Field Testing the Florida Department of Environmental Protection Bureau of Beaches and Coastal Systems Reconnaissance Offshore Sand Search (ROSS) Database

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ABSTRACT

The Reconnaissance Offshore Sand Search (ROSS) online, searchable database and Internet Map Service (IMS) is an ongoing, expanding project. The ROSS system provides a comprehensive tool that allows for the identification and assessment of potential offshore sand resources that are suitable for beach nourishment projects. The tool consists of a corporate database that can be addressed, searched and manipulated through an online query builder as well as with existing IMS and Geographic Information System (GIS) routines that provide access over the Internet (Web).

As part of the ROSS project, field verification studies are used to help aid in determining the accuracy of the data residing in the database as well as the validity of the conceptual geological model developed as a product of the ROSS project. This paper will present observations and findings from the field program conducted on the coast and in nearshore waters in the Florida Panhandle region. The field program was designed to include the collection of beach grab samples, geophysical data in the form of sub-bottom profiles and associated vibracores in select locations from the mouth of the Ochlockonee River, west to Pensacola. An additional bonus to the field program was the collection and radiometric dating of three organic samples which verified the geological model.

INTRODUCTION

Three offshore sites were chosen to verify the accuracy of the data residing in the database. These data include sediment samples, geophysical data in the form of sub-bottom profiles, and artificially shaded relief image of the sea floor geomorphology created from the NOAA GEODAS high-resolution bathymetry (http://www.ngdc.noaa.gov/mgg/gdas/gd_sys.html). Site 1, offshore of Panama City Beach, was chosen because of its position on a paleo-ebb tide delta, Site 2, offshore of East Pass, was chosen because of its position on a drowned barrier/shore complex, and Site 3, offshore of Santa Rosa Island, was chosen to confirm the interpretation that this feature is a drowned barrier system.

OFFSHORE OPERATIONS

The offshore surveying was carried out by Alpine Geophysical aboard the research vessel *Atlantic Twin*. This vessel is a 90-foot catamaran hull designed boat. The overall plan consisted of selecting three features for detailed reconnaissance. A series of geophysical tracklines were run across the features to establish its surface and sub-surface geometry. Three vibracores were taken on each feature.

Three areas were surveyed as part of the offshore phase. The first area is located offshore of Panama City, Florida, and consisted of 28 line miles of survey and three vibracore locations. The second area is located offshore of Destin, Florida and consisted of 15 line miles of survey and three core locations. The third area, located offshore of Pensacola, Florida, consisted of ten line miles of survey and three core locations. Alpine deployed the following equipment onto the *Atlantic Twin* for the basic geophysical survey:

- Trimble NT300D DGPS system with Coast Guard generated corrections
- Hypack Max software with PC for navigation data storage
- Fluxgate compass
- Innerspace 448 digital single beam echo sounder
- Geo-Acoustics GeoPulse 3.5 KHz subbottom profiler system
- EPC model 1086 recorder
- TSS 320B heave compensator for subbottom data

Positioning of the vessel was accomplished by deploying a Trimble NT300D Series DGPS system using differential corrections received from Coast Guard operated base stations. In order to control the quality of the differential navigation system, the ship-born navigation system was removed from the vessel and transported to a previously surveyed control point. The navigation antenna of the mobile unit was positioned over the survey point and data captured and logged using Hypack software. The observed Lat-Long of the unit using differential corrections from the base station was compared to the surveyed location to ascertain that navigation accuracy met project specifications. The fluxgate compass was calibrated using the systems automatic calibration routines. Prior to commencement of operations, offset positions were measured from the GPS antenna on-board the survey vessel to the relevant equipment (Echosounder, Subbottom Profiler). Data from the Trimble NT300D series DGPS unit onboard the vessel was fed into the HypackMax navigation software. The helmsman and lab were provided with a visual display of location in relation to the planned line. Positioning data was recorded on magnetic media for post-processing. Closures were transmitted to graphic recorders every 100 meters. Navigation data was transmitted from the navigation system to the subbottom acquisition system in real time for coordination of acquired seafloor data. Data from the echosounder was recorded directly onto the navigation system files. Prior to starting data collection all equipment was tested and calibrated. For single beam echosounding an Innerspace 448 or similar, with an over-the-side mounted transducer was used. The Innerspace 448 was calibrated via the bar check method to determine an index of error. A GeoAcoustics GeoPulse system was used to collect subbottom data. The unit was connected to a 3.5Khz transducer set and the data recorded on an EPC GSP 1086 recorder.

A navigation/event log book was kept in the field. The information included in this log book contains the date, line number, start and end times, laybacks, and beginning and end fix numbers, line abandonment, significant changes in course and any other events relevant to survey operations. A separate Line Log was kept with data logged for the operational settings, on each line, of each survey instrument, including but not limited to power settings and transmit frequency settings, firing rate, displayed data width, and timing line settings, etc. All analogue chart rolls were marked with the beginning and end fix numbers, the lines included, the date and project number. These data were transferred to the Norwood office at the end of the job.

Alpine collected (1) 20-foot vibracore sample at each of nine locations in accordance with marine sampling protocol. Alpine used the R/V *Atlantic Twin* fully equipped with a Contractor model 271 pneumatic vibracore ancillary.

A Trimble NT300D DGPS system, interfaced into a PC with Hypack Max Hydrographic software was used to accurately locate the vessel at the proposed sampling site. The DGPS antenna was mounted on the main A-frame used to lower the vibracore to the sea floor. Vibracore locations were determined to within +/- 3 meters. A position was classified as valid if it was within 50 feet of the intended position. The R/V *Atlantic Twin* anchored using a single point mooring before commencing core operations.

Depth and rate of penetration below the sea floor of the vibracore sampler was monitored and recorded continuously at each core site. The data collected by Corelog was later used to generate and plot penetration graphs for each core. Water depths were recorded at each core site using a calibrated echo sounder. Measured water depths were tidally corrected to datum elevation based on actual tides at the closest primary tide stations. The primary tides were corrected for phase and amplitude variations at selected locations closest to the work sites as contained in the NOAA Predicted Tide tables.

