

North Carolina Division of Coastal Management (NCDCM), 2017. North Carolina Coastal Sand Re- source Availability.

North Carolina Department of Environmental Quality (NCDEQ), 2016. North Carolina Coastal Habitat Protection Plan Source Document. Morehead City, NC. Division of Marine Fisheries, 475 p.

NMFS (National Marine Fisheries Service), 2013. NOAA Fisheries Service: Office of Protected Resources: Species Under the Endangered Species Act (ESA). National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS). http://www.nmfs.noaa.gov/pr/species/esa/.

NOAA, 2014. Fisheries of the Caribbean, Gulf of Mexico, and South Atlantic; Coral, Coral Reefs, and Live/Hard Bottom Habitats of the South Atlantic Region; Amendment, in: Department of Commerce, editor, Washington, DC.

Nordfjord, S., Goff, J.A., Austin, J.A., Gulick, S. P., 2006. Seismic facies of incised valley-fills. New Jersey continental shelf: Implications for erosion and preservation processes acting during late Pleistocene/Holocene transgression. Journal of Sedimentary Research 76.

Oertel, G.F., Henry, V.J., Foyle, A.M., 1991. Implications of tide-dominated lagoonal processes on the preservation of buried channels on a sediment-starved continental shelf: International Association of Sedimentologists 14, 379-393.

(OSI, 2004) Ocean Survey, Inc., 2004. Geophysical Survey of Sediment Deposits Offshore Bogue Island, Onslow Bay, North Carolina. OSI Report No. 01ES094.

Parker, R.O., Colby, D.R., Willis, T.D., 1983. Estimated amount of reef habitat on a portion of the U.S. South Atlantic and Gulf of Mexico continental shelf. Bulletin of Marine Science 33, 935-940.

Program for the Study of Developed Shorelines, 2018 (WCU, 2018). Western Carolina University. http://beachnourishment.wcu.edu.

Putney, T.R., Katuna, M.P., Harris, M.S., 2004. Subsurface stratigraphy and geomorphology of the Grand Strand, Georgetown and Horry Counties, South Carolina: Southeastern Geology 42(4), 217?236.

Reid, J.M., Reid, J.A., Jenkins, C.J., Hastings, M.E., Williams, S.J., L.J., Poppe. 2005. usSEABED: Atlantic Coast offshore surficial sediment data release: U.S. Geological Survey Data Series 118, version 1.0. http://pubs.usgs.gov/ds/2005/118/.

Riggs, S. R., Ames, D. V., Culver, S. J., Mallinson, D. J., Corbett, D. R., & Walsh, J. P. (2009). Eye of a human hurricane: Pea Island, Oregon Inlet, and Bodie Island, northern Outer Banks, North Carolina. Geological Society of America Special Papers, 460 , 43–72.

Riggs, S.R., Cleary, W.J., Snyder, S.W., 1995. Influence of inherited geologic framework on barrier shoreface morphology and dynamics. Marine Geology 126, 213-234.

Riggs, S.R., Snyder, S.W., Hine, A.C., Mearns, D.L., 1996. Hardbottom Morphology and relationship to the geologic framework; Mid-Atlantic continental shelf. Journal of Sedimentary Research 66(4), 830?846.

Riggs, S.R., Ambrose, W.G., Cook, J.W., Snyder, S.W., 1998. Sediment production on sediment-starved continental margins; the interrelationship between hard- bottoms, sedimentological and benthic community processes, and storm dynamics. Journal of Sedimentary Research 68(1), 155?168.

Rutecki, D., Dellapenna, T., Nestler, E., Scharf, F., Rooker, J., Glass, C., Pembroke, A., 2014. Understanding the Habitat Value and Function of Shoals and Shoal Complexes to Fish and Fisheries on the Atlantic and Gulf of Mexico Outer Continental Shelf. Literature Synthesis and Gap Analysis. Prepared for the U.S. Dept. of the Interior, Bureau of Ocean Energy Management. Contract # M12PS00009. BOEM 2015-012. 176 p.

SAFMC (South Atlantic Fish Manangement Council), 2008a. Comprehensive Ecosystem Based Amendment for the South Atlantic region. SAFMC, Charleston, SC.

Schmid, K., 1996. Sediments associated with mid-shelf hardbottoms in Onslow Bay, North Carolina. Unpublished M.S. thesis. East Carolina University, Greenville, NC., 125 p.

Schumacher, H., and Zubrowius, H., 1985. What is hermatypic? (a redefinition of ecological groups in corals and other organisms): Coral Reefs 4, 1-9.

Schwab, W.C., Thieler, E.R., Allen, J.R., Foster, D.S., Swift, B.A., Denny, J.F., 2000. Influence of inner-continental shelf geologic framework on the evolution and behavior of the barrier island system between Fire Island Inlet and Shinnecock Inlet, Long Island, New York. Journal of Coastal Research 16: 408-422.

Snedden, J.W., Dalrymple, R.W., 1999. Modern shelf sand ridges: from historical perspective to a unified hydrodynamic and evolutionary model, in: Bergman, K.M., and Snedden, J.W. (eds.), Isolated ShallowMarine Sand Bodies: Sequence Stratigraphic Analysis and Sedimentologic Interpretation. SEPM (Society for Sedimentary Geology), Special Publication, 13-28.

Snyder, S.W., Mallette, P.M., Snyder, S.W., Hine A.C., Riggs, S.R., 1988. Overview of seismic stratigraphy and lithofacies relationships in Pungo River Formation sediments of Onslow Bay, North Carolina continental shelf. Cushman Foundation Special Publication No. 25, 1-14.

Snyder, S., Hoffman, C., Riggs, S., 1994. Seismic stratigraphic framework of the inner continental shelf: Mason Inlet to New Inlet, North Carolina. North Carolina Geological Survey Bulletin No. 97, 61 p.

Street, M.W., Deaton, A.S., Chappell, W.S., Mooreside, P.D., 2005. North Carolina Coastal Habitat Protection Plan. North Carolina Department of Environment and Natural Resources, Division of Marine Fisheries, Morehead City, NC.

Stuiver, M., Reimer, P.J., and Reimer, R.W., 2019. CALIB 7.1. http://calib.org, accessed 2019-3-12.

Swift, D., 1976. Continental shelf sedimentation, in: Stanley, D.J., Swift, D.J.P. (Eds.), Marine Sediment Transport and Environmental Management. John Wiley and Sons, New York, p. 311?350.

Thieler, E.R., Pilkey, O.H., Cleary, W.J., Schwab, W.C., 2001. Modern sedimentation on the shoreface and inner continental shelf at Wrightsville Beach, North Carolina, U.S.A. Journal of Sedimentary Research 71 (6), 958?970.

Thieler, E.R., Foster, D.S., Mallinson, D.J., Himmelstoss, E.A., McNinch, J.E., List, J.H., Hammar-Klose, E.S., 2013. Quaternary geophysical framework of the northeastern North Carolina coastal system: U.S. Geological Survey Open-File Report 2011-1015,https://pubs.usgs.gov/of/2011/1015/.

Thieler, E.R., Foster, D.S., Himmelstoss, E.A, Mallinson, D.J., 2014. Geological framework of the northern North Carolina, USA inner continental shelf and its influence on coastal evolution. Marine Geology 348: 113-130.

USACE, 1982. Feasibility Report and Environmental Assessment on Shore and Hurricane Wave Protection, Wrightsville Beach, N.C.: Wilmington, North Carolina: Wilmington District, U.S. Army Corps of Engineers.

USACE, 1993. Beach Erosion Control and Hurricane Wave Protection, Carolina Beach and Vicinity, Area South Project, New Hanover County, North Carolina. Wilmington District U.S. Army Corps of Engineers.

USACE, 2000. Dare County Beaches (Bodie Island Portion), Final Feasibility Report and Environmental Impact Statement on Hurricane Protection and Beach Erosion Control, Volume 1. Wilmington District, U.S. Army Corps of Engineers.

USACE, 2004. Marine Geophysical Investigation for the Evaluation of Sand Resource Areas Offshore Topsail Island North Carolina. Final Report. Contract DACW54-02-D-0006, Delivery Order 0002. Prepared by Greenhorne and OMara, Inc., with consultant Ocean Surveys, Inc., (OSI).

USACE, 2010. Initial Appraisal for Continued Federal Participation, Carolina Beach and Vicinity, Carolina Beach Portion, Coastal Storm Damage Reduction Project, New Hanover County, North Carolina (Section 216). http://www.saw.usace.army.mil/Portals/59/docs/coastal storm _damage _reduction/ carolina%20 beach%20216%20report.pdf.

USACE, 2013. Integrated General Reevaluation Report and Environmental Impact Statement for Brunswick County Beach, North Carolina. Wilmington District, U.S. Army Corps of Engineers.

USACE, 2014. Final Integrated Feasibility Report and Environmental Impact Statement, Coastal Storm Damage Reduction. Bogue Banks, Carteret County, NC.

USACE, 2015a. Supplemental Environmental Impact Statement: Figure Eight Island Shoreline Management Project, Figure Eight Island, North Carolina. Last accessed June 2017 at http://www.saw.usace.army.mil/Missions/Regulatory-Permit-Program/Major-Projects/F8-SEIS/.

USACE, 2015b. Project Update Briefing - Carolina Beach & Vicinity, NC, Coastal Storm Damage Reduction Project. Carolina Beach Town Hall. October 27, 2015. http://www.carolinabeach.org/ hot topics/beach renourishment.php.

USACE. 2017. Website on Coastal Storm Damage Reduction Projects. Last accessed June 2017 at http://www.saw.usace.army.mil/Missions/Coastal-Storm-Damage-Reduction/.

VisitNC. (2017). Economic Impact Studies. Retrieved March 22, 2019, from VisitNC website: https://partners.visitnc.com/economic-impact-studies.

Walsh, J., Conery, I., Mallinson, D., Freeman, 2016a. Synthesis of Geophysical and Geologic Data on the North Carolina Shelf and Future Research Needs, NC-BOEM Cooperative Agreement Technical Report. A Report prepared for the Bureau of Ocean Energy Management (BOEM).

Walsh, J., Conery, I., Gibbons, R., Mallinson, D., Freeman, C., Richardson, K., 2016b. A Re-evaluation of Data and Sand Resource Need, Use, and Availability in Northeastern (Dare County) North Carolina. A Report prepared for the Bureau of Ocean Energy Management (BOEM).

Program for the Study of Developed Shorelines, WCU, 2018. Western Carolina University. Retrieved March 27, 2018, from Beach Nourishment WCU website: http:/beachnourishment.wcu.edu

Wren, P., Leonard, L., 2005. Sediment transport on the mid-continental shelf in Onslow Bay, North Carolina during Hurricane Isabel. Estuarine, Coastal and Shelf Science 63, 43-56. 10.1016/j.ecss.2004. 10.018.

Zaremba, N., Mallinson, D., Leorri, E., Culver, S., Riggs, S., Mulligan, R., Horsman, E., 2016. Controls on the stratigraphic record and paleoenvironmental change within a Holocene estuarine system: Pamlico Sound, North Carolina, USA. Marine Geology 379, 109-123.

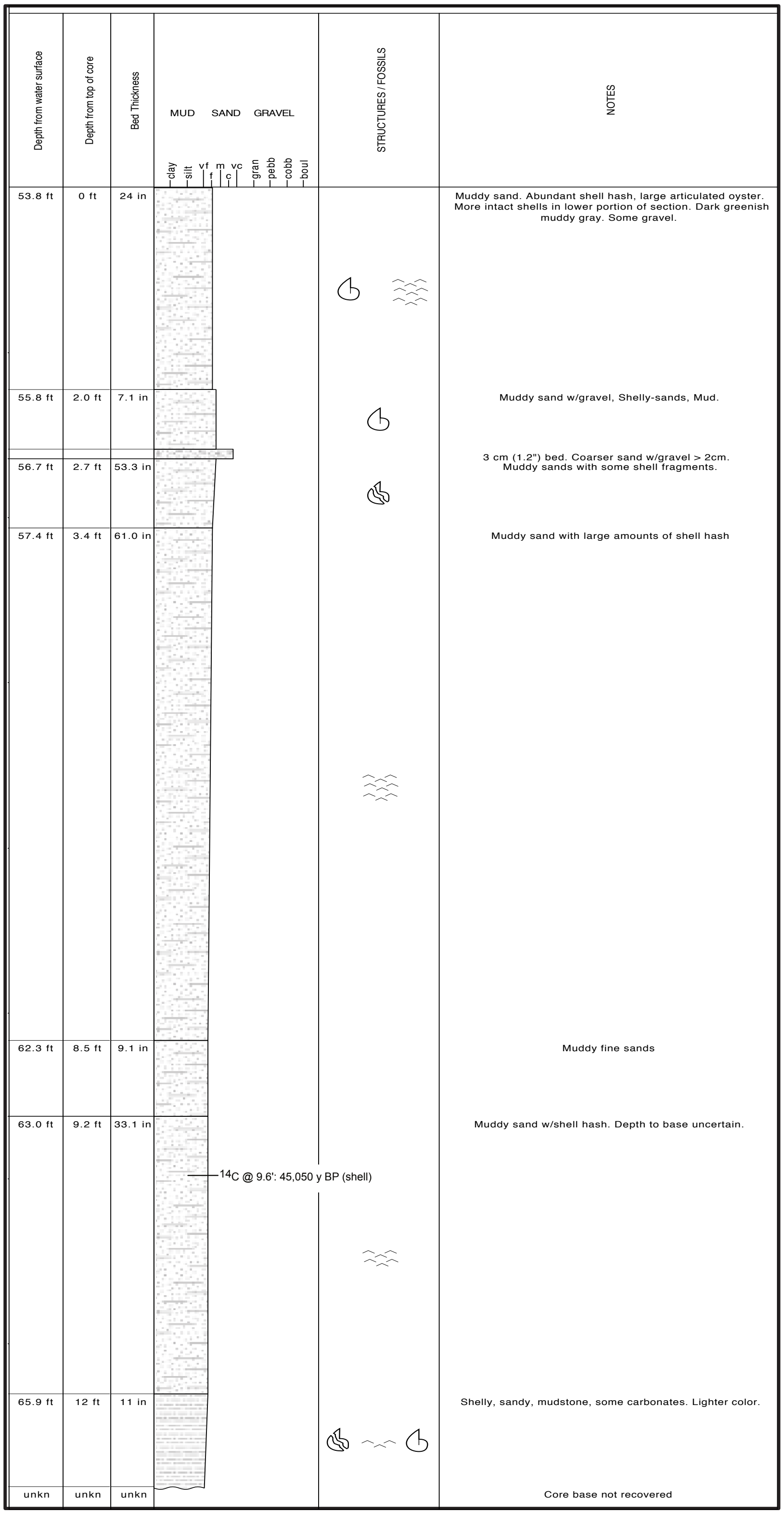
Zarra, Larry, 1991. Subsurface stratigraphic framework for Cenozoic strata in Brunswick and New Hanover Counties, North Carolina: North Carolina Geological Survey Information Circular 27, 1 sheet.

Appendix 1 Vibracore Logs

This appendix contains graphic diagrams detailing the sedimentary and fossiliferous content, characteristics, and selected artifact ages for each of the 24 vibracores collected as part of the study. Included are cores: VC01, VC03, VC04, VC06, VC08, VC09, VC10, VC13, VC15, VC16, VC17, VC18, VC19, VC23, VC24, VC25, VC27, VC28, VC31, VC32, VC33, VC34, VC37, and VC37A. The core log graphics were initially created using the software SedLog[1] with additional work done using Serif Europe's vector design program Affinity Designer.

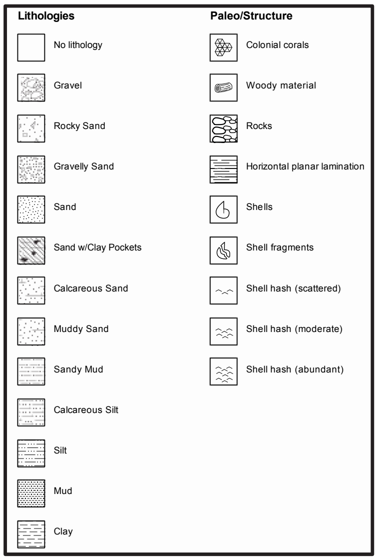
[1] SedLog: a shareware program for drawing graphic logs and log data manipulation", D. Zervas, G.J. Nichols, R. Hall, H.R. Smyth, C. Lthje and F. Murtagh, Computers & Geosciences, 35, 2151-2159, 2009.

NC-BOEM-2015 VC01



Depth from water surface	Depth from top of core	Bed Thickness	NOTES
53.8 ft	0 ft	24 in	Muddy sand. Abundant shell hash, large articulated oyster. More intact shells in lower portion of section. Dark greenish muddy gray. Some gravel.
55.8 ft	2.0 ft	7.1 in	Muddy sand w/gravel, Shelly-sands, Mud.
56.7 ft	2.7 ft	53.3 in	3 cm (1.2") bed. Coarser sand w/gravel > 2cm. Muddy sands with some shell fragments.
57.4 ft	3.4 ft	61.0 in	Muddy sand with large amounts of shell hash
62.3 ft	8.5 ft	9.1 in	Muddy fine sands
63.0 ft	9.2 ft	33.1 in	Muddy sand w/shell hash. Depth to base uncertain.
65.9 ft	12 ft	11 in	Shelly, sandy, mudstone, some carbonates. Lighter color.
unkn	unkn	unkn	Core base not recovered

Core logs created using SedLog™ Software (r3.1). Royal Halloway University of London. 2019.



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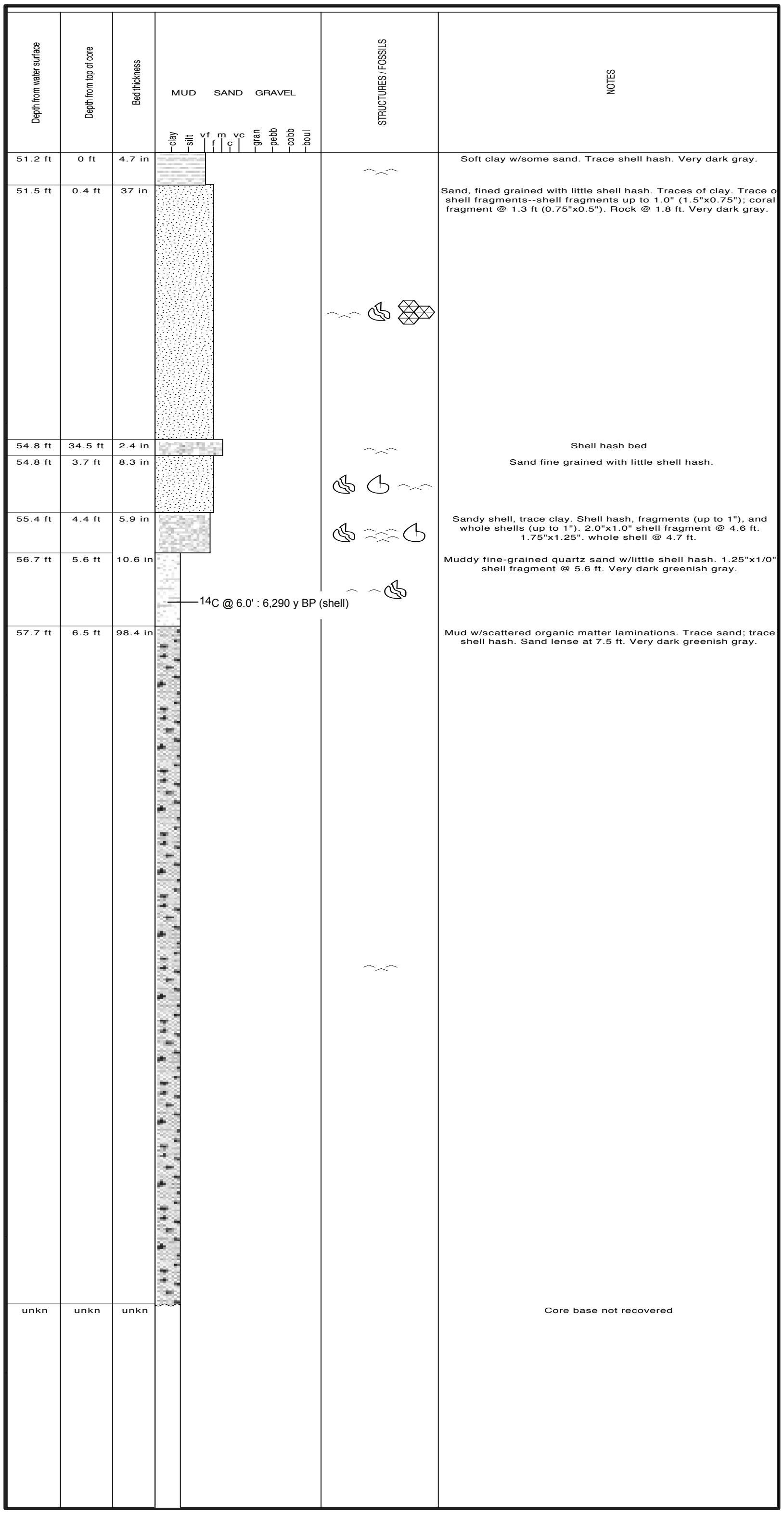
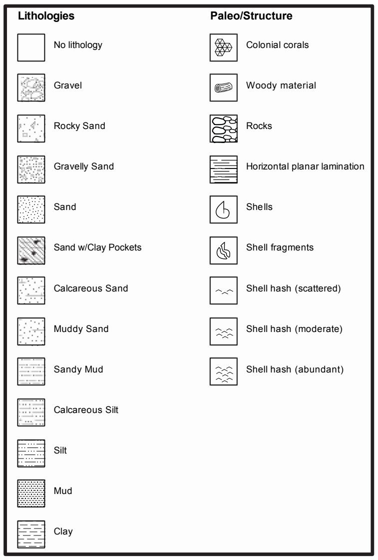
NC-BOEM-2015 VC01

NC-BOEM-2015 VC03



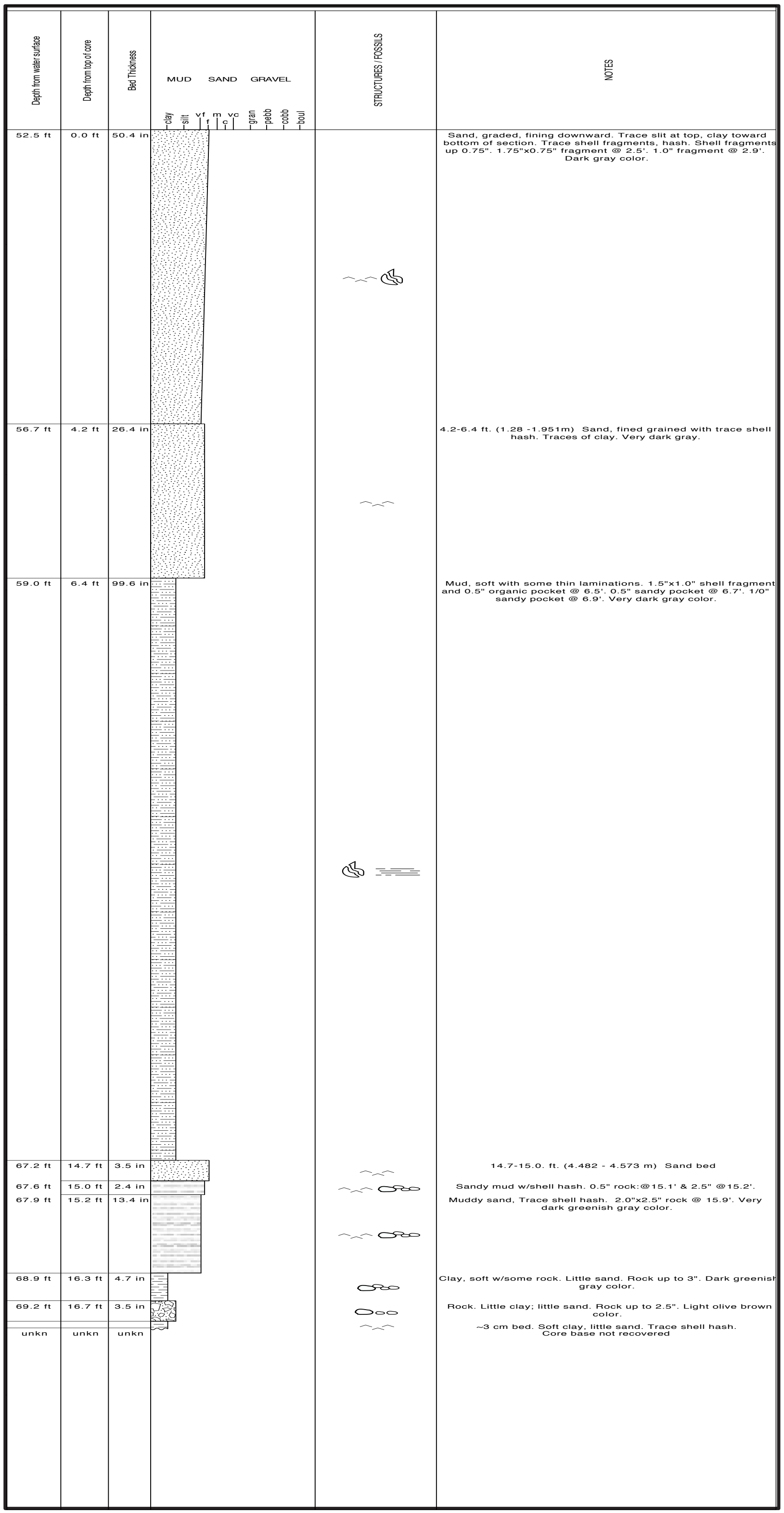
Depth from water surface	Depth from top of core	Bed thickness	NOTES
51.2 ft	0 ft	4.7 in	Soft clay w/some sand. Trace shell hash. Very dark gray.
51.5 ft	0.4 ft	37 in	Sand, fined grained with little shell hash. Traces of clay. Trace o shell fragments--shell fragments up to 1.0" (1.5"x0.75"); coral fragment @ 1.3 ft (0.75"x0.5"). Rock @ 1.8 ft. Very dark gray.
54.8 ft	34.5 ft	2.4 in	Shell hash bed
54.8 ft	3.7 ft	8.3 in	Sand fine grained with little shell hash.
55.4 ft	4.4 ft	5.9 in	Sandy shell, trace clay. Shell hash, fragments (up to 1"), and whole shells (up to 1"). 2.0"x1.0" shell fragment @ 4.6 ft. 1.75"x1.25". whole shell @ 4.7 ft.
56.7 ft	5.6 ft	10.6 in	Muddy fine-grained quartz sand w/little shell hash. 1.25"x1/0" shell fragment @ 5.6 ft. Very dark greenish gray.
57.7 ft	6.5 ft	98.4 in	Mud w/scattered organic matter laminations. Trace sand; trace shell hash. Sand lense at 7.5 ft. Very dark greenish gray.
unkn	unkn	unkn	Core base not recovered

Core logs created using SedLog^{TM} Software (r3.1). Royal Halloway University of London. 2019.

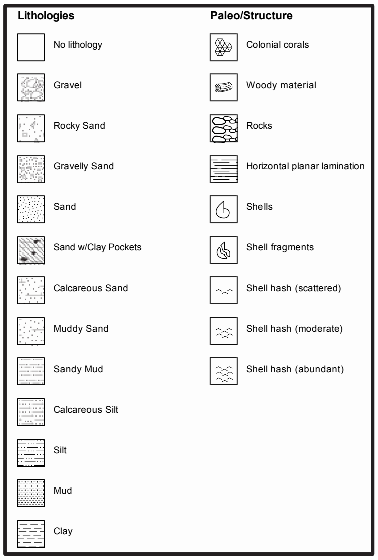


NC-BOEM-2015 VC03

NC-BOEM-2015 VC04



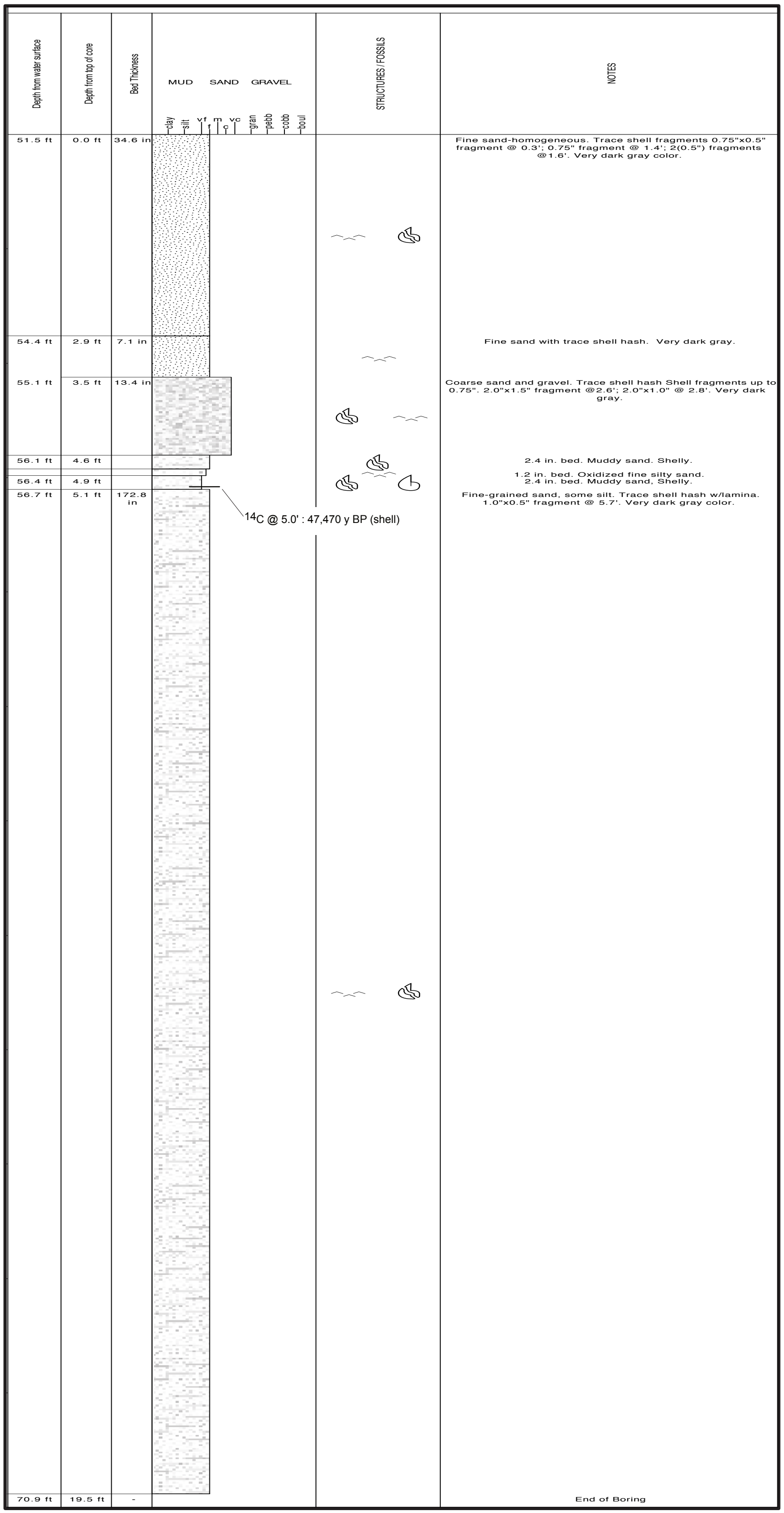
Depth from water surface	Depth from top of core	Bed Thickness	STRUCTURES / FOSSILS	NOTES
52.5 ft	0.0 ft	50.4 in		Sand, graded, fining downward. Trace slit at top, clay toward bottom of section. Trace shell fragments, hash. Shell fragments up 0.75". 1.75"x0.75" fragment @ 2.5'. 1.0" fragment @ 2.9'. Dark gray color.
56.7 ft	4.2 ft	26.4 in		4.2-6.4 ft. (1.28 -1.951m) Sand, fined grained with trace shell hash. Traces of clay. Very dark gray.
59.0 ft	6.4 ft	99.6 in		Mud, soft with some thin laminations. 1.5"x1.0" shell fragment and 0.5" organic pocket @ 6.5'. 0.5" sandy pocket @ 6.7'. 1/0" sandy pocket @ 6.9'. Very dark gray color.
67.2 ft	14.7 ft	3.5 in		14.7-15.0. ft. (4.482 - 4.573 m) Sand bed
67.6 ft	15.0 ft	2.4 in		Sandy mud w/shell hash. 0.5" rock:@15.1' & 2.5" @15.2'.
67.9 ft	15.2 ft	13.4 in		Muddy sand, Trace shell hash. 2.0"x2.5" rock @ 15.9'. Very dark greenish gray color.
68.9 ft	16.3 ft	4.7 in		Clay, soft w/some rock. Little sand. Rock up to 3". Dark greenish gray color.
69.2 ft	16.7 ft	3.5 in		Rock. Little clay; little sand. Rock up to 2.5". Light olive brown color.
				~3 cm bed. Soft clay, little sand. Trace shell hash.
unkn	unkn	unkn		Core base not recovered



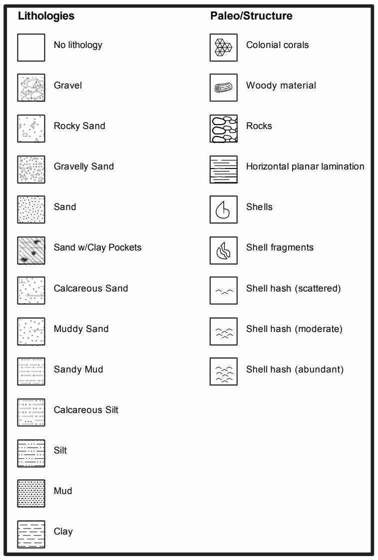
NC-BOEM-2015 VC04

Core logs created using SedLog^{TM} Software (r3.1). Royal Halloway University of London. 2019.

NC-BOEM-2015 VC06



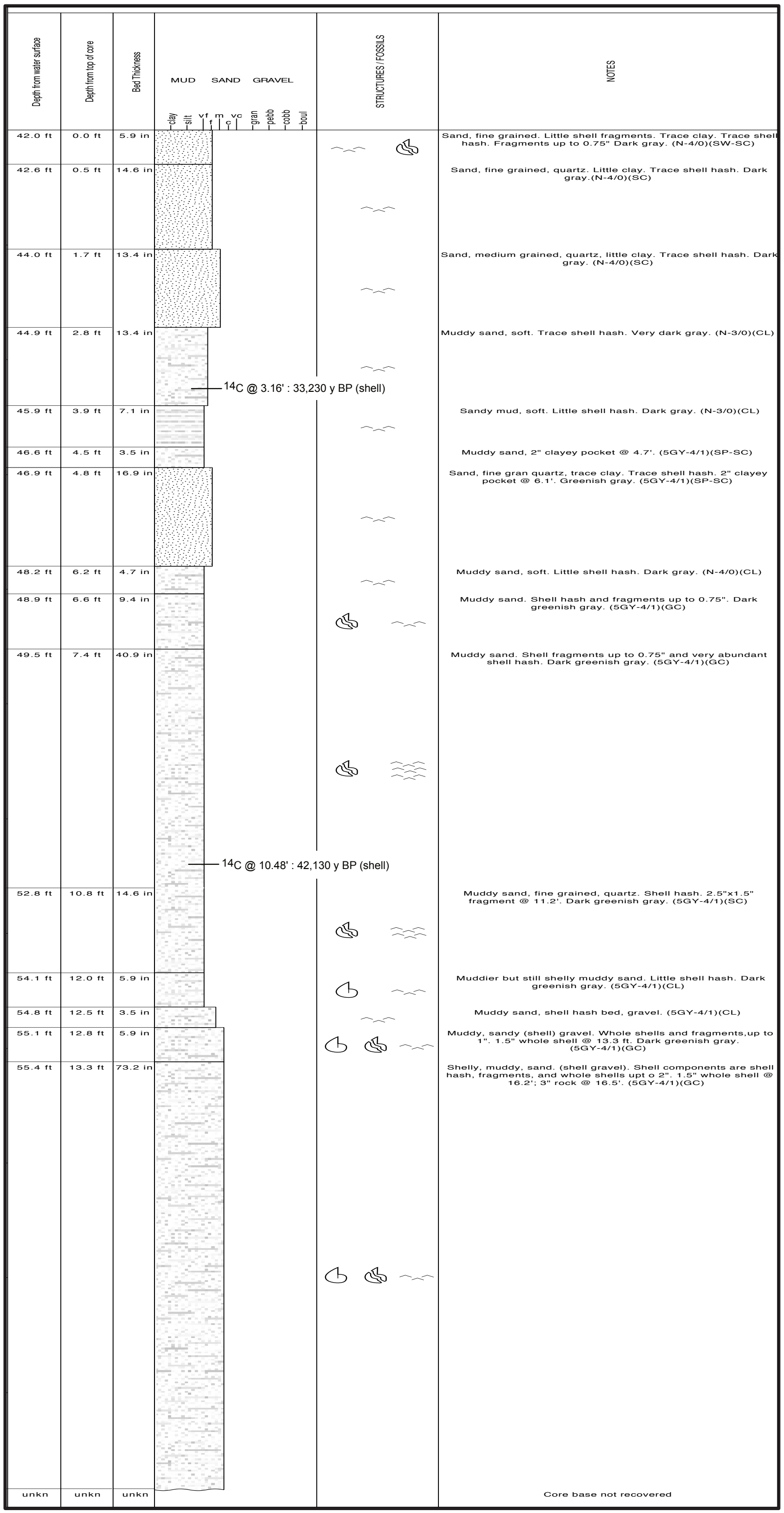
Depth from water surface	Depth from top of core	Bed Thickness	NOTES
51.5 ft	0.0 ft	34.6 in	Fine sand-homogeneous. Trace shell fragments 0.75"x0.5" fragment @ 0.3'; 0.75" fragment @ 1.4'; 2(0.5") fragments @1.6'. Very dark gray color.
54.4 ft	2.9 ft	7.1 in	Fine sand with trace shell hash. Very dark gray.
55.1 ft	3.5 ft	13.4 in	Coarse sand and gravel. Trace shell hash Shell fragments up to 0.75". 2.0"x1.5" fragment @2.6'; 2.0"x1.0" @ 2.8'. Very dark gray.
56.1 ft	4.6 ft		2.4 in. bed. Muddy sand. Shelly.
			1.2 in. bed. Oxidized fine silty sand.
56.4 ft	4.9 ft		2.4 in. bed. Muddy sand, Shelly.
56.7 ft	5.1 ft	172.8 in	Fine-grained sand, some silt. Trace shell hash w/lamina. 1.0"x0.5" fragment @ 5.7'. Very dark gray color.
70.9 ft	19.5 ft	-	End of Boring



Core logs created using SedLog^{TM} Software (r3.1). Royal Halloway University of London. 2019.

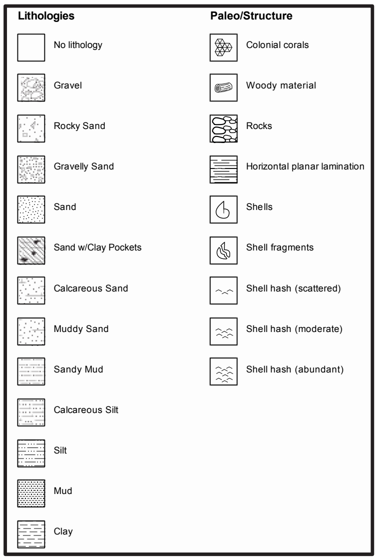
NC-BOEM-2015 VC06

NC-BOEM-2015 VC08



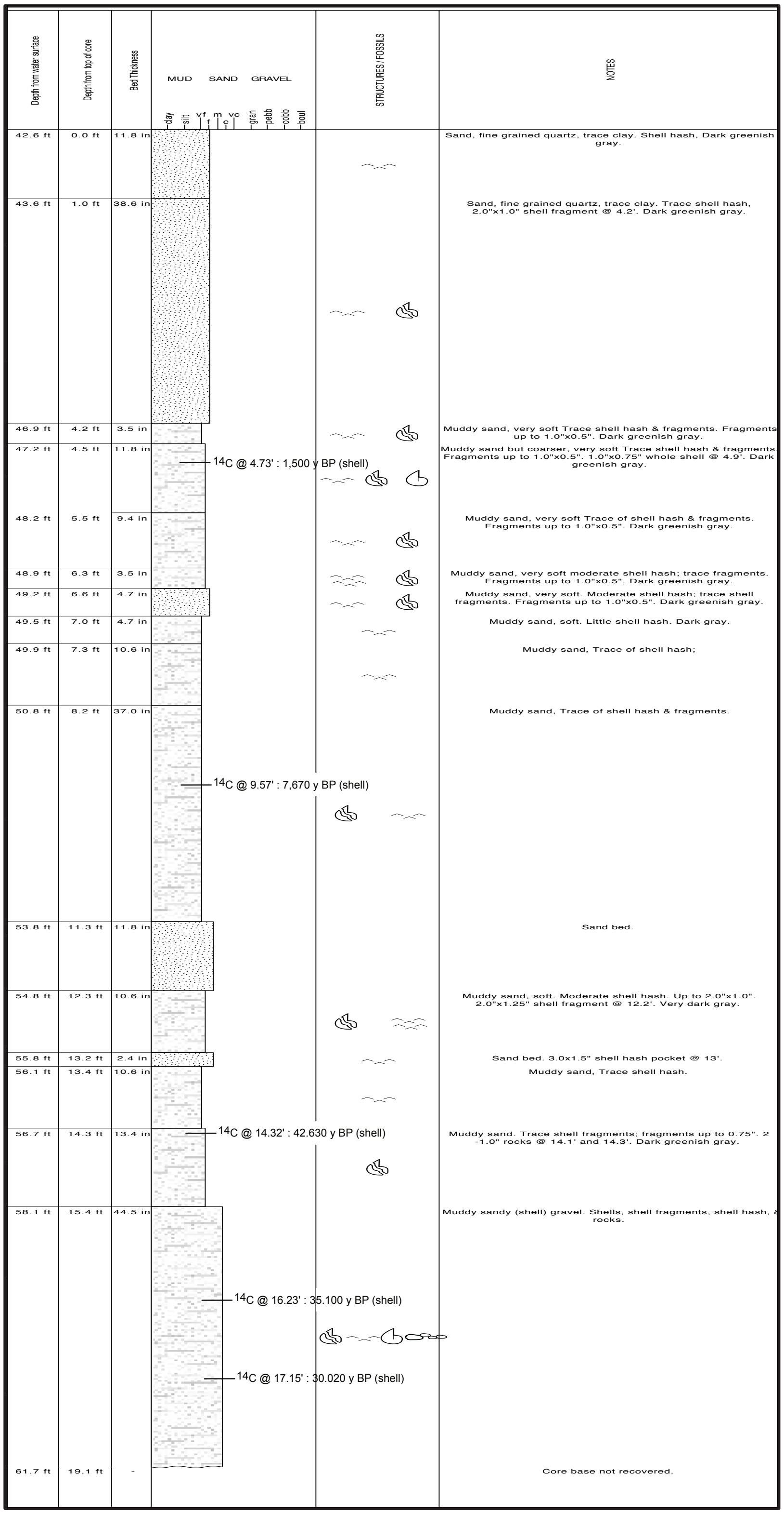
Depth from water surface	Depth from top of core	Bed Thickness	NOTES
42.0 ft	0.0 ft	5.9 in	Sand, fine grained. Little shell fragments. Trace clay. Trace shell hash. Fragments up to 0.75" Dark gray. (N-4/0)(SW-SC)
42.6 ft	0.5 ft	14.6 in	Sand, fine grained, quartz. Little clay. Trace shell hash. Dark gray.(N-4/0)(SC)
44.0 ft	1.7 ft	13.4 in	Sand, medium grained, quartz, little clay. Trace shell hash. Dark gray. (N-4/0)(SC)
44.9 ft	2.8 ft	13.4 in	Muddy sand, soft. Trace shell hash. Very dark gray. (N-3/0)(CL)
45.9 ft	3.9 ft	7.1 in	Sandy mud, soft. Little shell hash. Dark gray. (N-3/0)(CL)
46.6 ft	4.5 ft	3.5 in	Muddy sand, 2" clayey pocket @ 4.7'. (5GY-4/1)(SP-SC)
46.9 ft	4.8 ft	16.9 in	Sand, fine gran quartz, trace clay. Trace shell hash. 2" clayey pocket @ 6.1'. Greenish gray. (5GY-4/1)(SP-SC)
48.2 ft	6.2 ft	4.7 in	Muddy sand, soft. Little shell hash. Dark gray. (N-4/0)(CL)
48.9 ft	6.6 ft	9.4 in	Muddy sand. Shell hash and fragments up to 0.75". Dark greenish gray. (5GY-4/1)(GC)
49.5 ft	7.4 ft	40.9 in	Muddy sand. Shell fragments up to 0.75" and very abundant shell hash. Dark greenish gray. (5GY-4/1)(GC)
52.8 ft	10.8 ft	14.6 in	Muddy sand, fine grained, quartz. Shell hash. 2.5"x1.5" fragment @ 11.2'. Dark greenish gray. (5GY-4/1)(SC)
54.1 ft	12.0 ft	5.9 in	Muddier but still shelly muddy sand. Little shell hash. Dark greenish gray. (5GY-4/1)(CL)
54.8 ft	12.5 ft	3.5 in	Muddy sand, shell hash bed, gravel. (5GY-4/1)(CL)
55.1 ft	12.8 ft	5.9 in	Muddy, sandy (shell) gravel. Whole shells and fragments,up to 1". 1.5" whole shell @ 13.3 ft. Dark greenish gray. (5GY-4/1)(GC)
55.4 ft	13.3 ft	73.2 in	Shelly, muddy, sand. (shell gravel). Shell components are shell hash, fragments, and whole shells upt o 2". 1.5" whole shell @ 16.2'; 3" rock @ 16.5'. (5GY-4/1)(GC)
unkn	unkn	unkn	Core base not recovered

Core logs created using SedLog^{TM} Software (r3.1). Royal Halloway University of London. 2019.



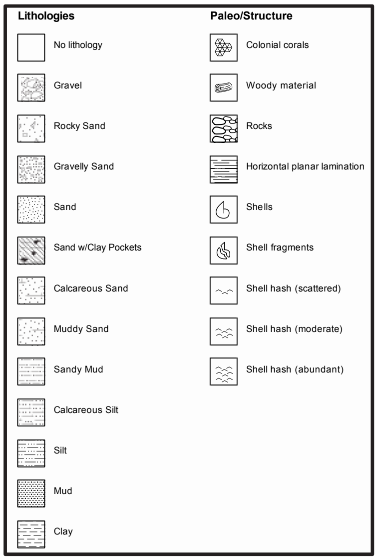
NC-BOEM-2015 VC08

NC-BOEM-2015 VC09



Depth from water surface	Depth from top of core	Bed Thickness	NOTES
42.6 ft	0.0 ft	11.8 in	Sand, fine grained quartz, trace clay. Shell hash, Dark greenish gray.
43.6 ft	1.0 ft	38.6 in	Sand, fine grained quartz, trace clay. Trace shell hash, 2.0"x1.0" shell fragment @ 4.2'. Dark greenish gray.
46.9 ft	4.2 ft	3.5 in	Muddy sand, very soft Trace shell hash & fragments. Fragments up to 1.0"x0.5". Dark greenish gray.
47.2 ft	4.5 ft	11.8 in	Muddy sand but coarser, very soft Trace shell hash & fragments. Fragments up to 1.0"x0.5". 1.0"x0.75" whole shell @ 4.9'. Dark greenish gray.
48.2 ft	5.5 ft	9.4 in	Muddy sand, very soft Trace of shell hash & fragments. Fragments up to 1.0"x0.5". Dark greenish gray.
48.9 ft	6.3 ft	3.5 in	Muddy sand, very soft moderate shell hash; trace fragments. Fragments up to 1.0"x0.5". Dark greenish gray.
49.2 ft	6.6 ft	4.7 in	Muddy sand, very soft. Moderate shell hash; trace shell fragments. Fragments up to 1.0"x0.5". Dark greenish gray.
49.5 ft	7.0 ft	4.7 in	Muddy sand, soft. Little shell hash. Dark gray.
49.9 ft	7.3 ft	10.6 in	Muddy sand, Trace of shell hash;
50.8 ft	8.2 ft	37.0 in	Muddy sand, Trace of shell hash & fragments.
53.8 ft	11.3 ft	11.8 in	Sand bed.
54.8 ft	12.3 ft	10.6 in	Muddy sand, soft. Moderate shell hash. Up to 2.0"x1.0". 2.0"x1.25" shell fragment @ 12.2'. Very dark gray.
55.8 ft	13.2 ft	2.4 in	Sand bed. 3.0x1.5" shell hash pocket @ 13'.
56.1 ft	13.4 ft	10.6 in	Muddy sand, Trace shell hash.
56.7 ft	14.3 ft	13.4 in	Muddy sand. Trace shell fragments; fragments up to 0.75". 2 -1.0" rocks @ 14.1' and 14.3'. Dark greenish gray.
58.1 ft	15.4 ft	44.5 in	Muddy sandy (shell) gravel. Shells, shell fragments, shell hash, & rocks.
61.7 ft	19.1 ft	-	Core base not recovered.

Core logs created using SedLog^{TM} Software (r3.1). Royal Halloway University of London. 2019.



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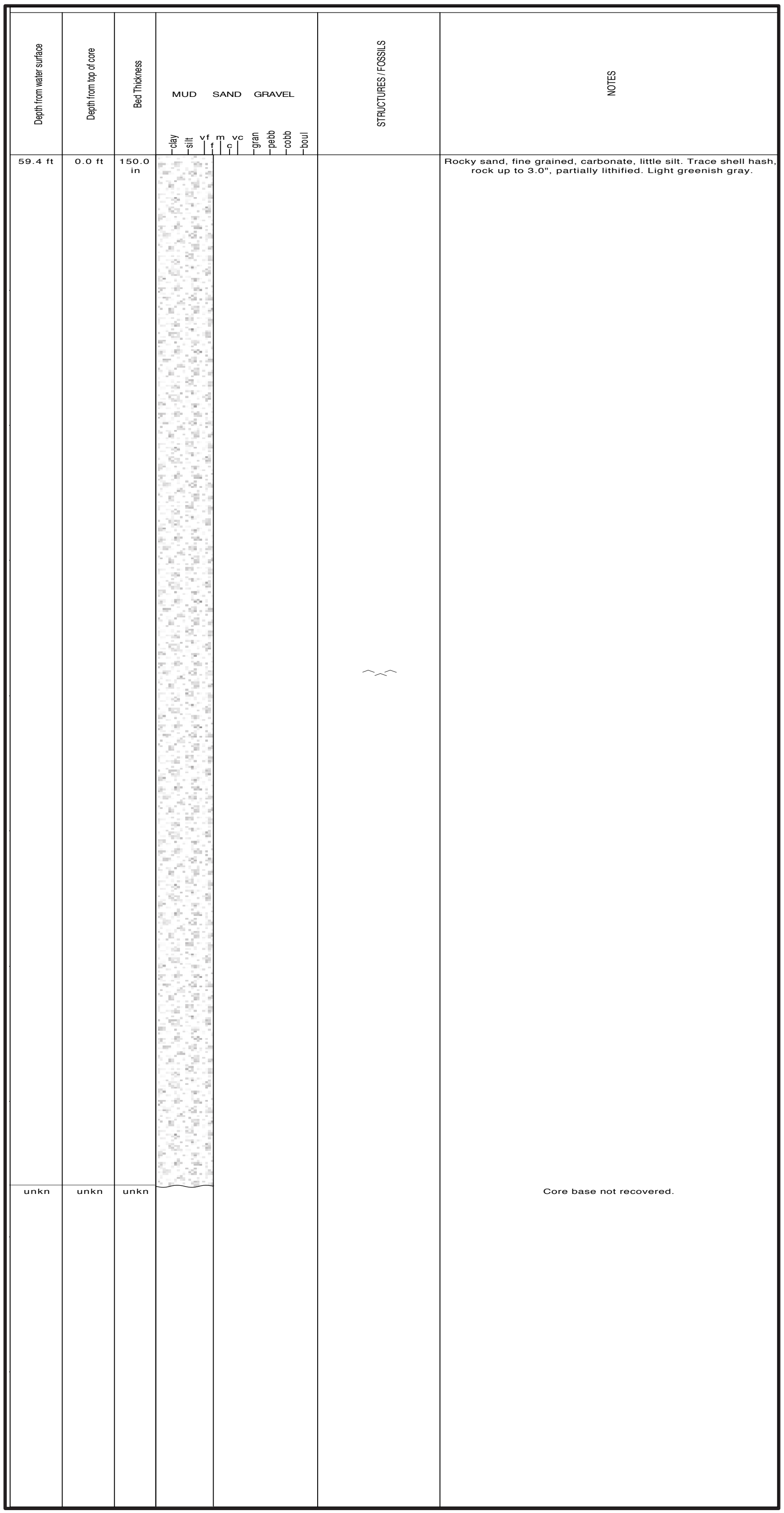
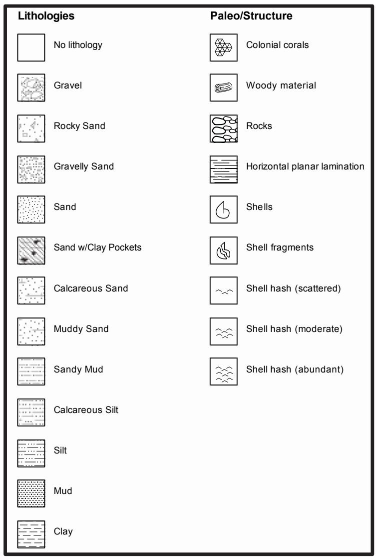
NC-BOEM-2015 VC10



Rocky sand, fine grained, carbonate, little silt. Trace shell hash, rock up to 3.0", partially lithified. Light greenish gray.

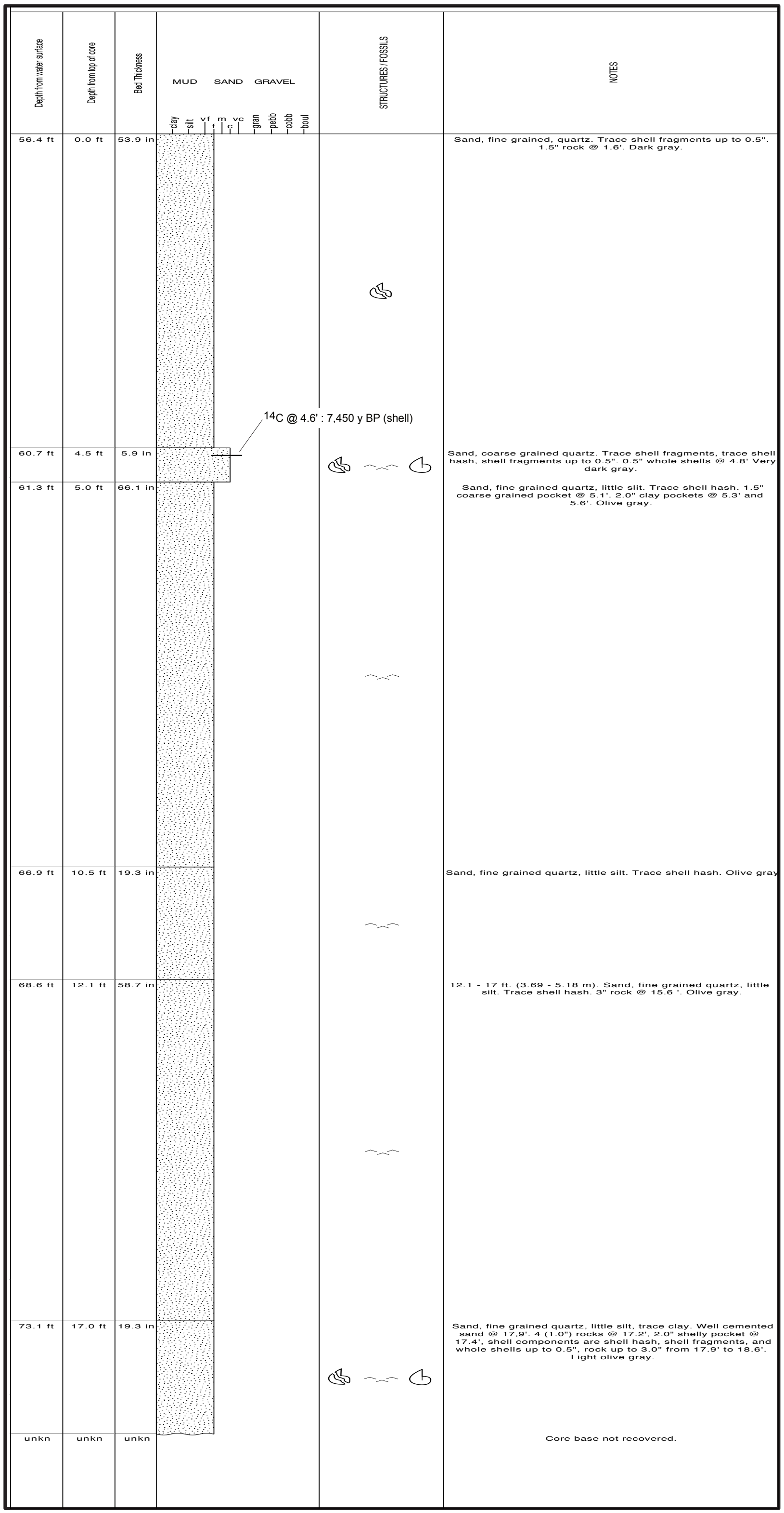
Core base not recovered.



NC-BOEM-2015 VC10

Core logs created using SedLog^{TM} Software (r3.1). Royal Halloway University of London. 2019.

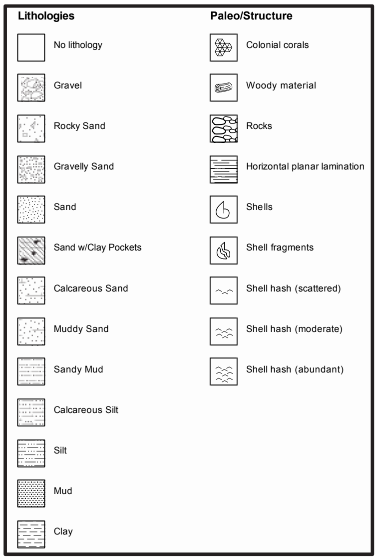
NC-BOEM-2015 VC13



^{14}C @ 4.6' : 7,450 y BP (shell)

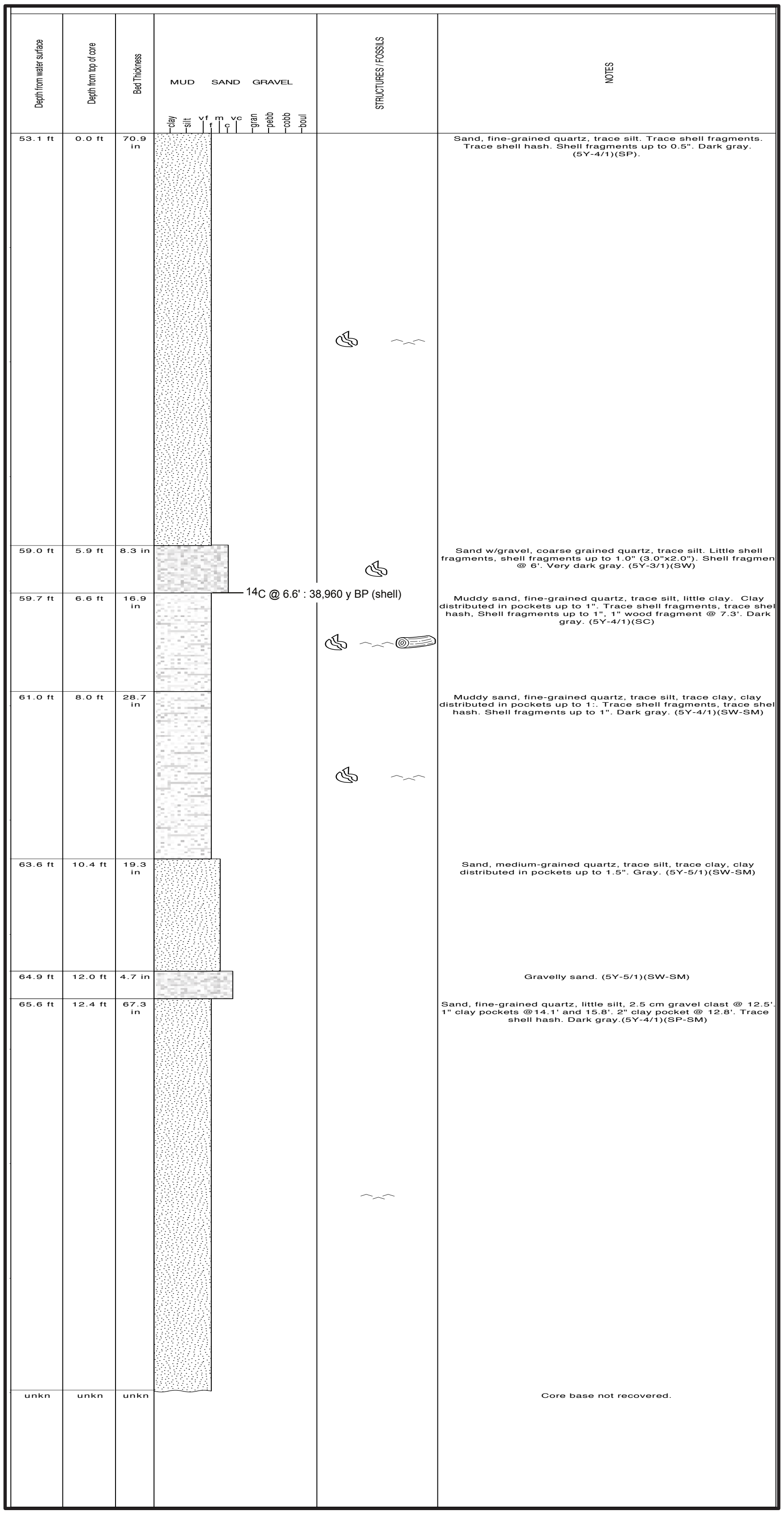
Depth from water surface	Depth from top of core	Bed Thickness	NOTES
56.4 ft	0.0 ft	53.9 in	Sand, fine grained, quartz. Trace shell fragments up to 0.5". 1.5" rock @ 1.6'. Dark gray.
60.7 ft	4.5 ft	5.9 in	Sand, coarse grained quartz. Trace shell fragments, trace shell hash, shell fragments up to 0.5". 0.5" whole shells @ 4.8' Very dark gray.
61.3 ft	5.0 ft	66.1 in	Sand, fine grained quartz, little slit. Trace shell hash. 1.5" coarse grained pocket @ 5.1'. 2.0" clay pockets @ 5.3' and 5.6'. Olive gray.
66.9 ft	10.5 ft	19.3 in	Sand, fine grained quartz, little silt. Trace shell hash. Olive gray
68.6 ft	12.1 ft	58.7 in	12.1 - 17 ft. (3.69 - 5.18 m). Sand, fine grained quartz, little silt. Trace shell hash. 3" rock @ 15.6 '. Olive gray.
73.1 ft	17.0 ft	19.3 in	Sand, fine grained quartz, little silt, trace clay. Well cemented sand @ 17,9'. 4 (1.0") rocks @ 17.2', 2.0" shelly pocket @ 17.4', shell components are shell hash, shell fragments, and whole shells up to 0.5", rock up to 3.0" from 17.9' to 18.6'. Light olive gray.
unkn	unkn	unkn	Core base not recovered.

Core logs created using SedLog™ Software (r3.1). Royal Halloway University of London. 2019.



NC-BOEM-2015 VC13

NC-BOEM-2015 VC15



Depth from water surface	Depth from top of core	Bed Thickness	NOTES
53.1 ft	0.0 ft	70.9 in	Sand, fine-grained quartz, trace silt. Trace shell fragments. Trace shell hash. Shell fragments up to 0.5". Dark gray. (5Y-4/1)(SP).
59.0 ft	5.9 ft	8.3 in	Sand w/gravel, coarse grained quartz, trace silt. Little shell fragments, shell fragments up to 1.0" (3.0"x2.0"). Shell fragmen @ 6'. Very dark gray. (5Y-3/1)(SW)
59.7 ft	6.6 ft	16.9 in	Muddy sand, fine-grained quartz, trace silt, little clay. Clay distributed in pockets up to 1". Trace shell fragments, trace shel hash, Shell fragments up to 1", 1" wood fragment @ 7.3'. Dark gray. (5Y-4/1)(SC)
61.0 ft	8.0 ft	28.7 in	Muddy sand, fine-grained quartz, trace silt, trace clay, clay distributed in pockets up to 1:. Trace shell fragments, trace shel hash. Shell fragments up to 1". Dark gray. (5Y-4/1)(SW-SM)
63.6 ft	10.4 ft	19.3 in	Sand, medium-grained quartz, trace silt, trace clay, clay distributed in pockets up to 1.5". Gray. (5Y-5/1)(SW-SM)
64.9 ft	12.0 ft	4.7 in	Gravelly sand. (5Y-5/1)(SW-SM)
65.6 ft	12.4 ft	67.3 in	Sand, fine-grained quartz, little silt, 2.5 cm gravel clast @ 12.5'. 1" clay pockets @14.1' and 15.8'. 2" clay pocket @ 12.8'. Trace shell hash. Dark gray.(5Y-4/1)(SP-SM)
unkn	unkn	unkn	Core base not recovered.

^{14}C @ 6.6' : 38,960 y BP (shell)

Core logs created using SedLog^{TM} Software (r3.1). Royal Halloway University of London. 2019.

Lithologies	Paleo/Structure
No lithology	Colonial corals
Gravel	Woody material
Rocky Sand	Rocks
Gravelly Sand	Horizontal planar lamination
Sand	Shells
Sand w/Clay Pockets	Shell fragments
Calcareous Sand	Shell hash (scattered)
Muddy Sand	Shell hash (moderate)
Sandy Mud	Shell hash (abundant)
Calcareous Silt	
Silt	
Mud	
Clay	

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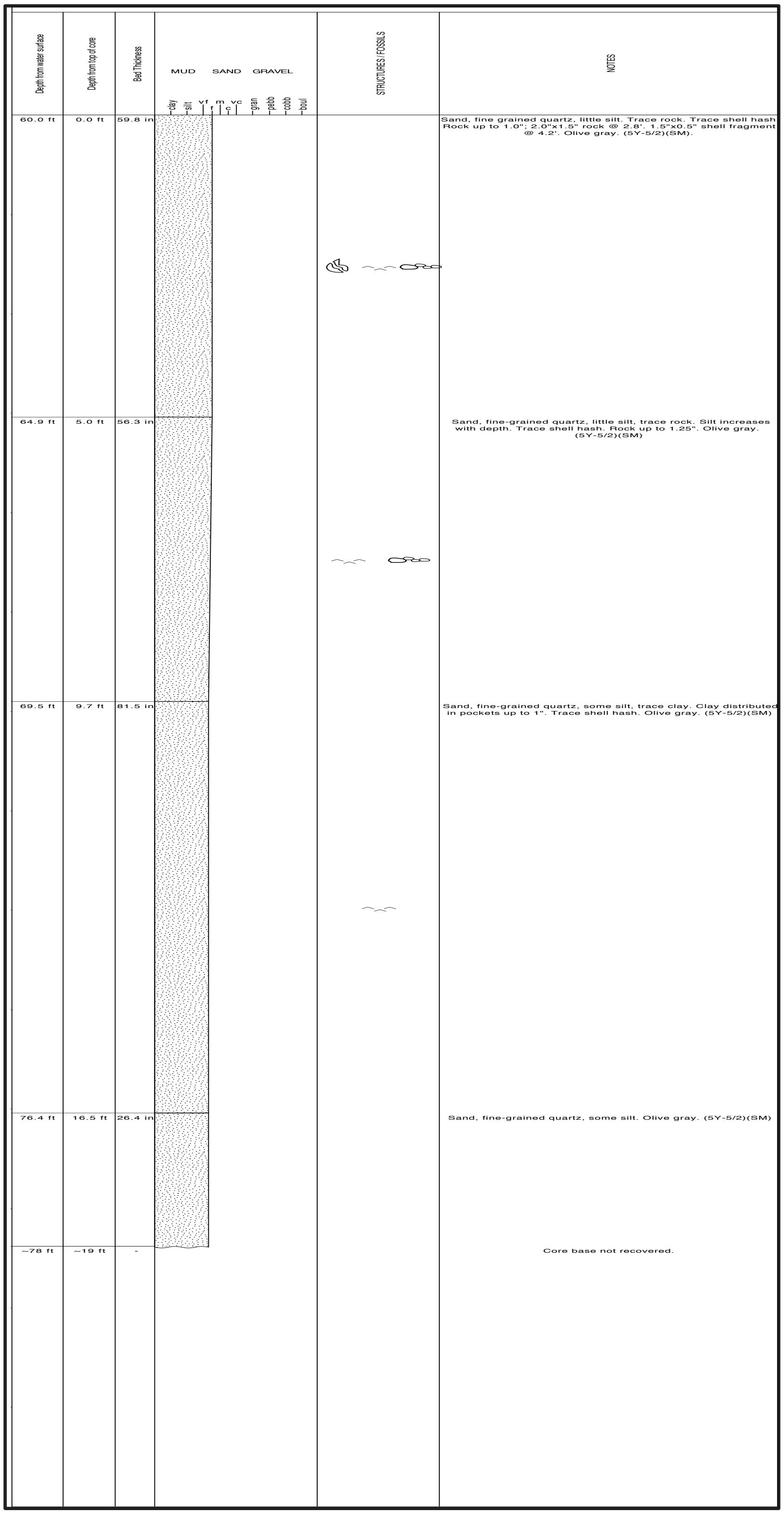
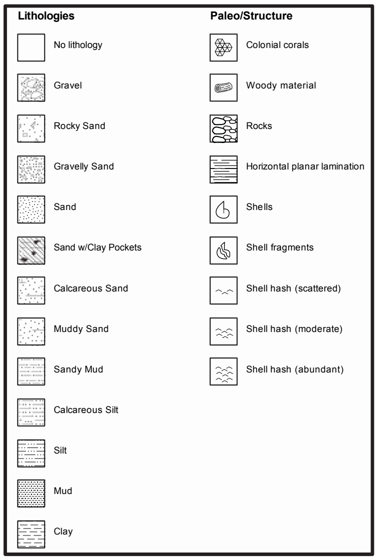
NC-BOEM-2015 VC15

NC-BOEM-2015 VC16



Core logs created using SedLog^{TM} Software (r3.1). Royal Halloway University of London. 2019.



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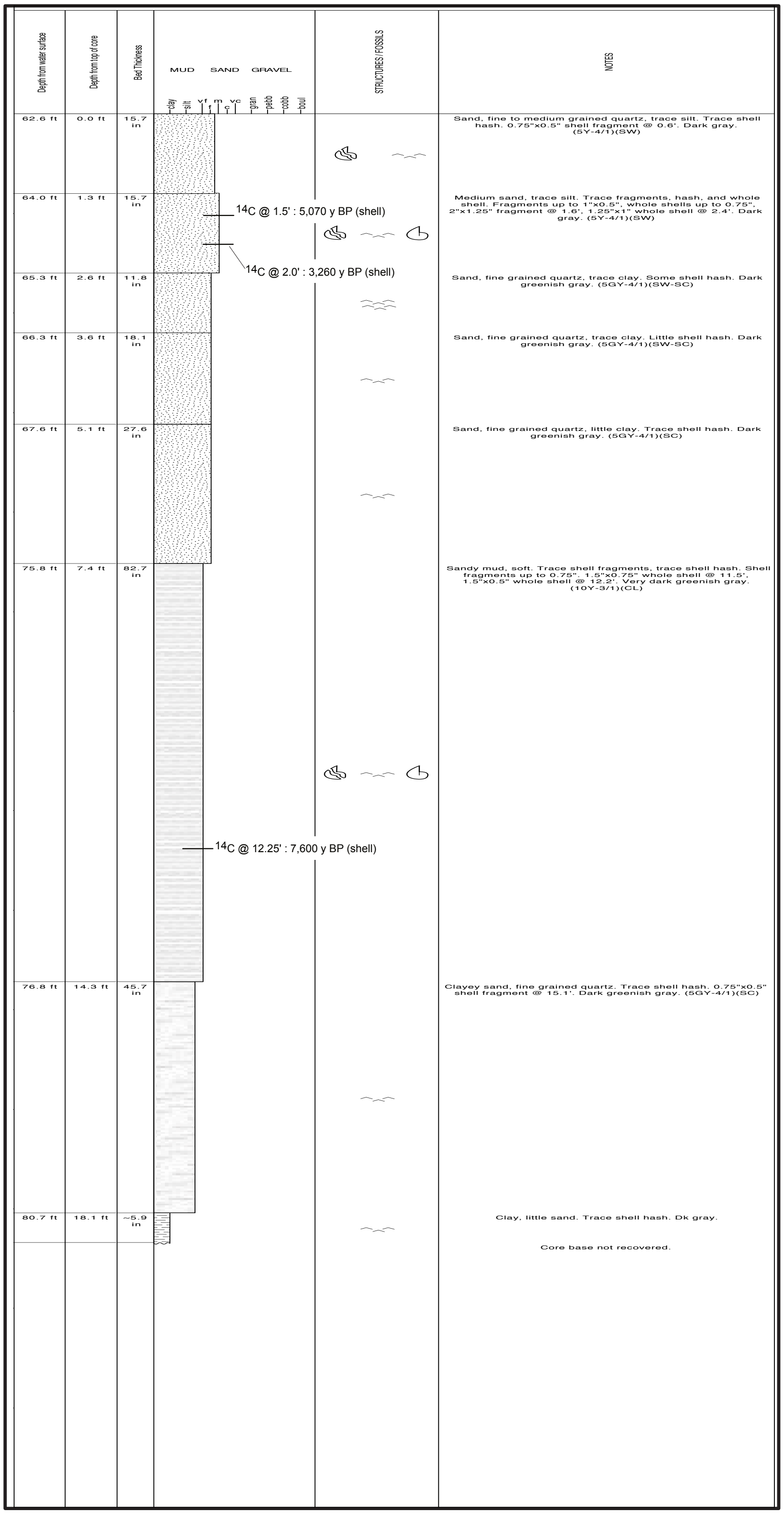
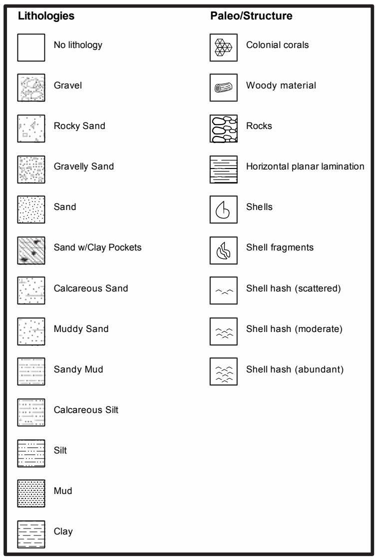
NC-BOEM-2015 VC16

NC-BOEM-2015 VC17



Depth from water surface	Depth from top of core	Bed Thickness	NOTES
62.6 ft	0.0 ft	15.7 in	Sand, fine to medium grained quartz, trace silt. Trace shell hash. 0.75"x0.5" shell fragment @ 0.6'. Dark gray. (5Y-4/1)(SW)
64.0 ft	1.3 ft	15.7 in	Medium sand, trace silt. Trace fragments, hash, and whole shell. Fragments up to 1"x0.5", whole shells up to 0.75", 2"x1.25" fragment @ 1.6', 1.25"x1" whole shell @ 2.4'. Dark gray. (5Y-4/1)(SW)
65.3 ft	2.6 ft	11.8 in	Sand, fine grained quartz, trace clay. Some shell hash. Dark greenish gray. (5GY-4/1)(SW-SC)
66.3 ft	3.6 ft	18.1 in	Sand, fine grained quartz, trace clay. Little shell hash. Dark greenish gray. (5GY-4/1)(SW-SC)
67.6 ft	5.1 ft	27.6 in	Sand, fine grained quartz, little clay. Trace shell hash. Dark greenish gray. (5GY-4/1)(SC)
75.8 ft	7.4 ft	82.7 in	Sandy mud, soft. Trace shell fragments, trace shell hash. Shell fragments up to 0.75". 1.5"x0.75" whole shell @ 11.5', 1.5"x0.5" whole shell @ 12.2'. Very dark greenish gray. (10Y-3/1)(CL)
76.8 ft	14.3 ft	45.7 in	Clayey sand, fine grained quartz. Trace shell hash. 0.75"x0.5" shell fragment @ 15.1'. Dark greenish gray. (5GY-4/1)(SC)
80.7 ft	18.1 ft	~5.9 in	Clay, little sand. Trace shell hash. Dk gray. Core base not recovered.

Core logs created using SedLog^{TM} Software (r3.1). Royal Halloway University of London. 2019.



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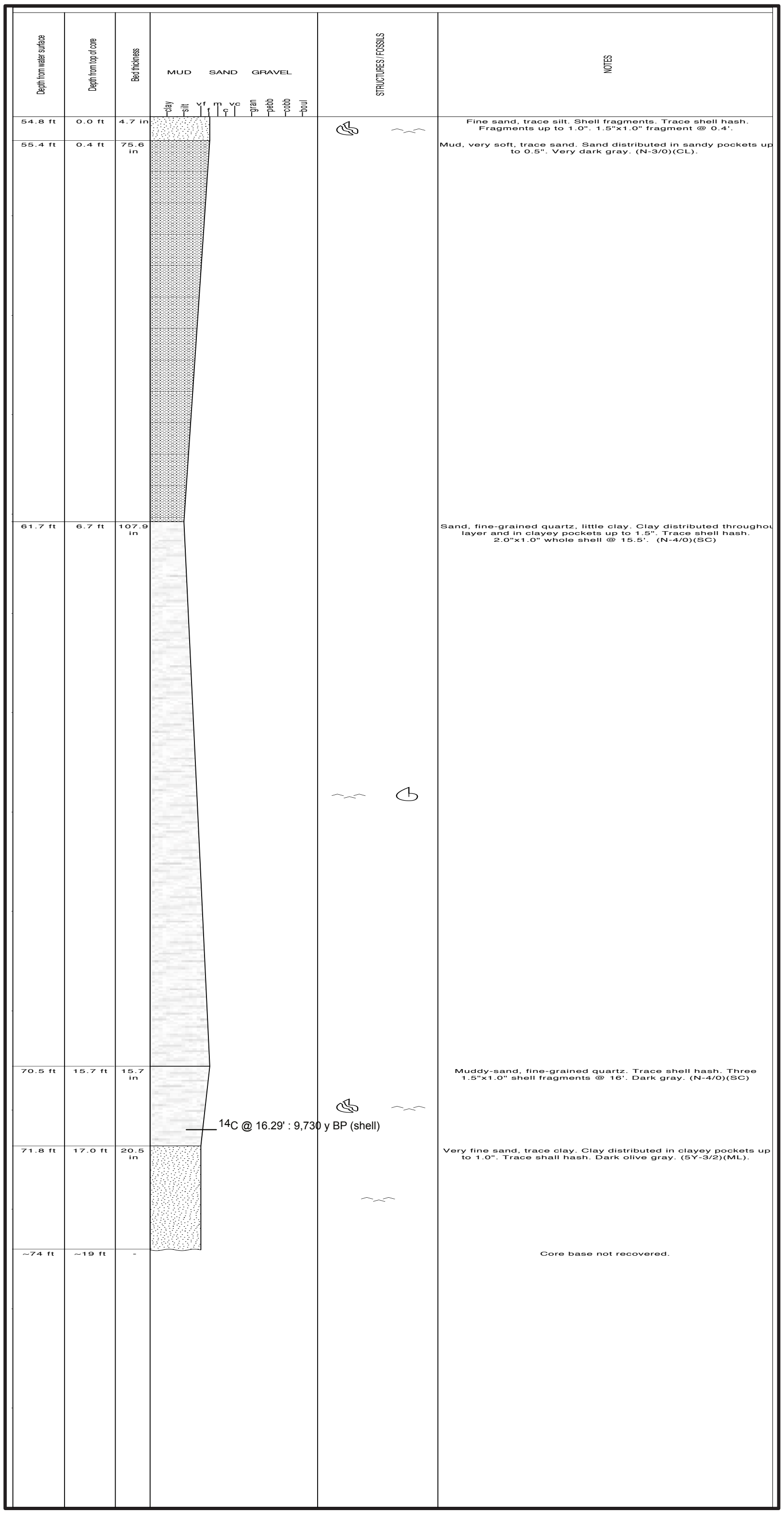
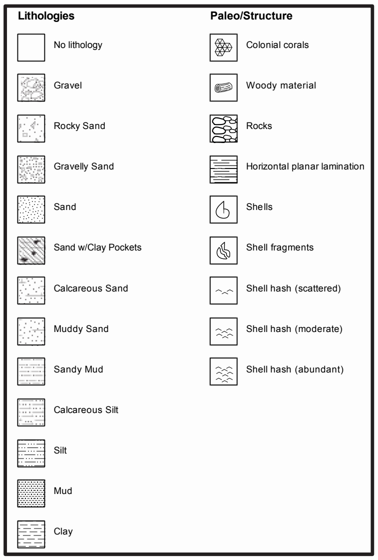
NC-BOEM-2015 VC17

NC-BOEM-2015 VC18



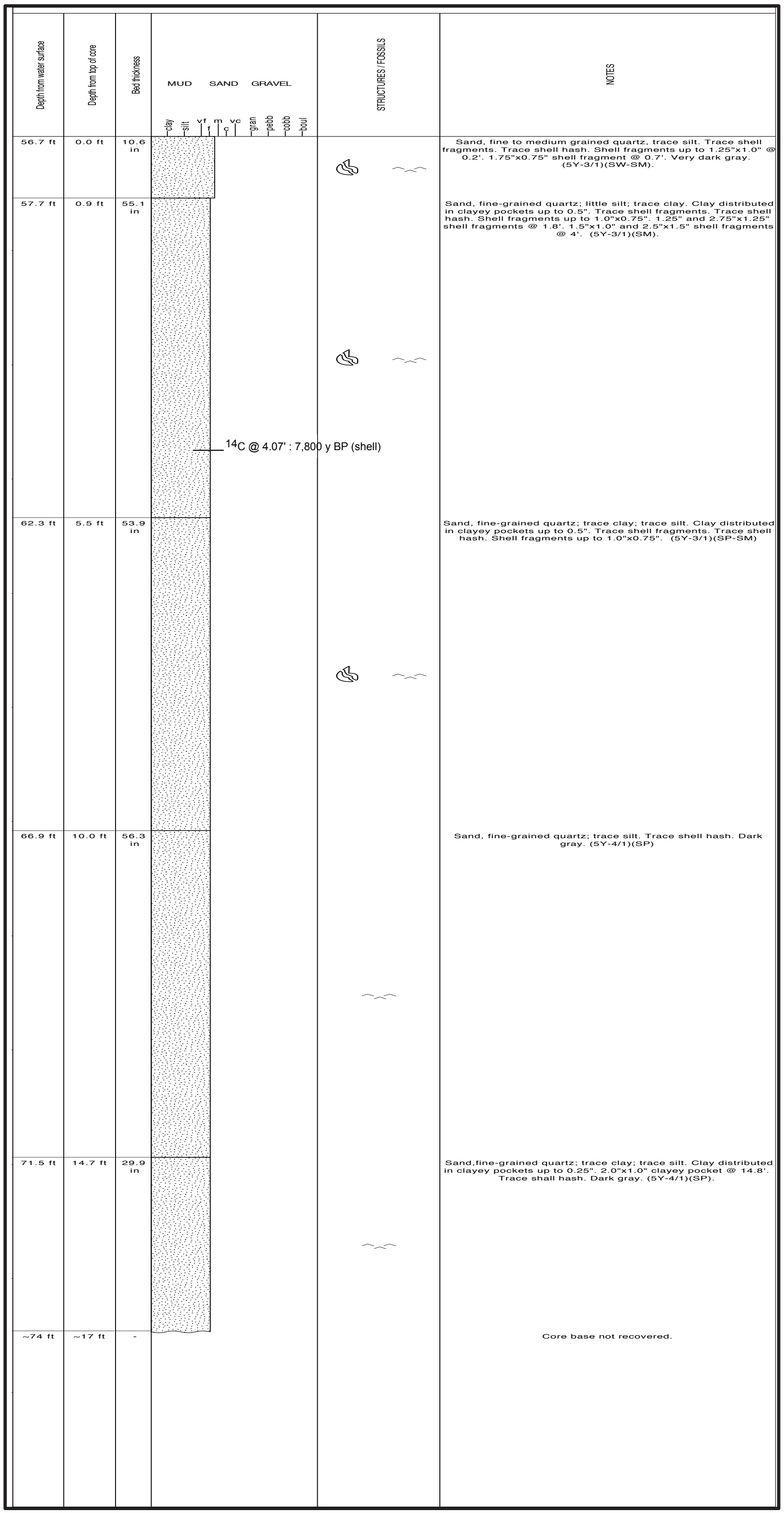
Depth from water surface	Depth from top of core	Bed thickness	NOTES
54.8 ft	0.0 ft	4.7 in	Fine sand, trace silt. Shell fragments. Trace shell hash. Fragments up to 1.0". 1.5"x1.0" fragment @ 0.4'.
55.4 ft	0.4 ft	75.6 in	Mud, very soft, trace sand. Sand distributed in sandy pockets up to 0.5". Very dark gray. (N-3/0)(CL).
61.7 ft	6.7 ft	107.9 in	Sand, fine-grained quartz, little clay. Clay distributed throughou layer and in clayey pockets up to 1.5". Trace shell hash. 2.0"x1.0" whole shell @ 15.5'. (N-4/0)(SC)
70.5 ft	15.7 ft	15.7 in	Muddy-sand, fine-grained quartz. Trace shell hash. Three 1.5"x1.0" shell fragments @ 16'. Dark gray. (N-4/0)(SC)
71.8 ft	17.0 ft	20.5 in	Very fine sand, trace clay. Clay distributed in clayey pockets up to 1.0". Trace shall hash. Dark olive gray. (5Y-3/2)(ML).
~74 ft	~19 ft	-	Core base not recovered.



Core logs created using SedLog™ Software (r3.1). Royal Halloway University of London. 2019.