Alpine took cores with a maximum penetration of 20 feet and a minimum acceptable penetration of 16 feet**.** The cores were taken after seismic acquisition was completed and located on the seismic lines to allow for better correlation and interpretation of the seismic images. The minimum acceptable core recovery was 80 percent of the penetrated depth. Once desired penetration was achieved at a given core site, the core rig was raised and secured along the side of the vessel where the filled core liner was extracted from the core pipe. The filled core liner was then placed on deck, measured for recovery length, cut into five-foot sections and capped. A small sediment sample was collected from each cut for initial visual analysis of the recovered sediments. The cores were labeled and stored in a vertical position on the vessel in order to maintain sediment stratification. The cores were taken to URS Corporation in Tallahassee, Florida and described, cut, photographed, and sampled by the authors. The seismic interpretation was completed by the authors, Dr. Joseph Donoghue, FSU, and Alan Niedoroda, URS Corporation.

Panama City Geophysical Data - This site was selected after a review of the existing geophysical data along with the artificially shaded relief image, indicated this feature was possibly an ebb tide delta or an inlet retreat path.

Field work included nine tracklines which transected this feature as well as the related feature to the east. Four of the tracklines criss-cross the main feature and the other five cover the eastern feature and the area between the two features. Figure 1 shows the location of this feature, along with the tracklines and core locations taken during the field work. Figure 2 is a portion of line PC-2 showing the location of core PC-3 and the edge of the feature as it is approached from the west.

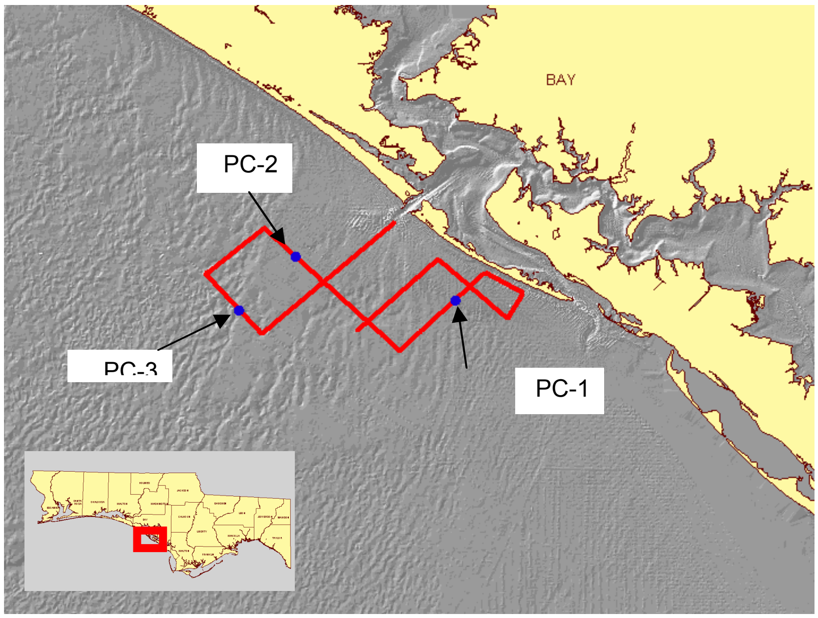

Figure 1. Panama City feature with tracklines and core locations.

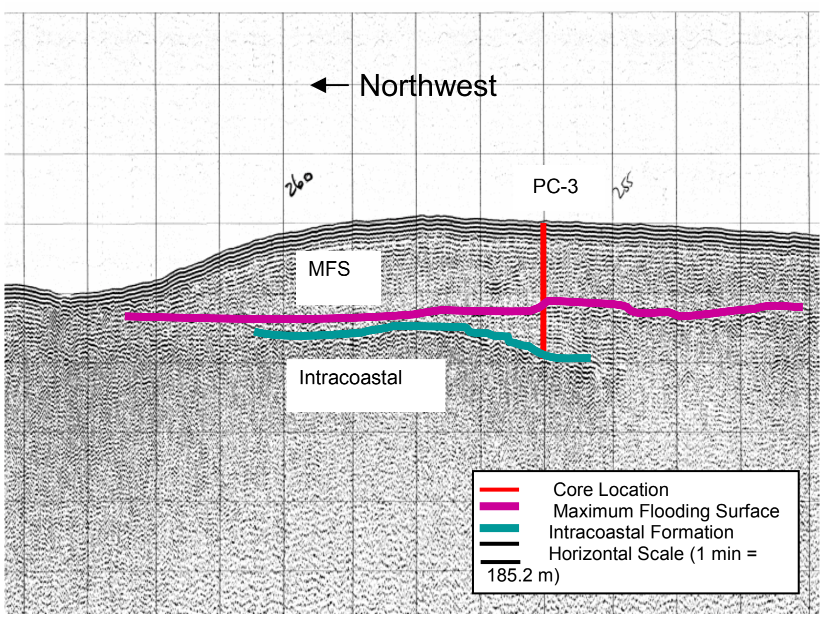

Figure 2. Line PC-2 showing edge of feature.

For all seismic images in this report, the purple line highlights the top of the Mid-Wisconsinan deposits and a Maximum Flooding Surface (MFS). The MFS is inferred to be a flooding surface separating the Pleistocene deposits below, which are generally older than 37 ka, from the early Holocene deposits above. The ages of the deposits above and below the MFS are supported by the radiocarbon dates from three samples obtained as part of this project and by the sea-level history of the area. This flooding surface in some cases is found directly above the Mio-Pliocene Intracoastal Formation (annotated in green) due to a lack of, or very thin, Mid-Wisconsian and other late Pleistocene-age deposits. The top of the Intracoastal Formation is annotated in green and this unit is Mio-Pliocene in age. These older deposits were recovered locally in the cores, but are most commonly identified only on the seismic lines as the deepest reflector. Due to the characteristics of the instrumentation used to collect the seismic data, the top of the basal limestone (Intracoastal Formation) is the deepest reflector because the outgoing signal was not strong enough to penetrate limestone and return to the surface (Koch, 2006).