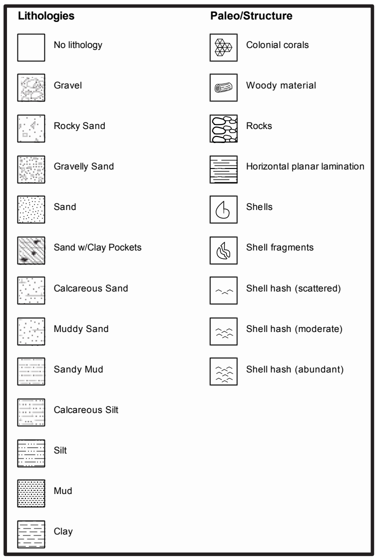
NC-BOEM-2015 VC18

NC-BOEM-2015 VC19



Depth from water surface	Depth from top of core	Bed thickness	NOTES
56.7 ft	0.0 ft	10.6 in	Sand, fine to medium grained quartz, trace silt. Trace shell fragments. Trace shell hash. Shell fragments up to 1.25"x1.0" @ 0.2'. 1.75"x0.75" shell fragment @ 0.7'. Very dark gray. (5Y-3/1)(SW-SM).
57.7 ft	0.9 ft	55.1 in	Sand, fine-grained quartz; little silt; trace clay. Clay distributed in clayey pockets up to 0.5". Trace shell fragments. Trace shell hash. Shell fragments up to 1.0"x0.75". 1.25" and 2.75"x1.25" shell fragments @ 1.8'. 1.5"x1.0" and 2.5"x1.5" shell fragments @ 4'. (5Y-3/1)(SM).
62.3 ft	5.5 ft	53.9 in	Sand, fine-grained quartz; trace clay; trace silt. Clay distributed in clayey pockets up to 0.5". Trace shell fragments. Trace shell hash. Shell fragments up to 1.0"x0.75". (5Y-3/1)(SP-SM)
66.9 ft	10.0 ft	56.3 in	Sand, fine-grained quartz; trace silt. Trace shell hash. Dark gray. (5Y-4/1)(SP)
71.5 ft	14.7 ft	29.9 in	Sand,fine-grained quartz; trace clay; trace silt. Clay distributed in clayey pockets up to 0.25". 2.0"x1.0" clayey pocket @ 14.8'. Trace shall hash. Dark gray. (5Y-4/1)(SP).
~74 ft	~17 ft	-	Core base not recovered.

Core logs created using SedLog^{TM} Software (r3.1). Royal Halloway University of London. 2019.



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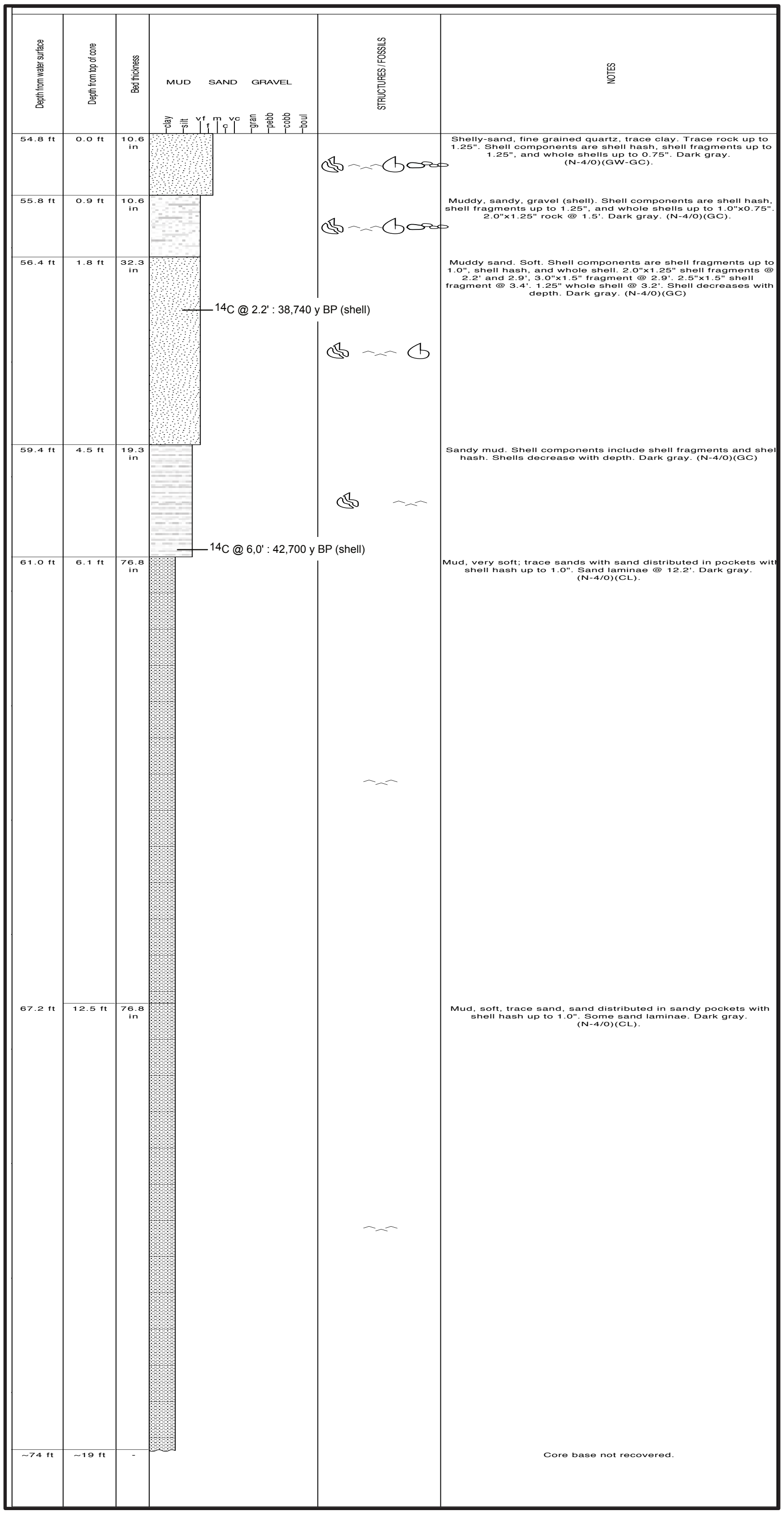
NC-BOEM-2015 VC19

NC-BOEM-2015 VC23



Depth from water surface	Depth from top of core	Bed thickness	NOTES
54.8 ft	0.0 ft	10.6 in	Shelly-sand, fine grained quartz, trace clay. Trace rock up to 1.25". Shell components are shell hash, shell fragments up to 1.25", and whole shells up to 0.75". Dark gray. (N-4/0)(GW-GC).
55.8 ft	0.9 ft	10.6 in	Muddy, sandy, gravel (shell). Shell components are shell hash, shell fragments up to 1.25", and whole shells up to 1.0"x0.75". 2.0"x1.25" rock @ 1.5'. Dark gray. (N-4/0)(GC).
56.4 ft	1.8 ft	32.3 in	Muddy sand. Soft. Shell components are shell fragments up to 1.0", shell hash, and whole shell. 2.0"x1.25" shell fragments @ 2.2' and 2.9', 3.0"x1.5" fragment @ 2.9'. 2.5"x1.5" shell fragment @ 3.4'. 1.25" whole shell @ 3.2'. Shell decreases with depth. Dark gray. (N-4/0)(GC)
59.4 ft	4.5 ft	19.3 in	Sandy mud. Shell components include shell fragments and shel hash. Shells decrease with depth. Dark gray. (N-4/0)(GC)
61.0 ft	6.1 ft	76.8 in	Mud, very soft; trace sands with sand distributed in pockets wit shell hash up to 1.0". Sand laminae @ 12.2'. Dark gray. (N-4/0)(CL).
67.2 ft	12.5 ft	76.8 in	Mud, soft, trace sand, sand distributed in sandy pockets with shell hash up to 1.0". Some sand laminae. Dark gray. (N-4/0)(CL).
~74 ft	~19 ft	-	Core base not recovered.

Core logs created using SedLog^{TM} Software (r3.1). Royal Halloway University of London. 2019.

Lithologies	**Paleo/Structure**
No lithology	Colonial corals
Gravel	Woody material
Rocky Sand	Rocks
Gravelly Sand	Horizontal planar lamination
Sand	Shells
Sand w/Clay Pockets	Shell fragments
Calcareous Sand	Shell hash (scattered)
Muddy Sand	Shell hash (moderate)
Sandy Mud	Shell hash (abundant)
Calcareous Silt	
Silt	
Mud	
Clay	

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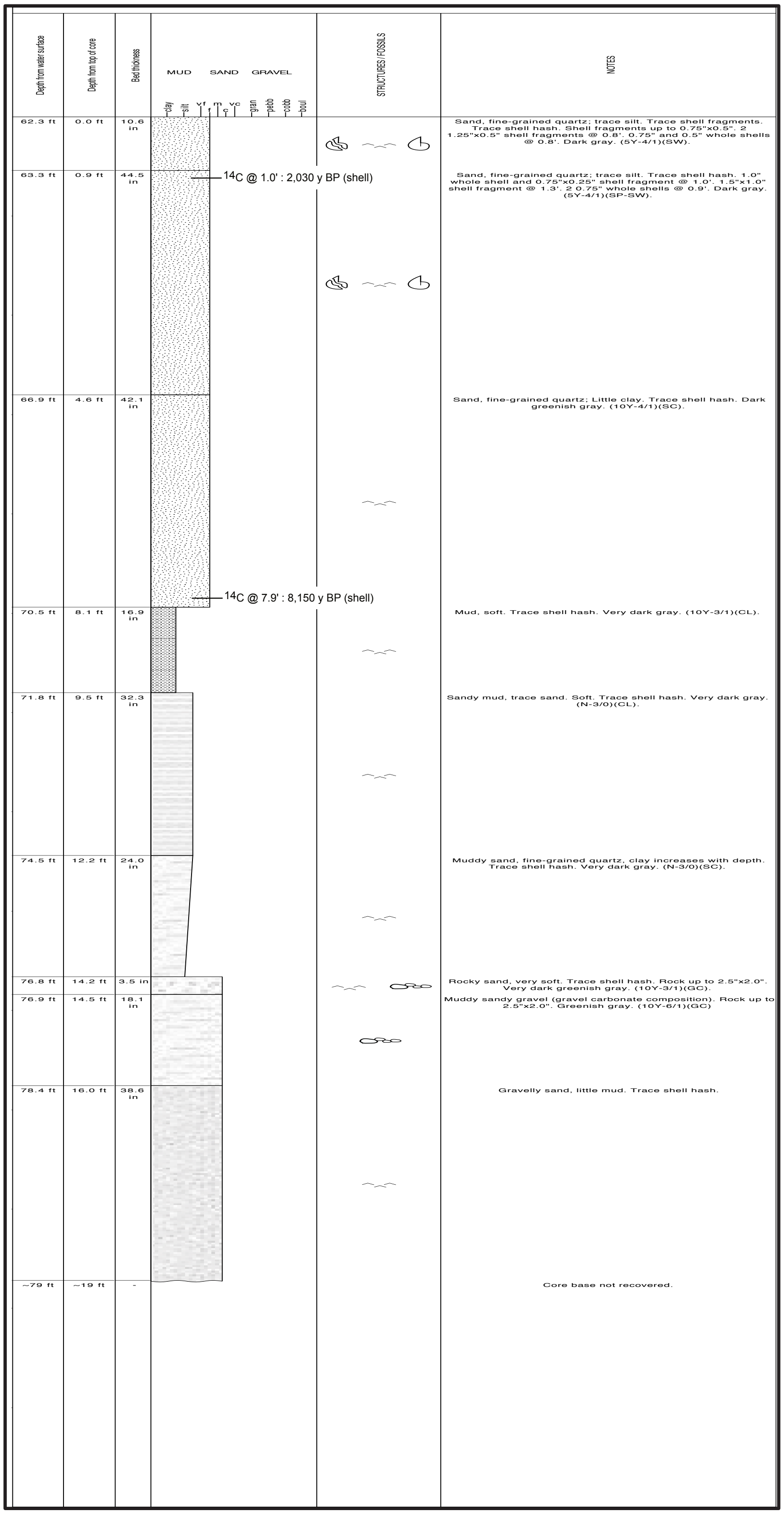
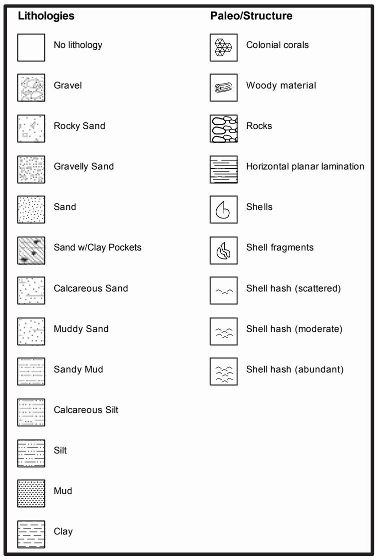
NC-BOEM-2015 VC23

NC-BOEM-2015 VC24



Depth from water surface	Depth from top of core	Bed thickness	NOTES
62.3 ft	0.0 ft	10.6 in	Sand, fine-grained quartz; trace silt. Trace shell fragments. Trace shell hash. Shell fragments up to 0.75"x0.5". 2 1.25"x0.5" shell fragments @ 0.8'. 0.75" and 0.5" whole shells @ 0.8'. Dark gray. (5Y-4/1)(SW).
63.3 ft	0.9 ft	44.5 in	Sand, fine-grained quartz; trace silt. Trace shell hash. 1.0" whole shell and 0.75"x0.25" shell fragment @ 1.0'. 1.5"x1.0" shell fragment @ 1.3'. 2 0.75" whole shells @ 0.9'. Dark gray. (5Y-4/1)(SP-SW).
66.9 ft	4.6 ft	42.1 in	Sand, fine-grained quartz; Little clay. Trace shell hash. Dark greenish gray. (10Y-4/1)(SC).
70.5 ft	8.1 ft	16.9 in	Mud, soft. Trace shell hash. Very dark gray. (10Y-3/1)(CL).
71.8 ft	9.5 ft	32.3 in	Sandy mud, trace sand. Soft. Trace shell hash. Very dark gray. (N-3/0)(CL).
74.5 ft	12.2 ft	24.0 in	Muddy sand, fine-grained quartz, clay increases with depth. Trace shell hash. Very dark gray. (N-3/0)(SC).
76.8 ft	14.2 ft	3.5 in	Rocky sand, very soft. Trace shell hash. Rock up to 2.5"x2.0". Very dark greenish gray. (10Y-3/1)(GC).
76.9 ft	14.5 ft	18.1 in	Muddy sandy gravel (gravel carbonate composition). Rock up to 2.5"x2.0". Greenish gray. (10Y-6/1)(GC)
78.4 ft	16.0 ft	38.6 in	Gravelly sand, little mud. Trace shell hash.
~79 ft	~19 ft	-	Core base not recovered.



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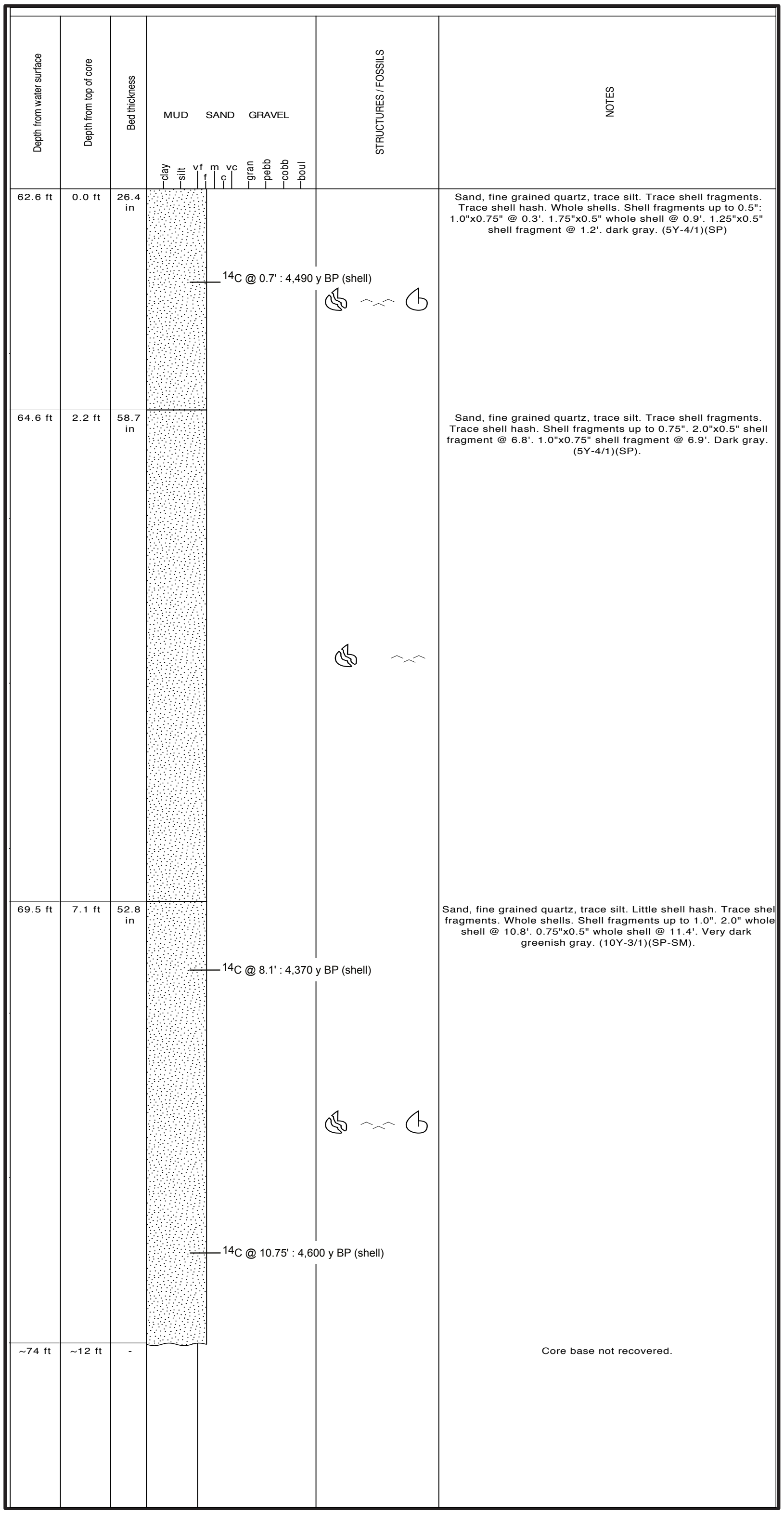
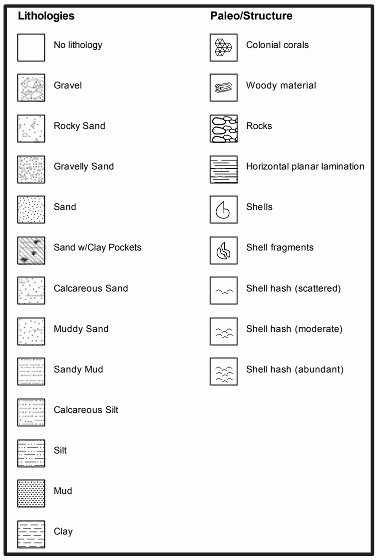
Core logs created using SedLog^{TM} Software (r3.1). Royal Halloway University of London. 2019.

NC-BOEM-2015 VC25



Depth from water surface	Depth from top of core	Bed thickness	NOTES
62.6 ft	0.0 ft	26.4 in	Sand, fine grained quartz, trace silt. Trace shell fragments. Trace shell hash. Whole shells. Shell fragments up to 0.5": 1.0"x0.75" @ 0.3'. 1.75"x0.5" whole shell @ 0.9'. 1.25"x0.5" shell fragment @ 1.2'. dark gray. (5Y-4/1)(SP)
64.6 ft	2.2 ft	58.7 in	Sand, fine grained quartz, trace silt. Trace shell fragments. Trace shell hash. Shell fragments up to 0.75". 2.0"x0.5" shell fragment @ 6.8'. 1.0"x0.75" shell fragment @ 6.9'. Dark gray. (5Y-4/1)(SP).
69.5 ft	7.1 ft	52.8 in	Sand, fine grained quartz, trace silt. Little shell hash. Trace shel fragments. Whole shells. Shell fragments up to 1.0". 2.0" whole shell @ 10.8'. 0.75"x0.5" whole shell @ 11.4'. Very dark greenish gray. (10Y-3/1)(SP-SM).
~74 ft	~12 ft	-	Core base not recovered.



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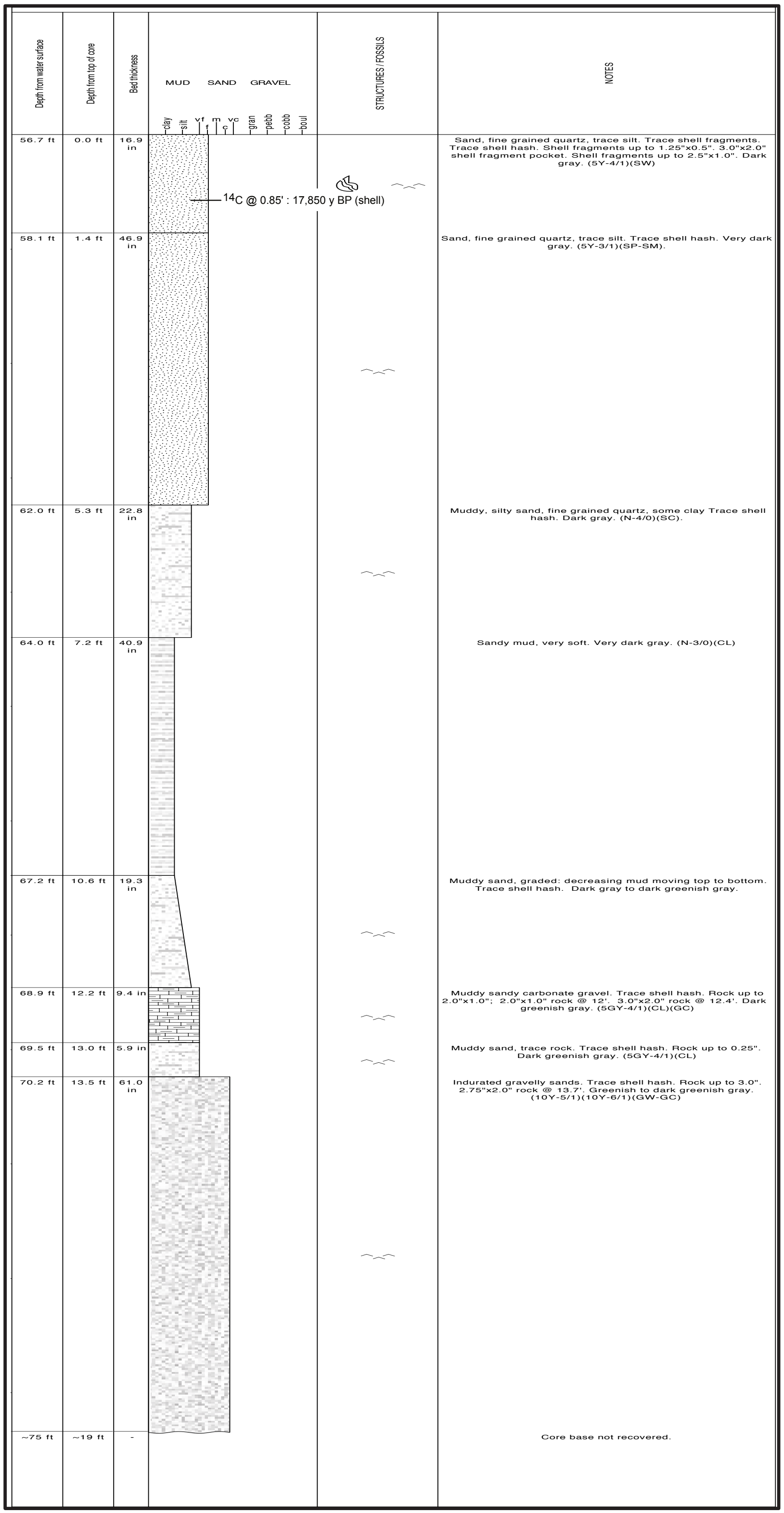
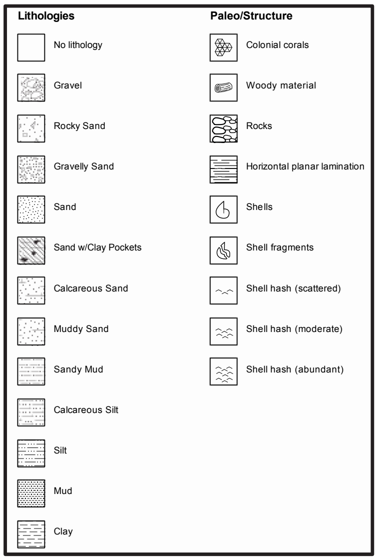
Core logs created using SedLog™ Software (r3.1). Royal Halloway University of London. 2019.

NC-BOEM-2015 VC27



Depth from water surface	Depth from top of core	Bed thickness	NOTES
56.7 ft	0.0 ft	16.9 in	Sand, fine grained quartz, trace silt. Trace shell fragments. Trace shell hash. Shell fragments up to 1.25"x0.5". 3.0"x2.0" shell fragment pocket. Shell fragments up to 2.5"x1.0". Dark gray. (5Y-4/1)(SW)
58.1 ft	1.4 ft	46.9 in	Sand, fine grained quartz, trace silt. Trace shell hash. Very dark gray. (5Y-3/1)(SP-SM).
62.0 ft	5.3 ft	22.8 in	Muddy, silty sand, fine grained quartz, some clay Trace shell hash. Dark gray. (N-4/0)(SC).
64.0 ft	7.2 ft	40.9 in	Sandy mud, very soft. Very dark gray. (N-3/0)(CL)
67.2 ft	10.6 ft	19.3 in	Muddy sand, graded: decreasing mud moving top to bottom. Trace shell hash. Dark gray to dark greenish gray.
68.9 ft	12.2 ft	9.4 in	Muddy sandy carbonate gravel. Trace shell hash. Rock up to 2.0"x1.0"; 2.0"x1.0" rock @ 12'. 3.0"x2.0" rock @ 12.4'. Dark greenish gray. (5GY-4/1)(CL)(GC)
69.5 ft	13.0 ft	5.9 in	Muddy sand, trace rock. Trace shell hash. Rock up to 0.25". Dark greenish gray. (5GY-4/1)(CL)
70.2 ft	13.5 ft	61.0 in	Indurated gravelly sands. Trace shell hash. Rock up to 3.0". 2.75"x2.0" rock @ 13.7'. Greenish to dark greenish gray. (10Y-5/1)(10Y-6/1)(GW-GC)
~75 ft	~19 ft	-	Core base not recovered.

Core logs created using SedLog^{TM} Software (r3.1). Royal Halloway University of London. 2019.



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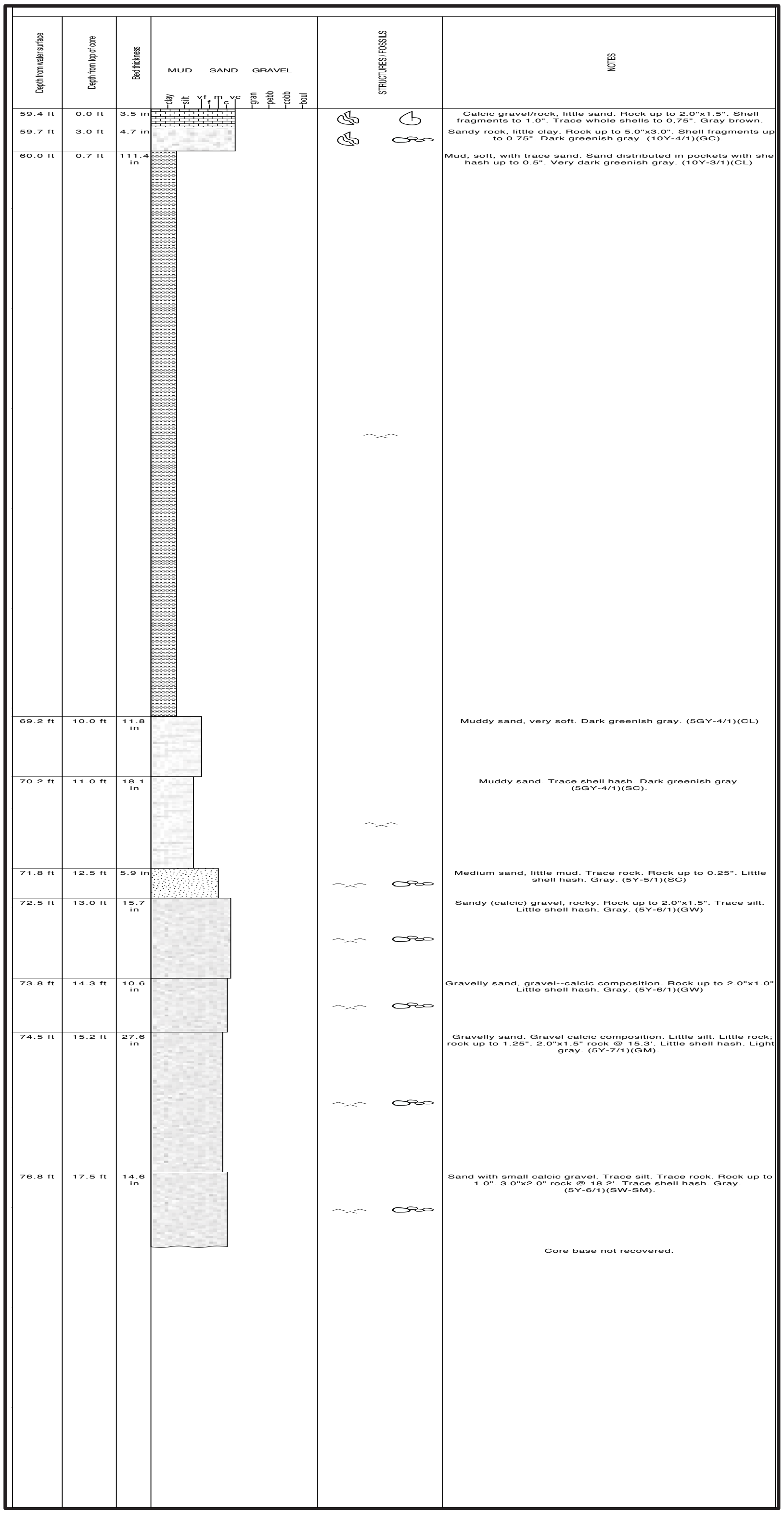
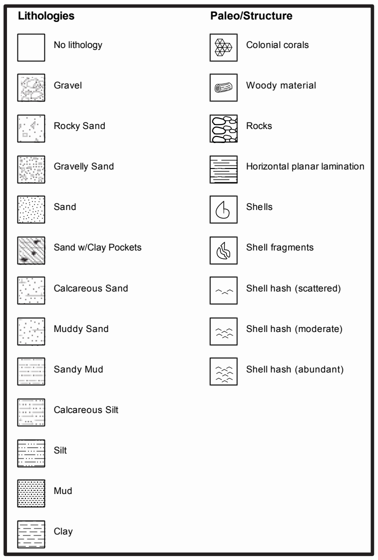
NC-BOEM-2015 VC28



Depth from water surface	Depth from top of core	Bed thickness	NOTES
59.4 ft	0.0 ft	3.5 in	Calcic gravel/rock, little sand. Rock up to 2.0"x1.5". Shell fragments to 1.0". Trace whole shells to 0,75". Gray brown.
59.7 ft	3.0 ft	4.7 in	Sandy rock, little clay. Rock up to 5.0"x3.0". Shell fragments up to 0.75". Dark greenish gray. (10Y-4/1)(GC).
60.0 ft	0.7 ft	111.4 in	Mud, soft, with trace sand. Sand distributed in pockets with she hash up to 0.5". Very dark greenish gray. (10Y-3/1)(CL)
69.2 ft	10.0 ft	11.8 in	Muddy sand, very soft. Dark greenish gray. (5GY-4/1)(CL)
70.2 ft	11.0 ft	18.1 in	Muddy sand. Trace shell hash. Dark greenish gray. (5GY-4/1)(SC).
71.8 ft	12.5 ft	5.9 in	Medium sand, little mud. Trace rock. Rock up to 0.25". Little shell hash. Gray. (5Y-5/1)(SC)
72.5 ft	13.0 ft	15.7 in	Sandy (calcic) gravel, rocky. Rock up to 2.0"x1.5". Trace silt. Little shell hash. Gray. (5Y-6/1)(GW)
73.8 ft	14.3 ft	10.6 in	Gravelly sand, gravel--calcic composition. Rock up to 2.0"x1.0" Little shell hash. Gray. (5Y-6/1)(GW)
74.5 ft	15.2 ft	27.6 in	Gravelly sand. Gravel calcic composition. Little silt. Little rock; rock up to 1.25". 2.0"x1.5" rock @ 15.3'. Little shell hash. Light gray. (5Y-7/1)(GM).
76.8 ft	17.5 ft	14.6 in	Sand with small calcic gravel. Trace silt. Trace rock. Rock up to 1.0". 3.0"x2.0" rock @ 18.2'. Trace shell hash. Gray. (5Y-6/1)(SW-SM).
			Core base not recovered.

Core logs created using SedLog^{TM} Software (r3.1). Royal Halloway University of London. 2019.



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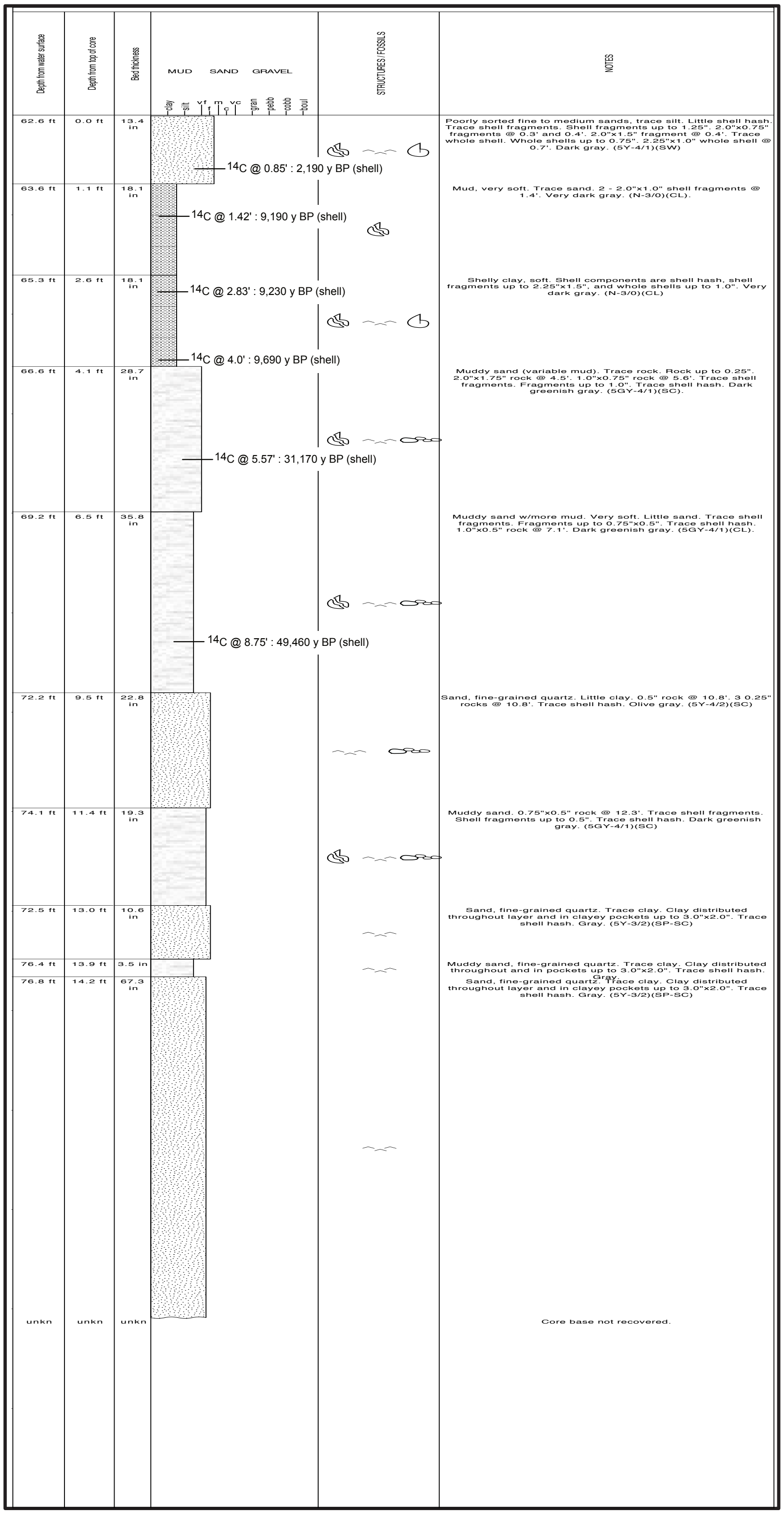
NC-BOEM-2015 VC31



Depth from water surface	Depth from top of core	Bed thickness	NOTES
62.6 ft	0.0 ft	13.4 in	Poorly sorted fine to medium sands, trace silt. Little shell hash. Trace shell fragments. Shell fragments up to 1.25". 2.0"x0.75" fragments @ 0.3' and 0.4'. 2.0"x1.5" fragment @ 0.4'. Trace whole shell. Whole shells up to 0.75". 2.25"x1.0" whole shell @ 0.7'. Dark gray. (5Y-4/1)(SW)
63.6 ft	1.1 ft	18.1 in	Mud, very soft. Trace sand. 2 - 2.0"x1.0" shell fragments @ 1.4'. Very dark gray. (N-3/0)(CL).
65.3 ft	2.6 ft	18.1 in	Shelly clay, soft. Shell components are shell hash, shell fragments up to 2.25"x1.5", and whole shells up to 1.0". Very dark gray. (N-3/0)(CL)
66.6 ft	4.1 ft	28.7 in	Muddy sand (variable mud). Trace rock. Rock up to 0.25". 2.0"x1.75" rock @ 4.5'. 1.0"x0.75" rock @ 5.6'. Trace shell fragments. Fragments up to 1.0". Trace shell hash. Dark greenish gray. (5GY-4/1)(SC).
69.2 ft	6.5 ft	35.8 in	Muddy sand w/more mud. Very soft. Little sand. Trace shell fragments. Fragments up to 0.75"x0.5". Trace shell hash. 1.0"x0.5" rock @ 7.1'. Dark greenish gray. (5GY-4/1)(CL).
72.2 ft	9.5 ft	22.8 in	Sand, fine-grained quartz. Little clay. 0.5" rock @ 10.8'. 3 0.25" rocks @ 10.8'. Trace shell hash. Olive gray. (5Y-4/2)(SC)
74.1 ft	11.4 ft	19.3 in	Muddy sand. 0.75"x0.5" rock @ 12.3'. Trace shell fragments. Shell fragments up to 0.5". Trace shell hash. Dark greenish gray. (5GY-4/1)(SC)
72.5 ft	13.0 ft	10.6 in	Sand, fine-grained quartz. Trace clay. Clay distributed throughout layer and in clayey pockets up to 3.0"x2.0". Trace shell hash. Gray. (5Y-3/2)(SP-SC)
76.4 ft	13.9 ft	3.5 in	Muddy sand, fine-grained quartz. Trace clay. Clay distributed throughout and in pockets up to 3.0"x2.0". Trace shell hash. Gray.
76.8 ft	14.2 ft	67.3 in	Sand, fine-grained quartz. Trace clay. Clay distributed throughout layer and in clayey pockets up to 3.0"x2.0". Trace shell hash. Gray. (5Y-3/2)(SP-SC)
unkn	unkn	unkn	Core base not recovered.

Core logs created using SedLog^{TM} Software (r3.1). Royal Halloway University of London. 2019.