Panama City Vibracores - The vibracores taken at the Panama City site were taken to assess the interpretation of this feature as a possible ebb-tidal delta or inlet retreat path. The cores taken confirm this interpretation.

Core PC-3 is based in an estuarine/marine environment that is the first stage in the growth of the ebb tide delta. As sea level begins to rise, the ebb delta begins to retreat landward, leaving deltaic deposits behind. Cores PC-1 and PC-2 both reveal a once deltaic environment that became possibly lagoonal or nearshore environments before being drowned by rising sea level (Niedoroda, et. al., 2004, Koch, 2006).

Core PC-1 is located on the east side of the feature. It is interpreted as being an ebb tidal delta environment (at the bottom) that has begun to erode and create a quiet nearshore or lagoonal-type setting with clay filled burrows and large complete shells. Table 1 is the core description for PC1 (Niedoroda, et. al., 2004, Koch, 2006).

Table 1. Vibracore PC1

Core #	Core Division	Description	comments
PC1-R2	0.0-5.9 ft	medium light tan, fine quartz sand, trace heavy minerals, trace shell fragments	<1% forams present, burrows present
	5.9-10.5 ft	light grayish tan, very fine to medium quartz sand, trace shell fragments, trace heavy minerals	trace frosted grains, <1% forams present, turitella shell at 8.9 ft.
	10.5-13.7 ft	light tannish gray, very fine to coarse quartz sand, trace carbonates, trace shell fragments	<1% forams present, <1% coral present, large burrow, complete shells at 12.5 and 13.0 ft.
	13.7-15.6 ft	medium gray to black, silty to medium quartz sand, trace heavy minerals	section fines downward to organic mud (peat)
	15.6-17.3 ft	medium to dark gray, silty to fine quartz sand, trace shell fragments, trace carbonates	<1% forams present
	17.3-19.5 ft	medium tannish gray, very fine to fine quartz sand, trace heavy	<1% forams present

Table 1. Vibracore PC1

		minerals, trace shell fragments, trace carbonates	
	19.5 ft	bottom of core	

Core PC-2 is located on the west of the feature. The core fines upward, contains roots (at 3.2-7 feet), and is mainly silty sand. The core is interpreted as a marshy environment that is a back barrier deposit. Table 2 is the PC2 vibracore description (Niedoroda, et. al., 2004, Koch, 2006).

Table 2. Vibracore PC2

Core #	Core Division	Description	Comments
PC2	0.0-2.25 ft	medium to dark gray, coarse quartz sand, trace shell fragments	carbonate cemented concretions throughout, <1% forams present
	2.25-11.75 ft	medium gray, silt to very fine quartz sand	root (or plant matter) @ 3.2 ft, 0.3 ft in length, thin root @ 7.78 ft, 0.4 ft in length, <1% forams present, <1% sea urchin spines present
	11.75-16.3 ft	medium to dark gray, silty to medium quartz sand, trace heavy minerals, trace shell fragments	14-15 ft large shell (~1 inch) hash
	16.3-19.5 ft	light gray, fine quartz sand, trace heavy minerals	mottling from roots, one large burrow, trace frosting
	19.5 ft	bottom of core	

Core PC3 is furthest offshore and is located on the edge of this feature. The core changes environment from marine or estuarine at the bottom to ebb delta at the front. The top portion of this core shows the effects of reworking by storm waves since sea level rises over the feature. Table 3 is the core description for vibracore PC3 (Niedoroda, et. al., 2004, Koch, 2006).

Table 3. Vibracore PC3

Core #	Core Division	Description	Comments
PC3	0.0-12.3 ft	light tannish gray, fine to very coarse quartz sand, trace heavy minerals, trace carbonates	little frosted grains, <1% bryozoan present, incomplete shells at 5.5 ft
	12.3-15.6 ft	light to medium gray, very fine to medium quartz sand, trace shell fragments, trace heavy minerals	trace frosted grains, <1% sea urchin spines present, <1% foraminifera present, <1% bryozoans present
	15.6-16.5 ft	medium gray, shelly silty to fine quartz sand	matrix is silty quartz sand around shells, 50% shell by volume
	16.5-17.95 ft	dark gray, mostly shell, some silty to fine quartz sand, trace shell fragments, trace heavy minerals	50% shell by volume, (freshwater shells), <1% foraminefera present
	17.95-18.6 ft	dark gray, fine to very fine quartz sand, trace carbonates, trace heavy minerals, trace shell fragments	<1% foraminefera present
	18.6-19.2 ft	dark gray, fine to very fine quartz sand, few shell fragments	carbonate cemented sand pieces
	19.2 ft	bottom of core	

Eastpass Site Geophysical Data - The East Pass study area was selected to confirm the interpretation of existing data that this feature is a drowned barrier island or shore complex. The term "shore complex" is used to include the zone between the lower shoreface and the landward limit of back-barrier overwash deposits. This interpretation was based on the artificially shaded relief image, as well as existing sub-bottom profiles collected with a high-resolution single channel "boomer" (Locker et al., 1988). Figure 3 shows the location of the interpreted feature, trackline locations and core positions. Using the bathymetric data and gray-scale image to view geomorphic patterns on the sea floor, this feature stands out very prominently.