Lithologies

- ☐ No lithology
- Gravel
- Rocky Sand
- Gravelly Sand
- Sand
- Sand w/Clay Pockets
- Calcareous Sand
- Muddy Sand
- Sandy Mud
- Calcareous Silt
- Silt
- Mud
- Clay

Paleo/Structure

- Colonial corals
- Woody material
- Rocks
- Horizontal planar lamination
- Shells
- Shell fragments
- Shell hash (scattered)
- Shell hash (moderate)
- Shell hash (abundant)

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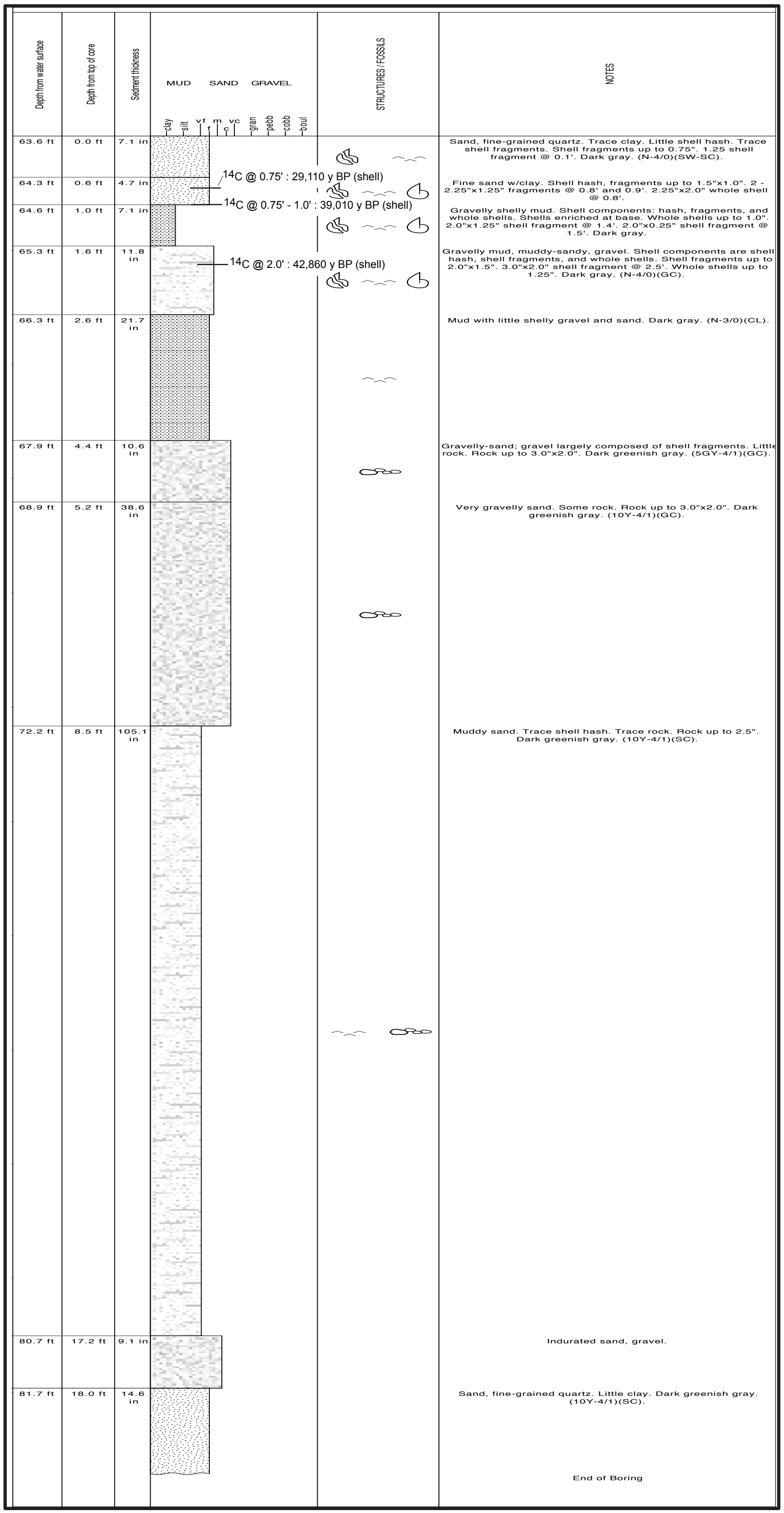
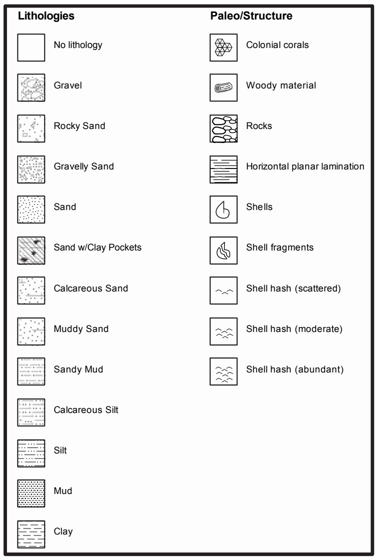
NC-BOEM-2015 VC32



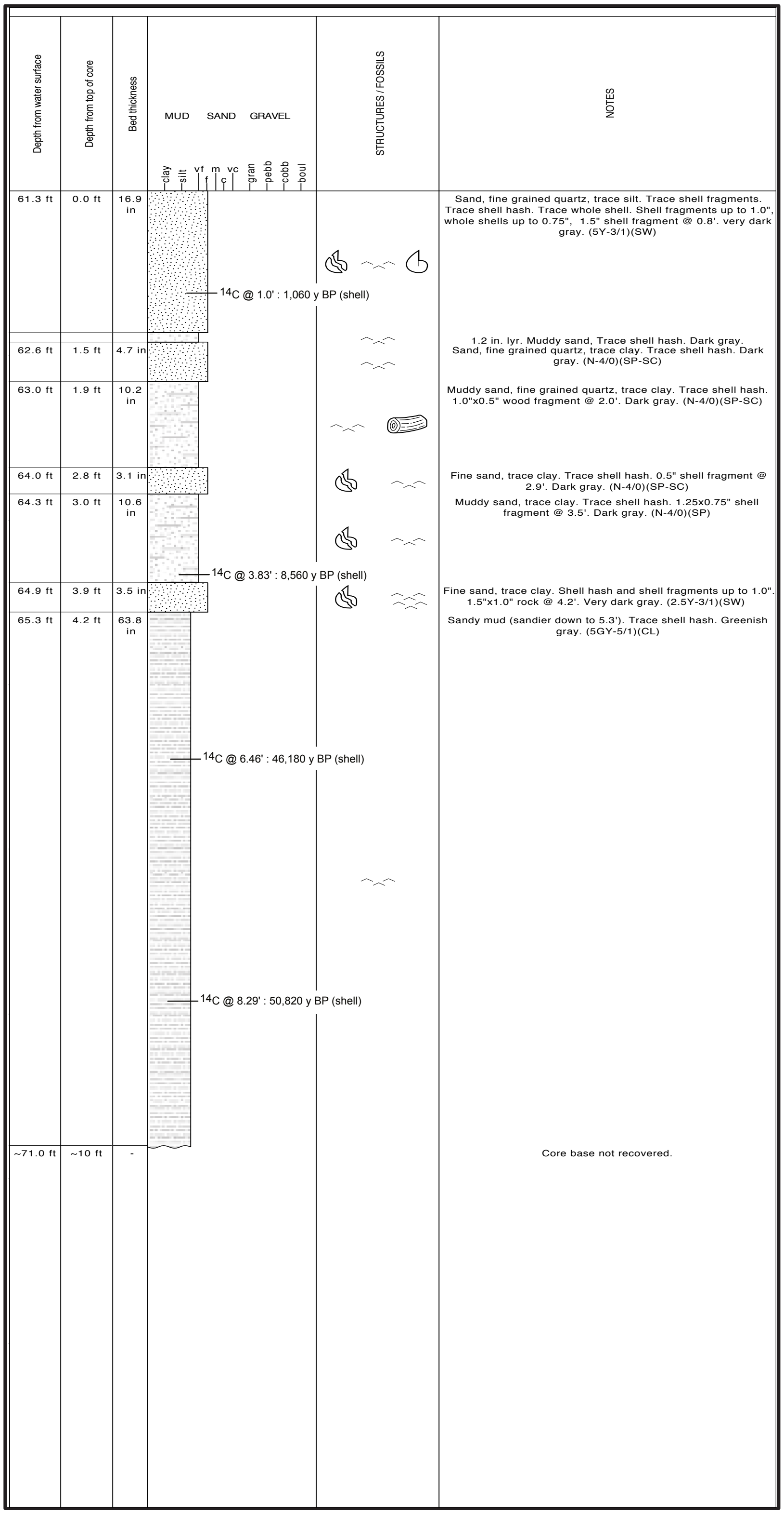
Depth from water surface	Depth from top of core	Sediment thickness	NOTES
63.6 ft	0.0 ft	7.1 in	Sand, fine-grained quartz. Trace clay. Little shell hash. Trace shell fragments. Shell fragments up to 0.75". 1.25 shell fragment @ 0.1'. Dark gray. (N-4/0)(SW-SC).
64.3 ft	0.6 ft	4.7 in	Fine sand w/clay. Shell hash, fragments up to 1.5"x1.0". 2 - 2.25"x1.25" fragments @ 0.8' and 0.9'. 2.25"x2.0" whole shell @ 0.8'.
64.6 ft	1.0 ft	7.1 in	Gravelly shelly mud. Shell components: hash, fragments, and whole shells. Shells enriched at base. Whole shells up to 1.0". 2.0"x1.25" shell fragment @ 1.4'. 2.0"x0.25" shell fragment @ 1.5'. Dark gray.
65.3 ft	1.6 ft	11.8 in	Gravelly mud, muddy-sandy, gravel. Shell components are shell hash, shell fragments, and whole shells. Shell fragments up to 2.0"x1.5". 3.0"x2.0" shell fragment @ 2.5'. Whole shells up to 1.25". Dark gray. (N-4/0)(GC).
66.3 ft	2.6 ft	21.7 in	Mud with little shelly gravel and sand. Dark gray. (N-3/0)(CL).
67.9 ft	4.4 ft	10.6 in	Gravelly-sand; gravel largely composed of shell fragments. Little rock. Rock up to 3.0"x2.0". Dark greenish gray. (5GY-4/1)(GC).
68.9 ft	5.2 ft	38.6 in	Very gravelly sand. Some rock. Rock up to 3.0"x2.0". Dark greenish gray. (10Y-4/1)(GC).
72.2 ft	8.5 ft	105.1 in	Muddy sand. Trace shell hash. Trace rock. Rock up to 2.5". Dark greenish gray. (10Y-4/1)(SC).
80.7 ft	17.2 ft	9.1 in	Indurated sand, gravel.
81.7 ft	18.0 ft	14.6 in	Sand, fine-grained quartz. Little clay. Dark greenish gray. (10Y-4/1)(SC). End of Boring

Core logs created using SedLog^{TM} Software (r3.1). Royal Halloway University of London. 2019.



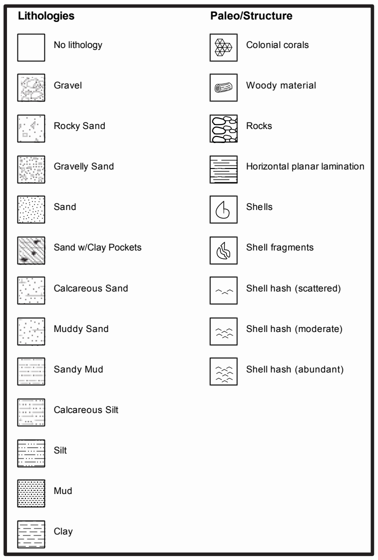
NC-BOEM-2015 VC32

NC-BOEM-2015 VC33



Depth from water surface	Depth from top of core	Bed thickness	NOTES
61.3 ft	0.0 ft	16.9 in	Sand, fine grained quartz, trace silt. Trace shell fragments. Trace shell hash. Trace whole shell. Shell fragments up to 1.0", whole shells up to 0.75", 1.5" shell fragment @ 0.8'. very dark gray. (5Y-3/1)(SW)
			1.2 in. lyr. Muddy sand, Trace shell hash. Dark gray.
62.6 ft	1.5 ft	4.7 in	Sand, fine grained quartz, trace clay. Trace shell hash. Dark gray. (N-4/0)(SP-SC)
63.0 ft	1.9 ft	10.2 in	Muddy sand, fine grained quartz, trace clay. Trace shell hash. 1.0"x0.5" wood fragment @ 2.0'. Dark gray. (N-4/0)(SP-SC)
64.0 ft	2.8 ft	3.1 in	Fine sand, trace clay. Trace shell hash. 0.5" shell fragment @ 2.9'. Dark gray. (N-4/0)(SP-SC)
64.3 ft	3.0 ft	10.6 in	Muddy sand, trace clay. Trace shell hash. 1.25x0.75" shell fragment @ 3.5'. Dark gray. (N-4/0)(SP)
64.9 ft	3.9 ft	3.5 in	Fine sand, trace clay. Shell hash and shell fragments up to 1.0". 1.5"x1.0" rock @ 4.2'. Very dark gray. (2.5Y-3/1)(SW)
65.3 ft	4.2 ft	63.8 in	Sandy mud (sandier down to 5.3'). Trace shell hash. Greenish gray. (5GY-5/1)(CL)
~71.0 ft	~10 ft	-	Core base not recovered.

Core logs created using SedLog^{TM} Software (r3.1). Royal Halloway University of London. 2019.



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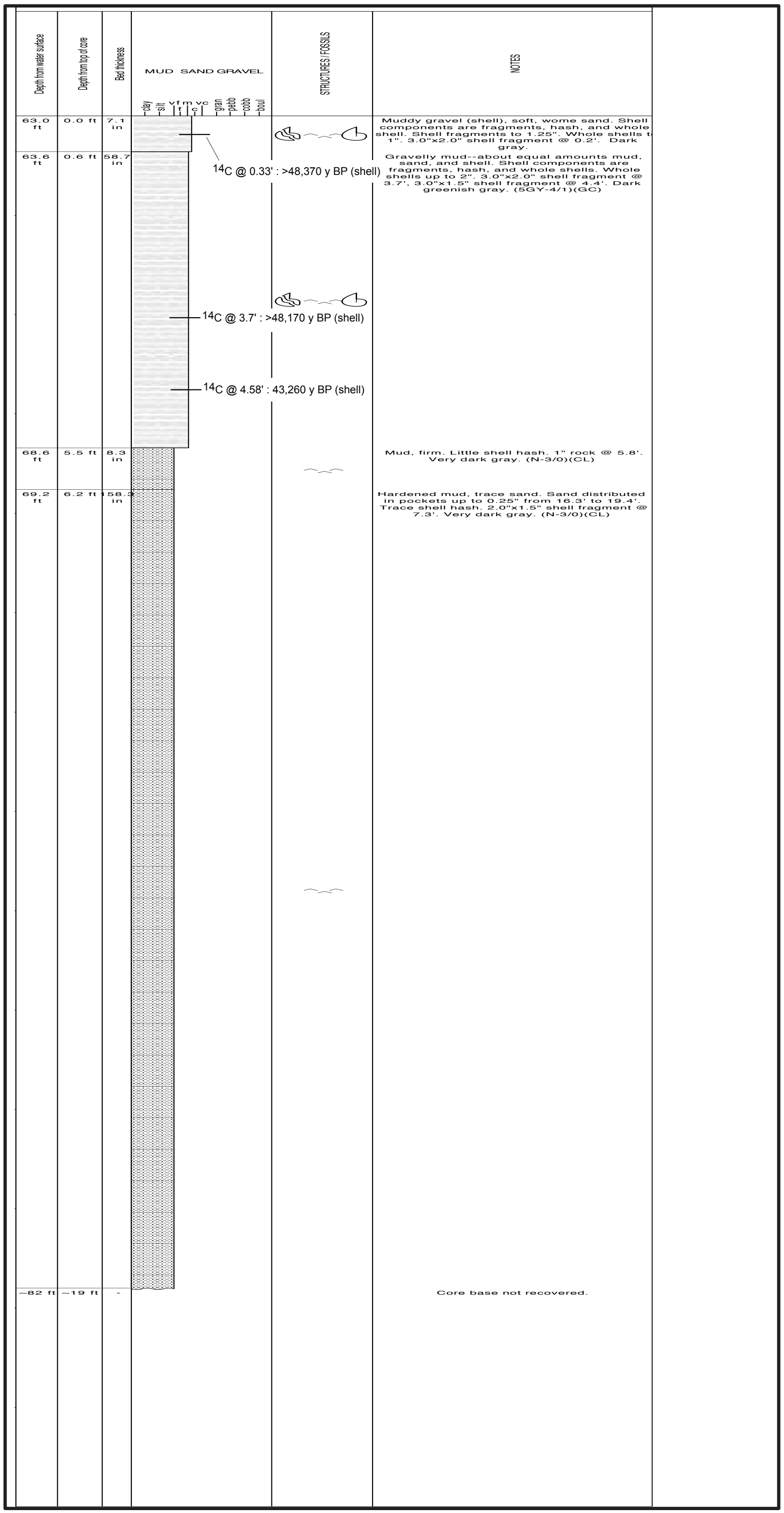
NC-BOEM-2015 VC34



Muddy gravel (shell), soft, wome sand. Shell components are fragments, hash, and whole shell. Shell fragments to 1.25". Whole shells t 1". 3.0"x2.0" shell fragment @ 0.2'. Dark gray.

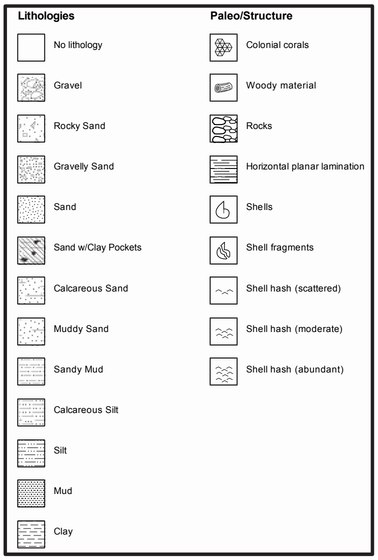
Gravelly mud--about equal amounts mud, sand, and shell. Shell components are fragments, hash, and whole shells. Whole shells up to 2". 3.0"x2.0" shell fragment @ 3.7', 3.0"x1.5" shell fragment @ 4.4'. Dark greenish gray. (5GY-4/1)(GC)

Mud, firm. Little shell hash. 1" rock @ 5.8'. Very dark gray. (N-3/0)(CL)

Hardened mud, trace sand. Sand distributed in pockets up to 0.25" from 16.3' to 19.4'. Trace shell hash. 2.0"x1.5" shell fragment @ 7.3'. Very dark gray. (N-3/0)(CL)

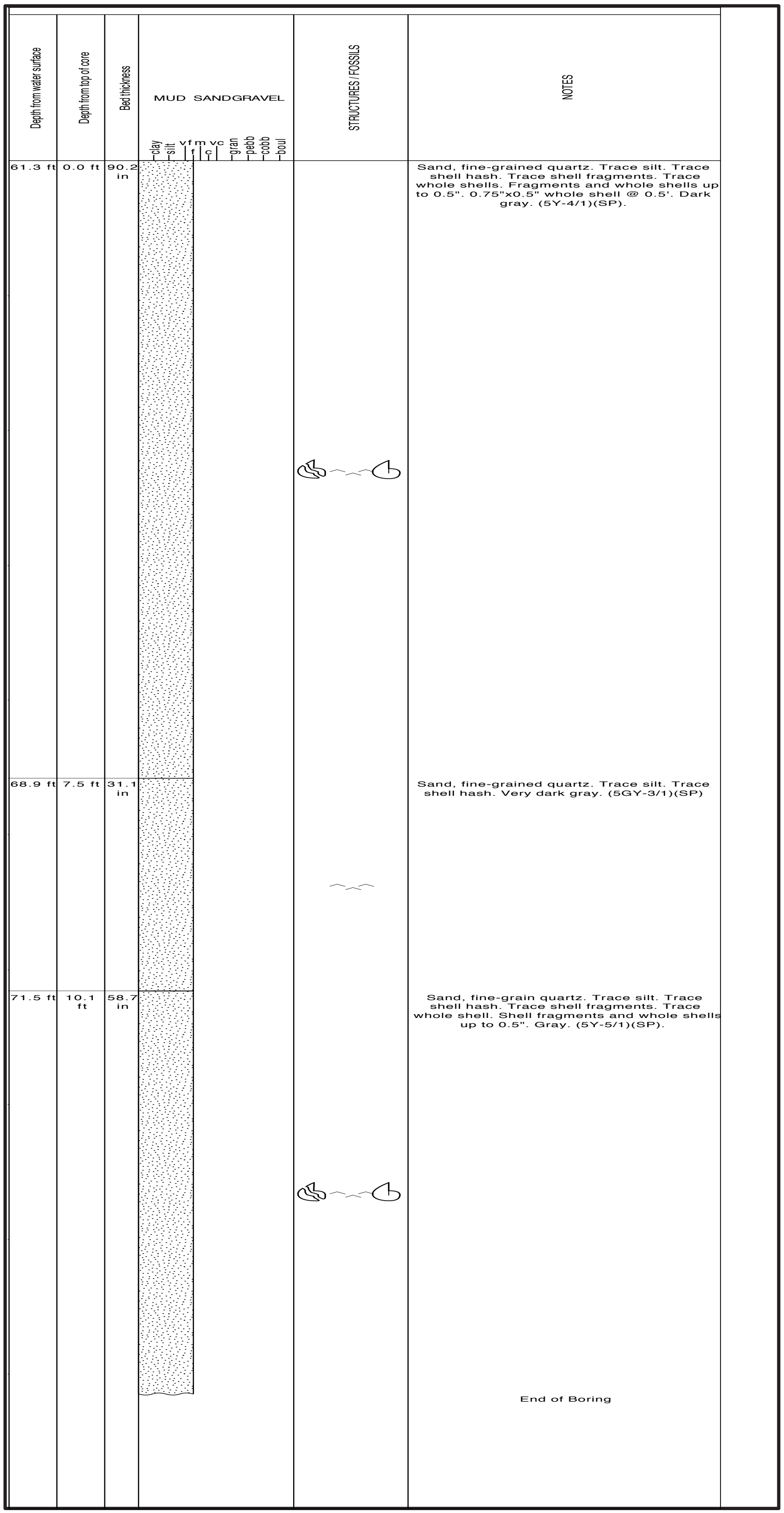
Core base not recovered.

Core logs created using SedLog^{TM} Software (r3.1). Royal Halloway University of London. 2019.



NC-BOEM-2015 VC34

NC-BOEM-2015 VC37

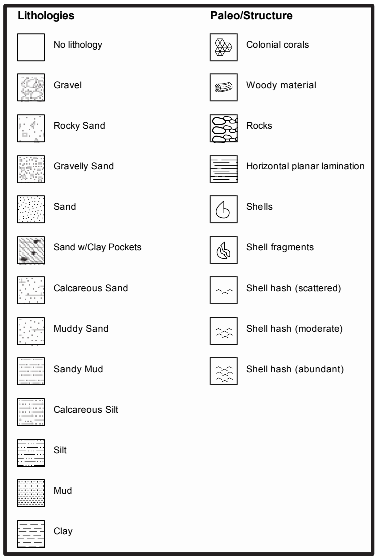


Sand, fine-grained quartz. Trace silt. Trace shell hash. Trace shell fragments. Trace whole shells. Fragments and whole shells up to 0.5". 0.75"x0.5" whole shell @ 0.5'. Dark gray. (5Y-4/1)(SP).

Sand, fine-grained quartz. Trace silt. Trace shell hash. Very dark gray. (5GY-3/1)(SP)

Sand, fine-grain quartz. Trace silt. Trace shell hash. Trace shell fragments. Trace whole shell. Shell fragments and whole shells up to 0.5". Gray. (5Y-5/1)(SP).

End of Boring



Core logs created using SedLog^{TM} Software (r3.1). Royal Halloway University of London. 2019.

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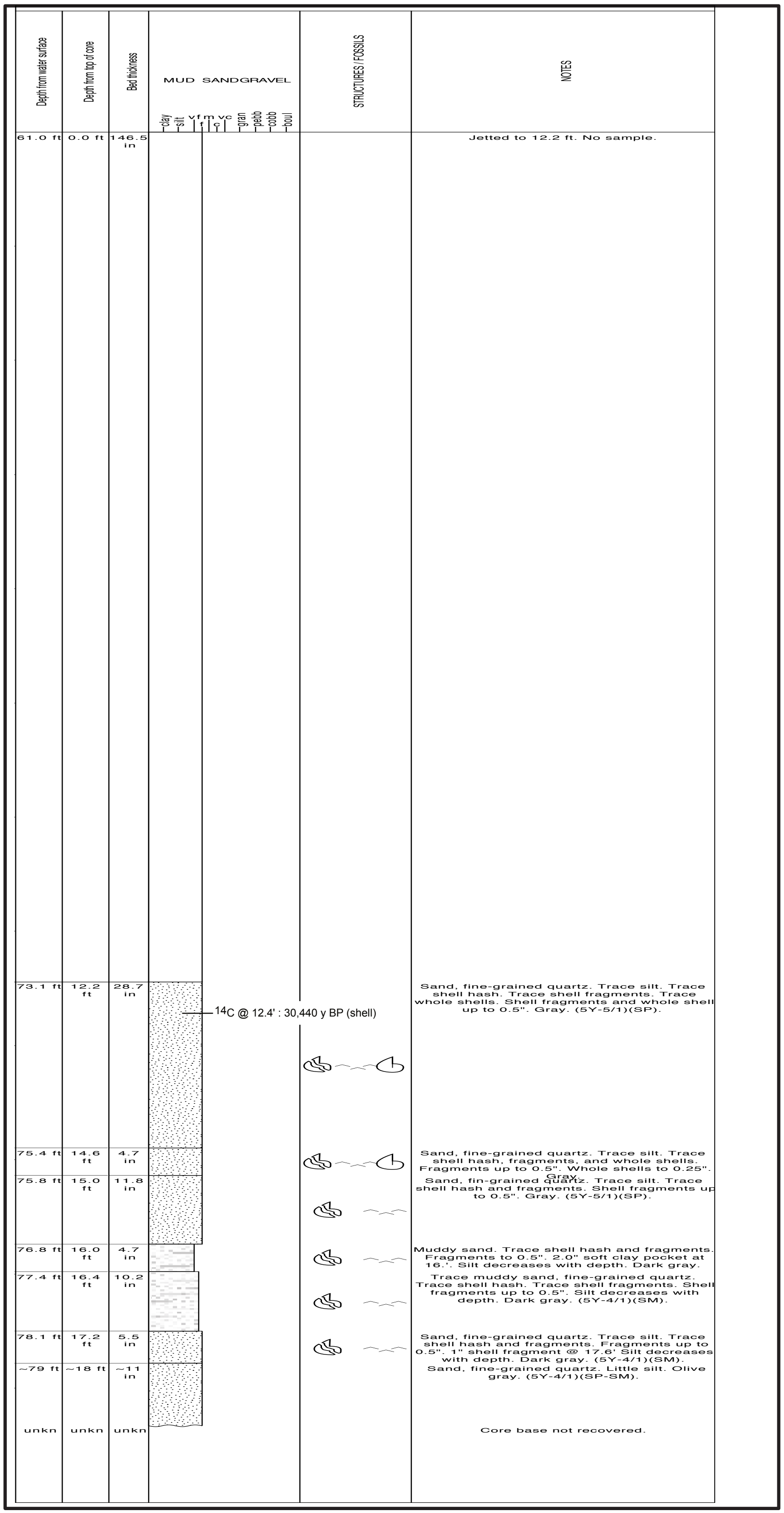
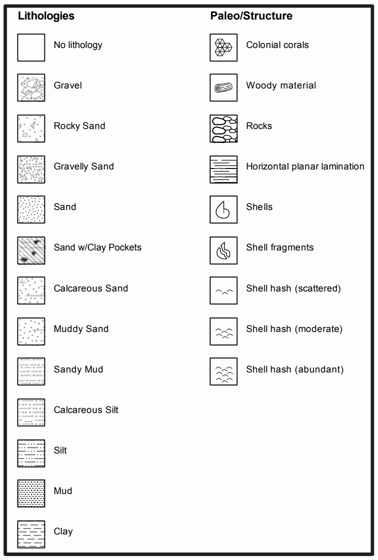
NC-BOEM-2015 VC37A



Depth from water surface	Depth from top of core	Bed thickness	NOTES
61.0 ft	0.0 ft	146.5 in	Jetted to 12.2 ft. No sample.
73.1 ft	12.2 ft	28.7 in	Sand, fine-grained quartz. Trace silt. Trace shell hash. Trace shell fragments. Trace whole shells. Shell fragments and whole shell up to 0.5". Gray. (5Y-5/1)(SP).
75.4 ft	14.6 ft	4.7 in	Sand, fine-grained quartz. Trace silt. Trace shell hash, fragments, and whole shells. Fragments up to 0.5". Whole shells to 0.25". Gray.
75.8 ft	15.0 ft	11.8 in	Sand, fin-grained quartz. Trace silt. Trace shell hash and fragments. Shell fragments up to 0.5". Gray. (5Y-5/1)(SP).
76.8 ft	16.0 ft	4.7 in	Muddy sand. Trace shell hash and fragments. Fragments to 0.5". 2.0" soft clay pocket at 16.'. Silt decreases with depth. Dark gray.
77.4 ft	16.4 ft	10.2 in	Trace muddy sand, fine-grained quartz. Trace shell hash. Trace shell fragments. Shell fragments up to 0.5". Silt decreases with depth. Dark gray. (5Y-4/1)(SM).
78.1 ft	17.2 ft	5.5 in	Sand, fine-grained quartz. Trace silt. Trace shell hash and fragments. Fragments up to 0.5". 1" shell fragment @ 17.6' Silt decreases with depth. Dark gray. (5Y-4/1)(SM).
~79 ft	~18 ft	~11 in	Sand, fine-grained quartz. Little silt. Olive gray. (5Y-4/1)(SP-SM).
unkn	unkn	unkn	Core base not recovered.

Core logs created using SedLog™ Software (r3.1). Royal Halloway University of London. 2019.



NC-BOEM-2015 VC37A

Appendix 2 Core Sediment Sample Grain-size Analyses Data

This appendix contains analysis results for sediment analyses performed on the 24 Vibracores collected as a part of this component of the North Carolina Outer Continental Shelf sand resource study. Sediment samples were collected from the cores typically at 1 foot intervals beginning at the top of the core and analyzed each as an individual sample. Four tables and one graphic are included for each of the 24 cores. The tables include:

- Sediment fraction weights from mechanical sieving of the dried coarse ($> 65\mu m$ portion of the sample
- Sediment fraction weights from wet sieve and settling tube as total silt ($4\varphi - 8\varphi$), total clay ($< 8\varphi$), and total fines (silt + clay fraction).
- Sediment weights and weight percentages by size class (gravel, sand, silt, clay).
- Sediment grain-size descriptive statistics (25^{th} and 75^{th} quartiles, mean (φ), median (φ), standard deviation (SD, φ), skewness (unit-less), and kurtosis (unit-less). Note that statistics use computational approach of Folk, 1980 and were only computed for those samples where mechanical sieve partitioning was carried out.

The included figure graphic consists of four panel subplots. From left to right these include:

- a 2-D histogram (results are shown only for samples mechanically sieved)
- a plot showing the first and second statistical moments of the mechanically sieved samples in the core
- a plot of percent sand in the sample
- a plot of cumulative weight percentage by size class (gravel, sand, silt, clay).

Vibracore: VC01 Dry Mechanical Sieve Weight Fraction (g) by Screen

Depth (ft)	-2.25φ	-1φ	-0.5φ	0φ	0.5φ	1.0φ	1.5φ	2.0φ	2.5φ	3.0φ	3.5φ	4.0φ	pan
0	0.06	0.96	1.42	2.06	2.58	3.57	2.70	3.10	3.21	3.99	2.27	0.78	0.43
1	9.69	2.32	1.15	1.52	2.08	2.69	2.63	2.58	2.65	5.00	4.16	0.66	0.08
2	8.93	1.94	1.16	1.01	0.96	0.99	0.78	1.23	2.17	3.44	1.47	0.54	0.24
3	0.00	1.08	1.75	2.52	2.70	2.97	2.56	3.44	3.46	3.37	1.50	1.02	0.56
4	2.71	2.65	2.68	3.91	3.24	3.00	2.65	2.96	3.67	3.30	0.60	0.32	0.12
5	0.46	4.41	3.63	5.79	5.33	3.56	2.39	2.53	3.12	2.96	0.63	0.38	0.27
6	0.59	4.43	4.17	4.52	3.61	3.08	1.70	1.80	2.22	2.05	0.50	0.19	0.01
7	1.61	4.82	3.10	2.78	2.91	3.38	3.22	4.61	4.69	3.47	0.78	0.33	0.30
8	0.69	1.71	1.46	1.63	1.64	2.26	2.28	2.91	4.64	5.32	1.96	0.53	0.08
9	0.30	3.22	2.46	2.29	1.86	2.03	1.51	2.33	4.27	5.37	1.86	0.71	0.04
10	1.84	5.51	3.49	3.79	3.46	3.40	2.77	2.38	1.93	1.48	0.50	0.33	0.30
11	5.94	6.96	3.40	2.69	2.33	2.41	1.74	2.15	1.83	1.60	0.62	0.41	0.28

Vibracore: VC01 Wet (pipetted $< 63\mu m$) Weight Fraction (g)

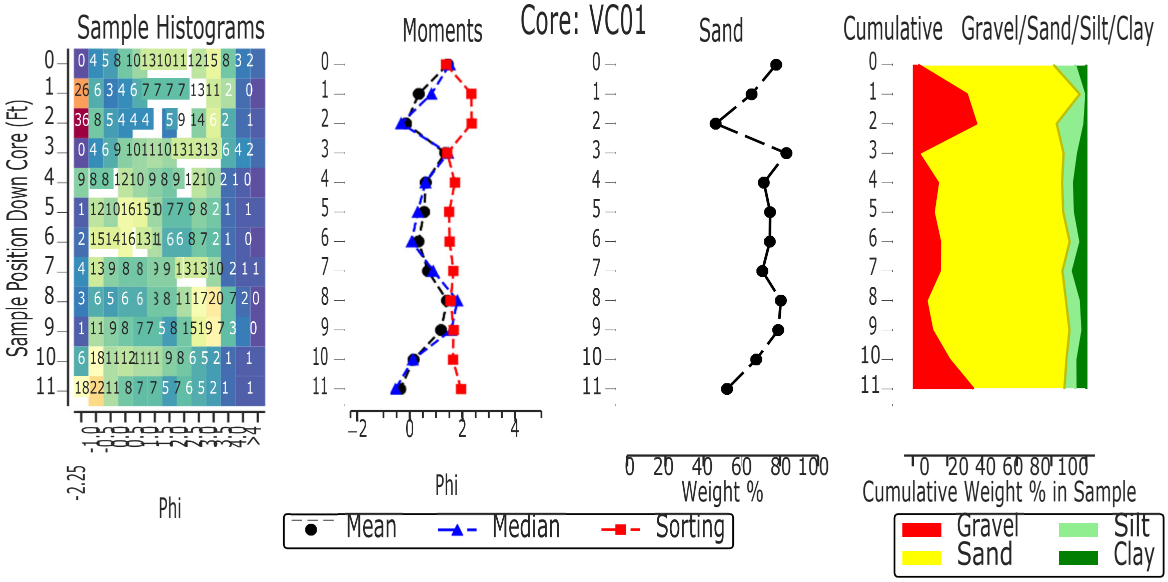
Depth (ft)	Cyl Vol (ml)	Pan Wt. 1st Draw (g)	Pan Wt. 2nd Draw (g)	Sample Wt. 1st Draw (g)	Sample Wt. 2nd Draw (g)
0	300	1.0211	1.0614	1.5069	1.3042
1	500	1.0743	1.0529	1.2283	1.1717
2	600	1.0358	1.0729	1.2965	1.1963
3	500	1.0285	1.0534	1.2645	1.2262
4	500	1.0253	1.0240	1.3251	1.2469
5	500	1.0270	1.0822	1.3297	1.3081
6	500	1.0933	1.0633	1.3150	1.2222
7	600	1.0342	1.0871	1.3130	1.3123
8	500	1.0757	1.0627	1.3155	1.2156
9	400	1.0500	1.0691	1.2985	1.2224
10	600	1.0548	1.0558	1.2762	1.2287
11	700	1.0646	1.0524	1.2884	1.2175

Vibracore: VC01 Weight and Percent Weight by Size Class

Depth	GravelWt	SandWt	TotalFinesWt	ClayWt	SiltWt	TotalWt	GravelWtPct	SandWtPct	SiltWtPct	ClayWtPct
0	1.02	25.68	6.22	2.14	4.08	32.92	3.1	78.0	12.4	6.5
1	12.01	25.12	1.43	0.47	0.96	38.56	31.1	65.1	2.5	1.2
2	10.87	13.75	5.06	0.70	4.36	29.68	36.6	46.3	14.7	2.4
3	1.08	25.29	3.96	1.82	2.14	30.33	3.6	83.4	7.1	6.0
4	5.36	26.33	5.11	3.07	2.04	36.80	14.6	71.5	5.5	8.3
5	4.87	30.32	5.34	3.15	2.19	40.53	12.0	74.8	5.4	7.8
6	5.02	23.84	3.05	1.47	1.58	31.91	15.7	74.7	5.0	4.6
7	6.43	29.27	5.66	3.76	1.90	41.36	15.5	70.8	4.6	9.1
8	2.40	24.63	3.57	1.32	2.25	30.60	7.8	80.5	7.4	4.3
9	3.52	24.69	3.01	1.07	1.94	31.22	11.3	79.1	6.2	3.4
10	7.35	23.53	3.94	2.19	1.75	34.82	21.1	67.6	5.0	6.3
11	12.90	19.18	4.61	2.28	2.33	36.69	35.2	52.3	6.4	6.2

Vibracore: VC01 Descriptive Statistics (Log Inclusive Graphics Method)

Depth (ft)	Q1	Median	Q3	Mean	SD	Skew	Kurt
0.0	0.442	1.535	2.586	1.463	1.392	-0.093	0.832
1.0	-2.290	0.843	2.560	0.367	2.356	-0.236	0.543
2.0	-2.554	-0.302	2.379	-0.119	2.366	0.114	0.536
3.0	0.256	1.478	2.459	1.363	1.444	-0.086	0.844
4.0	-0.516	0.619	2.008	0.630	1.727	-0.084	0.906
5.0	-0.468	0.323	1.703	0.568	1.516	0.157	0.905
6.0	-0.737	0.100	1.368	0.355	1.530	0.183	0.940
7.0	-0.585	0.911	2.061	0.714	1.675	-0.187	0.797
8.0	0.393	1.824	2.605	1.435	1.566	-0.390	0.940
9.0	-0.264	1.598	2.585	1.208	1.684	-0.326	0.739
10.0	-0.936	0.139	1.342	0.170	1.657	0.030	0.946
11.0	-1.864	-0.518	1.155	-0.333	1.960	0.147	0.798



Vibracore: VC03 Dry Mechanical Sieve Weight Fraction (g) by Screen

Depth (ft)	-2.25φ	-1φ	-0.5φ	0φ	0.5φ	1.0φ	1.5φ	2.0φ	2.5φ	3.0φ	3.5φ	4.0φ	pan
0	0.47	0.69	0.48	0.45	0.37	0.45	0.43	0.67	1.65	3.23	1.86	0.28	0.02
1	0.51	0.60	0.54	0.56	0.67	0.85	1.00	1.55	3.73	12.18	9.50	1.43	0.10
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Vibracore: VC03 Wet (pipetted $< 63\mu m$) Weight Fraction (g)

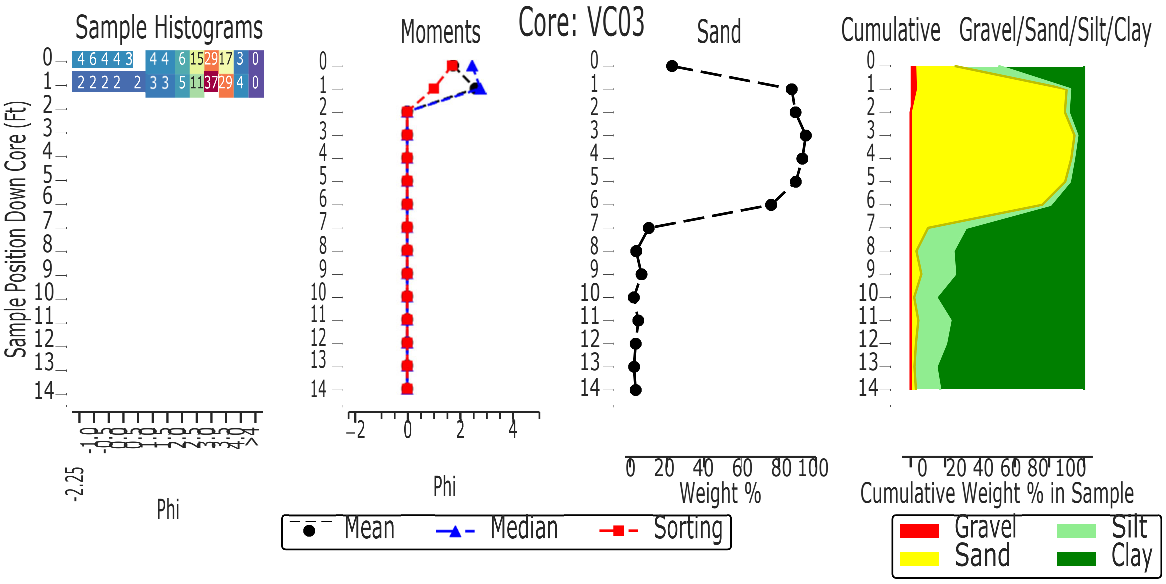
Depth (ft)	Cyl Vol (ml)	Pan Wt. 1st Draw (g)	Pan Wt. 2nd Draw (g)	Sample Wt. 1st Draw (g)	Sample Wt. 2nd Draw (g)
0	1700	2.0533	2.0594	2.5357	2.4125
1	500	1.0529	1.0874	1.2964	1.3040
2	500	1.0176	0.9628	1.2690	1.1849
3	500	1.0194	1.0228	1.1947	1.1751
4	500	1.0218	1.0135	1.2289	1.1974
5	500	1.0178	0.9946	1.2294	1.1779
6	700	1.0396	1.0079	1.3912	1.3094
7	1000	0.9755	0.9944	1.3933	1.3354
8	800	1.0116	0.9970	1.5166	1.4126
9	1000	0.9964	0.9917	1.3847	1.3203
10	900	1.0224	1.0038	1.5548	1.4803
11	1020	1.0219	1.0256	1.3346	1.2971
12	1000	1.0102	1.0247	1.3618	1.3311
13	800	1.0169	0.9894	1.3999	1.3357
14	1000	0.9995	1.0216	1.3389	1.3264

Vibracore: VC03 Weight and Percent Weight by Size Class

Depth	GravelWt	SandWt	TotalFinesWt	ClayWt	SiltWt	TotalWt	GravelWtPct	SandWtPct	SiltWtPct	ClayWtPct
0	1.16	9.87	32.52	21.51	11.01	43.55	2.7	22.7	25.3	49.4
1	1.11	32.01	3.69	2.92	0.77	36.81	3.0	87.0	2.1	7.9
2	0.00	30.61	3.78	3.05	0.73	34.39	0.0	89.0	2.1	8.9
3	0.00	32.32	1.88	1.31	0.57	34.20	0.0	94.5	1.7	3.8
4	0.00	33.81	2.68	2.10	0.58	36.49	0.0	92.7	1.6	5.8
5	0.00	22.95	2.79	2.08	0.71	25.74	0.0	89.2	2.8	8.1
6	0.00	27.70	8.81	7.05	1.76	36.51	0.0	75.9	4.8	19.3
7	0.00	1.79	15.89	12.05	3.84	17.68	0.0	10.1	21.7	68.2
8	0.00	0.57	16.20	12.62	3.58	16.77	0.0	3.4	21.3	75.3
9	0.00	0.96	14.42	11.43	2.99	15.38	0.0	6.2	19.4	74.3
10	0.00	0.42	19.46	16.94	2.52	19.88	0.0	2.1	12.7	85.2
11	0.00	0.51	10.85	8.75	2.10	11.36	0.0	4.5	18.5	77.0
12	0.00	0.40	12.58	10.32	2.26	12.98	0.0	3.1	17.4	79.5
13	0.00	0.26	11.32	9.85	1.47	11.58	0.0	2.2	12.7	85.1
14	0.00	0.38	11.97	10.24	1.73	12.35	0.0	3.1	14.0	82.9

Vibracore: VC03 Descriptive Statistics (Log Inclusive Graphics Method)

Depth (ft)	Q1	Median	Q3	Mean	SD	Skew	Kurt
0.0	0.836	2.459	2.907	1.735	1.704	-0.638	1.095
1.0	2.271	2.771	3.143	2.587	1.006	-0.490	1.872
2.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Vibracore: VC04 Dry Mechanical Sieve Weight Fraction (g) by Screen

Depth (ft)	-2.25φ	-1φ	-0.5φ	0φ	0.5φ	1.0φ	1.5φ	2.0φ	2.5φ	3.0φ	3.5φ	4.0φ	pan
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.00	0.18	0.25	0.56	0.79	1.90	3.33	6.70	9.66	9.45	1.31	0.20	0.03
2	0.00	0.09	0.12	0.29	0.73	2.93	5.43	8.55	9.83	7.77	0.98	0.18	0.02
3	0.00	0.13	0.19	0.29	0.50	1.16	2.96	6.00	8.55	11.22	2.42	0.35	0.06
4	0.40	0.52	0.23	0.32	0.54	1.00	1.62	4.06	5.78	10.05	2.66	0.41	0.05
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.03	0.08	0.13	0.18	0.94	6.30	16.03	8.44	2.65	0.47	0.22	0.04
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	14.18	1.50	0.77	0.82	0.91	1.54	2.87	3.99	2.34	0.95	0.46	0.46	0.34

Vibracore: VC04 Wet (pipetted $< 63\mu m$) Weight Fraction (g)

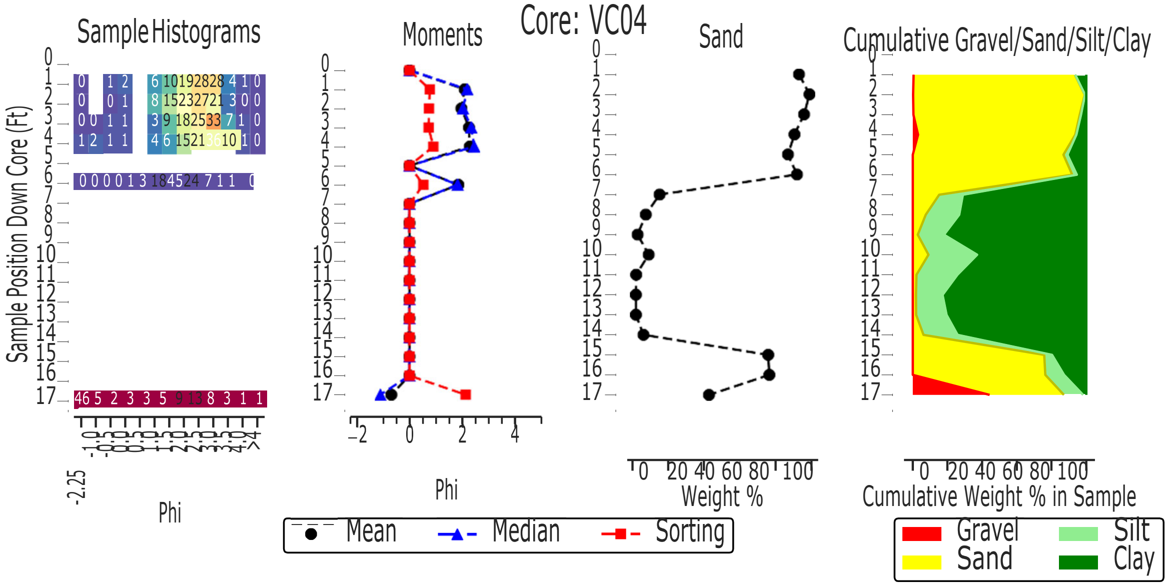
Depth (ft)	Cyl Vol (ml)	Pan Wt. 1st Draw (g)	Pan Wt. 2nd Draw (g)	Sample Wt. 1st Draw (g)	Sample Wt. 2nd Draw (g)
0	0.0	0.0000	0.0000	0.0000	0.0000
1	500.0	1.0430	1.0548	1.2369	1.2472
2	600.0	1.0734	1.0336	1.1833	1.1417
3	500.0	1.0252	1.0363	1.1756	1.1780
4	500.0	1.0464	1.0566	1.2195	1.2231
5	500.0	1.0169	1.0050	1.3212	1.2726
6	600.0	1.0428	1.0267	1.2446	1.1953
7	1000.0	1.0118	1.0180	1.3940	1.3545
8	800.0	1.0116	1.0149	1.5301	1.4462
9	1000.0	0.9939	0.9959	1.4177	1.3695
10	800.0	1.0200	1.0258	1.5387	1.4153
11	900.0	1.0346	1.0041	1.5939	1.4524
12	700.0	1.0232	1.0446	1.7339	1.6604
13	1000.0	1.0041	1.0324	1.5074	1.4636
14	1000.0	1.0044	0.9577	1.5273	1.3919
15	900.0	1.0050	0.9982	1.2744	1.2365
16	500.0	1.0621	1.0015	1.5088	1.2904
17	600.0	1.0660	1.0510	1.3059	1.1719

Vibracore: VC04 Weight and Percent Weight by Size Class

Depth	GravelWt	SandWt	TotalFinesWt	ClayWt	SiltWt	TotalWt	GravelWtPct	SandWtPct	SiltWtPct	ClayWtPct
0	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0
1	0.18	34.15	2.38	2.31	0.07	36.71	0.5	93.0	0.2	6.3
2	0.09	36.81	0.32	0.24	0.08	37.22	0.2	98.9	0.2	0.6
3	0.13	33.64	1.32	1.04	0.28	35.09	0.4	95.9	0.8	3.0
4	0.92	26.67	1.88	1.66	0.22	29.47	3.1	90.5	0.7	5.6
5	0.00	33.81	5.11	4.19	0.92	38.92	0.0	86.9	2.4	10.8
6	0.03	35.44	3.09	2.06	1.03	38.56	0.1	91.9	2.7	5.3
7	0.00	2.53	14.11	11.82	2.29	16.64	0.0	15.2	13.8	71.0
8	0.00	1.36	16.74	13.25	3.49	18.10	0.0	7.5	19.3	73.2
9	0.00	0.49	16.19	13.68	2.51	16.68	0.0	2.9	15.0	82.0
10	0.00	1.68	16.75	11.58	5.17	18.43	0.0	9.1	28.1	62.8
11	0.00	0.45	20.67	15.67	5.00	21.12	0.0	2.1	23.7	74.2
12	0.00	0.43	21.37	18.05	3.32	21.80	0.0	2.0	15.2	82.8
13	0.00	0.41	20.17	16.56	3.61	20.58	0.0	2.0	17.5	80.5
14	0.00	1.40	21.15	16.71	4.44	22.55	0.0	6.2	19.7	74.1
15	0.00	23.93	7.62	6.22	1.40	31.55	0.0	75.8	4.4	19.7
16	0.00	28.15	8.67	4.72	3.95	36.82	0.0	76.5	10.7	12.8
17	15.68	15.11	4.54	0.63	3.91	35.33	44.4	42.8	11.1	1.8

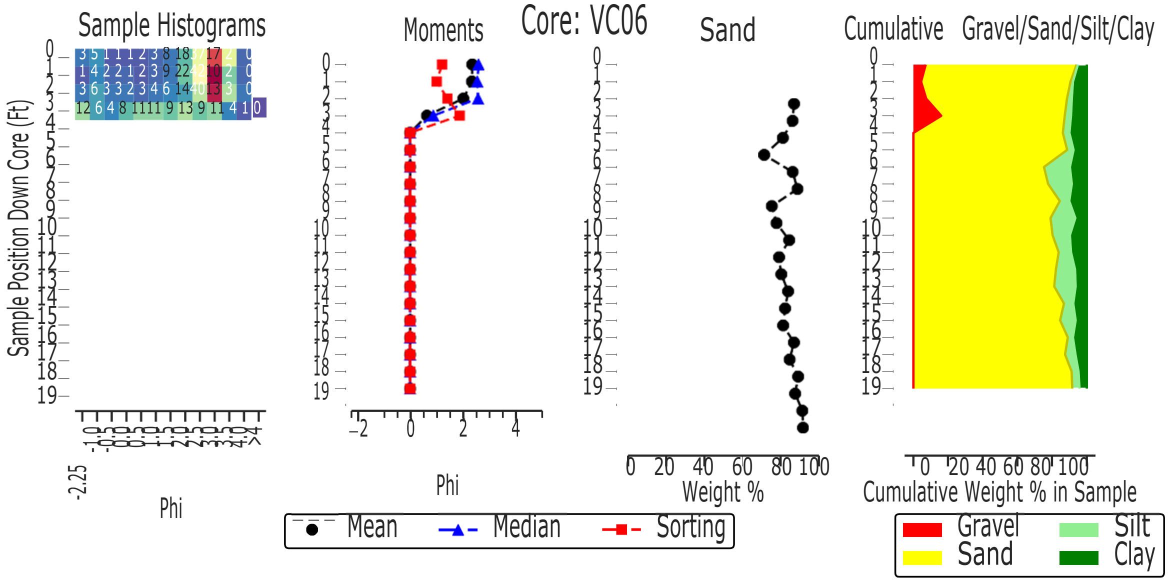
Vibracore: VC04 Descriptive Statistics (Log Inclusive Graphics Method)

Depth (ft)	Q1	Median	Q3	Mean	SD	Skew	Kurt
0.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.0	1.618	2.180	2.627	2.081	0.763	-0.277	1.028
2.0	1.467	2.016	2.486	1.958	0.740	-0.157	0.946
3.0	1.769	2.332	2.749	2.244	0.719	-0.233	1.039
4.0	1.781	2.444	2.811	2.272	0.900	-0.418	1.379
5.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6.0	1.538	1.815	2.174	1.841	0.523	0.096	1.141
7.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17.0	-2.701	-1.096	1.595	-0.683	2.118	0.286	0.571



Vibracore: VC06 Dry Mechanical Sieve Weight Fraction (g) by   Screen

Depth (ft)	-2.25φ	-1φ	-0.5φ	0φ	0.5φ	1.0φ	1.5φ	2.0φ	2.5φ	3.0φ	3.5φ	4.0φ	pan
0	1.09	1.71	0.55	0.39	0.43	0.78	1.27	2.88	6.73	13.79	6.27	0.89	0.03
1	0.24	1.55	0.88	0.72	0.52	0.62	1.09	3.10	7.94	15.28	3.64	0.62	0.06
2	0.94	2.08	0.91	1.03	0.82	1.12	1.57	2.23	5.05	14.33	4.70	0.94	0.12
3	4.49	2.29	1.66	2.80	4.20	3.99	3.47	4.66	3.39	4.11	1.38	0.46	0.05
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00



Vibracore: VC06 Wet (pipetted $< 63 \mu m$) Weight Fraction (g)

Depth (ft)	Cyl Vol (ml)	Pan Wt. 1st Draw (g)	Pan Wt. 2nd Draw (g)	Sample Wt. 1st Draw (g)	Sample Wt. 2nd Draw (g)
0	500	1.0023	0.9977	1.1934	1.1776
1	500	0.9987	1.0182	1.2454	1.2457
2	500	0.9950	0.9948	1.2741	1.2325
3	500	1.0068	1.0005	1.3185	1.2541
4	500	0.9903	1.0009	1.2933	1.2475
5	500	1.0100	1.0150	1.2810	1.2305
6	500	1.0179	1.0191	1.4688	1.2576
7	500	1.0066	1.0177	1.4277	1.2429
8	500	1.0021	1.0227	1.3229	1.2663
9	700	1.0028	0.9997	1.3004	1.1615
10	500	1.0068	0.9968	1.3636	1.2235
11	500	1.0150	1.0162	1.3406	1.2429
12	500	1.0205	1.0098	1.3560	1.1989
13	500	1.0071	1.0374	1.3587	1.2239
14	500	1.0131	0.9978	1.2873	1.2013
15	500	1.0123	1.0424	1.3365	1.2356
16	600	1.0086	1.0223	1.2291	1.2104
17	480	1.0291	1.0003	1.3006	1.1891
18	500	1.0194	0.9878	1.2511	1.1596
19	500	1.0446	0.9928	1.2674	1.1543

Vibracore: VC06 Weight and Percent Weight by Size Class

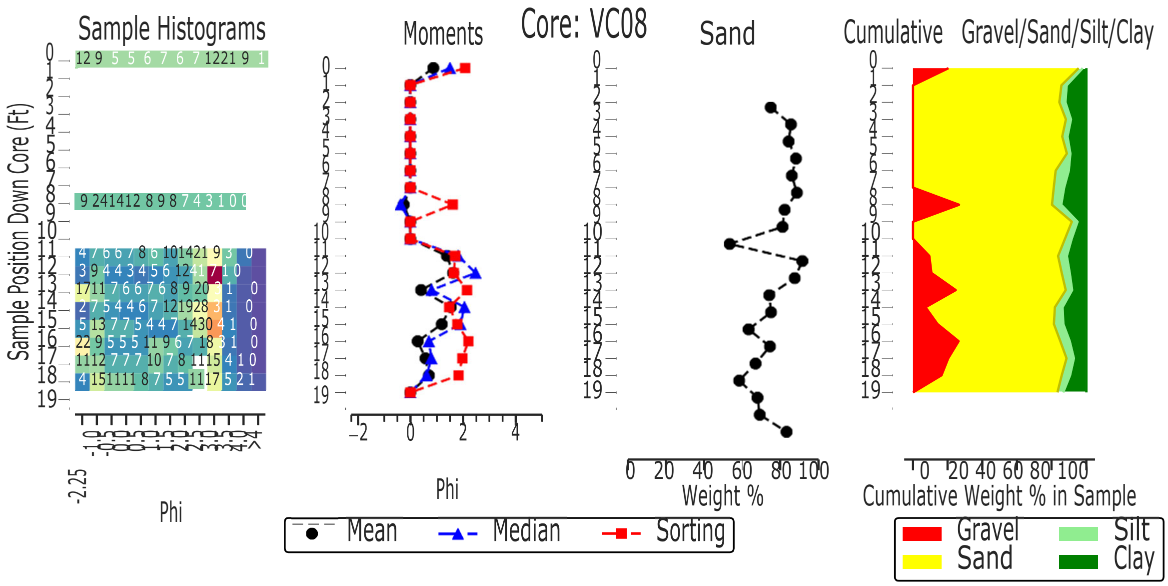
Depth	GravelWt	SandWt	TotalFinesWt	ClayWt	SiltWt	TotalWt	GravelWtPct	SandWtPct	SiltWtPct	ClayWtPct
0	2.80	33.98	2.31	2.00	0.31	39.09	7.2	86.9	0.8	5.1
1	1.79	34.41	3.73	3.19	0.54	39.93	4.5	86.2	1.4	8.0
2	3.02	32.70	4.60	3.44	1.16	40.32	7.5	81.1	2.9	8.5
3	6.78	30.12	5.34	3.84	1.50	42.24	16.1	71.3	3.6	9.1
4	0.00	31.72	5.07	3.67	1.40	36.79	0.0	86.2	3.8	10.0
5	0.00	33.69	4.27	2.89	1.38	37.96	0.0	88.8	3.6	7.6
6	0.00	26.77	8.77	3.46	5.31	35.54	0.0	75.3	14.9	9.7
7	0.00	28.09	8.03	3.13	4.90	36.12	0.0	77.8	13.6	8.7
8	0.00	29.89	5.52	3.59	1.93	35.41	0.0	84.4	5.5	10.1
9	0.00	26.17	6.92	2.16	4.76	33.09	0.0	79.1	14.4	6.5
10	0.00	26.13	6.42	3.17	3.25	32.55	0.0	80.3	10.0	9.7
11	0.00	29.23	5.64	3.17	2.47	34.87	0.0	83.8	7.1	9.1
12	0.00	27.30	5.89	2.23	3.66	33.19	0.0	82.3	11.0	6.7
13	0.00	27.26	6.29	2.16	4.13	33.55	0.0	81.3	12.3	6.4
14	0.00	28.86	4.36	2.59	1.77	33.22	0.0	86.9	5.3	7.8
15	0.00	30.86	5.61	2.33	3.28	36.47	0.0	84.6	9.0	6.4
16	0.00	29.50	3.62	2.64	0.98	33.12	0.0	89.1	3.0	8.0
17	0.00	28.84	4.12	2.13	1.99	32.96	0.0	87.5	6.0	6.5
18	0.00	34.37	3.29	1.79	1.50	37.66	0.0	91.3	4.0	4.8
19	0.00	33.72	3.07	1.54	1.53	36.79	0.0	91.7	4.2	4.2

Vibracore: VC06 Descriptive Statistics (Log Inclusive Graphics Method)

Depth (ft)	Q1	Median	Q3	Mean	SD	Skew	Kurt
0.0	2.008	2.593	2.927	2.356	1.210	-0.543	2.287
1.0	2.022	2.548	2.845	2.343	1.012	-0.532	2.157
2.0	1.610	2.576	2.888	2.017	1.415	-0.667	1.655
3.0	-0.358	0.880	2.022	0.639	1.883	-0.226	1.008
4.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Vibracore: VC08 Dry Mechanical Sieve Weight Fraction (g) by Screen

Depth (ft)	-2.25φ	-1φ	-0.5φ	0φ	0.5φ	1.0φ	1.5φ	2.0φ	2.5φ	3.0φ	3.5φ	4.0φ	pan
0	4.78	3.58	2.02	1.89	2.15	2.88	2.20	2.82	4.63	8.27	3.34	0.39	0.07
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	2.97	8.35	4.77	4.01	2.83	3.22	2.66	2.53	1.47	0.90	0.31	0.12	0.11
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	1.21	2.26	1.71	1.97	2.11	2.34	1.98	2.95	4.21	6.40	2.70	1.00	0.08
12	1.00	2.86	1.19	1.12	0.96	1.25	1.65	1.97	3.85	12.86	2.11	0.38	0.07
13	5.02	3.38	2.05	1.69	1.69	2.01	1.86	2.33	2.83	5.94	1.00	0.24	0.09
14	0.54	1.91	1.40	1.23	1.24	1.72	1.97	3.40	5.36	7.87	0.94	0.24	0.07
15	1.42	3.83	2.16	2.12	1.44	1.29	1.21	2.04	4.25	8.92	1.17	0.26	0.08
16	6.15	2.59	1.31	1.34	1.50	3.00	2.59	1.61	2.09	4.96	0.74	0.26	0.07
17	3.17	3.67	1.99	2.12	2.22	2.88	2.09	2.31	3.40	4.32	1.14	0.40	0.07
18	1.40	4.63	3.44	3.44	2.45	2.14	1.56	1.46	3.40	5.36	1.66	0.56	0.22
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00



Vibracore: VC08 Wet (pipetted $< 63\mu m$) Weight Fraction (g)

Depth (ft)	Cyl Vol (ml)	Pan Wt. 1st Draw (g)	Pan Wt. 2nd Draw (g)	Sample Wt. 1st Draw (g)	Sample Wt. 2nd Draw (g)
0	500	1.0491	1.0764	1.2177	1.2090
1	500	1.0057	0.9913	1.3064	1.2491
2	500	1.0059	1.0486	1.3610	1.3467
3	500	1.0209	1.0449	1.2980	1.2786
4	500	1.0323	1.0306	1.3357	1.2890
5	500	1.0095	1.0261	1.2809	1.2662
6	500	0.9986	1.0160	1.3460	1.2583
7	500	0.9892	0.9716	1.3642	1.2599
8	600	1.0194	1.0223	1.3963	1.3273
9	500	1.0188	1.0230	1.2427	1.1970
10	500	1.0068	1.0548	1.2907	1.2798
11	500	1.0131	0.9902	1.3494	1.2548
12	500	1.0072	1.0198	1.3097	1.2578
13	600	0.9859	1.0012	1.2173	1.1938
14	600	1.0165	1.0350	1.3189	1.2893
15	500	1.0235	1.0153	1.3963	1.3120
16	500	1.0097	0.9974	1.3053	1.2237
17	500	1.0222	1.0071	1.2728	1.2026
18	500	0.9825	0.9858	1.2822	1.2228
19	600	1.0065	1.0216	1.3341	1.3042

Vibracore: VC08 Weight and Percent Weight by Size Class

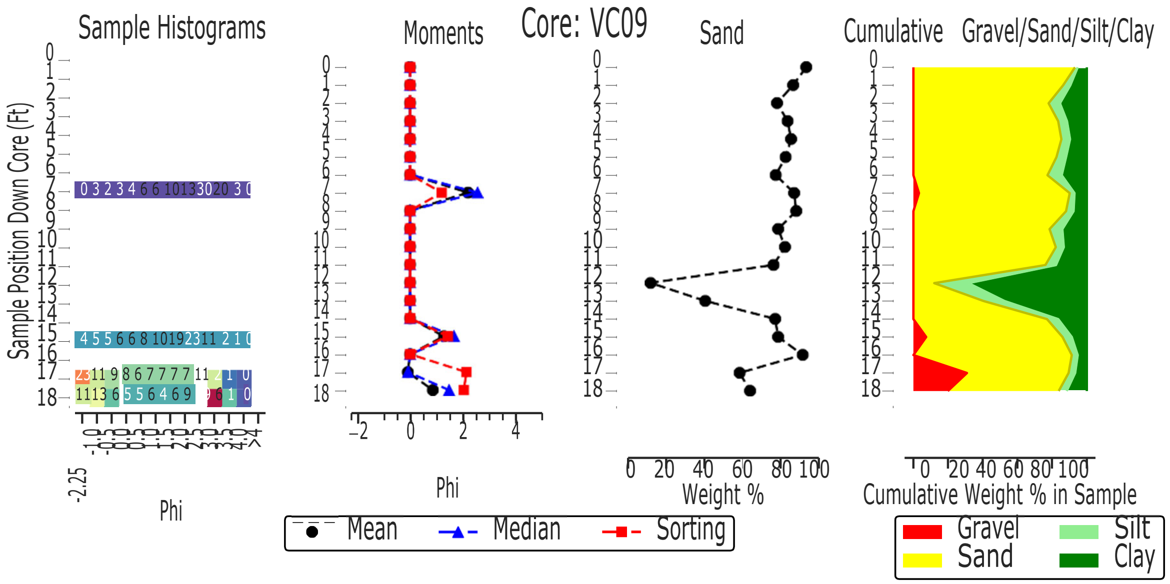
Depth	GravelWt	SandWt	TotalFinesWt	ClayWt	SiltWt	TotalWt	GravelWtPct	SandWtPct	SiltWtPct	ClayWtPct
0	8.36	30.59	1.79	0.82	0.97	40.74	20.5	75.1	2.4	2.0
1	0.00	30.05	5.02	3.95	1.07	35.07	0.0	85.7	3.1	11.3
2	0.00	34.65	6.38	4.95	1.43	41.03	0.0	84.5	3.5	12.1
3	0.00	33.43	4.43	3.34	1.09	37.86	0.0	88.3	2.9	8.8
4	0.00	31.55	5.09	3.96	1.13	36.64	0.0	86.1	3.1	10.8
5	0.00	33.94	4.28	3.50	0.78	38.22	0.0	88.8	2.0	9.2
6	0.00	28.88	6.18	3.56	2.62	35.06	0.0	82.4	7.5	10.2
7	0.00	29.85	6.88	4.71	2.17	36.73	0.0	81.3	5.9	12.8
8	11.32	22.82	8.42	6.15	2.27	42.56	26.6	53.6	5.3	14.5
9	0.00	33.89	3.10	1.85	1.25	36.99	0.0	91.6	3.4	5.0
10	0.00	32.58	4.60	3.13	1.47	37.18	0.0	87.6	4.0	8.4
11	3.47	27.37	5.99	4.11	1.88	36.83	9.4	74.3	5.1	11.2
12	3.86	27.34	5.13	3.45	1.68	36.33	10.6	75.3	4.6	9.5
13	8.40	21.64	4.03	2.78	1.25	34.07	24.7	63.5	3.7	8.2
14	2.45	25.37	6.14	4.63	1.51	33.96	7.2	74.7	4.4	13.6
15	5.25	24.86	6.90	4.92	1.98	37.01	14.2	67.2	5.3	13.3
16	8.74	19.40	4.96	3.16	1.80	33.10	26.4	58.6	5.4	9.5
17	6.84	22.87	3.83	2.39	1.44	33.54	20.4	68.2	4.3	7.1
18	6.03	25.47	5.21	3.43	1.78	36.71	16.4	69.4	4.8	9.3
19	0.00	34.24	6.83	5.48	1.35	41.07	0.0	83.4	3.3	13.3

Vibracore: VC08 Descriptive Statistics (Log Inclusive Graphics   Method)

Depth (ft)	Q1	Median	Q3	Mean	SD	Skew	Kurt
0.0	-0.655	1.502	2.640	0.872	2.075	-0.416	0.761
1.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8.0	-1.413	-0.371	0.928	-0.251	1.611	0.100	0.889
9.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.0	0.137	1.819	2.691	1.387	1.699	-0.395	0.879
12.0	0.775	2.472	2.796	1.619	1.650	-0.728	1.063
13.0	-1.321	0.807	2.454	0.408	2.148	-0.253	0.644
14.0	0.690	2.050	2.636	1.532	1.471	-0.554	0.986
15.0	-0.468	1.898	2.662	1.192	1.779	-0.557	0.684
16.0	-1.814	0.703	2.255	0.280	2.199	-0.245	0.603
17.0	-0.848	0.799	2.277	0.576	1.969	-0.191	0.765
18.0	-0.724	0.617	2.481	0.704	1.830	0.016	0.698
19.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Vibracore: VC09 Dry Mechanical Sieve Weight Fraction (g) by   Screen

Depth (ft)	-2.25φ	-1φ	-0.5φ	0φ	0.5φ	1.0φ	1.5φ	2.0φ	2.5φ	3.0φ	3.5φ	4.0φ	pan
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.12	1.19	0.73	1.00	1.32	2.19	2.22	3.52	4.79	11.23	7.34	1.14	0.14
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	1.45	1.58	1.63	1.97	2.12	2.93	3.56	6.66	8.08	3.70	0.83	0.34	0.07
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	8.54	4.11	3.22	2.87	2.36	2.56	2.51	2.64	2.55	4.15	0.79	0.24	0.06
18	3.73	4.59	2.24	1.73	1.86	2.02	1.51	2.04	3.02	10.14	1.94	0.30	0.12



Vibracore: VC09 Wet (pipetted $< 63\mu m$) Weight Fraction (g)

Depth (ft)	Cyl Vol (ml)	Pan Wt. 1st Draw (g)	Pan Wt. 2nd Draw (g)	Sample Wt. 1st Draw (g)	Sample Wt. 2nd Draw (g)
0	500	1.0212	1.0071	1.2176	1.1813
1	500	1.0273	1.0167	1.3142	1.2466
2	500	1.0545	1.0343	1.4457	1.3388
3	500	0.9957	1.0425	1.3217	1.2979
4	500	1.0265	1.0483	1.3382	1.2877
5	500	1.0004	1.0325	1.3283	1.2886
6	500	1.0011	0.9880	1.4328	1.2993
7	500	1.0213	1.0233	1.2758	1.2376
8	500	1.0063	1.0143	1.2836	1.2271
9	500	1.0027	1.0178	1.4242	1.3293
10	600	1.0000	1.0024	1.3136	1.2602
11	500	1.0347	1.0294	1.4605	1.3717
12	1000	1.0075	1.0004	1.4455	1.3625
13	500	1.0062	1.0073	1.6565	1.5458
14	500	1.0141	1.0291	1.4211	1.3498
15	500	1.0112	1.0040	1.3339	1.2423
16	500	1.0201	1.0486	1.2496	1.2266
17	500	1.0466	1.0036	1.3161	1.2117
18	600	1.0207	0.9931	1.3428	1.2552

Vibracore: VC09 Weight and Percent Weight by Size Class

Depth	GravelWt	SandWt	TotalFinesWt	ClayWt	SiltWt	TotalWt	GravelWtPct	SandWtPct	SiltWtPct	ClayWtPct
0	0.00	33.57	2.41	1.85	0.56	35.98	0.0	93.3	1.6	5.1
1	0.00	29.84	4.67	3.25	1.42	34.51	0.0	86.5	4.1	9.4
2	0.00	25.85	7.28	5.11	2.17	33.13	0.0	78.0	6.5	15.4
3	0.00	28.69	5.65	3.89	1.76	34.34	0.0	83.5	5.1	11.3
4	0.00	30.89	5.29	3.49	1.80	36.18	0.0	85.4	5.0	9.6
5	0.00	26.90	5.70	3.90	1.80	32.60	0.0	82.5	5.5	12.0
6	0.00	28.30	8.29	5.28	3.01	36.59	0.0	77.3	8.2	14.4
7	1.31	35.48	4.00	2.86	1.14	40.79	3.2	87.0	2.8	7.0
8	0.00	32.74	4.43	2.82	1.61	37.17	0.0	88.1	4.3	7.6
9	0.00	29.56	8.04	5.29	2.75	37.60	0.0	78.6	7.3	14.1
10	0.00	29.57	6.41	4.73	1.68	35.98	0.0	82.2	4.7	13.1
11	0.00	26.08	8.14	6.06	2.08	34.22	0.0	76.2	6.1	17.7
12	0.00	2.30	16.90	13.11	3.79	19.20	0.0	12.0	19.7	68.3
13	0.00	9.37	13.76	10.96	2.80	23.13	0.0	40.5	12.1	47.4
14	0.00	25.79	7.68	5.52	2.16	33.47	0.0	77.1	6.5	16.5
15	3.03	31.82	5.64	3.46	2.18	40.49	7.5	78.6	5.4	8.5
16	0.00	34.59	3.24	1.95	1.29	37.83	0.0	91.4	3.4	5.2
17	12.65	23.89	4.30	2.70	1.60	40.84	31.0	58.5	3.9	6.6
18	8.32	26.80	6.78	4.86	1.92	41.90	19.9	64.0	4.6	11.6

Vibracore: VC09 Descriptive Statistics (Log Inclusive Graphics Method)

Depth (ft)	Q1	Median	Q3	Mean	SD	Skew	Kurt
0.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7.0	1.566	2.562	2.973	2.200	1.203	-0.513	1.193
8.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15.0	0.495	1.667	2.265	1.287	1.431	-0.453	1.146
16.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17.0	-2.064	-0.077	1.742	-0.087	2.137	-0.001	0.640
18.0	-0.891	1.480	2.682	0.863	2.041	-0.421	0.680

Vibracore: VC10 Dry Mechanical Sieve Weight Fraction (g) by Screen

Depth (ft)	-2.25φ	-1φ	-0.5φ	0φ	0.5φ	1.0φ	1.5φ	2.0φ	2.5φ	3.0φ	3.5φ	4.0φ	pan
0	2.74	2.74	1.01	1.16	1.30	1.89	1.97	3.16	3.92	3.33	1.46	1.07	0.30
1	1.16	1.81	1.14	1.22	1.39	2.20	2.29	3.74	4.69	4.02	1.72	1.24	0.36
2	2.16	1.63	0.98	1.08	1.28	2.14	2.35	3.90	4.86	4.16	1.58	1.12	0.32
3	3.46	2.66	1.04	1.31	1.40	2.07	1.99	3.29	4.08	3.33	1.41	1.03	0.30
4	2.61	2.84	1.27	1.61	1.76	2.59	2.45	4.07	5.19	4.12	1.57	1.11	0.28
5	3.09	2.35	1.44	1.58	1.78	2.55	2.54	4.10	5.23	4.11	1.55	1.23	0.33
6	1.94	2.35	1.18	1.23	1.54	2.34	2.26	4.10	5.20	4.01	1.37	1.04	0.26
7	3.47	1.99	1.08	1.34	1.60	2.46	3.14	4.06	4.95	4.21	1.38	1.08	0.28
8	5.09	1.50	1.08	1.16	1.48	2.36	2.44	3.72	4.82	3.66	1.29	0.95	0.27
9	2.69	1.31	1.10	1.35	1.61	2.35	2.25	3.71	4.64	3.71	1.20	0.93	0.32
10	4.66	1.23	0.89	1.12	1.54	2.57	2.54	3.97	4.81	3.80	1.20	0.97	0.36
11	1.62	1.27	1.02	1.41	1.82	2.95	3.02	4.82	5.80	4.60	1.39	1.07	0.49
12	3.44	1.70	0.84	0.96	1.27	2.24	2.23	3.85	4.97	4.15	1.39	1.09	0.42

Vibracore: VC10 Wet (pipetted $< 63\mu m$) Weight Fraction (g)

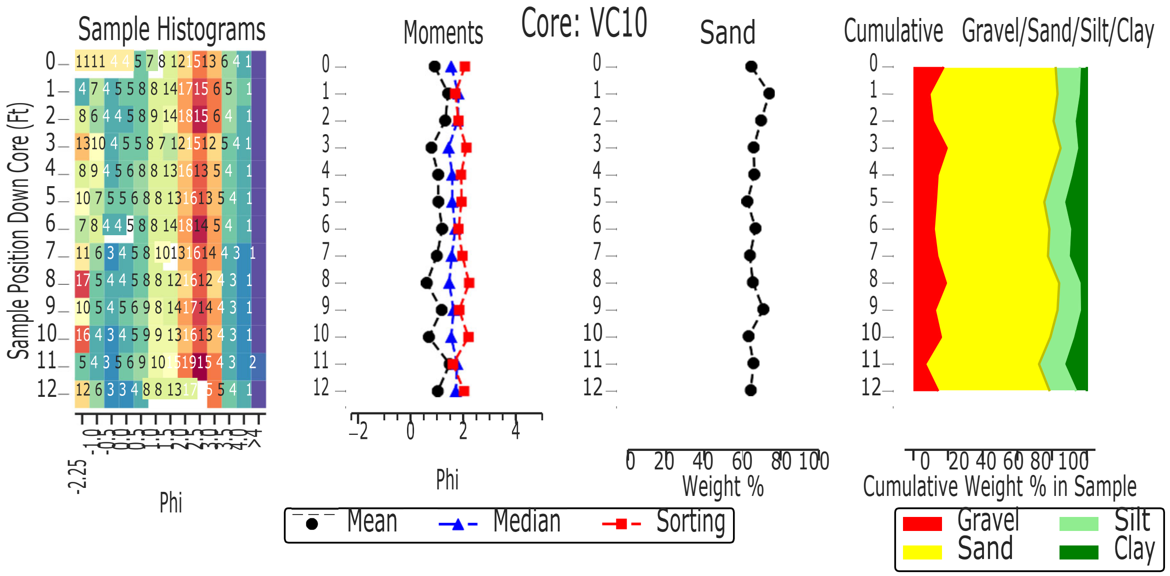
Depth	GravelWt	SandWt	TotalFinesWt	ClayWt	SiltWt	TotalWt	GravelWtPct	SandWtPct	SiltWtPct	ClayWtPct
0	5.48	20.27	5.65	1.25	4.40	31.40	17.5	64.6	14.0	4.0
1	2.97	23.65	5.36	1.50	3.86	31.98	9.3	74.0	12.1	4.7
2	3.79	23.45	6.44	2.36	4.08	33.68	11.3	69.6	12.1	7.0
3	6.12	20.95	4.78	1.78	3.00	31.85	19.2	65.8	9.4	5.6
4	5.45	25.74	7.76	3.48	4.28	38.95	14.0	66.1	11.0	8.9
5	5.44	26.11	10.22	5.48	4.74	41.77	13.0	62.5	11.3	13.1
6	4.29	24.27	7.81	3.50	4.31	36.37	11.8	66.7	11.9	9.6
7	5.46	25.30	8.86	4.16	4.70	39.62	13.8	63.9	11.9	10.5
8	6.59	22.96	5.58	1.47	4.11	35.13	18.8	65.4	11.7	4.2
9	4.00	22.85	5.43	1.29	4.14	32.28	12.4	70.8	12.8	4.0
10	5.89	23.41	7.76	2.96	4.80	37.06	15.9	63.2	13.0	8.0
11	2.89	27.90	11.69	5.55	6.14	42.48	6.8	65.7	14.5	13.1
12	5.14	22.99	7.63	2.18	5.45	35.76	14.4	64.3	15.2	6.1

Vibracore: VC10 Weight and Percent Weight by Size Class

Depth (ft)	GravelWt	SandWt	TotalFinesWt	ClayWt	SiltWt	TotalWt	GravelWtPct	SandWtPct	SiltWtPct	ClayWtPct
0	5.48	20.27	5.6480	1.2460	4.4020	31.3980	17.453341	64.558252	14.020001	3.968406
1	2.97	23.65	5.3640	1.4960	3.8680	31.9840	9.285893	73.943222	12.093547	4.677339
2	3.79	23.45	6.4385	2.3595	4.0790	33.6785	11.253470	69.628992	12.111585	7.005953
3	6.12	20.95	4.7780	1.7800	2.9980	31.8480	19.216277	65.781211	9.413464	5.589048
4	5.45	25.74	7.7560	3.4825	4.2735	38.9460	13.993735	66.091511	10.972886	8.941868
5	5.44	26.11	10.2180	5.4750	4.7430	41.7680	13.024325	62.511971	11.355583	13.108121
6	4.29	24.27	7.8050	3.4975	4.3075	36.3650	11.797058	66.739997	11.845181	9.617764
7	5.46	25.30	8.8600	4.1550	4.7050	39.6200	13.780919	63.856638	11.875315	10.487128
8	6.59	22.96	5.5825	1.4725	4.1100	35.1325	18.757561	65.352594	11.698570	4.191276
9	4.00	22.85	5.4250	1.2950	4.1300	32.2750	12.393493	70.797831	12.796282	4.012393
10	5.89	23.41	7.7625	2.9575	4.8050	37.0625	15.892074	63.163575	12.964587	7.979764
11	2.89	27.90	11.6890	5.5530	6.1360	42.4790	6.803362	65.679512	14.444784	13.072342
12	5.14	22.99	7.6300	2.1850	5.4450	35.7600	14.373602	64.289709	15.226510	6.110179

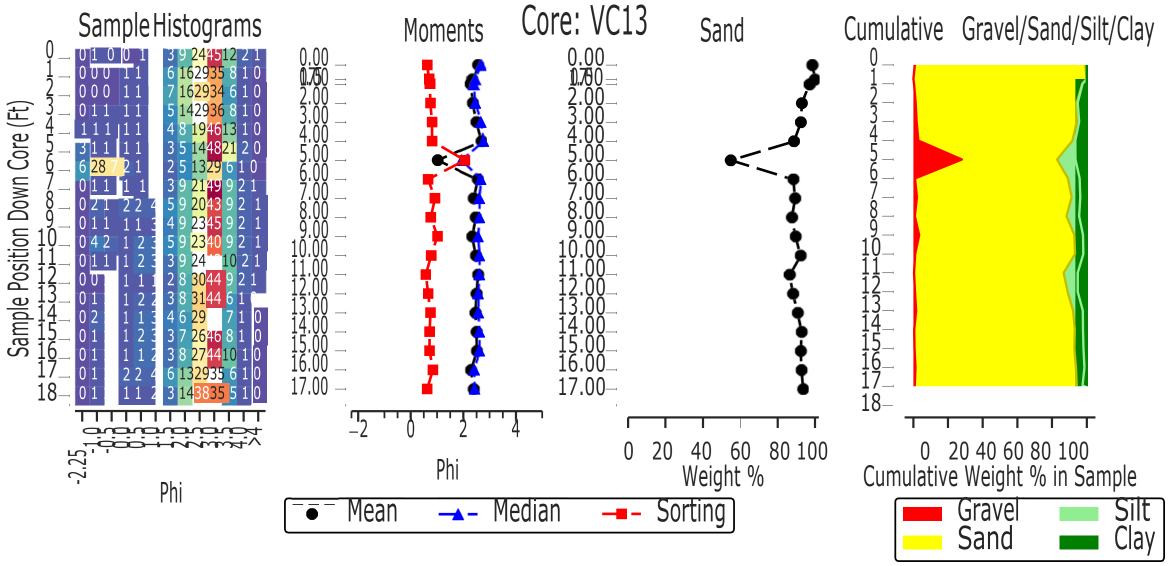
Vibracore: VC10 Descriptive Statistics (Log Inclusive Graphics Method)

Depth (ft)	Q1	Median	Q3	Mean	SD	Skew	Kurt
0.0	-0.490	1.534	2.455	0.911	2.055	-0.396	0.878
1.0	0.506	1.805	2.574	1.422	1.689	-0.361	1.134
2.0	0.406	1.777	2.535	1.309	1.810	-0.415	1.182
3.0	-0.653	1.438	2.405	0.791	2.104	-0.389	0.850
4.0	-0.144	1.574	2.424	1.046	1.905	-0.395	0.972
5.0	-0.155	1.574	2.428	1.051	1.927	-0.392	0.987
6.0	0.164	1.691	2.450	1.195	1.808	-0.410	1.068
7.0	-0.045	1.554	2.418	0.993	1.956	-0.407	1.037
8.0	-0.600	1.459	2.367	0.612	2.213	-0.449	0.877
9.0	0.106	1.625	2.432	1.176	1.836	-0.393	1.092
10.0	-0.217	1.535	2.387	0.693	2.183	-0.461	1.002
11.0	0.615	1.762	2.477	1.476	1.599	-0.348	1.273
12.0	0.078	1.707	2.491	1.028	2.021	-0.454	1.082



Vibracore: VC13 Dry Mechanical Sieve Weight Fraction (g) by Screen

Depth (ft)	-2.25φ	-1φ	-0.5φ	0φ	0.5φ	1.0φ	1.5φ	2.0φ	2.5φ	3.0φ	3.5φ	4.0φ	pan
0.00	0.02	0.28	0.11	0.14	0.26	0.64	1.03	3.25	8.51	15.89	4.31	0.76	0.26
0.75	0.00	0.03	0.11	0.21	0.42	1.21	2.41	6.18	11.18	13.71	2.96	0.34	0.06
1.00	0.00	0.15	0.14	0.31	0.50	1.20	2.59	5.72	10.04	11.73	2.17	0.27	0.00
2.00	0.00	0.51	0.28	0.31	0.44	1.11	1.84	5.22	10.59	13.43	2.85	0.33	0.02
3.00	0.28	0.35	0.34	0.34	0.48	1.01	1.16	2.52	6.12	15.10	4.36	0.45	0.03
4.00	0.98	0.21	0.27	0.25	0.35	0.62	1.02	1.78	5.07	17.83	7.83	0.69	0.06
5.00	2.05	9.71	2.40	0.58	0.35	0.42	0.68	1.60	4.46	9.96	2.13	0.52	0.07
6.00	0.00	0.39	0.24	0.26	0.29	0.58	1.10	3.37	7.51	17.49	3.34	0.86	0.25
7.00	0.00	0.70	0.39	0.48	0.57	1.19	1.39	2.80	6.06	13.11	2.78	0.76	0.20
8.00	0.00	0.30	0.25	0.41	0.45	1.01	1.17	2.93	7.30	14.16	2.70	0.72	0.23
9.00	0.00	1.34	0.61	0.48	0.73	1.24	1.72	3.46	8.26	14.62	3.25	0.71	0.19
10.00	0.00	0.40	0.32	0.42	0.62	1.09	1.17	3.06	8.45	15.09	3.55	0.74	0.23
11.00	0.00	0.13	0.18	0.21	0.26	0.42	0.61	2.72	9.78	14.32	2.78	0.60	0.21
12.00	0.00	0.30	0.24	0.24	0.45	0.70	0.75	2.42	9.33	13.23	1.94	0.29	0.10
13.00	0.00	0.63	0.41	0.41	0.52	0.96	1.50	2.37	10.64	16.21	2.60	0.37	0.08
14.00	0.00	0.20	0.35	0.42	0.67	1.04	1.12	2.63	9.43	16.59	3.02	0.48	0.07
15.00	0.01	0.28	0.36	0.50	0.49	0.93	1.21	2.89	9.95	16.57	3.72	0.54	0.07
16.00	0.00	0.51	0.54	0.58	0.74	1.40	2.40	4.89	11.04	13.39	2.33	0.54	0.11
17.00	0.00	0.35	0.35	0.29	0.38	0.70	1.16	5.63	15.71	14.52	2.03	0.49	0.09



Vibracore: VC13 Wet (pipetted $< 63\mu m$) Weight Fraction (g)

Depth (ft)	Cyl Vol (ml)	Pan Wt. 1st Draw (g)	Pan Wt. 2nd Draw (g)	Sample Wt. 1st Draw (g)	Sample Wt. 2nd Draw (g)
0.00	500	1.0181	1.0395	1.1140	1.1259
0.75	600	0.9705	1.0226	1.0493	1.0983
1.00	500	1.0304	1.0286	1.1672	1.1628
2.00	500	1.0107	1.0240	1.1999	1.2059
3.00	500	0.9795	1.0429	1.1577	1.2027
4.00	500	1.0247	1.0451	1.2557	1.2511
5.00	500	1.0081	1.0131	1.3929	1.2227
6.00	500	0.9847	1.0371	1.2457	1.2029
7.00	500	1.0044	0.9988	1.2121	1.1482
8.00	500	0.9904	1.0485	1.2472	1.2105
9.00	500	1.0062	1.0306	1.2106	1.1639
10.00	600	0.9849	1.0118	1.1624	1.1361
11.00	600	1.0314	1.0132	1.2887	1.1769
12.00	500	1.0174	0.9898	1.2617	1.1592
13.00	500	1.0449	1.0379	1.2664	1.1745
14.00	500	1.0050	1.0199	1.2079	1.1521
15.00	500	1.0052	1.0186	1.2168	1.1491
16.00	500	1.0169	1.0010	1.2137	1.1234
17.00	500	1.0379	1.0141	1.2358	1.1570

Vibracore: VC13 Weight and Percent Weight by Size Class

Depth	GravelWt	SandWt	TotalFinesWt	ClayWt	SiltWt	TotalWt	GravelWtPct	SandWtPct	SiltWtPct	ClayWtPct
0.00	0.30	34.90	0.26	0.00	0.26	35.46	0.8	98.4	0.7	0.0
0.75	0.03	38.73	0.06	0.00	0.06	38.82	0.1	99.8	0.2	0.0
1.00	0.15	34.67	0.92	0.86	0.06	35.74	0.4	97.0	0.2	2.4
2.00	0.51	36.40	2.25	2.05	0.20	39.16	1.3	93.0	0.5	5.2
3.00	0.63	31.88	1.98	1.50	0.48	34.49	1.8	92.4	1.4	4.3
4.00	1.19	35.71	3.34	2.65	0.69	40.24	3.0	88.7	1.7	6.6
5.00	11.76	23.10	7.19	2.74	4.45	42.05	28.0	54.9	10.6	6.5
6.00	0.39	35.04	4.28	1.65	2.63	39.71	1.0	88.2	6.6	4.2
7.00	0.70	29.53	2.89	1.24	1.65	33.12	2.1	89.2	5.0	3.7
8.00	0.30	31.10	4.15	1.55	2.60	35.55	0.8	87.5	7.3	4.4
9.00	1.34	35.08	2.80	0.83	1.97	39.22	3.4	89.4	5.0	2.1
10.00	0.40	34.51	2.56	0.73	1.83	37.47	1.1	92.1	4.9	1.9
11.00	0.13	31.88	4.93	1.91	3.02	36.94	0.4	86.3	8.2	5.2
12.00	0.30	29.59	3.71	1.73	1.98	33.60	0.9	88.1	5.9	5.1
13.00	0.63	35.99	3.12	0.92	2.20	39.74	1.6	90.6	5.5	2.3
14.00	0.20	35.75	2.64	0.80	1.84	38.59	0.5	92.6	4.8	2.1
15.00	0.29	37.16	2.86	0.76	2.10	40.31	0.7	92.2	5.2	1.9
16.00	0.51	37.85	2.53	0.56	1.97	40.89	1.2	92.6	4.8	1.4
17.00	0.35	41.26	2.54	1.07	1.47	44.15	0.8	93.5	3.3	2.4

Vibracore: VC13 Descriptive Statistics (Log Inclusive Graphics   Method)