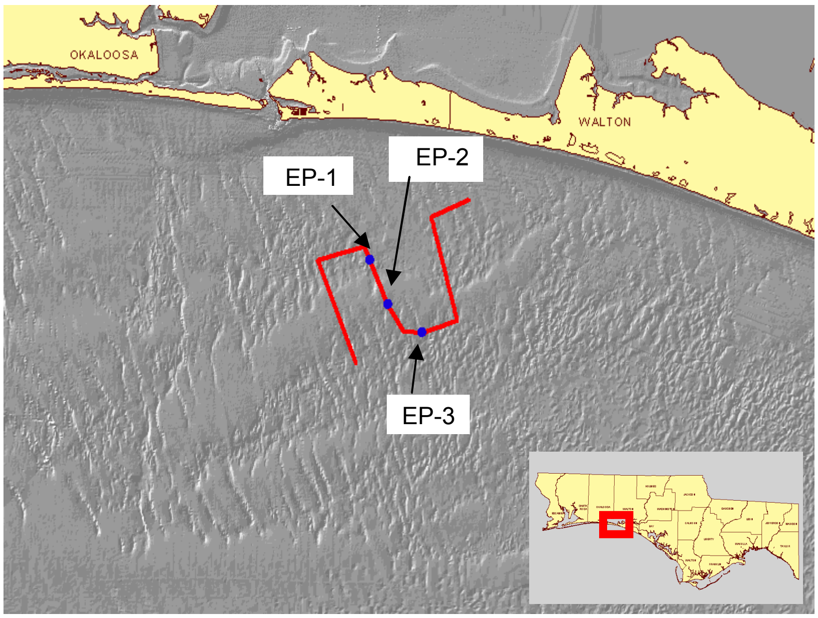

Figure 3. East Pass feature with tracklines and core locations.

A total of eight tracklines were run over the study area. Five cross the feature perpendicular to its long axis. These are lines EP-2, EP-5, EP-6, and EP-8A&B. One line, EP-3 was run parallel to the feature along the probable lower shoreface zone.

Line EP-2 (Figure 4) is shown to illustrate the transgressive and regressive depositional patterns. These data establish that the feature is indeed a drowned barrier island or shore complex (Niedoroda, et. al., 2004, Koch, 2006).

East Pass Vibracores - The series of cores from East Pass, (EP-1, EP-2, and EP-3), support the interpretation of this feature as a drowned barrier complex (Niedoroda, et. al., 2004, Koch, 2006). This interpretation fits with the bathymetric expression. As sea level dropped or reached a still-stand, a barrier island or shore complex built out to the location of EP-3. At location EP-2, a back bay environment (or possibly lagoonal environment) is overlain by a beach/barrier. At location EP-1, a back barrier/lagoonal environment existed behind the barrier at EP-2. This entire area was then overstepped and drowned by rising sea level.

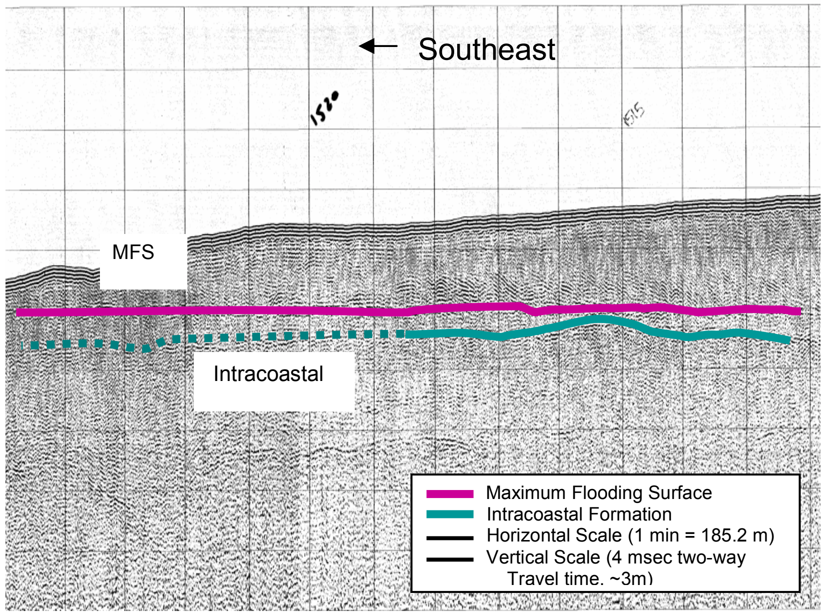

Figure 4. Line EP-2 showing transgressive and regressive patterns.

Vibracore EP1 (Table 4) is interpreted as a back barrier marsh to lagoonal environment (Niedoroda, et. al., 2004, Koch, 2006). The top of the core is sandy with a large amount of heavy minerals and is burrowed, indicating a lagoonal depositional environment. A 0.3-foot shell hash is located at 9.2 feet and the core begins to fine from this point down. Black to dark gray organic muds appear at ~11.5 feet and are mottled. A thin root was found at 12.2 feet.

Table 4. Vibracore EP1

Core #	Core Division	Description	Comments
EP1	0-2.85 ft	fine to medium quartz sand, speckled black and medium gray, little heavy minerals, few shell fragments, few shell fragments	with burrows
	2.85-9.2 ft	fine to medium quartz sand, trace shell fragments, trace heavy minerals, trace carbonates	
	9.2-9.5 ft	shelly quartz sand, some shell hash, some fine to medium quartz sand, some heavy minerals	
	9.5-11.55 ft	fine to very fine silty sand, trace heavy minerals, trace shell fragments, trace carbonates	
	11.55-13.6 ft	black to dark gray fine to very fine silty sand, little shells	root present @ 12.2ft, dark organic mud
	13.6-14.5 ft	dark gray very fine to medium silty sand	
	14.5-15.6 ft	medium gray, very fine to medium quartz sand, trace heavy minerals, trace shell fragments, trace clay	
	15.6-18.55 ft	dark gray to black, fine to medium quartz sand, trace shell fragments, trace heavy minerals	
	18.55-19.6 ft	light gray, very fine to medium quartz sand, trace heavy minerals, trace shell fragments, some clay	clay nodules and burrows present
	19.6 ft	bottom of core	

Vibracore EP2 (Table 5) is interpreted as a beach/barrier that has built out over a lagoonal environment (Niedoroda, et. al., 2004, Koch, 2006). Sediment mean grain size in the core becomes finer towards the bottom and is burrowed throughout. The shell content increases upwards and numerous large, complete shells are found at approximately five feet down-core. The top of Core EP2-R2 is a well sorted, medium to coarse sand, typical of modern beaches in this area of the Panhandle of Florida.

Table 5. Vibracore EP2

Core #	Core Division	Description	Comments
EP2-R2	0-2.9 ft	light tan, medium to coarse quartz sand, trace shell fragments	complete shells @ .7 inch and 1.2 ft from top, mostly frosted grains
EP2-R2	2.9-6.4 ft	light tan, medium to fine quartz sand, trace shell fragments, trace heavy minerals	mostly frosted grains, dark gray burrows 3.2-4.5 ft., large complete shells @ 4.7,5.0,5.1,5.3 ft.
	6.4-8.7	light gray, medium to fine quartz sand, trace shell fragments	large complete shells @ 6.8,7.0,7.6,8.1 ft, little frosted grains
	8.7-9.1 ft	tannish gray, medium to fine quartz sand, some shell hash, trace heavy minerals	shell lag
	9.1-11.65 ft	light to medium gray, fine to very fine quartz sand, trace clay, trace shell fragments, trace heavy minerals	mottled
	11.65-13.7 ft	dark gray, very fine silty quartz sand, trace shell fragments	mottled
	13.7-14.6 ft	light gray to dark gray, very fine to fine quartz sand	Mottled, possible burrows
		very fine to fine	possible burrows
		quartz sand	
	14.6	bottom of core	

The vibracore furthest offshore is EP-3 (Table 6). The base of Core EP-3 is estuarine, possibly lagoonal, with burrowed silty sand, shell hashes and incomplete shells. Urchin spines and foraminifera are also seen in the bottom section of the core. The remainder of the sediments in the core (the top 14.7 feet) increase in mean grain size upwards which shows a transgressive sequence created as the barrier island complex migrates shoreward (Niedoroda, et. al., 2004, Koch, 2006).

Table 6. Vibracore EP3

Core #	Core Division	Description	Comments
EP3	0.0-6.5 ft	light tan to dark tan, fine to medium quartz sand, trace heavy minerals, trace carbonates, trace foraminifera, trace shell fragments	dark tan mottles, some frosted grains
	6.5-7.4 ft	dark grayish tan to light tan, very fine to fine quartz sand, trace carbonates, trace heavy minerals	trace frosted grains
	7.4-9.2 ft	light greenish-gray to medium greenish gray, very fine to fine quartz sand, trace heavy minerals, trace carbonates, trace sea urchin spines, trace foraminifera	

Table 6. Vibracore EP3

	9.2-17.7 ft	dark greenish gray to dark gray, silty quartz sand, trace heavy minerals, trace shell fragments, trace sea urchin spines	mottling
	17.7 ft	bottom of core	

Santa Rosa Site Geophysical Data - The Santa Rosa site was selected because it was thought to be a major sand shoal. Using the artificially shaded relief image and existing ROSS geophysical data, this site was mapped as a large positive relief feature extending southwest for approximately five miles beginning three miles off Escambia County. Four tracklines were run on this feature. Figure 5 shows the location of this feature, along with the tracklines and core locations taken during the field work. Figure 6 is a portion of trackline P-4 that shows the location of core SR-3, the MFS and the Intracoastal Formation.

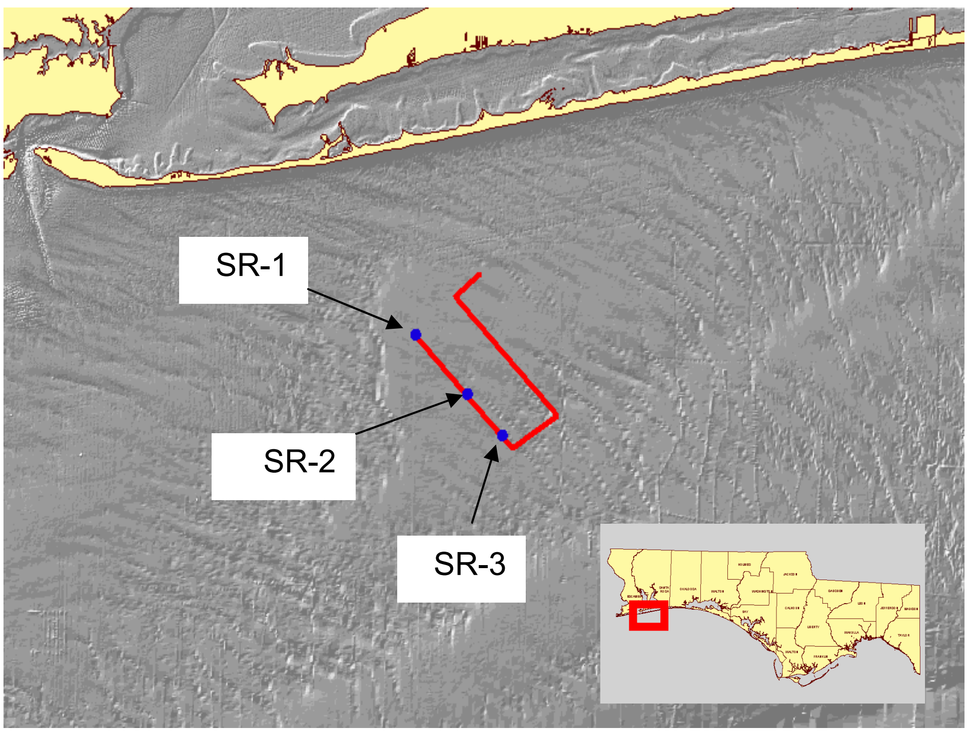

Figure 5. Santa Rosa feature with tracklines and core locations.

Santa Rosa Cores

As sea level dropped and the MFS was sub-aerial, a mound of sand was already located at this position. As sea level began to rise this mound became an island and the sediments comprising this feature were reworked (Niedoroda, et. al., 2004).