Depth (ft)	Q1	Median	Q3	Mean	SD	Skew	Kurt
0.00	2.184	2.610	2.889	2.530	0.591	-0.264	1.311
0.75	1.930	2.395	2.769	2.313	0.654	-0.224	1.102
1.00	1.833	2.339	2.733	2.255	0.689	-0.253	1.090
2.00	1.954	2.413	2.775	2.316	0.710	-0.298	1.297
3.00	2.135	2.622	2.891	2.452	0.771	-0.460	1.647
4.00	2.371	2.722	2.981	2.645	0.772	-0.383	2.172
5.00	-1.390	1.898	2.698	0.987	2.015	-0.557	0.564
6.00	2.179	2.617	2.872	2.501	0.622	-0.339	1.412
7.00	2.007	2.562	2.852	2.349	0.880	-0.481	1.673
8.00	2.095	2.570	2.850	2.424	0.724	-0.393	1.519
9.00	1.938	2.516	2.829	2.294	0.979	-0.507	1.819
10.00	2.101	2.568	2.859	2.431	0.738	-0.387	1.563
11.00	2.180	2.563	2.844	2.513	0.534	-0.189	1.246
12.00	2.128	2.521	2.805	2.455	0.624	-0.327	1.526
13.00	2.112	2.528	2.811	2.415	0.711	-0.406	1.679
14.00	2.137	2.565	2.836	2.457	0.677	-0.384	1.592
15.00	2.136	2.565	2.848	2.467	0.676	-0.355	1.556
16.00	1.853	2.370	2.752	2.249	0.805	-0.348	1.381
17.00	2.050	2.382	2.731	2.349	0.585	-0.195	1.278

Vibracore: VC15 Dry Mechanical Sieve Weight Fraction (g) by Screen

Depth (ft)	-2.25φ	-1φ	-0.5φ	0φ	0.5φ	1.0φ	1.5φ	2.0φ	2.5φ	3.0φ	3.5φ	4.0φ	pan
0.0	0.91	1.31	1.14	1.08	1.73	4.33	5.61	8.68	11.53	6.02	0.62	0.08	0.00
1.0	0.49	1.23	0.99	1.08	2.09	5.64	4.88	7.21	8.31	3.81	0.35	0.02	0.00
2.0	0.25	0.19	0.31	0.45	0.52	1.34	3.28	7.85	13.13	8.56	0.95	0.08	0.00
3.0	0.00	0.25	0.46	0.40	0.48	0.94	1.71	6.33	14.62	10.88	1.42	0.11	0.00
4.0	0.00	0.28	0.47	0.55	0.67	1.11	1.43	5.42	13.75	10.18	1.05	0.15	0.00
5.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.0	8.07	9.46	3.81	2.24	2.15	2.63	1.40	1.55	2.72	2.55	0.56	0.12	0.00
7.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9.0	1.03	1.34	1.60	1.73	2.33	3.60	5.30	8.20	7.78	5.06	1.18	0.38	0.00
10.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11.0	0.57	1.55	2.00	3.43	4.57	6.39	8.27	7.33	3.15	1.62	0.28	0.11	0.00
12.0	0.47	4.12	3.18	3.93	5.63	7.70	4.60	2.69	2.63	1.51	0.17	0.05	0.00
13.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.0	0.00	0.06	0.20	0.25	0.18	0.12	0.13	3.66	19.51	11.75	0.85	0.33	0.08
16.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17.0	0.00	0.00	0.04	0.06	0.07	0.12	0.20	2.41	17.79	13.24	0.84	0.25	0.08

Vibracore: VC15 Wet (pipetted $< 63\mu m$) Weight Fraction (g)

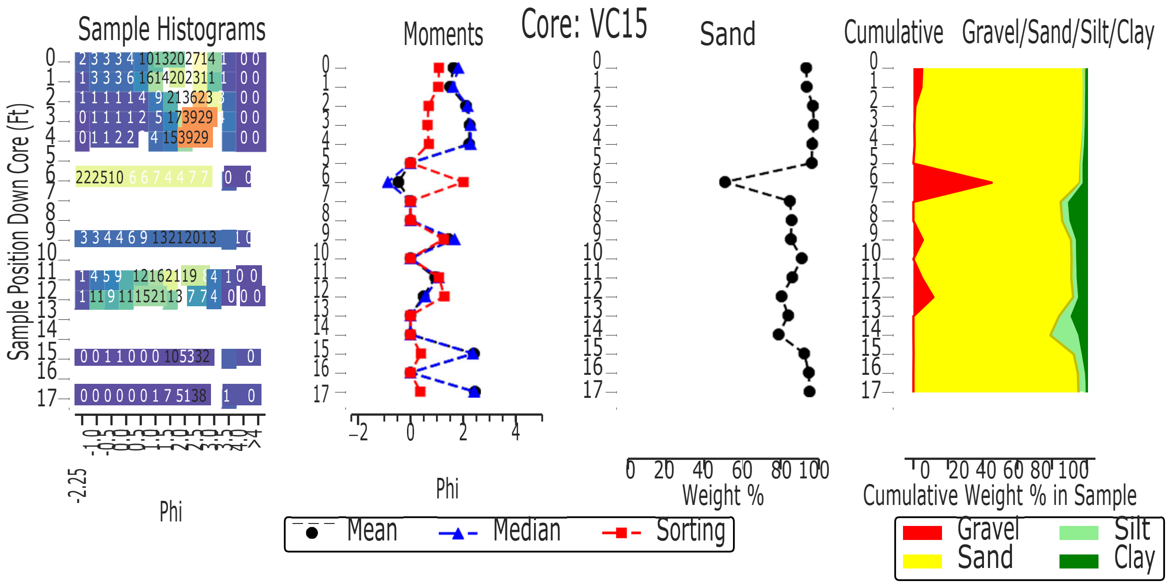
Depth (ft)	Cyl Vol (ml)	Pan Wt. 1st Draw (g)	Pan Wt. 2nd Draw (g)	Sample Wt. 1st Draw (g)	Sample Wt. 2nd Draw (g)
0.0	500	1.0174	1.0210	1.1418	1.1550
1.0	500	1.0404	1.0312	1.1632	1.1542
2.0	500	1.0333	1.0310	1.1605	1.1553
3.0	500	1.0032	0.9668	1.1319	1.0954
4.0	500	1.0200	1.0176	1.1566	1.1502
5.0	500	1.0049	0.9957	1.1559	1.1388
6.0	500	0.9936	1.0126	1.1543	1.1604
7.0	500	1.0063	1.0040	1.3345	1.2793
8.0	500	1.0280	1.0236	1.3436	1.2860
9.0	500	0.9976	0.9883	1.2556	1.2098
10.0	500	1.0021	1.0002	1.2337	1.2000
11.0	500	1.0097	0.9998	1.2626	1.2120
12.0	500	1.0040	0.9887	1.2295	1.1785
13.0	500	1.0075	1.0165	1.3426	1.2662
14.0	500	1.0361	0.9889	1.4387	1.1690
15.0	500	0.9986	1.0459	1.2137	1.2024
16.0	500	0.9653	1.0158	1.1385	1.1392
17.0	500	1.0220	1.0176	1.1887	1.1329

Vibracore: VC15 Weight and Percent Weight by Size Class

Depth	GravelWt	SandWt	TotalFinesWt	ClayWt	SiltWt	TotalWt	GravelWtPct	SandWtPct	SiltWtPct	ClayWtPct
0.0	2.22	40.82	0.61	0.85	0.00	43.65	5.1	93.5	0.0	1.9
1.0	1.72	34.38	0.57	0.57	0.00	36.67	4.7	93.8	0.0	1.6
2.0	0.44	36.47	0.68	0.61	0.07	37.59	1.2	97.0	0.2	1.6
3.0	0.25	37.35	0.72	0.71	0.01	38.32	0.7	97.5	0.0	1.9
4.0	0.28	34.78	0.92	0.81	0.11	35.98	0.8	96.7	0.3	2.3
5.0	0.00	34.59	1.28	1.08	0.20	35.87	0.0	96.4	0.6	3.0
6.0	17.53	19.73	1.52	1.20	0.32	38.78	45.2	50.9	0.8	3.1
7.0	0.00	32.17	5.71	4.38	1.33	37.88	0.0	84.9	3.5	11.6
8.0	0.00	32.74	5.39	4.06	1.33	38.13	0.0	85.9	3.5	10.6
9.0	2.37	37.16	3.95	3.04	0.91	43.48	5.5	85.5	2.1	7.0
10.0	0.00	33.95	3.29	2.49	0.80	37.24	0.0	91.2	2.1	6.7
11.0	2.12	37.15	3.82	2.80	1.02	43.09	4.9	86.2	2.4	6.5
12.0	4.59	32.09	3.14	2.25	0.89	39.82	11.5	80.6	2.2	5.7
13.0	0.00	31.05	5.88	3.74	2.14	36.93	0.0	84.1	5.8	10.1
14.0	0.00	28.54	7.57	2.00	5.57	36.11	0.0	79.0	15.4	5.5
15.0	0.06	36.98	2.96	1.41	1.55	40.00	0.2	92.5	3.9	3.5
16.0	0.00	33.99	1.83	0.58	1.25	35.82	0.0	94.9	3.5	1.6
17.0	0.00	35.02	1.75	0.38	1.37	36.77	0.0	95.2	3.7	1.0

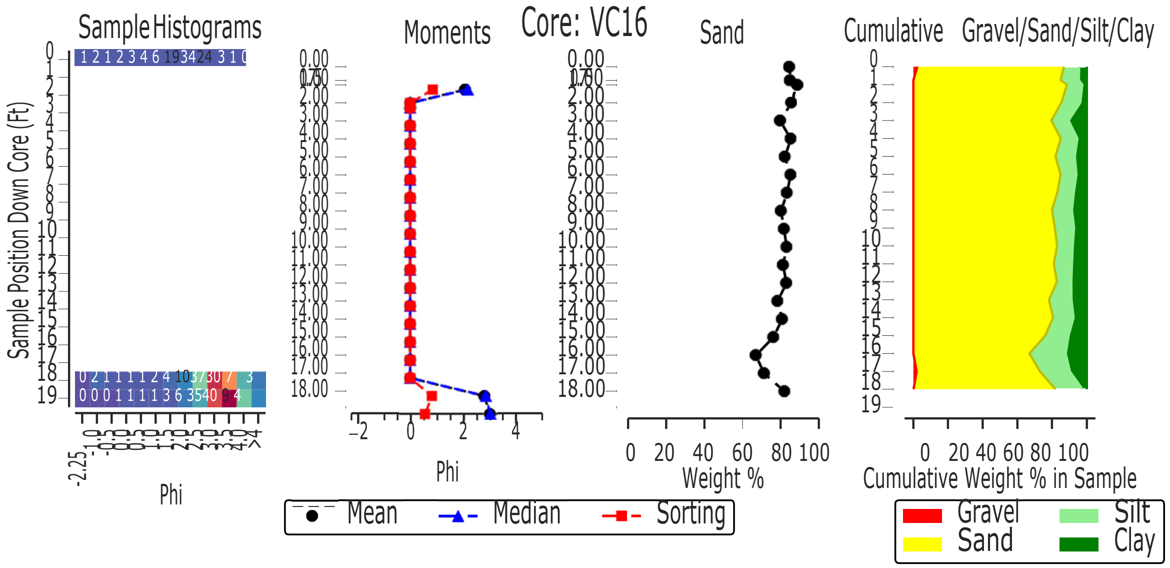
Vibracore: VC15 Descriptive Statistics (Log Inclusive Graphics Method)

Depth (ft)	Q1	Median	Q3	Mean	SD	Skew	Kurt
0.0	1.023	1.812	2.325	1.629	1.075	-0.373	1.241
1.0	0.779	1.614	2.208	1.498	1.053	-0.273	1.081
2.0	1.684	2.162	2.521	2.104	0.685	-0.240	1.178
3.0	1.908	2.281	2.638	2.238	0.642	-0.254	1.308
4.0	1.893	2.276	2.628	2.220	0.695	-0.307	1.469
5.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6.0	-2.085	-0.856	0.921	-0.457	2.004	0.259	0.789
7.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9.0	0.757	1.673	2.290	1.445	1.254	-0.345	1.157
10.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.0	0.248	1.068	1.682	0.935	1.079	-0.197	1.040
12.0	-0.322	0.566	1.270	0.496	1.284	-0.098	1.111
13.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15.0	2.120	2.358	2.659	2.398	0.396	0.035	1.026
16.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17.0	2.165	2.412	2.713	2.440	0.373	0.021	0.909



Vibracore: VC16 Dry Mechanical Sieve Weight Fraction (g) by Screen

Depth (ft)	-2.25φ	-1φ	-0.5φ	0φ	0.5φ	1.0φ	1.5φ	2.0φ	2.5φ	3.0φ	3.5φ	4.0φ	pan
0.00	0.37	0.54	0.49	0.58	0.91	1.42	2.14	6.64	11.72	8.23	0.91	0.44	0.15
0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17.00	0.07	0.62	0.29	0.20	0.26	0.38	0.55	1.23	2.87	10.44	8.48	1.91	0.76
18.00	0.00	0.07	0.10	0.17	0.22	0.32	0.40	0.95	1.88	11.75	13.30	3.09	1.26



Vibracore: VC16 Wet (pipetted $< 63 \mu m$) Weight Fraction (g)

Depth (ft)	Cyl Vol (ml)	Pan Wt. 1st Draw (g)	Pan Wt. 2nd Draw (g)	Sample Wt. 1st Draw (g)	Sample Wt. 2nd Draw (g)
0.00	500	1.0360	1.0499	1.3403	1.2192
0.75	500	0.9986	1.0340	1.3280	1.2028
1.00	500	1.0143	1.0463	1.2855	1.1839
2.00	500	1.0265	1.0040	1.3337	1.1566
3.00	500	0.9963	1.0066	1.4345	1.2803
4.00	500	1.0131	1.0107	1.3318	1.1899
5.00	500	1.0208	1.0144	1.3957	1.2195
6.00	500	1.0388	0.9883	1.3509	1.1727
7.00	500	1.0139	1.0036	1.3724	1.2164
8.00	500	1.0074	1.0341	1.3982	1.2581
9.00	500	1.0337	1.0115	1.4116	1.2225
10.00	500	1.0446	1.0410	1.3731	1.2480
11.00	500	1.0181	1.0358	1.3955	1.2603
12.00	500	0.9663	1.0517	1.3054	1.2750
13.00	500	0.9996	1.0029	1.4331	1.2373
14.00	500	1.0041	1.0243	1.3726	1.2291
15.00	500	0.9922	0.9984	1.4304	1.2456
16.00	500	1.0651	1.0062	1.6533	1.2849
17.00	500	1.0584	1.0749	1.5310	1.3203
18.00	500	1.0553	0.9990	1.3881	1.1371

Vibracore: VC16 Weight and Percent Weight by Size Class

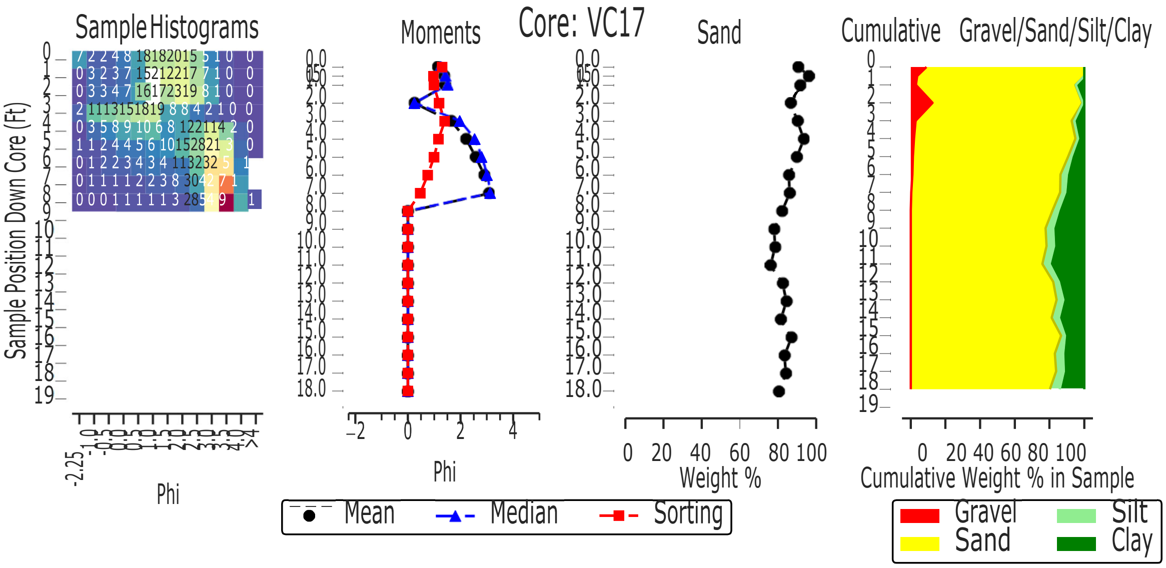
Depth	GravelWt	SandWt	TotalFinesWt	ClayWt	SiltWt	TotalWt	GravelWtPct	SandWtPct	SiltWtPct	ClayWtPct
0.00	0.91	33.48	5.26	1.73	3.53	39.65	2.3	84.4	8.9	4.4
0.75	0.00	32.14	5.74	1.72	4.02	37.88	0.0	84.8	10.6	4.5
1.00	0.00	33.27	4.28	0.94	3.34	37.55	0.0	88.6	8.9	2.5
2.00	0.00	30.30	5.18	1.32	3.86	35.48	0.0	85.4	10.9	3.7
3.00	0.00	32.91	8.46	4.34	4.12	41.37	0.0	79.6	10.0	10.5
4.00	0.00	31.10	5.47	1.98	3.49	36.57	0.0	85.0	9.5	5.4
5.00	0.00	31.31	6.87	2.63	4.24	38.18	0.0	82.0	11.1	6.9
6.00	0.00	30.01	5.30	2.11	3.19	35.31	0.0	85.0	9.0	6.0
7.00	0.00	31.71	6.46	2.82	3.64	38.17	0.0	83.1	9.5	7.4
8.00	0.00	29.06	7.27	3.10	4.17	36.33	0.0	80.0	11.5	8.5
9.00	0.00	30.73	6.95	2.77	4.18	37.68	0.0	81.6	11.1	7.4
10.00	0.00	27.70	5.71	2.68	3.03	33.41	0.0	82.9	9.1	8.0
11.00	0.00	29.69	6.94	3.11	3.83	36.63	0.0	81.1	10.5	8.5
12.00	0.00	28.73	5.98	3.08	2.90	34.71	0.0	82.8	8.4	8.9
13.00	0.00	29.87	8.34	3.36	4.98	38.21	0.0	78.2	13.0	8.8
14.00	0.00	27.80	6.71	2.62	4.09	34.51	0.0	80.6	11.9	7.6
15.00	0.00	26.83	8.45	3.68	4.77	35.28	0.0	76.0	13.5	10.4
16.00	0.00	24.72	12.21	4.47	7.74	36.93	0.0	66.9	21.0	12.1
17.00	0.69	26.61	10.07	3.64	6.43	37.37	1.8	71.2	17.2	9.7
18.00	0.07	32.18	7.08	0.95	6.13	39.33	0.2	81.8	15.6	2.4

Vibracore: VC16 Descriptive Statistics (Log Inclusive Graphics Method)

Depth (ft)	Q1	Median	Q3	Mean	SD	Skew	Kurt
0.00	1.665	2.178	2.567	2.072	0.853	-0.356	1.456
0.75	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17.00	2.526	2.862	3.244	2.803	0.825	-0.286	1.942
18.00	2.682	3.034	3.349	3.016	0.564	-0.125	1.367

Vibracore: VC17 Dry Mechanical Sieve Weight Fraction (g) by   Screen

Depth (ft)	-2.25φ	-1φ	-0.5φ	0φ	0.5φ	1.0φ	1.5φ	2.0φ	2.5φ	3.0φ	3.5φ	4.0φ	pan
0.0	2.72	1.02	0.84	1.65	3.21	7.48	7.42	8.19	6.06	2.14	0.32	0.06	0.02
0.5	0.17	1.15	0.82	1.25	2.42	5.54	7.74	7.82	6.00	2.64	0.40	0.06	0.00
1.0	0.00	1.36	1.18	1.63	3.15	6.74	7.28	9.75	8.29	3.37	0.47	0.08	0.01
2.0	0.66	4.40	5.07	6.08	7.21	7.53	3.01	2.97	1.58	0.80	0.23	0.06	0.00
3.0	0.04	1.19	2.18	3.45	3.78	4.14	2.58	3.38	5.13	8.68	5.59	0.84	0.11
4.0	0.23	0.53	0.91	1.40	1.68	2.08	2.54	3.81	5.73	11.08	8.23	1.15	0.11
5.0	0.00	0.48	0.63	0.80	1.11	1.34	1.07	1.57	3.80	11.43	11.13	1.72	0.19
6.0	0.00	0.38	0.37	0.41	0.46	0.68	0.72	1.13	2.75	10.57	14.83	2.43	0.27
7.0	0.00	0.13	0.17	0.19	0.20	0.29	0.29	0.51	1.20	9.99	19.09	3.07	0.36
8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00



Vibracore: VC17 Wet (pipetted $< 63\mu m$) Weight Fraction (g)

Depth (ft)	Cyl Vol (ml)	Pan Wt. 1st Draw (g)	Pan Wt. 2nd Draw (g)	Sample Wt. 1st Draw (g)	Sample Wt. 2nd Draw (g)
0.0	500	1.0538	1.0059	1.1298	1.0782
0.5	500	1.0454	1.0254	1.1341	1.1114
1.0	500	1.0365	1.0239	1.2293	1.2113
2.0	500	1.0579	1.0595	1.1744	1.1707
3.0	600	1.0129	0.9857	1.2167	1.1694
4.0	500	1.0551	1.0831	1.2336	1.2415
5.0	500	0.9993	1.0208	1.2354	1.2349
6.0	500	1.0245	0.9768	1.3331	1.2386
7.0	500	0.9845	0.9963	1.2970	1.2750
8.0	500	0.9939	1.0155	1.3645	1.3353
9.0	500	0.9899	1.0525	1.4098	1.4094
10.0	500	0.9871	0.9705	1.4030	1.3237
11.0	500	0.9907	1.0617	1.4250	1.4382
12.0	500	0.9903	0.9788	1.3688	1.3075
13.0	500	1.0534	1.0008	1.3824	1.2750
14.0	500	1.0212	1.0171	1.4250	1.3520
15.0	500	1.0097	1.0324	1.3170	1.3055
16.0	500	1.0175	1.0109	1.3725	1.2937
17.0	600	1.0389	1.0290	1.3634	1.2914
18.0	500	1.0177	1.0420	1.4194	1.3581

Vibracore: VC17 Weight and Percent Weight by Size Class

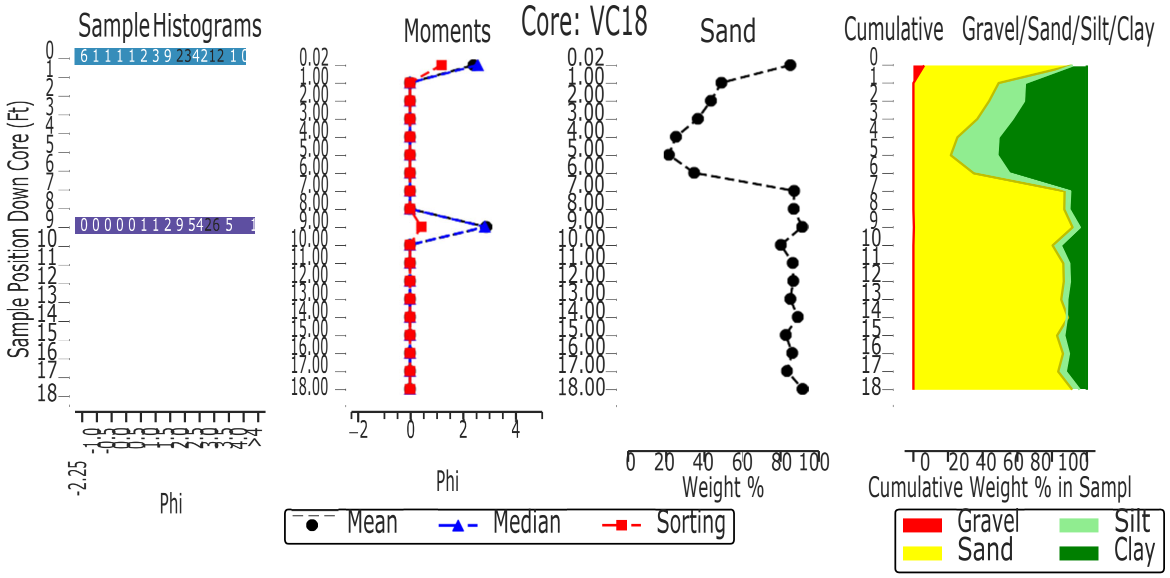
Depth	GravelWt	SandWt	TotalFinesWt	ClayWt	SiltWt	TotalWt	GravelWtPct	SandWtPct	SiltWtPct	ClayWtPct
0.0	3.74	37.37	0.02	0.00	0.02	41.13	9.1	90.9	0.0	0.0
0.5	1.32	34.69	0.00	0.00	0.00	36.01	3.7	96.3	0.0	0.0
1.0	1.36	41.94	2.33	2.18	0.15	45.63	3.0	91.9	0.3	4.8
2.0	5.06	34.54	0.41	0.28	0.13	40.01	12.6	86.3	0.3	0.7
3.0	1.23	39.75	3.22	2.51	0.71	44.20	2.8	89.9	1.6	5.7
4.0	0.76	38.61	2.07	1.46	0.61	41.44	1.8	93.2	1.5	3.5
5.0	0.48	34.60	3.59	2.85	0.74	38.67	1.2	89.5	1.9	7.4
6.0	0.38	34.35	5.48	4.04	1.44	40.21	0.9	85.4	3.6	10.0
7.0	0.13	35.00	5.67	4.47	1.20	40.80	0.3	85.8	2.9	11.0
8.0	0.00	30.45	6.77	5.49	1.28	37.22	0.0	81.8	3.4	14.8
9.0	0.00	27.95	8.00	6.42	1.58	35.95	0.0	77.7	4.4	17.9
10.0	0.00	28.44	7.90	6.33	1.57	36.34	0.0	78.3	4.3	17.4
11.0	0.00	26.26	8.36	6.91	1.45	34.62	0.0	75.9	4.2	20.0
12.0	0.00	32.22	6.96	5.72	1.24	39.18	0.0	82.2	3.2	14.6
13.0	0.00	30.35	5.73	4.35	1.38	36.08	0.0	84.1	3.8	12.1
14.0	0.00	32.74	7.59	5.87	1.72	40.33	0.0	81.2	4.3	14.6
15.0	0.00	33.74	5.18	4.33	0.85	38.92	0.0	86.7	2.2	11.1
16.0	0.00	31.40	6.38	4.57	1.81	37.78	0.0	83.1	4.8	12.1
17.0	0.00	34.94	6.74	4.87	1.87	41.68	0.0	83.8	4.5	11.7
18.0	0.00	30.50	7.54	5.40	2.14	38.04	0.0	80.2	5.6	14.2

Vibracore: VC17 Descriptive Statistics (Log Inclusive Graphics Method)

Depth (ft)	Q1	Median	Q3	Mean	SD	Skew	Kurt
0.0	0.556	1.246	1.897	1.156	1.302	-0.296	1.561
0.5	0.788	1.430	2.008	1.399	0.970	-0.145	1.160
1.0	0.760	1.516	2.084	1.424	0.989	-0.209	1.059
2.0	-0.523	0.249	0.917	0.253	1.185	-0.016	1.165
3.0	0.451	1.971	2.785	1.643	1.398	-0.323	0.740
4.0	1.566	2.537	2.983	2.202	1.162	-0.478	1.113
5.0	2.239	2.799	3.190	2.566	0.992	-0.493	1.567
6.0	2.588	3.001	3.296	2.889	0.754	-0.424	1.794
7.0	2.795	3.125	3.357	3.067	0.470	-0.245	1.294
8.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Vibracore: VC18 Dry Mechanical Sieve Weight Fraction (g) by   Screen

Depth (ft)	-2.25φ	-1φ	-0.5φ	0φ	0.5φ	1.0φ	1.5φ	2.0φ	2.5φ	3.0φ	3.5φ	4.0φ	pan
0.02	2.25	0.41	0.20	0.30	0.36	0.61	1.00	3.36	8.86	16.62	4.79	0.53	0.07
1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9.00	0.00	0.12	0.12	0.14	0.15	0.17	0.26	0.55	2.99	17.67	8.51	1.50	0.31
10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00



Vibracore: VC18 Wet (pipetted $< 63\mu m$) Weight Fraction (g)

Depth (ft)	Cyl Vol (ml)	Pan Wt. 1st Draw (g)	Pan Wt. 2nd Draw (g)	Sample Wt. 1st Draw (g)	Sample Wt. 2nd Draw (g)
0.02	500	0.9958	1.0896	1.2397	1.3258
1.00	700	0.9724	0.9969	1.4473	1.3599
2.00	900	1.0249	1.0161	1.4854	1.3479
3.00	900	1.0233	0.9744	1.4811	1.3174
4.00	900	1.0182	1.0369	1.5374	1.4226
5.00	900	1.0177	1.0264	1.5439	1.4066
6.00	900	1.0125	1.0026	1.5560	1.4065
7.00	500	1.0112	1.0183	1.3077	1.2659
8.00	600	1.0216	1.0226	1.2791	1.2439
9.00	500	1.0446	1.0447	1.2465	1.2013
10.00	500	1.0286	1.0249	1.4082	1.3371
11.00	500	1.0647	1.0206	1.3583	1.2664
12.00	500	1.0154	0.9790	1.3088	1.2213
13.00	500	0.9979	1.0063	1.3344	1.2863
14.00	500	0.9951	1.0422	1.2583	1.3148
15.00	500	0.9845	1.0346	1.3523	1.3376
16.00	600	1.0163	1.0307	1.2923	1.2621
17.00	600	1.0037	0.9842	1.3250	1.2466
18.00	700	0.9780	0.9825	1.1611	1.1237

Vibracore: VC18 Weight and Percent Weight by Size Class

Depth	GravelWt	SandWt	TotalFinesWt	ClayWt	SiltWt	TotalWt	GravelWtPct	SandWtPct	SiltWtPct	ClayWtPct
0.02	2.66	36.63	3.67	3.41	0.26	42.96	6.2	85.3	0.6	7.9
1.00	0.00	12.70	13.12	9.21	3.91	25.82	0.0	49.2	15.1	35.7
2.00	0.00	12.58	16.22	10.43	5.79	28.80	0.0	43.7	20.1	36.2
3.00	0.00	9.39	16.10	10.93	5.17	25.49	0.0	36.8	20.3	42.9
4.00	0.00	6.41	18.86	12.86	6.00	25.27	0.0	25.4	23.7	50.9
5.00	0.00	5.29	19.18	12.61	6.57	24.47	0.0	21.6	26.8	51.5
6.00	0.00	10.69	19.96	13.68	6.28	30.65	0.0	34.9	20.5	44.6
7.00	0.00	33.70	4.91	3.69	1.22	38.61	0.0	87.3	3.2	9.6
8.00	0.00	31.76	4.72	3.64	1.08	36.48	0.0	87.1	3.0	10.0
9.00	0.12	32.06	2.86	1.42	1.44	35.04	0.3	91.5	4.1	4.1
10.00	0.00	28.49	6.99	5.31	1.68	35.48	0.0	80.3	4.7	15.0
11.00	0.00	31.10	4.84	3.65	1.19	35.94	0.0	86.5	3.3	10.2
12.00	0.00	31.82	4.83	3.56	1.27	36.65	0.0	86.8	3.5	9.7
13.00	0.00	34.26	5.91	4.50	1.41	40.17	0.0	85.3	3.5	11.2
14.00	0.00	33.57	4.08	4.31	0.00	37.65	0.0	89.2	0.0	11.4
15.00	0.00	32.38	6.70	5.07	1.63	39.08	0.0	82.9	4.2	13.0
16.00	0.00	33.19	5.28	3.94	1.34	38.47	0.0	86.3	3.5	10.2
17.00	0.00	33.63	6.64	4.87	1.77	40.27	0.0	83.5	4.4	12.1
18.00	0.00	32.06	2.91	1.44	1.47	34.97	0.0	91.7	4.2	4.1

Vibracore: VC18 Descriptive Statistics (Log Inclusive Graphics Method)

Depth (ft)	Q1	Median	Q3	Mean	SD	Skew	Kurt
0.02	2.076	2.570	2.866	2.406	1.193	-0.552	2.974
1.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9.00	2.603	2.832	3.129	2.884	0.429	0.074	1.202
10.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Vibracore: VC19 Dry Mechanical Sieve Weight Fraction (g) by Screen

Depth (ft)	-2.25φ	-1φ	-0.5φ	0φ	0.5φ	1.0φ	1.5φ	2.0φ	2.5φ	3.0φ	3.5φ	4.0φ	pan
0.0	0.67	1.51	0.86	1.29	1.76	4.44	5.12	4.21	3.12	2.90	5.81	0.82	0.11
1.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.0	0.00	0.01	0.05	0.05	0.08	0.14	0.17	0.37	0.92	11.52	16.03	2.13	0.24
4.0	0.07	0.23	0.17	0.17	0.16	0.22	0.31	0.51	1.46	13.49	17.56	2.72	0.42
5.0	0.00	0.29	0.14	0.11	0.08	0.06	0.10	0.33	1.52	17.90	14.84	1.97	0.29
6.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	1.48	15.37	14.31	1.65	0.16
7.0	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.20	3.88	17.73	12.71	1.65	0.26
8.0	0.00	0.00	0.08	0.07	0.06	0.09	0.12	0.35	3.27	19.95	10.42	1.74	0.30
9.0	0.00	0.11	0.03	0.05	0.03	0.02	0.10	0.41	4.41	20.31	11.63	1.88	0.26
10.0	0.00	0.07	0.08	0.12	0.17	0.27	0.32	1.06	7.84	17.96	7.22	0.94	0.13
11.0	0.00	0.00	0.00	0.00	0.00	0.09	0.31	1.11	8.44	21.14	6.02	0.57	0.09
12.0	0.00	0.11	0.01	0.08	0.11	0.11	0.17	0.61	5.16	23.81	9.27	1.26	0.24
13.0	0.00	0.00	0.00	0.00	0.00	0.09	0.19	0.53	3.65	22.58	8.57	0.85	0.09
14.0	0.00	0.18	0.17	0.23	0.17	0.23	0.36	1.11	6.88	22.12	6.04	0.60	0.07
15.0	0.00	0.00	0.01	0.05	0.01	0.03	0.07	0.39	4.63	23.07	6.51	0.52	0.09
16.0	0.00	0.00	0.00	0.00	0.06	0.11	0.20	1.00	6.25	24.89	8.76	0.83	0.13
17.0	0.00	0.00	0.00	0.00	0.03	0.04	0.14	0.61	4.42	21.02	6.35	0.90	0.33

Vibracore: VC19 Wet (pipetted $< 63\mu m$) Weight Fraction (g)

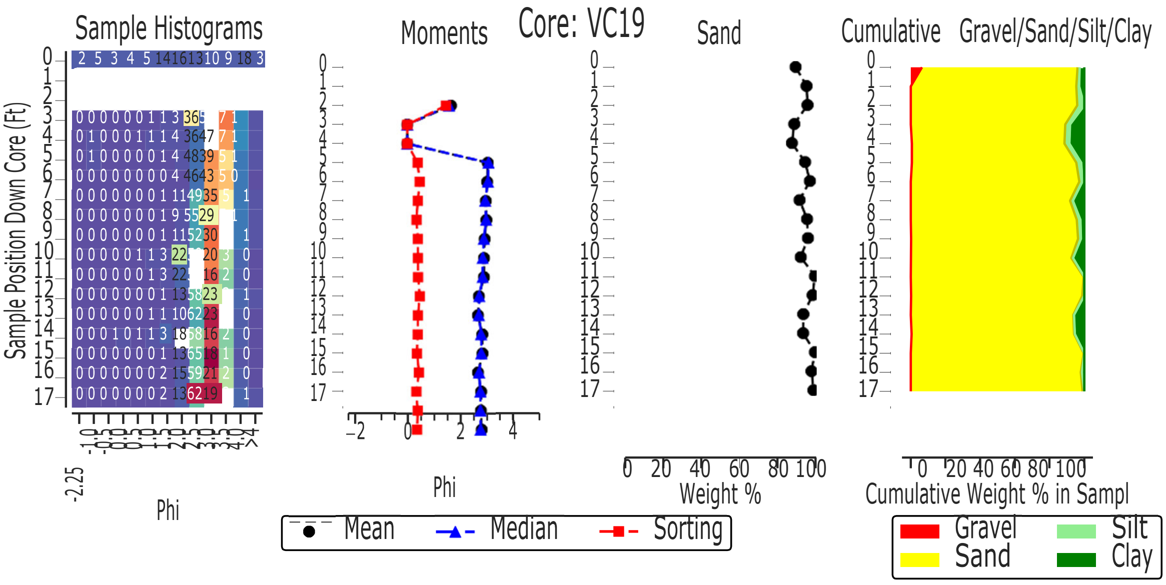
Depth (ft)	Cyl Vol (ml)	Pan Wt. 1st Draw (g)	Pan Wt. 2nd Draw (g)	Sample Wt. 1st Draw (g)	Sample Wt. 2nd Draw (g)
0.0	500	1.0375	1.0703	1.1844	1.2049
1.0	500	0.9999	0.9830	1.1629	1.1226
2.0	500	1.0161	1.2067	1.1698	1.1627
3.0	500	1.0639	1.0270	1.3081	1.2415
4.0	500	1.0156	1.0520	1.2904	1.2940
5.0	600	1.0374	1.0577	1.1872	1.1793
6.0	500	1.0316	1.0536	1.1637	1.1674
7.0	500	1.0153	1.0364	1.2339	1.2389
8.0	500	1.0535	1.0496	1.2063	1.1829
9.0	500	1.0328	1.0376	1.1801	1.1678
10.0	700	1.0275	1.0592	1.2059	1.2310
11.0	500	1.0678	1.0258	1.1434	1.0988
12.0	500	1.0684	1.0508	1.1776	1.1520
13.0	500	1.0660	1.0647	1.2595	1.2552
14.0	500	1.0274	1.1012	1.2201	1.2880
15.0	500	1.0768	1.0595	1.1708	1.1495
16.0	500	1.0425	1.0578	1.1715	1.1789
17.0	500	1.0949	1.0553	1.1820	1.1282

Vibracore: VC19 Weight and Percent Weight by Size Class

Depth	GravelWt	SandWt	TotalFinesWt	ClayWt	SiltWt	TotalWt	GravelWtPct	SandWtPct	SiltWtPct	ClayWtPct
0.0	2.18	30.33	1.28	0.87	0.41	33.79	6.5	89.8	1.2	2.6
1.0	0.00	32.92	1.58	0.99	0.59	34.50	0.0	95.4	1.7	2.9
2.0	0.00	31.70	1.34	0.00	1.34	33.04	0.0	95.9	4.1	0.0
3.0	0.01	31.46	3.84	2.86	0.98	35.31	0.0	89.1	2.8	8.1
4.0	0.30	36.77	4.79	3.55	1.24	41.86	0.7	87.8	3.0	8.5
5.0	0.29	37.05	1.78	0.65	1.13	39.12	0.7	94.7	2.9	1.7
6.0	0.00	32.91	0.96	0.34	0.62	33.87	0.0	97.2	1.8	1.0
7.0	0.00	36.19	3.22	2.56	0.66	39.41	0.0	91.8	1.7	6.5
8.0	0.00	36.15	1.62	0.83	0.79	37.77	0.0	95.7	2.1	2.2
9.0	0.11	38.87	1.44	0.75	0.69	40.42	0.3	96.2	1.7	1.9
10.0	0.07	35.98	2.87	2.51	0.36	38.92	0.2	92.4	0.9	6.4
11.0	0.00	37.68	0.09	0.00	0.09	37.77	0.0	99.8	0.2	0.0
12.0	0.11	40.59	0.47	0.03	0.44	41.17	0.3	98.6	1.1	0.1
13.0	0.00	36.46	2.43	2.26	0.17	38.89	0.0	93.8	0.4	5.8
14.0	0.18	37.91	2.39	2.17	0.22	40.48	0.4	93.7	0.5	5.4
15.0	0.00	35.29	0.09	0.00	0.09	35.38	0.0	99.7	0.3	0.0
16.0	0.00	42.10	0.86	0.53	0.33	42.96	0.0	98.0	0.8	1.2
17.0	0.00	33.51	0.33	0.00	0.33	33.84	0.0	99.0	1.0	0.0

Vibracore: VC19 Descriptive Statistics (Log Inclusive Graphics Method)

Depth (ft)	Q1	Median	Q3	Mean	SD	Skew	Kurt
0.0	0.733	1.578	2.756	1.654	1.461	-0.080	0.991
1.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3.0	2.766	3.079	3.327	3.046	0.389	-0.097	0.946
4.0	2.725	3.056	3.323	3.025	0.466	-0.163	1.179
5.0	2.689	2.952	3.259	2.973	0.398	0.021	0.965
6.0	2.718	2.986	3.274	2.995	0.348	0.055	0.770
7.0	2.641	2.898	3.217	2.931	0.399	0.039	0.939
8.0	2.627	2.856	3.161	2.906	0.406	0.102	1.075
9.0	2.614	2.856	3.170	2.902	0.412	0.077	1.039
10.0	2.444	2.727	2.979	2.712	0.474	-0.068	1.212
11.0	2.470	2.711	2.935	2.678	0.404	-0.065	1.213
12.0	2.581	2.796	3.029	2.843	0.391	0.082	1.270
13.0	2.604	2.806	3.022	2.850	0.369	0.088	1.283
14.0	2.505	2.720	2.936	2.679	0.445	-0.166	1.561
15.0	2.579	2.771	2.963	2.798	0.344	0.066	1.366
16.0	2.559	2.771	2.983	2.790	0.393	0.021	1.329
17.0	2.577	2.778	2.979	2.818	0.374	0.092	1.392



Vibracore: VC23 Dry Mechanical Sieve Weight Fraction (g) by Screen

Depth (ft)	-2.25φ	-1φ	-0.5φ	0φ	0.5φ	1.0φ	1.5φ	2.0φ	2.5φ	3.0φ	3.5φ	4.0φ	pan
0.00	3.12	1.80	1.00	1.04	1.30	2.32	3.83	5.93	9.73	6.93	0.78	0.13	0.04
0.75	1.60	4.77	2.38	2.20	1.98	2.61	2.64	4.42	6.64	4.08	0.54	0.19	0.15
1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Vibracore: VC23 Wet (pipetted < 63μm) Weight Fraction (g)