Core SR-1 contains one unit that is well-sorted, fine, clean quartz sand. Sand and shell fragment filled burrows are found throughout (Koch, 2006). Table 7 is the description for vibracore SR1 (Niedoroda, et. al., 2004).

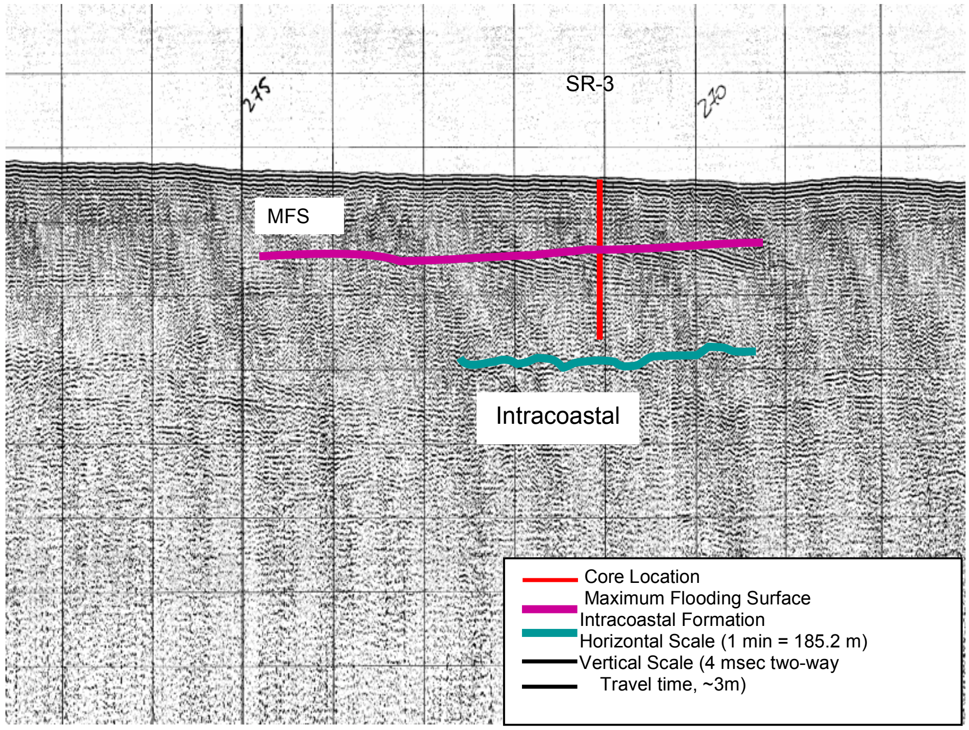

Figure 6. Line P-4 showing location of Core SR-3, the MFS and the Intracoastal Formation.

Table 7. Vibracore SR1

Core #	Core Division	Description	Comments
SR1	0.0-18.6 ft	light tan, medium to very fine, quartz sand, trace heavy minerals, trace shell fragments, trace carbonates	burrows @ 3 ft, 9.6 ft, 10-10.9 ft 12.2 ft, 13.2-13.6, 13.8-13.9 ft, 18.6 ft some frosting on grains <1% forams
	18.6 ft	bottom of core	

Core SR-2 overall coarsens upward and is a medium to dark gray fine to very fine sand. The top 0.65 feet is mottled and burrowed. Foraminifera and shell fragments are found in the section from 3.7-8.25 feet. From 10.4 feet to the bottom of the core, the core is layered, becomes increasingly organic, looses all shell content, and contains a few wood fragments. Table 8 is the description for vibracore SR2 (Niedoroda, et. al., 2004).

Table 8. Vibracore SR2

Core #	Core Division	Description	Comments
SR2	0.0-0.65 ft	light to medium gray, fine to medium quartz sand, trace shell fragments	mostly frosted grains, mottling
	0.65-3.7 ft	medium to dark gray, very fine to medium quartz sand, trace heavy minerals, trace shell fragments	Mottling

Table 8. Vibracore SR2

	3.7-8.25 ft	medium gray, very fine to medium quartz sand, little shell fragments, trace heavy minerals, trace carbonates	mica present, little frosted grains
	8.25-10.4 ft	medium tannish gray. Very fine to medium quartz sand, trace heavy minerals, trace shell fragments, trace carbonates, trace foraminifera	little frosted grains, unit grades downward, mottling
	10.4-10.8 ft	light to dark gray, silty to very fine quartz sand, few heavy minerals, trace mica	
	10.8-11.1 ft	medium gray, very fine quartz sand, trace heavy minerals	
	11.1-12.45 ft	medium gray, very fine to fine quartz sand, trace heavy minerals	little frosted grains, mottling
	12.45-13.6 ft	medium to dark gray, very fine quartz sand, trace organics, trace heavy minerals, trace mica	layered sand, dark layers contain plant fragments, <1% mica
	13.6-14.25 ft	medium gray, very fine silty quartz sand, trace heavy minerals	
	14.25-16.9 ft	light to medium gray, very fine to fine quartz sand	heavy organic smell, layered sand, wood fragment, little frosted grains
	16.9-17.9 ft	medium gray, very fine silty quartz sand, trace heavy minerals	<1% mica, little frosted grains
SR2	17.9-20.0 ft	dark gray, very fine silty quartz sand	
	20.0 ft	bottom of core	

The core furthest offshore, SR-3 contains a large amount of overwash atop a medium to dark gray, fine to medium sand. This sand is most likely lagoonal with landward overwash of a seaward barrier (Koch, 2006). Table 9 is the description for vibracore SR3 (Niedoroda, et. al., 2004).

Table 9. Vibracore SR3

Core #	Core Division	Description	Comments
SR3	0.0-1.2 ft	medium tannish gray, fine quartz sand, trace shell fragments, trace heavy minerals, trace carbonates	mostly frosted grains, mottling
	1.2-1.5 ft	light to medium gray, very fine to fine quartz sand, trace heavy minerals, trace shell fragments, trace carbonates	possible Overwash, mostly frosted grains, <1% foraminefera
	1.5-2.1 ft	light tannish gray, very fine to fine quartz sand, trace shell fragments, trace carbonates, trace heavy minerals	shell hash at top, large incomplete shells, mostly frosted grains, <1% foraminifera
	2.1-2.25 ft	medium to dark gray, very fine to fine quartz sand, trace shell fragments, trace heavy minerals	possible Overwash, some frosted grains
	2.25-3.1 ft	medium to dark brown, fine to medium quartz sand, trace heavy minerals	possible iron staining, some frosted grains
	3.1-3.85 ft	medium brown, very fine to fine quartz sand, trace heavy minerals	

Table 9. Vibracore SR3

SR3	3.85-4.55 ft	medium to dark gray, very fine to fine quartz sand, trace heavy minerals	burrows present, some frosted grains
	4.55-6.1 ft	dark gray, very fine to fine quartz sand, trace heavy minerals, trace shell fragments	some frosted grains, urchin spine
	6.1-8.2 ft	light gray, silty quartz sand, trace shell fragments	<1% foraminefera
	8.2-9.7 ft	medium gray, very fine to fine quartz sand, trace shell fragments, trace carbonates, trace heavy minerals	transition zone, few frosted grains
	9.7-14.65 ft	medium to dark gray, silty quartz sand, trace heavy minerals, trace carbonates	<1% mica, burrows present
	14.65-17.05 ft	medium to dark gray, silty to fine quartz sand, trace shell fragments, trace heavy minerals, trace carbonates	
	17.05-19.6 ft	medium gray, fine quartz sand, trace shell fragments, trace carbonates, trace heavy minerals	mostly frosted grains, <1% coral present, <1% plagioclase
	19.6 ft	bottom of core	

ENVIRONMENTS OF DEPOSITION

After reviewing the core descriptions and seismic records, the following interpretation was made for the environments of deposition concerning cores EP 1-3, PC 1-3, and SR 1-3. For a more complete explanation, please see Koch 2006.

Panama City Cores - The series of cores offshore of Panama City was taken to confirm the interpretation of this feature, seen using high-resolution bathymetry, as a possible retreat path of an estuary and/or ebb-tidal delta. The cores taken confirm this interpretation. Core PC-3 is based in an estuarine/marine environment that undergoes delta building. As sea level then begins to rise, the delta begins to retreat landward, leaving deltaic deposits behind. Cores PC-1 and PC-2 both reveal a once deltaic environment that became possibly lagoonal or nearshore environment before being drowned by rising sea level.

Core PC-3 is furthest offshore and is located on the edge of this feature. The core changes environment from marine or estuarine at the bottom to delta front. The top portion of this core may be alternatively interpreted as nearshore environment.

Core PC-2 is located on the west of the feature. The core fines upward, contains roots (at 3.2-7 feet), and is mainly silty sand. The core is interpreted as a marshy environment that is deltaic, or back barrier using alternative interpretation for the top portion of PC-2.

Core PC-1 is located on the east side of the feature. It is interpreted as being a deltaic environment (at the bottom) that has begun to erode and create a quiet nearshore or lagoonal-type setting with clay filled burrows and large complete shells.

East Pass Cores - The series of cores from East Pass, EP-1, EP-2, and EP-3, are interpreted as a drowned barrier complex. This interpretation fits well with the bathymetric expression seen in the area of a drowned barrier or shoreline complex. As sea level dropped or reached a still-stand, a delta built out to the location of EP-3. At location EP-2, a deltaic environment (or possibly lagoonal environment) is overlain by a beach/barrier. This could be the result of deltaic erosion and sea level began to rise. At location EP-1, a back barrier marsh/lagoonal environment existed behind the barrier at EP-2. This entire area was then overstepped and drowned by rising sea level.

The core furthest offshore, EP-3, is interpreted as a delta-building sequence. The base of Core EP-3 is estuarine, possibly lagoonal, with burrowed silty sand, shell hashes and incomplete shells. Urchin spines and foraminifera are also seen in the bottom section of the core. The remainder of the core (the top 14.7 feet) shows a delta building sequence, which coarsens upwards and has a decreasing shell content upwards.

Core EP-2 is interpreted as a beach/barrier that has built out over a deltaic or lagoonal environment. The core fines downward and is burrowed throughout. The shell content increases upwards and numerous large, complete shells are found at approximately five feet down-core. The top of Core EP-2 is a well sorted, medium to coarse sand, typical of modern beaches in this area of the Panhandle of Florida.

Core EP-1 is interpreted as a back barrier marsh to lagoonal environment. The top of the core is sandy with a large amount of heavy minerals and is burrowed, indicating a lagoonal or beach environment. A 0.3-foot shell hash is located at 9.2 feet and the core begins to fine from this point down. Black to dark gray organic muds appear at ~11.5 feet and are mottled. A thin root was found at 12.2 feet.

Santa Rosa Cores - As sea level dropped or reached a still stand, a delta built out to the approximate location of SR-2 and a lagoonal/estuarine environment existed at the location of SR-3, becoming fully lagoonal as a barrier built seaward of SR-3. As sea level began to rise, the barrier/beach rolled over the area of SR-3 and SR-2 coming to rest near SR-1. The barrier/beach was then overstepped and drowned by the rising sea level.

The core furthest offshore, SR-3, contains a large amount of overwash atop a medium to dark gray, fine to medium sand. This sand is most likely lagoonal with landward overwash of a seaward barrier.

Core SR-2 overall coarsens upward and is a medium to dark gray fine to very fine sand. The top 0.65 feet is mottled and burrowed. Foraminifera and shell fragments are found in the section from 3.7-8.25 feet. From 10.4-feet to the bottom of the core, the core is layered, becomes increasingly organic, looses all shell content, and contains a few wood fragments.