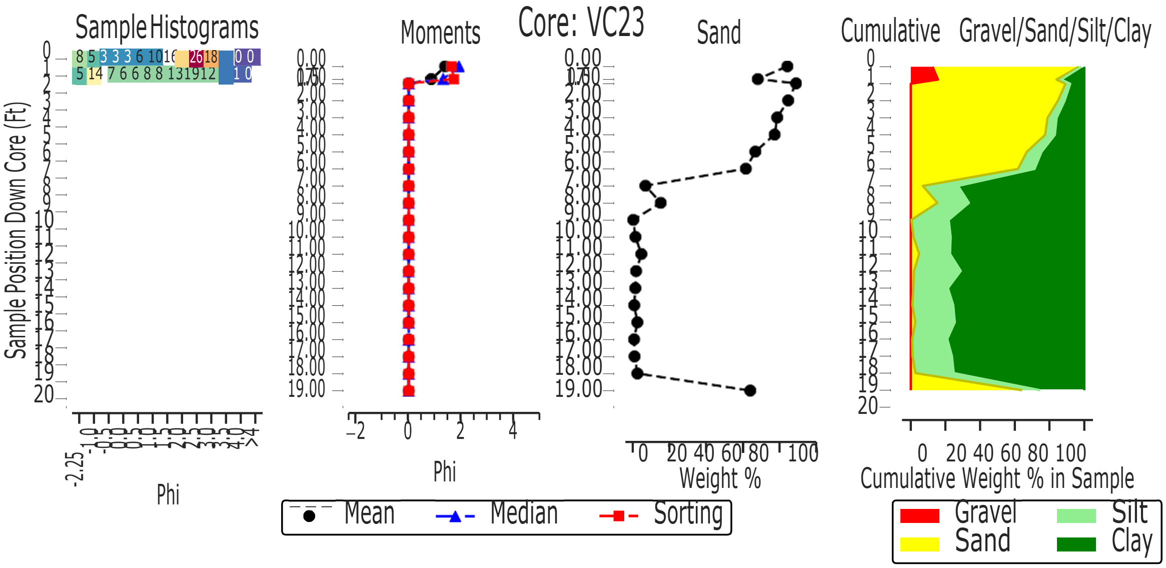
Depth (ft)	Cyl Vol (ml)	Pan Wt. 1st Draw (g)	Pan Wt. 2nd Draw (g)	Sample Wt. 1st Draw (g)	Sample Wt. 2nd Draw (g)
0.00	500	1.0638	1.0433	1.2095	1.1708
0.75	500	1.0356	1.0618	1.3894	1.3760
1.00	500	1.0220	1.0378	1.2900	1.2627
2.00	500	1.0125	1.0150	1.3557	1.2960
3.00	600	1.0413	1.0354	1.4131	1.3393
4.00	600	0.9959	1.0321	1.3797	1.3458
5.00	600	1.0510	1.0266	1.5514	1.4242
6.00	600	1.0280	1.0079	1.5843	1.4496
7.00	800	1.0272	1.0184	1.6168	1.5014
8.00	700	1.0397	1.0277	1.7392	1.5985
9.00	800	1.0076	0.9931	1.5944	1.4746
10.00	1000	1.0347	1.0447	1.5878	1.4995
11.00	900	1.0404	0.9923	1.5980	1.4641
12.00	1000	1.0205	0.9679	1.5603	1.3872
13.00	1000	1.0215	1.0147	1.5059	1.4212
14.00	900	1.0322	1.0309	1.6457	1.5220
15.00	900	1.0383	0.9982	1.5994	1.4516
16.00	800	0.9965	1.0190	1.6439	1.5549
17.00	900	1.0199	1.0313	1.6995	1.5782
18.00	800	1.0129	1.0229	1.7086	1.5832
19.00	500	1.0318	1.0299	1.6370	1.4873

Vibracore: VC23 Weight and Percent Weight by Size Class

Depth	GravelWt	SandWt	TotalFinesWt	ClayWt	SiltWt	TotalWt	GravelWtPct	SandWtPct	SiltWtPct	ClayWtPct
0.00	4.92	32.99	1.18	0.69	0.49	39.09	12.6	84.4	1.3	1.8
0.75	6.37	27.68	6.49	5.35	1.14	40.54	15.7	68.3	2.8	13.2
1.00	0.00	34.55	4.20	3.12	1.08	38.75	0.0	89.2	2.8	8.1
2.00	0.00	34.00	6.08	4.53	1.55	40.08	0.0	84.8	3.9	11.3
3.00	0.00	30.39	8.15	6.12	2.03	38.54	0.0	78.9	5.3	15.9
4.00	0.00	29.25	8.51	6.41	2.10	37.76	0.0	77.5	5.6	17.0
5.00	0.00	24.31	12.01	8.93	3.08	36.32	0.0	66.9	8.5	24.6
6.00	0.00	22.11	13.69	10.25	3.44	35.80	0.0	61.8	9.6	28.6
7.00	0.00	1.48	19.58	15.32	4.26	21.06	0.0	7.0	20.2	72.7
8.00	0.00	3.81	20.98	16.48	4.50	24.79	0.0	15.4	18.2	66.5
9.00	0.00	0.08	19.47	15.26	4.21	19.55	0.0	0.4	21.5	78.1
10.00	0.00	0.37	22.66	17.74	4.92	23.03	0.0	1.6	21.4	77.0
11.00	0.00	1.04	20.59	16.73	3.86	21.63	0.0	4.8	17.8	77.3
12.00	0.00	0.44	21.99	15.97	6.02	22.43	0.0	2.0	26.8	71.2
13.00	0.00	0.30	19.22	15.33	3.89	19.52	0.0	1.5	19.9	78.5
14.00	0.00	0.22	23.11	17.60	5.51	23.33	0.0	0.9	23.6	75.4
15.00	0.00	0.56	20.75	15.90	4.85	21.31	0.0	2.6	22.8	74.6
16.00	0.00	0.19	21.90	17.44	4.46	22.09	0.0	0.9	20.2	78.9
17.00	0.00	0.29	26.08	20.11	5.97	26.37	0.0	1.1	22.6	76.3
18.00	0.00	0.65	23.83	18.41	5.42	24.48	0.0	2.7	22.1	75.2
19.00	0.00	22.61	12.63	8.94	3.69	35.24	0.0	64.2	10.5	25.4

Vibracore: VC23 Descriptive Statistics (Log Inclusive Graphics Method)

Depth (ft)	Q1	Median	Q3	Mean	SD	Skew	Kurt
0.00	0.765	1.885	2.417	1.363	1.609	-0.568	1.383
0.75	-0.542	1.295	2.230	0.840	1.700	-0.371	0.757
1.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000


Core: VC23
Sample Histograms
Sample Position Down Core (Ft)
8 5 3 3 3 6 10 16 26 18 0 0
5 14 7 6 6 8 8 13 19 12 1 0
-2.25
Phi
Moments
Phi
Mean
Median
Sorting
Sand
Weight %
Cumulative Gravel/Sand/Silt/Clay
Cumulative Weight % in Sample
Gravel
Sand
Silt
Clay

Vibracore: VC24 Dry Mechanical Sieve Weight Fraction (g) by Screen

Depth (ft)	-2.25φ	-1φ	-0.5φ	0φ	0.5φ	1.0φ	1.5φ	2.0φ	2.5φ	3.0φ	3.5φ	4.0φ	pan
0	0.16	0.26	0.33	0.40	0.71	1.67	2.77	7.19	14.75	11.71	1.18	0.17	0.02
1	0.45	0.59	0.24	0.41	0.75	1.83	3.69	6.36	12.53	11.80	0.83	0.16	0.08
2	0.00	0.25	0.18	0.21	0.26	0.79	1.46	3.74	13.63	13.77	0.89	0.18	0.10
3	0.00	0.21	0.25	0.24	0.36	0.75	1.26	3.59	13.29	14.40	0.92	0.24	0.15
4	0.00	0.31	0.38	0.43	0.53	0.94	1.06	2.57	11.08	13.61	1.16	0.26	0.10
5	0.00	0.33	0.44	0.40	0.42	0.73	0.99	2.41	11.16	17.59	1.68	0.38	0.13
6	0.11	0.55	0.48	0.40	0.33	0.48	0.59	1.57	7.18	14.13	2.44	0.76	0.24
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	11.55	5.76	1.80	1.00	0.81	0.68	0.44	0.57	0.79	6.30	4.81	1.58	0.66
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.14	0.52	0.32	0.19	0.16	0.22	0.19	0.33	0.97	10.82	14.69	3.55	0.97
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Vibracore: VC24 Wet (pipetted $< 63\mu m$) Weight Fraction (g)

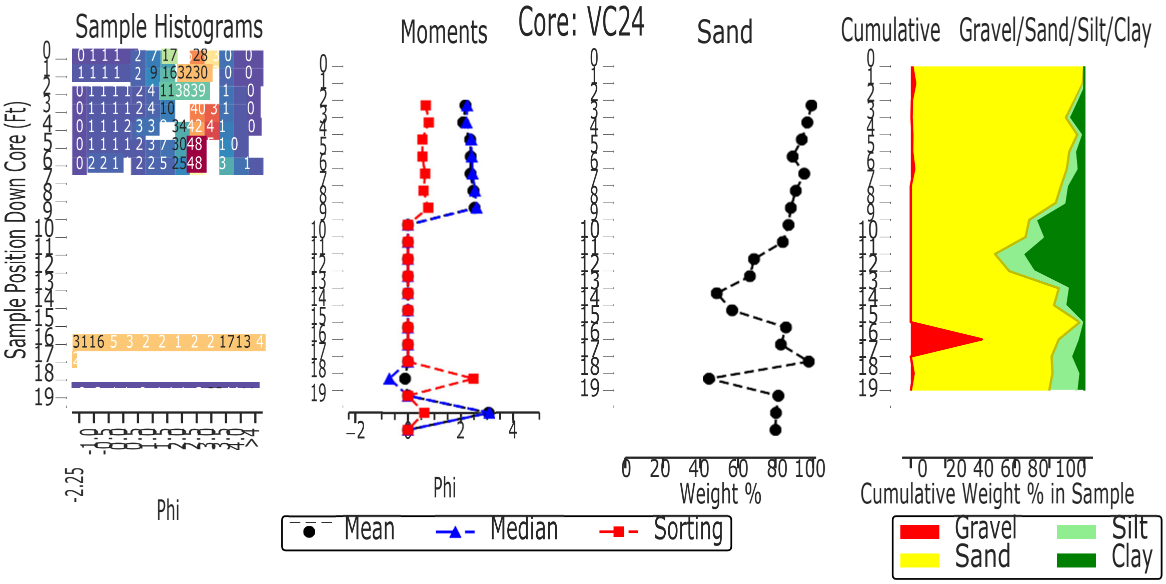
Depth (ft)	Cyl Vol (ml)	Pan Wt. 1st Draw (g)	Pan Wt. 2nd Draw (g)	Sample Wt. 1st Draw (g)	Sample Wt. 2nd Draw (g)
0	600	1.0271	1.0448	1.1129	1.1298
1	500	1.0614	1.0997	1.1696	1.1898
2	500	1.0631	1.0234	1.2431	1.1888
3	500	1.0581	1.0507	1.3204	1.2930
4	600	1.0410	1.0838	1.1830	1.2057
5	600	1.0493	1.0241	1.2598	1.1960
6	500	1.0592	1.0469	1.2791	1.2046
7	500	0.9874	1.0368	1.2992	1.2952
8	600	1.0275	1.0119	1.3487	1.2673
9	700	1.0041	1.0513	1.4106	1.4221
10	800	1.0009	1.0355	1.4961	1.4154
11	900	0.9945	1.0314	1.4352	1.3664
12	900	1.0234	1.0203	1.4373	1.3319
13	700	1.0286	1.0312	1.2990	1.2429
14	600	0.9919	1.0402	1.3294	1.2916
15	600	1.0262	1.0452	1.2090	1.1853
16	500	0.9904	0.9912	1.3105	1.1556
17	600	1.0097	1.0545	1.3688	1.2599
18	500	1.0571	1.1082	1.4055	1.2614
19	600	1.0113	1.0284	1.3970	1.1930

Vibracore: VC24 Weight and Percent Weight by Size Class

Depth	GravelWt	SandWt	TotalFinesWt	ClayWt	SiltWt	TotalWt	GravelWtPct	SandWtPct	SiltWtPct	ClayWtPct
0	0.42	40.88	0.02	0.00	0.02	41.32	1.0	98.9	0.0	0.0
1	1.04	38.60	0.29	0.00	0.29	39.93	2.6	96.7	0.7	0.0
2	0.25	35.11	2.10	1.63	0.47	37.46	0.7	93.7	1.3	4.4
3	0.21	35.30	4.21	3.56	0.65	39.72	0.5	88.9	1.6	9.0
4	0.31	32.02	1.36	0.66	0.70	33.69	0.9	95.0	2.1	2.0
5	0.33	36.20	3.45	2.16	1.29	39.98	0.8	90.5	3.2	5.4
6	0.66	28.36	3.24	1.44	1.80	32.26	2.0	87.9	5.6	4.5
7	0.00	34.49	5.29	3.96	1.33	39.78	0.0	86.7	3.3	10.0
8	0.00	33.96	6.64	4.66	1.98	40.60	0.0	83.6	4.9	11.5
9	0.00	23.17	10.73	9.48	1.25	33.90	0.0	68.3	3.7	28.0
10	0.00	30.93	15.81	11.20	4.61	46.74	0.0	66.2	9.9	24.0
11	0.00	14.48	15.33	10.57	4.76	29.81	0.0	48.6	16.0	35.5
12	0.00	18.54	14.13	9.52	4.61	32.67	0.0	56.7	14.1	29.1
13	0.00	34.74	5.96	3.91	2.05	40.70	0.0	85.4	5.0	9.6
14	0.00	33.96	7.12	4.54	2.58	41.08	0.0	82.7	6.3	11.1
15	0.00	95.35	2.48	1.20	1.28	97.83	0.0	97.5	1.3	1.2
16	17.31	18.78	6.16	1.61	4.55	42.25	41.0	44.4	10.8	3.8
17	0.00	33.75	7.77	3.16	4.61	41.52	0.0	81.3	11.1	7.6
18	0.66	31.44	7.18	1.33	5.85	39.28	1.7	80.0	14.9	3.4
19	0.00	33.83	8.57	1.94	6.63	42.40	0.0	79.8	15.6	4.6

Vibracore: VC24 Descriptive Statistics (Log Inclusive Graphics Method)

Depth (ft)	Q1	Median	Q3	Mean	SD	Skew	Kurt
0.0	1.780	2.243	2.617	2.180	0.678	-0.273	1.179
1.0	1.655	2.221	2.625	2.093	0.792	-0.361	1.168
2.0	2.072	2.398	2.721	2.357	0.545	-0.264	1.231
3.0	2.085	2.420	2.736	2.378	0.548	-0.283	1.260
4.0	2.085	2.451	2.758	2.372	0.649	-0.396	1.536
5.0	2.154	2.541	2.802	2.481	0.592	-0.369	1.543
6.0	2.195	2.604	2.863	2.524	0.766	-0.398	2.148
7.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16.0	-2.455	-0.704	2.830	-0.108	2.484	0.297	0.521
17.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18.0	2.742	3.091	3.372	3.056	0.616	-0.251	1.712
19.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000


Core: VC24
Sample Histograms
Sample Position Down Core (Ft)
0 1 1 1 2 7 17 28 0 0
1 1 1 1 2 9 16 32 30 0 0
0 1 1 1 1 2 4 11 38 39 1 0
0 1 1 1 1 2 4 10 40 3 1 0
0 1 1 1 2 3 3 34 42 4 1 0
0 1 1 1 1 2 3 7 30 48 1 0
0 2 2 1 2 2 5 25 48 3 1
31 16 5 3 2 2 1 2 2 17 13 4
-2.25
Phi
Moments
-2
0
2
4
Phi
Mean
Median
Sorting
Sand
0 20 40 60 80 100
Weight %
Cumulative Gravel/Sand/Silt/Clay
0 20 40 60 80 100
Cumulative Weight % in Sample
Gravel
Sand
Silt
Clay
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19

Vibracore: VC25 Dry Mechanical Sieve Weight Fraction (g) by Screen

Depth (ft)	-2.25φ	-1φ	-0.5φ	0φ	0.5φ	1.0φ	1.5φ	2.0φ	2.5φ	3.0φ	3.5φ	4.0φ	pan
0	0.29	0.48	0.27	0.23	0.25	0.60	1.24	3.33	9.43	16.76	1.69	0.16	0.02
1	0.25	0.22	0.21	0.24	0.22	0.53	1.53	3.79	10.36	20.40	2.23	0.23	0.04
2	0.12	1.03	0.34	0.31	0.29	0.68	1.49	4.03	10.63	18.63	2.13	0.15	0.02
3	0.17	0.35	0.21	0.19	0.23	0.57	1.38	4.09	10.62	20.73	2.11	0.17	0.02
4	0.00	0.10	0.12	0.19	0.17	0.39	1.20	2.99	7.73	18.45	2.33	0.19	0.02
5	0.00	0.14	0.11	0.12	0.13	0.23	0.75	2.31	7.61	22.43	3.60	0.27	0.06
6	0.08	0.17	0.19	0.29	0.27	0.40	0.82	2.63	8.28	22.06	3.63	0.31	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.06	0.72	0.45	0.44	0.41	0.49	0.86	1.96	6.78	19.36	4.53	0.39	0.03
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.02	0.54	0.56	0.55	0.48	0.75	0.74	1.46	4.48	16.44	7.58	0.84	0.23

Vibracore: VC25 Wet (pipetted $< 63\mu m$) Weight Fraction (g)

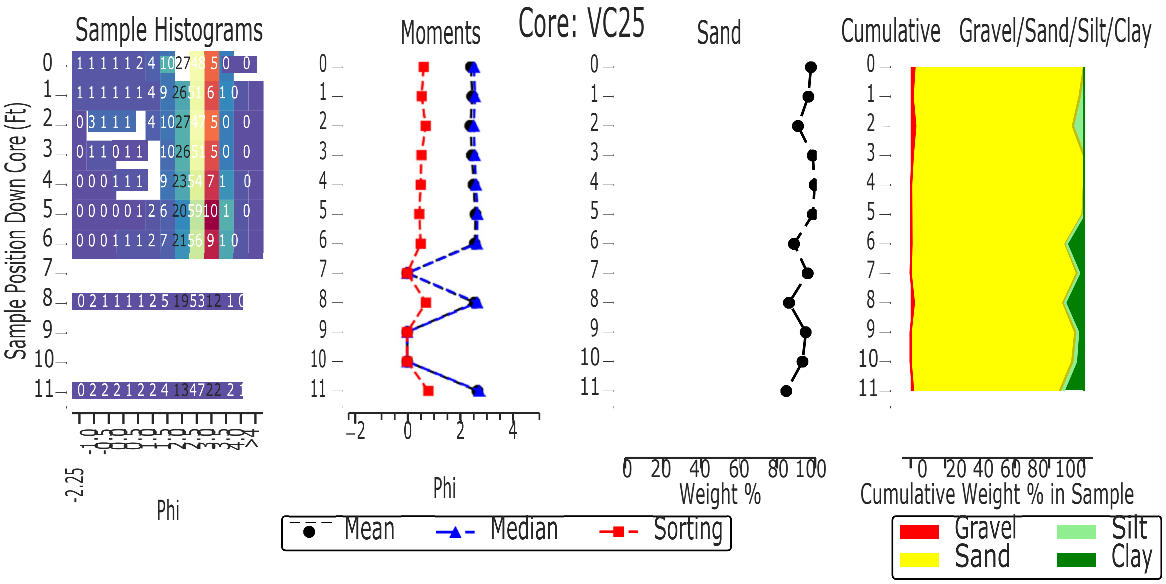
Depth (ft)	Cyl Vol (ml)	Pan Wt. 1st Draw (g)	Pan Wt. 2nd Draw (g)	Sample Wt. 1st Draw (g)	Sample Wt. 2nd Draw (g)
0	500	1.0664	1.0513	1.1355	1.1153
1	500	1.0230	1.0910	1.1627	1.1258
2	500	1.1102	1.9781	1.3183	1.1836
3	500	1.0098	1.0591	1.0923	1.1354
4	500	1.0373	1.0556	1.1262	1.1368
5	500	1.0541	1.0859	1.1657	1.1874
6	500	1.0559	1.0344	1.3423	1.3087
7	500	1.0329	0.9792	1.1877	1.1170
8	500	0.9800	0.9898	1.2768	1.2697
9	500	1.0205	0.9866	1.1890	1.1334
10	500	1.0239	0.9922	1.2175	1.1568
11	500	1.0511	1.0271	1.3638	1.3160

Vibracore: VC25 Weight and Percent Weight by Size Class

Depth	GravelWt	SandWt	TotalFinesWt	ClayWt	SiltWt	TotalWt	GravelWtPct	SandWtPct	SiltWtPct	ClayWtPct
0	0.77	33.96	0.02	0.00	0.02	34.75	2.2	97.7	0.1	0.0
1	0.47	39.74	1.03	0.00	1.03	41.24	1.1	96.4	2.5	0.0
2	1.15	38.68	2.72	0.00	2.72	42.55	2.7	90.9	6.4	0.0
3	0.52	40.30	0.02	0.00	0.02	40.84	1.3	98.7	0.0	0.0
4	0.10	33.76	0.02	0.00	0.02	33.88	0.3	99.6	0.1	0.0
5	0.14	37.56	0.35	0.04	0.31	38.05	0.4	98.7	0.8	0.1
6	0.25	38.88	4.66	4.36	0.30	43.79	0.6	88.8	0.7	10.0
7	0.00	32.68	1.37	0.95	0.42	34.05	0.0	96.0	1.2	2.8
8	0.78	35.67	4.95	4.50	0.45	41.40	1.9	86.2	1.1	10.9
9	0.00	32.35	1.71	1.17	0.54	34.06	0.0	95.0	1.6	3.4
10	0.00	32.39	2.34	1.62	0.72	34.73	0.0	93.3	2.1	4.7
11	0.56	33.88	5.55	4.72	0.83	39.99	1.4	84.7	2.1	11.8

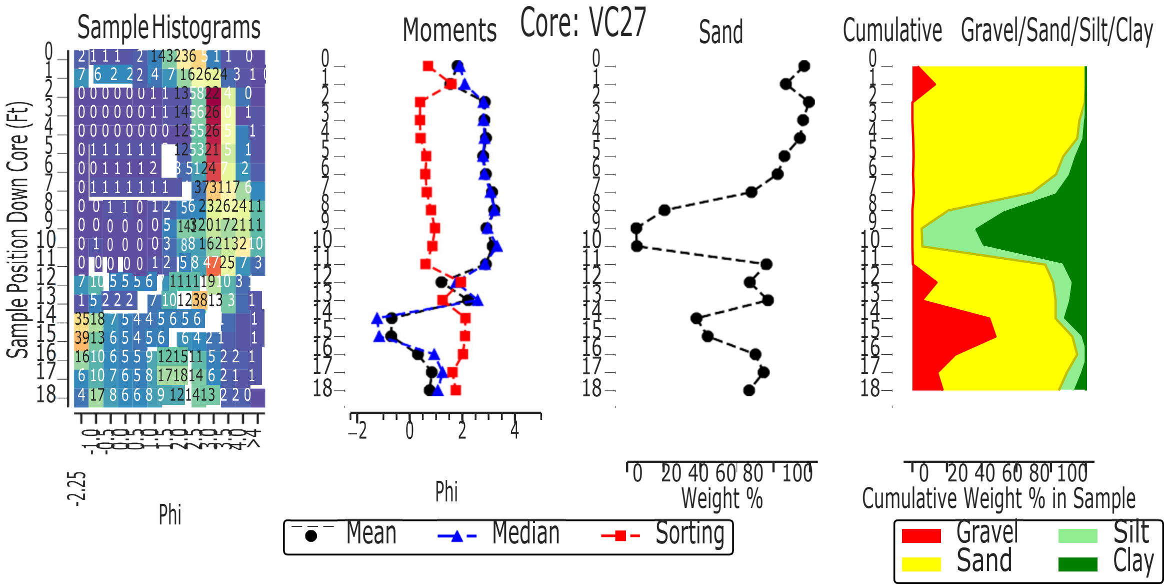
Vibracore: VC25 Descriptive Statistics (Log Inclusive Graphics Method)

Depth (ft)	Q1	Median	Q3	Mean	SD	Skew	Kurt
0.0	2.106	2.537	2.797	2.419	0.622	-0.454	1.399
1.0	2.148	2.568	2.815	2.466	0.547	-0.386	1.227
2.0	2.079	2.527	2.794	2.394	0.697	-0.478	1.571
3.0	2.142	2.563	2.809	2.460	0.539	-0.401	1.194
4.0	2.214	2.610	2.839	2.516	0.511	-0.351	1.233
5.0	2.371	2.667	2.877	2.589	0.458	-0.281	1.374
6.0	2.298	2.646	2.868	2.559	0.509	-0.327	1.391
7.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8.0	2.275	2.657	2.892	2.556	0.714	-0.443	2.097
9.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.0	2.398	2.736	2.999	2.664	0.802	-0.382	2.312



Vibracore: VC27 Dry Mechanical Sieve Weight Fraction (g) by Screen

Depth (ft)	-2.25φ	-1φ	-0.5φ	0φ	0.5φ	1.0φ	1.5φ	2.0φ	2.5φ	3.0φ	3.5φ	4.0φ	pan
0	0.86	0.28	0.26	0.36	0.83	1.79	5.17	12.06	13.88	2.09	0.27	0.27	0.02
1	2.71	2.15	0.78	0.57	0.58	1.31	2.67	6.12	9.76	9.05	1.26	0.30	0.01
2	0.00	0.00	0.00	0.00	0.00	0.05	0.41	0.41	4.19	19.02	7.25	1.31	0.16
3	0.00	0.00	0.00	0.01	0.03	0.04	0.52	0.52	5.13	21.26	9.95	0.15	0.26
4	0.07	0.09	0.06	0.01	0.00	0.00	0.06	0.16	4.12	19.52	9.13	1.77	0.39
5	0.00	0.27	0.31	0.36	0.27	0.29	0.31	0.75	3.60	16.03	6.22	1.61	0.28
6	0.00	0.14	0.30	0.26	0.21	0.24	0.46	0.74	2.32	14.47	6.74	2.10	0.49
7	0.07	0.21	0.14	0.16	0.15	0.13	0.23	0.26	0.88	8.95	7.52	4.12	1.45
8	0.00	0.00	0.04	0.03	0.00	0.06	0.08	0.23	0.24	1.01	1.11	1.06	0.47
9	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.18	0.17	0.27	0.22	0.28	0.14
10	0.00	0.01	0.00	0.00	0.00	0.00	0.05	0.12	0.12	0.23	0.31	0.47	0.14
11	0.00	0.11	0.08	0.13	0.11	0.33	0.69	1.33	2.31	13.85	7.50	2.08	1.01
12	2.14	2.87	1.49	1.50	1.38	1.81	1.93	3.13	3.29	5.65	2.96	1.00	0.40
13	0.40	1.71	0.61	0.62	0.66	1.23	2.14	3.34	3.78	12.50	4.36	1.01	0.49
14	12.94	6.75	2.60	1.86	1.39	1.54	1.80	2.11	2.00	2.20	0.99	0.48	0.20
15	14.67	4.73	2.16	1.86	1.59	1.98	2.43	2.73	2.36	1.60	0.72	0.53	0.28
16	6.42	3.99	2.25	2.08	2.18	3.82	4.78	6.17	4.64	2.14	0.87	0.64	0.44
17	2.47	3.87	2.73	2.20	2.09	3.32	6.57	7.25	5.46	2.31	0.68	0.58	0.26
18	1.42	6.81	3.30	2.53	2.24	3.17	3.43	4.64	5.47	5.29	0.76	0.64	0.17



Vibracore: VC27 Wet (pipetted $< 63\mu m$) Weight Fraction (g)

Depth (ft)	Cyl Vol (ml)	Pan Wt. 1st Draw (g)	Pan Wt. 2nd Draw (g)	Sample Wt. 1st Draw (g)	Sample Wt. 2nd Draw (g)
0	500	1.0667	1.0396	1.1432	1.1132
1	500	1.0476	1.0621	1.1214	1.1368
2	600	1.0365	1.0195	1.1143	1.0925
3	500	1.0381	1.0703	1.1851	1.1965
4	500	1.0334	1.0365	1.1909	1.1740
5	500	1.0176	1.0418	1.2867	1.2392
6	500	0.9927	0.9947	1.3043	1.2361
7	600	1.0097	0.9956	1.4028	1.2928
8	1000	1.0274	0.9794	1.4113	1.2565
9	900	1.0560	0.9911	1.6205	1.4108
10	700	1.0115	1.0022	1.7207	1.4906
11	600	1.0292	1.0387	1.3848	1.3106
12	500	0.9674	0.9993	1.3208	1.2252
13	500	1.0359	1.0398	1.3891	1.3010
14	500	1.0100	1.0410	1.4118	1.3790
15	600	1.0175	1.0712	1.2129	1.2123
16	500	1.0892	1.0500	1.2536	1.1249
17	500	1.0891	1.0606	1.3719	1.2211
18	500	1.0893	1.0488	1.4758	1.2948

Vibracore: VC27 Weight and Percent Weight by Size Class

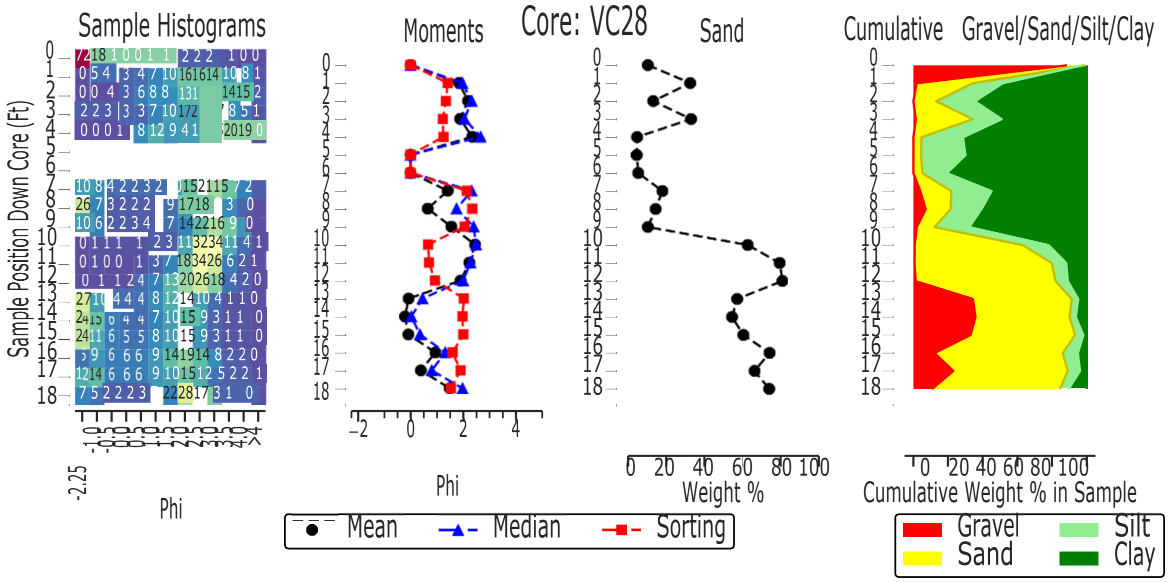
Depth (ft)	GravelWt	SandWt	TotalFinesWt	ClayWt	SiltWt	TotalWt	GravelWtPct	SandWtPct	SiltWtPct	ClayWtPct
0	1.14	36.98	0.0200	0.0000	0.0200	38.1400	2.988988	96.958574	0.052438	0.000000
1	4.86	32.40	0.0100	0.0000	0.0100	37.2700	13.039979	86.933190	0.026831	0.000000
2	0.00	32.64	0.1600	0.0000	0.1600	32.8000	0.000000	99.512195	0.487805	0.000000
3	0.00	37.61	1.4350	0.6550	0.7800	39.0450	0.000000	96.324753	1.997695	1.677552
4	0.16	34.83	1.8275	0.9375	0.8900	36.8175	0.434576	94.601752	2.417329	2.546343
5	0.27	29.75	4.5075	2.4350	2.0725	34.5275	0.781985	86.163203	6.002462	7.052350
6	0.14	27.84	5.7800	3.5350	2.2450	33.7600	0.414692	82.464455	6.649882	10.470972
7	0.28	22.54	10.2430	5.9160	4.3270	33.0630	0.846868	68.172882	13.087137	17.893113
8	0.00	3.86	14.6650	8.8550	5.8100	18.5250	0.000000	20.836707	31.363023	47.800270
9	0.00	1.19	21.0425	14.3865	6.6560	22.2325	0.000000	5.352524	29.938154	64.709322
10	0.01	1.30	21.4620	13.5940	7.8680	22.7720	0.043914	5.708765	34.551203	59.696118
11	0.11	28.41	8.6780	5.1570	3.5210	37.1980	0.295715	76.375074	9.465563	13.863649
12	5.01	24.14	6.7350	3.1475	3.5875	35.8850	13.961265	67.270447	9.997213	8.771074
13	2.11	30.25	6.8200	4.0300	2.7900	39.1800	5.385401	77.207759	7.120980	10.285860
14	19.69	16.97	7.7450	5.9500	1.7950	44.4050	44.341853	38.216417	4.042338	13.399392
15	19.40	17.96	3.1420	1.2330	1.9090	40.5020	47.898869	44.343489	4.713347	3.044294
16	10.41	29.57	2.0500	0.0000	2.0500	42.0300	24.768023	70.354509	4.877468	0.000000
17	6.34	33.19	4.8300	1.5125	3.3175	44.3600	14.292155	74.819657	7.478584	3.409603
18	8.23	31.47	7.3325	3.6500	3.6825	47.0325	17.498538	66.911178	7.829692	7.760591

Vibracore: VC27 Descriptive Statistics (Log Inclusive Graphics Method)

Depth (ft)	Q1	Median	Q3	Mean	SD	Skew	Kurt
0.0	1.499	1.895	2.252	1.813	0.695	-0.300	1.409
1.0	1.228	2.089	2.572	1.543	1.584	-0.614	1.691
2.0	2.583	2.798	3.036	2.847	0.395	0.095	1.263
3.0	2.576	2.798	3.045	2.832	0.388	0.033	1.180
4.0	2.610	2.836	3.134	2.891	0.415	0.139	1.134
5.0	2.544	2.780	3.043	2.787	0.629	-0.167	2.129
6.0	2.585	2.831	3.164	2.887	0.596	-0.023	1.756
7.0	2.714	3.063	3.467	3.120	0.646	0.030	1.320
8.0	2.699	3.214	3.711	3.205	0.806	-0.072	1.225
9.0	2.243	2.954	3.656	2.907	0.955	-0.021	0.885
10.0	2.636	3.315	3.763	3.145	0.865	-0.253	1.066
11.0	2.583	2.849	3.214	2.887	0.603	-0.004	1.545
12.0	-0.204	1.764	2.732	1.203	1.939	-0.421	0.844
13.0	1.626	2.577	2.906	2.217	1.247	-0.574	1.545
14.0	-2.538	-1.233	1.157	-0.678	2.116	0.365	0.673
15.0	-2.609	-1.153	1.255	-0.697	2.096	0.317	0.638
16.0	-1.096	0.931	1.889	0.313	2.016	-0.360	0.813
17.0	-0.301	1.245	1.955	0.839	1.625	-0.377	0.971
18.0	-0.737	1.068	2.216	0.758	1.745	-0.249	0.709

Vibracore: VC28 Dry Mechanical Sieve Weight Fraction (g) by Screen

Depth (ft)	-2.25φ	-1φ	-0.5φ	0φ	0.5φ	1.0φ	1.5φ	2.0φ	2.5φ	3.0φ	3.5φ	4.0φ	pan
0	27.14	6.67	0.39	0.17	0.14	0.22	0.32	0.67	0.90	0.77	0.22	0.11	0.07
1	0.00	0.48	0.34	0.31	0.39	0.68	0.95	1.49	1.46	1.29	0.89	0.70	0.12
2	0.00	0.01	0.11	0.10	0.18	0.24	0.25	0.40	0.40	0.45	0.43	0.46	0.07
3	0.16	0.24	0.28	0.27	0.33	0.72	0.99	1.63	2.11	1.68	0.73	0.47	0.08
4	0.00	0.00	0.00	0.01	0.08	0.12	0.09	0.04	0.10	0.15	0.20	0.19	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.56	0.43	0.20	0.11	0.12	0.15	0.11	0.52	0.82	1.16	0.82	0.38	0.09
8	1.52	0.40	0.15	0.09	0.09	0.12	0.25	0.52	0.98	1.01	0.48	0.15	0.00
9	0.28	0.17	0.07	0.05	0.08	0.11	0.11	0.21	0.40	0.62	0.45	0.25	0.00
10	0.00	0.24	0.13	0.18	0.17	0.35	0.61	2.21	6.56	6.98	2.20	0.85	0.23
11	0.00	0.26	0.14	0.15	0.37	1.07	2.09	5.43	10.44	8.00	1.84	0.68	0.16
12	0.10	0.44	0.43	0.81	1.25	2.38	4.46	6.69	8.60	5.92	1.40	0.56	0.15
13	10.55	3.95	1.55	1.69	1.72	2.93	4.64	5.54	3.69	1.54	0.43	0.29	0.11
14	9.40	5.99	2.15	1.74	1.74	2.84	3.71	5.78	3.42	1.25	0.43	0.26	0.07
15	8.57	4.13	2.11	1.93	1.79	2.95	3.71	5.40	3.21	1.16	0.54	0.40	0.15
16	2.16	3.56	2.42	2.62	2.45	3.52	5.49	7.76	5.73	3.07	0.92	0.68	0.20
17	4.09	4.87	2.09	2.25	2.26	3.07	3.37	5.23	4.26	1.87	0.72	0.53	0.27
18	3.07	2.16	0.86	0.66	0.78	1.39	2.84	9.10	11.52	6.95	1.32	0.28	0.08



Vibracore: VC28 Wet (pipetted $< 63\mu m$) Weight Fraction (g)

Depth (ft)	Cyl Vol (ml)	Pan Wt. 1st Draw (g)	Pan Wt. 2nd Draw (g)	Sample Wt. 1st Draw (g)	Sample Wt. 2nd Draw (g)
0	500	1.0034	1.0035	1.1166	1.1418
1	900	1.0252	1.0134	1.5055	1.3955
2	1000	1.0181	1.0102	1.5178	1.4083
3	1000	0.9900	0.9834	1.4568	1.3584
4	900	1.0152	0.9747	1.5599	1.4077
5	1000	1.0272	1.0348	1.5978	1.4797
6	900	1.0057	1.0287	1.7288	1.6591
7	800	1.0460	1.0088	1.6234	1.4458
8	900	1.0108	1.0194	1.5777	1.4808
9	900	1.0302	1.0265	1.5766	1.4711
10	900	1.0054	1.0165	1.3649	1.2747
11	500	1.0083	1.0260	1.4088	1.3070
12	500	1.0182	1.0409	1.4023	1.3161
13	500	1.0440	1.0822	1.2851	1.2641
14	500	1.0349	1.0845	1.3014	1.2924
15	500	1.0010	1.0723	1.1997	1.2020
16	500	1.0572	1.0115	1.4091	1.2072
17	500	1.0291	1.0334	1.2868	1.1940
18	500	1.0329	1.0198	1.4295	1.3237

Vibracore: VC28 Weight and Percent Weight by Size Class

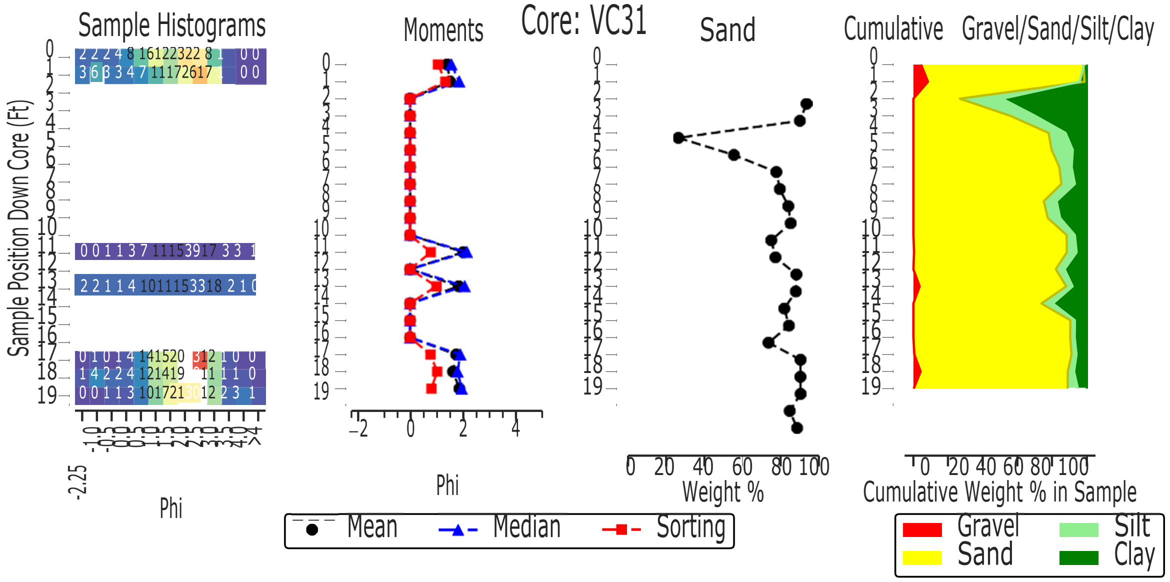
Depth	GravelWt	SandWt	TotalFinesWt	ClayWt	SiltWt	TotalWt	GravelWtPct	SandWtPct	SiltWtPct	ClayWtPct
0	33.81	3.91	0.40	0.96	0.00	38.12	88.7	10.3	0.0	2.5
1	0.48	8.50	17.23	12.69	4.54	26.21	1.8	32.4	17.3	48.4
2	0.01	3.02	20.06	14.91	5.15	23.09	0.0	13.1	22.3	64.6
3	0.40	9.21	18.42	13.75	4.67	28.03	1.4	32.9	16.7	49.1
4	0.00	0.98	20.01	14.98	5.03	20.99	0.0	4.7	24.0	71.4
5	0.00	1.10	23.53	17.25	6.28	24.63	0.0	4.5	25.5	70.0
6	0.00	1.55	28.04	23.87	4.17	29.59	0.0	5.2	14.1	80.7
7	0.99	4.39	19.19	13.48	5.71	24.57	4.0	17.9	23.2	54.9
8	1.92	3.84	21.01	16.26	4.75	26.77	7.2	14.3	17.7	60.7
9	0.45	2.35	20.09	15.51	4.58	22.89	2.0	10.3	20.0	67.8
10	0.24	20.24	11.91	7.12	4.79	32.39	0.7	62.5	14.8	22.0
11	0.26	30.21	7.67	4.52	3.15	38.14	0.7	79.2	8.3	11.9
12	0.54	32.50	7.25	4.38	2.87	40.29	1.3	80.7	7.1	10.9
13	14.50	24.02	3.64	2.05	1.59	42.16	34.4	57.0	3.8	4.9
14	15.39	23.32	4.23	2.70	1.53	42.94	35.8	54.3	3.6	6.3
15	12.70	23.20	2.62	0.74	1.88	38.52	33.0	60.2	4.9	1.9
16	5.72	34.66	6.50	2.39	4.11	46.88	12.2	73.9	8.8	5.1
17	8.96	25.65	4.21	1.51	2.70	38.82	23.1	66.1	7.0	3.9
18	5.23	35.70	7.50	5.10	2.40	48.43	10.8	73.7	5.0	10.5

Vibracore: VC28 Descriptive Statistics (Log Inclusive Graphics   Method)

Depth (ft)	Q1	Median	Q3	Mean	SD	Skew	Kurt
0.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.0	1.039	1.970	2.781	1.844	1.412	-0.198	1.135
2.0	1.270	2.325	3.215	2.187	1.351	-0.199	0.892
3.0	1.213	2.053	2.660	1.887	1.228	-0.268	1.252
4.0	1.194	2.667	3.362	2.344	1.252	-0.341	0.686
5.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7.0	0.281	2.326	2.967	1.415	2.135	-0.578	0.995
8.0	-2.303	1.750	2.599	0.654	2.347	-0.549	0.536
9.0	0.727	2.400	3.000	1.555	2.054	-0.591	1.167
10.0	2.098	2.493	2.864	2.454	0.672	-0.151	1.378
11.0	1.829	2.278	2.689	2.238	0.704	-0.137	1.204
12.0	1.324	2.002	2.484	1.904	0.928	-0.226	1.143
13.0	-2.335	0.458	1.675	-0.072	2.028	-0.288	0.583
14.0	-2.188	0.032	1.631	-0.208	1.975	-0.132	0.598
15.0	-2.116	0.359	1.671	-0.082	2.006	-0.238	0.620
16.0	-0.117	1.324	2.040	0.947	1.599	-0.366	1.002
17.0	-1.062	0.806	1.898	0.394	1.901	-0.280	0.798
18.0	1.235	1.980	2.430	1.495	1.540	-0.582	1.905

Vibracore: VC31 Dry Mechanical Sieve Weight Fraction (g) by Screen

Depth (ft)	-2.25φ	-1φ	-0.5φ	0φ	0.5φ	1.0φ	1.5φ	2.0φ	2.5φ	3.0φ	3.5φ	4.0φ	pan
0	0.92	0.97	1.01	1.76	3.31	6.68	5.04	9.42	8.99	3.28	0.30	0.06	0.01
1	1.19	2.37	1.37	1.41	1.78	3.07	4.63	6.98	11.01	7.18	0.58	0.11	0.01
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.17	0.23	0.53	1.04	2.62	4.45	6.04	15.23	6.70	1.00	1.03	0.30
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.77	0.78	0.36	0.56	1.39	3.73	4.10	5.56	12.40	6.81	0.77	0.55	0.11
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.25	0.15	0.36	1.43	5.07	5.60	7.33	12.38	4.36	0.33	0.17	0.07
18	0.20	1.66	0.70	0.90	1.60	4.69	5.47	7.48	11.64	4.28	0.43	0.20	0.09
19	0.00	0.10	0.20	0.36	1.03	3.78	6.57	8.07	11.62	4.53	0.92	1.00	0.57



Vibracore: VC31 Wet (pipetted $< 63\mu m$) Weight Fraction (g)

Depth (ft)	Cyl Vol (ml)	Pan Wt. 1st Draw (g)	Pan Wt. 2nd Draw (g)	Sample Wt. 1st Draw (g)	Sample Wt. 2nd Draw (g)
0	500	1.0500	1.0447	1.1812	1.1744
1	500	1.0335	1.0295	1.1561	1.1964
2	800	1.0186	1.0105	1.5608	1.4059
3	900	1.0124	1.0013	1.3924	1.2906
4	800	1.0293	1.0332	1.3317	1.2452
5	700	1.0427	1.0022	1.3689	1.1920
6	600	1.0346	1.0128	1.3498	1.2312
7	800	1.0239	0.9900	1.2521	1.1504
8	800	0.9706	1.0073	1.3002	1.2693
9	700	1.0268	1.0339	1.3793	1.3058
10	800	0.9952	1.0264	1.2058	1.1919
11	600	1.0345	1.0120	1.2937	1.1971
12	800	0.9801	1.0144	1.2480	1.2343
13	700	1.0263	1.0511	1.2687	1.2505
14	900	1.0161	0.9888	1.3362	1.2530
15	500	1.0037	0.9934	1.2463	1.1980
16	600	1.0520	1.0211	1.2734	1.2100
17	500	0.9986	1.0115	1.2397	1.2088
18	500	0.9809	1.0397	1.2687	1.2687
19	500	1.0223	1.0157	1.2882	1.2034

Vibracore: VC31 Weight and Percent Weight by Size Class

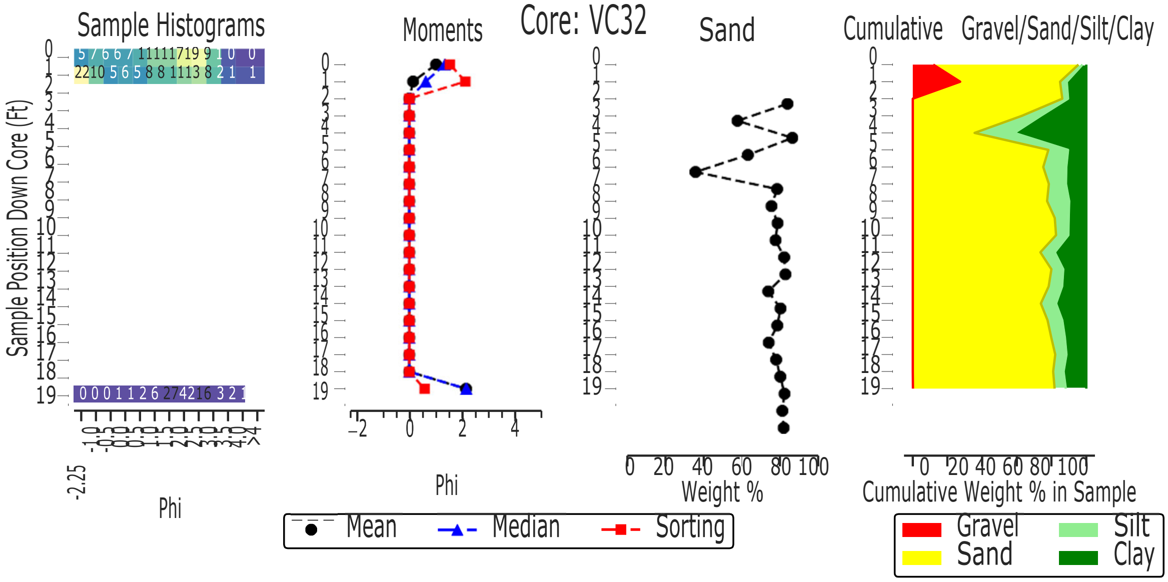
Depth	GravelWt	SandWt	TotalFinesWt	ClayWt	SiltWt	TotalWt	GravelWtPct	SandWtPct	SiltWtPct	ClayWtPct
0	1.89	39.85	0.79	0.74	0.05	42.53	4.4	93.7	0.1	1.7
1	3.56	38.12	0.57	1.67	0.00	42.25	8.4	90.2	0.0	4.0
2	0.00	6.49	17.69	11.82	5.87	24.18	0.0	26.8	24.3	48.9
3	0.00	15.92	12.60	8.52	4.08	28.52	0.0	55.8	14.3	29.9
4	0.00	28.60	8.10	4.48	3.62	36.70	0.0	77.9	9.9	12.2
5	0.00	31.21	7.92	3.14	4.78	39.13	0.0	79.8	12.2	8.0
6	0.00	34.36	6.46	3.55	2.91	40.82	0.0	84.2	7.1	8.7
7	0.00	30.05	5.13	2.42	2.71	35.18	0.0	85.4	7.7	6.9
8	0.00	28.00	9.18	6.48	2.70	37.18	0.0	75.3	7.3	17.4
9	0.00	30.41	8.84	6.02	2.82	39.25	0.0	77.5	7.2	15.3
10	0.00	33.70	4.42	2.62	1.80	38.12	0.0	88.4	4.7	6.9
11	0.17	38.87	5.08	2.55	2.53	44.12	0.4	88.1	5.7	5.8
12	0.00	30.80	6.72	4.80	1.92	37.52	0.0	82.1	5.1	12.8
13	1.55	36.23	5.09	3.48	1.61	42.87	3.6	84.5	3.8	8.1
14	0.00	27.99	9.90	7.39	2.51	37.89	0.0	73.9	6.6	19.5
15	0.00	34.27	3.56	2.62	0.94	37.83	0.0	90.6	2.5	6.9
16	0.00	34.65	3.64	2.67	0.97	38.29	0.0	90.5	2.5	7.0
17	0.25	37.18	3.60	2.43	1.17	41.03	0.6	90.6	2.9	5.9
18	1.86	37.39	4.78	3.22	1.56	44.03	4.2	84.9	3.5	7.3
19	0.10	38.08	4.72	2.19	2.53	42.90	0.2	88.8	5.9	5.1

Vibracore: VC31 Descriptive Statistics (Log Inclusive Graphics   Method)

Depth (ft)	Q1	Median	Q3	Mean	SD	Skew	Kurt
0.0	0.685	1.563	2.122	1.400	1.058	-0.298	1.038
1.0	0.875	1.860	2.385	1.512	1.332	-0.486	1.271
2.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.0	1.566	2.151	2.474	2.016	0.784	-0.250	1.211
12.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13.0	1.230	2.068	2.450	1.841	0.995	-0.425	1.172
14.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17.0	1.189	1.902	2.320	1.745	0.768	-0.264	0.891
18.0	1.008	1.797	2.292	1.624	1.025	-0.363	1.206
19.0	1.321	1.954	2.385	1.867	0.803	-0.099	1.066

Vibracore: VC32 Dry Mechanical Sieve Weight Fraction (g) by   Screen

Depth (ft)	-2.25φ	-1φ	-0.5φ	0φ	0.5φ	1.0φ	1.5φ	2.0φ	2.5φ	3.0φ	3.5φ	4.0φ	pan
0	2.25	3.06	2.36	2.57	3.15	4.91	4.58	7.27	8.05	3.78	0.52	0.21	0.16
1	8.09	3.57	1.91	2.05	1.92	2.80	3.04	4.12	4.65	2.89	0.73	0.38	0.29
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.06	0.15	0.21	0.30	0.82	1.97	9.60	14.59	5.48	0.98	0.65	0.33



Vibracore: VC32 Wet (pipetted $< 63\mu m$) Weight Fraction (g)

Depth (ft)	Cyl Vol (ml)	Pan Wt. 1st Draw (g)	Pan Wt. 2nd Draw (g)	Sample Wt. 1st Draw (g)	Sample Wt. 2nd Draw (g)
0	500	1.0407	1.0367	1.2144	1.1760
1	500	1.0199	1.0469	1.3638	1.3369
2	600	1.0051	0.9841	1.2905	1.2240
3	800	1.0470	1.0161	1.4780	1.3511
4	1000	1.0011	1.0361	1.5203	1.4066
5	600	1.0021	1.0245	1.3760	1.2552
6	800	0.9867	1.0005	1.3325	1.2149
7	600	0.9867	1.0188	1.3543	1.2638
8	500	1.0154	0.9898	1.4529	1.2359
9	500	1.0296	0.9980	1.4169	1.2582
10	500	1.0064	1.0035	1.3501	1.2474
11	500	1.0017	1.0545	1.5041	1.4305
12	500	1.0124	0.9920	1.4143	1.2913
13	500	1.0343	1.0017	1.4702	1.3173
14	500	1.0150	1.0033	1.4957	1.3558
15	500	0.9940	0.9939	1.4210	1.2968
16	500	1.0026	1.0532	1.4114	1.3412
17	500	1.0453	1.0062	1.4307	1.2883
18	500	1.0352	1.0504	1.4208	1.3460
19	500	1.0389	0.9732	1.4357	1.2731

Vibracore: VC32 Weight and Percent Weight by Size Class

Depth	GravelWt	SandWt	TotalFinesWt	ClayWt	SiltWt	TotalWt	GravelWtPct	SandWtPct	SiltWtPct	ClayWtPct
0	5.31	37.40	2.00	0.98	1.02	44.71	11.9	83.7	2.3	2.2
1	11.66	24.49	6.39	4.75	1.64	42.54	27.4	57.6	3.9	11.2
2	0.00	34.79	5.56	4.20	1.36	40.35	0.0	86.2	3.4	10.4
3	0.00	22.54	13.24	9.40	3.84	35.78	0.0	63.0	10.7	26.3
4	0.00	11.63	20.96	13.53	7.43	32.59	0.0	35.7	22.8	41.5
5	0.00	29.54	8.22	3.92	4.30	37.76	0.0	78.2	11.4	10.4
6	0.00	29.96	9.83	4.58	5.25	39.79	0.0	75.3	13.2	11.5
7	0.00	29.28	8.03	4.35	3.68	37.31	0.0	78.5	9.9	11.7
8	0.00	28.95	8.44	3.65	4.79	37.39	0.0	77.4	12.8	9.8
9	0.00	32.54	7.18	4.00	3.18	39.72	0.0	81.9	8.0	10.1
10	0.00	28.87	6.09	3.60	2.49	34.96	0.0	82.6	7.1	10.3
11	0.00	28.08	10.06	6.90	3.16	38.14	0.0	73.6	8.3	18.1
12	0.00	30.20	7.55	4.98	2.57	37.75	0.0	80.0	6.8	13.2
13	0.00	30.37	8.40	5.39	3.01	38.77	0.0	78.3	7.8	13.9
14	0.00	26.90	9.52	6.31	3.21	36.42	0.0	73.9	8.8	17.3
15	0.00	28.55	8.18	5.07	3.11	36.73	0.0	77.7	8.5	13.8
16	0.00	30.71	7.72	4.70	3.02	38.43	0.0	79.9	7.9	12.2
17	0.00	32.73	7.14	4.55	2.59	39.87	0.0	82.1	6.5	11.4
18	0.00	30.37	7.14	4.89	2.25	37.51	0.0	81.0	6.0	13.0
19	0.06	34.75	7.75	5.00	2.75	42.56	0.1	81.6	6.5	11.7

Vibracore: VC32 Descriptive Statistics (Log Inclusive Graphics Method)

Depth (ft)	Q1	Median	Q3	Mean	SD	Skew	Kurt
0.0	0.076	1.342	2.124	1.011	1.536	-0.373	1.027
1.0	-1.893	0.621	1.979	0.142	2.118	-0.260	0.630
2.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19.0	1.775	2.153	2.454	2.143	0.574	-0.050	1.237

Vibracore: VC33 Dry Mechanical Sieve Weight Fraction (g) by Screen

Depth (ft)	-2.25φ	-1φ	-0.5φ	0φ	0.5φ	1.0φ	1.5φ	2.0φ	2.5φ	3.0φ	3.5φ	4.0φ	pan
0.0	0.90	1.36	0.75	0.86	1.05	2.23	2.72	7.58	10.71	8.82	4.51	0.69	0.09
1.0	0.48	1.22	0.63	0.66	1.07	2.27	2.94	8.39	11.98	9.20	2.15	0.30	0.06
2.0	0.00	0.43	0.31	0.50	0.55	1.00	1.74	6.39	11.02	10.92	6.31	0.96	0.15
3.0	0.07	1.56	0.82	0.75	0.65	0.98	2.82	8.12	8.42	8.21	2.92	0.39	0.04
4.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Vibracore: VC33 Wet (pipetted $< 63 \mu m$) Weight Fraction (g)

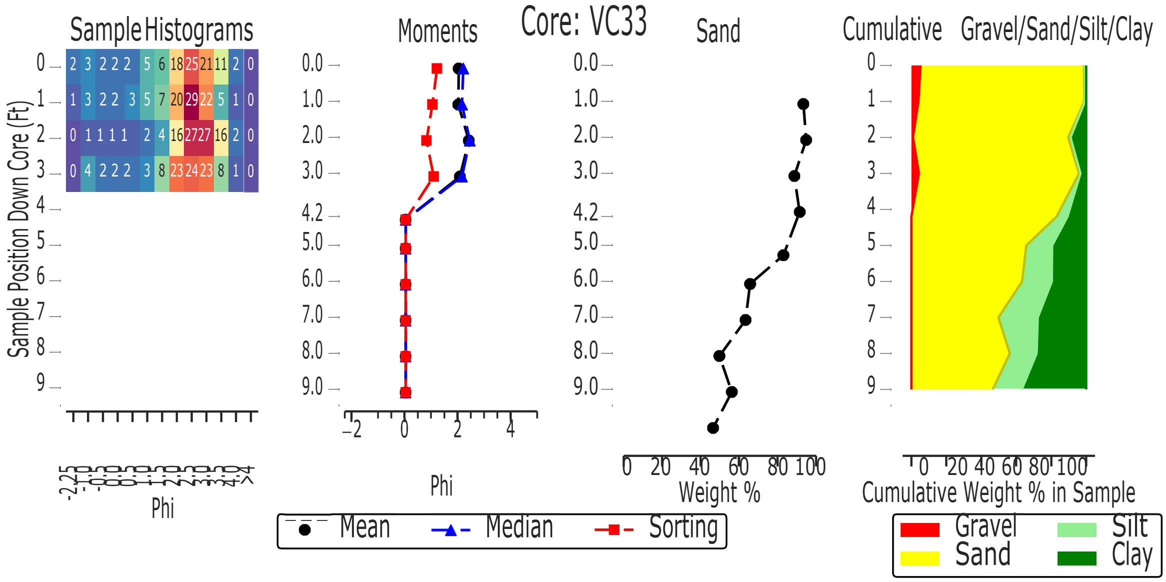
Depth (ft)	Cyl Vol (ml)	Pan Wt. 1st Draw (g)	Pan Wt. 2nd Draw (g)	Sample Wt. 1st Draw (g)	Sample Wt. 2nd Draw (g)
0.0	500	1.0613	1.0586	1.1801	1.1719
1.0	500	1.0586	1.0416	1.1739	1.1525
2.0	500	1.0545	1.0442	1.3330	1.3050
3.0	500	1.0293	1.0530	1.1892	1.2020
4.2	500	0.9870	1.0089	1.3415	1.2688
5.0	500	1.0108	1.0089	1.5664	1.3675
6.0	600	0.9883	1.0088	1.4647	1.3104
7.0	900	1.0187	1.0124	1.5029	1.3237
8.0	800	1.0226	1.0005	1.4612	1.3199
9.0	800	1.0067	1.0213	1.4590	1.3634

Vibracore: VC33 Weight and Percent Weight by Size Class

Depth	GravelWt	SandWt	TotalFinesWt	ClayWt	SiltWt	TotalWt	GravelWtPct	SandWtPct	SiltWtPct	ClayWtPct
0.0	2.26	39.92	0.56	0.33	0.23	42.74	5.3	93.4	0.5	0.8
1.0	1.70	39.59	0.44	0.27	0.17	41.73	4.1	94.9	0.4	0.6
2.0	0.43	39.70	4.61	4.02	0.59	44.74	1.0	88.7	1.3	9.0
3.0	1.63	34.08	1.54	1.23	0.31	37.25	4.4	91.5	0.8	3.3
4.2	0.00	31.12	6.36	4.00	2.36	37.48	0.0	83.0	6.3	10.7
5.0	0.00	21.82	11.39	6.47	4.92	33.21	0.0	65.7	14.8	19.5
6.0	0.00	19.52	11.29	6.05	5.24	30.81	0.0	63.4	17.0	19.6
7.0	0.00	17.12	17.29	9.51	7.78	34.41	0.0	49.8	22.6	27.6
8.0	0.00	17.39	13.54	8.78	4.76	30.93	0.0	56.2	15.4	28.4
9.0	0.00	12.23	14.09	9.68	4.41	26.32	0.0	46.5	16.8	36.8

Vibracore: VC32 Descriptive Statistics (Log Inclusive Graphics Method)

Q1	Median	Q3	Mean	SD	Skew	Kurt
1.546	2.172	2.701	2.000	1.181	-0.366	1.592
1.564	2.126	2.575	1.984	1.009	-0.367	1.545
1.933	2.418	2.879	2.382	0.783	-0.180	1.220
1.579	2.125	2.660	2.046	1.057	-0.296	1.582
0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000



Core: VC33
Sample Histograms
Sample Position Down Core (Ft)
0
1
2
3
4
5
6
7
8
9
2 3 2 2 2 5 6 18 25 21 11 2 0
1 3 2 2 3 5 7 20 29 22 5 1 0
0 1 1 1 1 2 4 16 27 27 16 2 0
0 4 2 2 2 3 8 23 24 23 8 1 0
-2.25
>4
Phi
Moments
0.0
1.0
2.0
3.0
4.2
5.0
6.0
7.0
8.0
9.0
−2
0
2
4
Phi
Mean
Median
Sorting
Sand
0.0
1.0
2.0
3.0
4.2
5.0
6.0
7.0
8.0
9.0
0
20
40
60
80
100
Weight %
Cumulative Gravel/Sand/Silt/Clay
0
1
2
3
4
5
6
7
8
9
0
20
40
60
80
100
Cumulative Weight % in Sample
Gravel
Sand
Silt
Clay

Vibracore: VC34 Dry Mechanical Sieve Weight Fraction (g) by Screen

Depth (ft)	-2.25φ	-1φ	-0.5φ	0φ	0.5φ	1.0φ	1.5φ	2.0φ	2.5φ	3.0φ	3.5φ	4.0φ	pan
0.0	8.42	4.28	2.33	1.78	1.56	2.49	3.08	3.38	3.94	4.02	0.81	0.43	0.21
1.0	11.72	6.73	2.10	1.66	1.54	2.70	3.24	3.18	2.85	3.28	0.68	0.30	0.14
2.0	6.62	7.39	2.68	2.02	1.81	2.51	2.18	2.59	3.00	3.56	0.87	0.39	0.20
3.0	6.40	7.02	3.05	1.91	1.59	1.81	1.58	2.44	3.94	4.63	1.05	0.44	0.26
4.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Vibracore: VC34 Wet (pipetted $< 63 \mu m$) Weight Fraction (g)

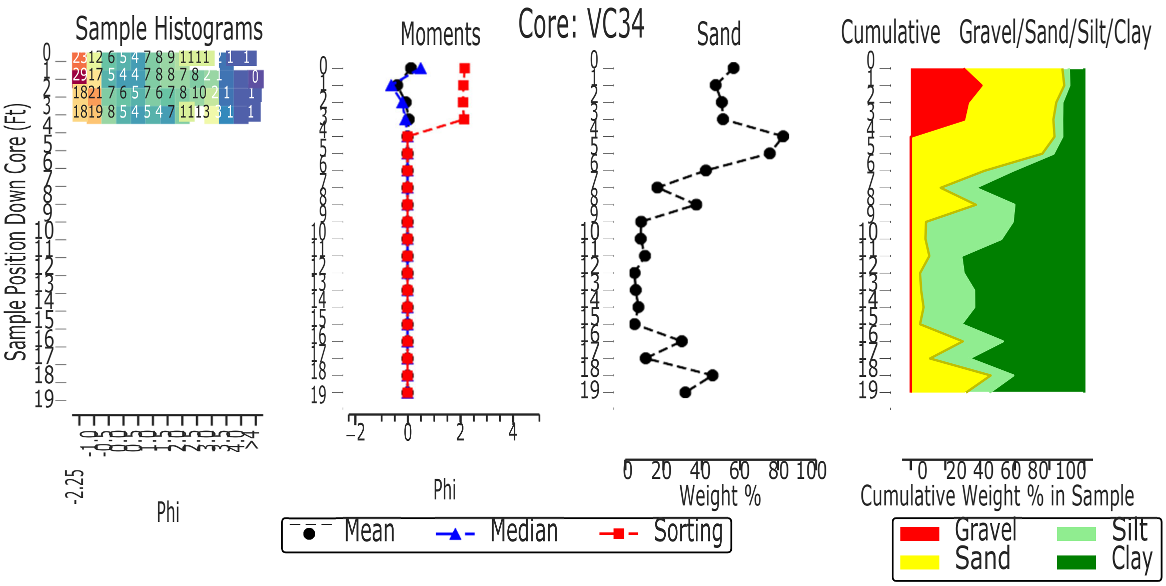
Depth (ft)	Cyl Vol (ml)	Pan Wt. 1st Draw (g)	Pan Wt. 2nd Draw (g)	Sample Wt. 1st Draw (g)	Sample Wt. 2nd Draw (g)
0.0	500	1.0267	1.0261	1.3289	1.2740
1.0	500	1.0079	1.0148	1.3103	1.2713
2.0	600	1.0353	1.0104	1.3571	1.2884
3.0	500	1.0357	1.0343	1.4342	1.3565
4.0	600	1.0251	1.0706	1.3344	1.3253
5.0	1000	1.0576	1.0104	1.3643	1.2626
6.0	1000	0.9988	1.0096	1.4474	1.3598
7.0	900	0.9969	0.9893	1.6624	1.5186
8.0	1000	1.0454	1.0065	1.3760	1.2552
9.0	1000	1.0051	1.0120	1.3325	1.2149
10.0	1000	0.9853	1.0229	1.3543	1.2638
11.0	1000	0.9867	1.0290	1.5003	1.4578
12.0	1000	0.9845	1.0259	1.5281	1.4516
13.0	1000	1.0254	0.9873	1.5417	1.3686
14.0	1000	1.0335	1.0094	1.6078	1.4340
15.0	800	1.0292	1.0134	1.7805	1.6004
16.0	1000	1.0403	1.0236	1.5277	1.3835
17.0	900	1.0313	1.0057	1.7159	1.5426
18.0	600	1.0194	1.0009	1.7120	1.5500
19.0	1000	1.0067	1.0503	1.6140	1.5568

Vibracore: VC34 Weight and Percent Weight by Size Class

Depth	GravelWt	SandWt	TotalFinesWt	ClayWt	SiltWt	TotalWt	GravelWtPct	SandWtPct	SiltWtPct	ClayWtPct
0.0	12.70	23.82	5.26	3.70	1.56	41.78	30.4	57.0	3.7	8.9
1.0	18.45	21.53	5.20	3.91	1.29	45.18	40.8	47.7	2.9	8.7
2.0	14.01	21.61	6.85	5.34	1.51	42.47	33.0	50.9	3.6	12.6
3.0	13.42	22.44	7.72	5.56	2.16	43.58	30.8	51.5	5.0	12.8
4.0	0.00	30.34	6.28	4.64	1.64	36.62	0.0	82.9	4.5	12.7
5.0	0.00	32.51	10.34	7.61	2.73	42.85	0.0	75.9	6.4	17.8
6.0	0.00	12.91	17.43	12.51	4.92	30.34	0.0	42.6	16.2	41.2
7.0	0.00	5.31	25.45	19.32	6.13	30.76	0.0	17.3	19.9	62.8
8.0	0.00	6.94	11.53	7.44	4.09	18.47	0.0	37.6	22.1	40.3
9.0	0.00	1.10	11.37	5.15	6.22	12.47	0.0	8.8	49.9	41.3
10.0	0.00	1.26	13.45	7.05	6.40	14.71	0.0	8.6	43.5	47.9
11.0	0.00	2.50	20.68	16.44	4.24	23.18	0.0	10.8	18.3	70.9
12.0	0.00	1.26	22.18	16.28	5.90	23.44	0.0	5.4	25.2	69.5
13.0	0.00	1.32	20.82	14.07	6.75	22.14	0.0	6.0	30.5	63.6
14.0	0.00	1.89	23.71	16.23	7.48	25.60	0.0	7.4	29.2	63.4
15.0	0.00	1.48	26.05	19.48	6.57	27.53	0.0	5.4	23.9	70.8
16.0	0.00	8.30	19.37	12.99	6.38	27.67	0.0	30.0	23.1	46.9
17.0	0.00	3.31	26.31	19.66	6.65	29.62	0.0	11.2	22.5	66.4
18.0	0.00	15.16	17.78	13.47	4.31	32.94	0.0	46.0	13.1	40.9
19.0	0.00	11.85	25.37	20.32	5.05	37.22	0.0	31.8	13.6	54.6

Vibracore: VC34 Descriptive Statistics (Log Inclusive Graphics Method)

Depth (ft)	Q1	Median	Q3	Mean	SD	Skew	Kurt
0.0	-2.027	0.498	2.029	0.131	2.157	-0.200	0.605
1.0	-2.394	-0.617	1.563	-0.391	2.113	0.156	0.616
2.0	-1.855	-0.198	1.819	-0.067	2.090	0.073	0.662
3.0	-1.782	-0.084	2.164	0.045	2.131	0.056	0.619
4.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000


Core: VC34
Sample Histograms
Sample Position Down Core (Ft)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
23 12 6 5 4 7 8 9 11 11 1 1
29 17 5 4 4 7 8 8 7 8 2 0
18 21 7 6 5 7 6 7 8 10 2 1 1
18 19 8 5 4 5 4 7 11 13 3 1 1
-2.25
-1.0
-0.5
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
>4
Phi
Moments
−2
0
2
4
Phi
Mean
Median
Sorting
Sand
0
20
40
60
80
100
Weight %
Cumulative Gravel/Sand/Silt/Clay
0
20
40
60
80
100
Cumulative Weight % in Sample
Gravel
Sand
Silt
Clay

Vibracore: VC37 Dry Mechanical Sieve Weight Fraction (g) by Screen

Depth (ft)	-2.25φ	-1φ	-0.5φ	0φ	0.5φ	1.0φ	1.5φ	2.0φ	2.5φ	3.0φ	3.5φ	4.0φ	pan
0	0.00	0.00	0.03	0.04	0.10	0.22	0.73	5.23	17.49	14.10	2.02	0.79	0.10
1	0.00	0.00	0.00	0.01	0.02	0.12	0.48	4.50	17.84	14.41	2.08	0.68	0.07
2	0.14	0.05	0.00	0.01	0.05	0.19	0.60	5.64	17.61	10.75	1.52	0.38	0.01
3	0.00	0.42	0.17	0.18	0.28	0.59	1.23	7.00	18.13	10.35	1.73	0.34	0.00
4	0.26	1.15	0.52	0.46	0.46	0.64	1.00	5.59	16.33	12.45	1.73	0.99	0.10
5	0.07	1.30	0.54	0.45	0.55	1.00	1.89	7.24	16.98	11.02	1.22	0.32	0.00
6	0.00	0.16	0.03	0.07	0.14	0.46	1.89	7.91	16.63	13.62	1.64	0.70	0.08
7	0.00	0.00	0.00	0.02	0.07	0.23	0.67	5.95	17.08	13.14	2.26	0.96	0.08
8	0.28	1.32	0.51	0.43	0.48	0.63	0.95	6.15	15.80	9.83	1.31	0.49	0.03
9	1.03	0.73	0.21	0.18	0.19	0.30	0.74	4.93	14.27	10.81	1.40	0.57	0.04
10	0.00	0.18	0.27	0.40	0.33	0.42	0.93	5.67	16.95	15.56	2.00	0.74	0.11
11	0.00	0.01	0.03	0.10	0.15	0.31	0.98	6.60	14.03	12.04	3.06	1.29	0.14
12	0.00	0.24	0.08	0.10	0.16	0.38	0.96	5.18	16.25	16.42	2.90	0.67	0.08
13	0.00	0.04	0.05	0.07	0.18	0.52	1.78	6.90	14.19	13.87	2.24	0.76	0.14
14	0.00	0.15	0.07	0.07	0.12	0.26	1.09	6.99	16.48	14.05	1.85	0.58	0.13
15	0.13	0.00	0.00	0.00	0.00	0.19	0.72	5.24	14.84	14.55	3.00	1.22	0.23

Vibracore: VC37 Wet (pipetted $< 63\mu m$) Weight Fraction (g)

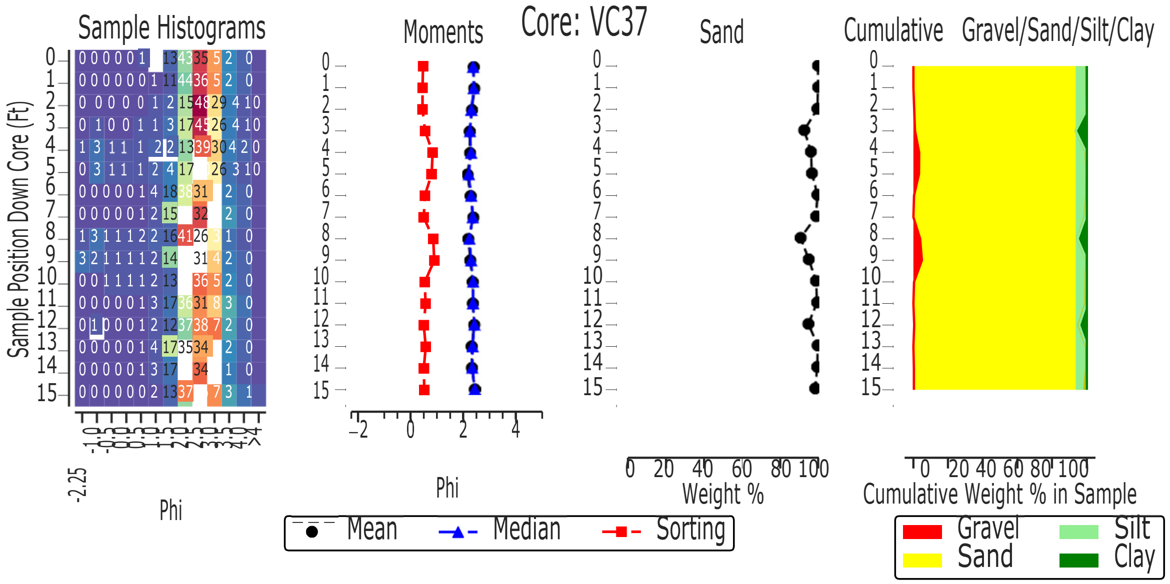
Depth (ft)	Cyl Vol (ml)	Pan Wt. 1st Draw (g)	Pan Wt. 2nd Draw (g)	Sample Wt. 1st Draw (g)	Sample Wt. 2nd Draw (g)
0	500	1.0235	1.0624	1.1085	1.1408
1	500	1.0671	1.0442	1.1306	1.1062
2	500	1.0395	1.0831	1.1054	1.1471
3	600	1.0665	1.0146	1.2593	1.2066
4	500	1.0248	1.0497	1.1305	1.1557
5	500	1.0297	1.0666	1.1329	1.1681
6	500	1.0041	1.0360	1.0757	1.1072
7	500	1.0301	1.0435	1.1462	1.1576
8	500	1.0327	1.0490	1.2171	1.2341
9	500	1.0376	1.0852	1.1284	1.1727
10	500	1.0519	1.0324	1.1634	1.1419
11	500	1.0563	1.0340	1.1610	1.1375
12	500	1.0549	1.0492	1.2377	1.2278
13	500	1.0576	1.0820	1.1580	1.1730
14	500	1.0892	1.0207	1.1892	1.1102
15	600	1.0761	1.0532	1.1868	1.1559

Vibracore: VC37 Weight and Percent Weight by Size Class

Depth	GravelWt	SandWt	TotalFinesWt	ClayWt	SiltWt	TotalWt	GravelWtPct	SandWtPct	SiltWtPct	ClayWtPct
0	0.00	40.75	0.10	0.00	0.10	40.85	0.0	99.8	0.2	0.0
1	0.00	40.14	0.07	0.00	0.07	40.21	0.0	99.8	0.2	0.0
2	0.19	36.75	0.01	0.00	0.01	36.95	0.5	99.5	0.0	0.0
3	0.42	40.00	2.78	2.76	0.02	43.20	1.0	92.6	0.0	6.4
4	1.41	40.17	0.24	0.15	0.09	41.82	3.4	96.1	0.2	0.4
5	1.37	41.21	0.08	0.04	0.04	42.66	3.2	96.6	0.1	0.1
6	0.16	43.09	0.08	0.00	0.08	43.33	0.4	99.4	0.2	0.0
7	0.00	40.38	0.48	0.35	0.13	40.86	0.0	98.8	0.3	0.9
8	1.60	36.58	2.14	2.13	0.01	40.32	4.0	90.7	0.0	5.3
9	1.76	33.60	0.04	0.00	0.04	35.40	5.0	94.9	0.1	0.0
10	0.18	43.27	0.40	0.24	0.16	43.85	0.4	98.7	0.4	0.5
11	0.01	38.59	0.26	0.09	0.17	38.86	0.0	99.3	0.4	0.2
12	0.24	43.10	2.15	1.97	0.18	45.49	0.5	94.7	0.4	4.3
13	0.04	40.56	0.15	0.00	0.15	40.75	0.1	99.5	0.4	0.0
14	0.15	41.56	0.13	0.00	0.13	41.84	0.4	99.3	0.3	0.0
15	0.13	39.76	0.55	0.08	0.47	40.44	0.3	98.3	1.2	0.2

Vibracore: VC37 Descriptive Statistics (Log Inclusive Graphics Method)

Depth (ft)	Q1	Median	Q3	Mean	SD	Skew	Kurt
0.0	2.110	2.402	2.741	2.426	0.463	0.041	1.057
1.0	2.138	2.420	2.749	2.444	0.443	0.046	1.036
2.0	2.073	2.335	2.659	2.360	0.440	0.017	1.013
3.0	2.006	2.285	2.612	2.277	0.539	-0.120	1.257
4.0	2.010	2.329	2.695	2.290	0.825	-0.302	2.122
5.0	1.835	2.243	2.587	2.191	0.787	-0.339	1.760
6.0	2.005	2.331	2.691	2.310	0.530	-0.099	1.034
7.0	2.093	2.389	2.741	2.410	0.486	0.061	1.073
8.0	1.903	2.264	2.607	2.223	0.849	-0.355	2.149
9.0	2.019	2.329	2.684	2.297	0.890	-0.357	2.503
10.0	2.079	2.401	2.742	2.387	0.526	-0.109	1.148
11.0	2.054	2.399	2.784	2.393	0.556	0.030	1.061
12.0	2.116	2.450	2.781	2.445	0.491	-0.043	1.067
13.0	2.023	2.382	2.746	2.347	0.564	-0.097	1.086
14.0	2.052	2.369	2.719	2.358	0.493	-0.043	0.984
15.0	2.126	2.464	2.808	2.467	0.507	0.024	1.091



Vibracore: VC37A Dry Mechanical Sieve Weight Fraction (g) by Screen

Depth (ft)	-2.25φ	-1φ	-0.5φ	0φ	0.5φ	1.0φ	1.5φ	2.0φ	2.5φ	3.0φ	3.5φ	4.0φ	pan
13	0.06	0.32	0.17	0.26	0.57	1.36	2.80	8.82	13.57	10.91	2.06	0.73	0.03
14	0.00	0.61	0.38	0.46	0.51	1.20	2.57	8.04	11.33	9.47	1.92	0.84	0.06
15	0.00	0.56	0.25	0.40	0.53	1.21	2.22	5.88	8.30	5.72	1.89	2.20	0.80
16	0.33	0.57	0.24	0.23	0.22	0.37	0.99	3.65	7.67	6.66	1.07	0.71	0.21
17	0.00	0.46	0.38	0.27	0.24	0.32	0.35	1.58	6.33	14.22	6.91	6.25	0.81
18	0.00	0.60	0.40	0.35	0.27	0.39	0.44	1.76	9.13	16.75	4.15	1.02	0.16

Vibracore: VC37A Wet (pipetted $< 63\mu m$) Weight Fraction (g)

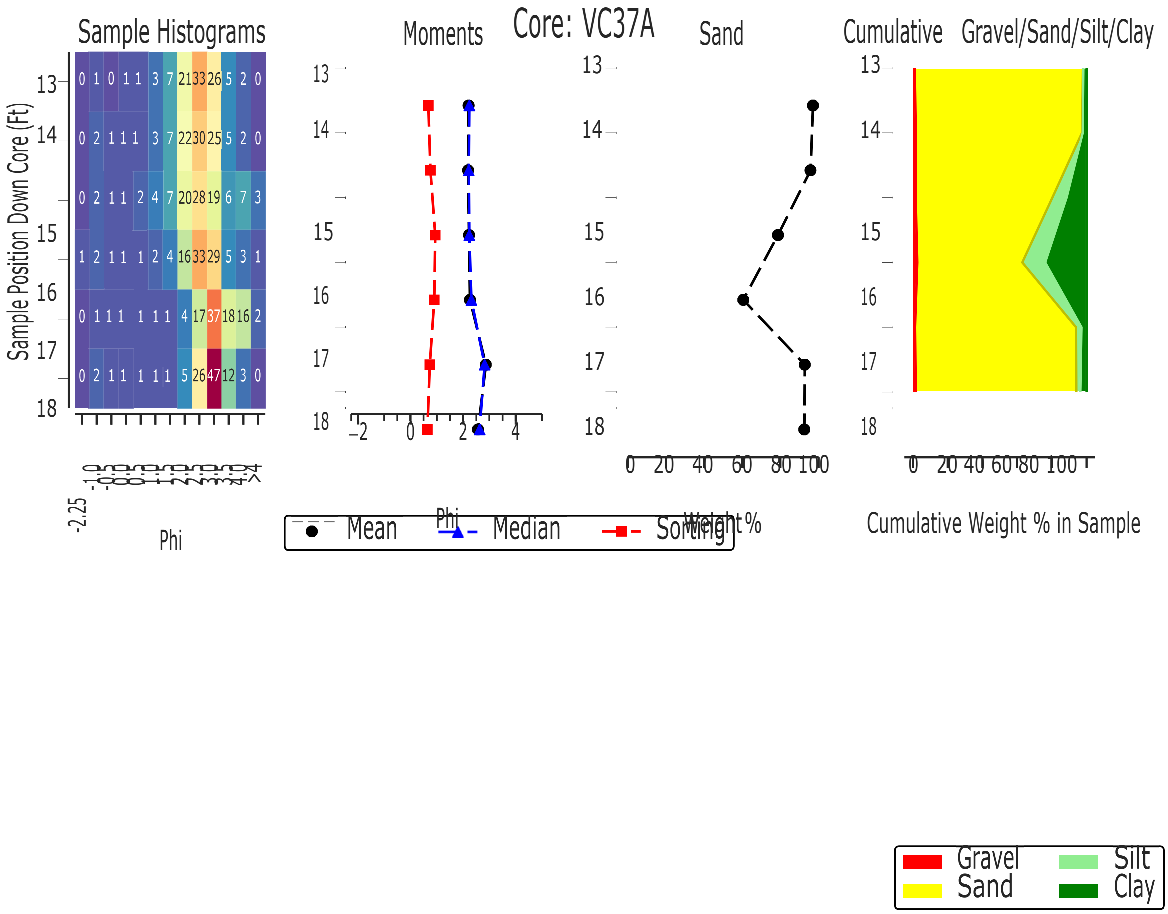
Depth (ft)	Cyl Vol (ml)	Pan Wt. 1st Draw (g)	Pan Wt. 2nd Draw (g)	Sample Wt. 1st Draw (g)	Sample Wt. 2nd Draw (g)
13	500	0.9820	1.0363	1.1157	1.1675
14	500	0.9917	1.0331	1.1299	1.1664
15	700	1.0143	1.0314	1.2965	1.2511
16	1000	1.0338	1.0159	1.3964	1.2882
17	500	1.0031	1.0267	1.1670	1.1727
18	500	1.0346	0.9809	1.2169	1.1329

Vibracore: VC37A Weight and Percent Weight by Size Class

Depth	GravelWt	SandWt	TotalFinesWt	ClayWt	SiltWt	TotalWt	GravelWtPct	SandWtPct	SiltWtPct	ClayWtPct
13	0.38	41.25	0.87	0.78	0.09	42.50	0.9	97.1	0.2	1.8
14	0.61	36.72	1.01	0.83	0.18	38.34	1.6	95.8	0.5	2.2
15	0.56	28.60	7.18	4.19	2.99	36.34	1.5	78.7	8.2	11.5
16	0.90	21.81	13.34	8.61	4.73	36.05	2.5	60.5	13.1	23.9
17	0.46	36.85	2.41	1.15	1.26	39.72	1.2	92.8	3.2	2.9
18	0.60	34.66	2.22	1.30	0.92	37.48	1.6	92.5	2.5	3.5

Vibracore: VC37A Descriptive Statistics (Log Inclusive Graphics Method)

Depth (ft)	Q1	Median	Q3	Mean	SD	Skew	Kurt
13.0	1.776	2.238	2.652	2.209	0.682	-0.146	1.133
14.0	1.725	2.217	2.655	2.189	0.759	-0.169	1.250
15.0	1.697	2.237	2.773	2.226	0.944	-0.061	1.359
16.0	1.881	2.317	2.719	2.263	0.907	-0.286	1.898
17.0	2.468	2.821	3.321	2.865	0.735	-0.028	1.237
18.0	2.254	2.630	2.895	2.567	0.642	-0.312	1.749


Core: VC37A
Sample Histograms
Sample Position Down Core (Ft)
13
14
15
16
17
18
0 1 0 1 1 3 7 21 33 26 5 2 0
0 2 1 1 1 3 7 22 30 25 5 2 0
0 2 1 1 2 4 7 20 28 19 6 7 3
1 2 1 1 1 2 4 16 33 29 5 3 1
0 1 1 1 1 1 1 4 17 37 18 16 2
0 2 1 1 1 1 1 5 26 47 12 3 0
-2.25
-1.0
-0.5
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
>4
Phi
Moments
−2
0
2
4
Phi
Mean
Median
Sorting
Sand
0
20
40
60
80
100
Weight %
Cumulative Gravel/Sand/Silt/Clay
0
20
40
60
80
100
Cumulative Weight % in Sample
Gravel
Sand
Silt
Clay