Core SR-1 contains one unit that is well-sorted, fine, clean quartz sand. Sand and shell fragment filled burrows are found throughout.

AGE DATING

A review of the geophysical data collected during Phase III in August 2003 revealed a very distinct sub-surface reflector underlying the entire study area (Figures 2, 4 and 6). This reflector was determined to be the Maximum Flooding Surface (MFS). This is an erosional surface created during the last glacial maximum. This flooding surface represents either upland or lagoonal feature or a broad shallow estuary analogous to Florida Bay today. This surface is an unconformity representing a period of non-deposition or erosion. The results from the dated samples, calibrated to a corrected calendar age using Bards (1998) calibration curve allowed for minimum age of this surface to be around 47,000 ybp. This then determines that the sediments found above this surface are less than this age placing them in the Holocene Epoch (Koch, 2006).

Taking these dates and comparing them to the sea level curves (Figure 7), it is possible to determine that these ages correspond to a sea level still stand at these locations of around 9,000 ybp. With the understanding that the sediments on top of MSF have been determined to be less than 9,000 years in age, it follows that in the three sites surveyed, if the grain size and composition are within native beach parameters, then these bodies of sand could serve as potential borrow sand for future nourishment projects. A description of each of the radiocarbon dated samples follows:

The sample from core PC1 referred to as sample PC1A was taken at a core depth of 15.3 feet, for a total depth of 62.8 feet (19.1 m) below present Mean Sea Level (MSL). This sample is composed of organic sediment interpreted as lagoonal or deltaic in origin. The organic sediment was described as medium to dark gray to black, fine silty sand, and peaty. This section of the core was fining downward with silty sand at the top of the unit. Sample PC1A was dated by standard beta analysis and yielded a conventional radiocarbon age of 37,470 ybp +/- 1,060 ybp. Using Bard's (1998) calibration curve, PC1A yields a calculated calendar age of 47,316 ybp (Koch, 2006).

The sample from core EP1 referred to as sample EP1A was taken at a core depth

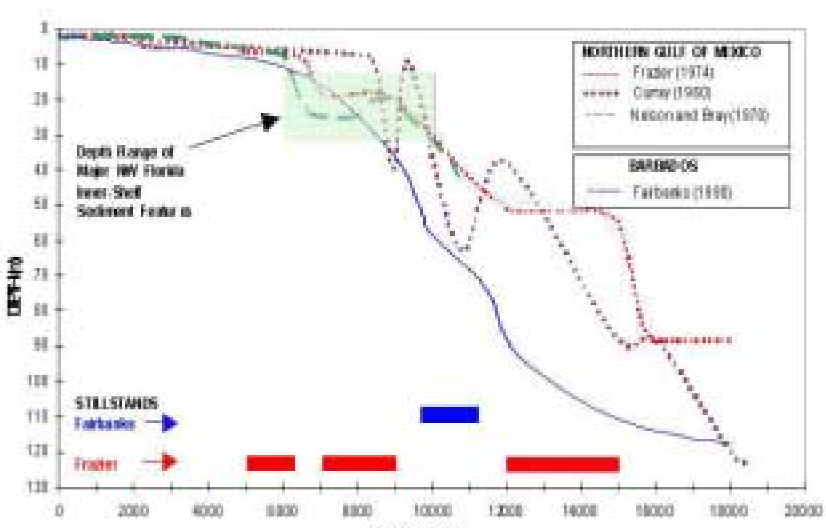

Figure 7. Sea-Level Curves of the Northern Gulf of Mexico.

of 12.2 feet, for a total depth of 88.9 feet (27.1 m) below present Mean Sea Level (MSL). This sample is composed of wood (root) and is thought to be deltaic in origin based on the silty, organic sediment surrounding the root. This portion of the core was mottled with dark organic mud and silty sand. The sand portion contained ~15% shell and a trace of heavy minerals. The quartz sand was coated with silt. After reviewing the seismic record for this core, this sample appears to be from the edge of a paleo-channel. Sample EP1A was dated by AMS analysis and yielded a conventional radiocarbon date of >46,850 ybp, meaning that the age of the sediment is beyond the limit of radiocarbon dating. Using Bard's (1998) calibration curve, PC1A yields a calculated calendar age of 59,413 ybp (Koch, 2006).

The sample from core SR3, referred to as SR3A, was taken at a core depth of 12.2 feet, for a total depth of 105.6 feet (32.2 m) below present MSL. This sample is composed of wood (stem or branch) and is thought to be deltaic in origin. This section of the core was described as silty fine sand that has been slightly burrowed. Three larger burrows (0.1-0.3 feet long) were seen in this approximately five foot section. Sample SR3A was dated by AMS analysis and yielded a conventional radiocarbon date of 38,370 ybp. Using Bard's (1998) calibration curve, SR3A yielded a calculated calendar age of 48,477 ybp (Koch, 2006).

The age dating proved to be a great aid in understanding both the mode of origin and the volume of the Holocene sand in each of the features. By clearly delineating these volumes, the limits to which the grain size and composition data from the older grab samples and newer vibracores were also determined. This allows a reconnaissance-level estimation of both these sand sources and the sand resources in other similar features.

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References:

Bard, E., 1998. Geochronologic and geophysical implications of radiocarbon calibration: Geochimica et Cosmochimica Acta, v. 62, p. 2025-2038.

Koch, Jennifer L. 2006. Late Quaternary Evolution of the Northwest Florida Coast and Margin: Development of a Conceptual Model For Identifying and Characterizing Shelf Sediment Deposits. Geology, Tallahassee, Florida State University.

Locker, S.D., K.T. Logue and L.O. Doyle. 1988. Neogene Stratigraphy, Bedforms and Surface Sediments: NW Florida State Waters. U.S.F. Report, 75 pp.

Niedoroda, Alan W., Hatchett, Lyle and Donoghue, Joseph. 2004. Reconnaissance Level Regional Sand Search of the Florida Panhandle, URS (unpubl. consulting report), 60 p.