nearshore and offshore in the observed temperature and velocity fields. A strong alongshore polarization of the nearshore stations was observed at all frequencies. However, diurnal and semidiurnal currents were less polarized than subtidal currents. These results are discussed in terms of their importance in cross-shore transport over the inner shelf and in nearshore waters.

## OS71B MCC: Hall D Sunday 0830h

## Coastal Geology of the Carolinas: Linking the Shelf and Shore II Posters *(joint with T)*

*Presiding:* **W C Schwab,** U.S. Geological Survey**; P T Gayes,** Coastal Carolina University

### OS71B-0270 0830h POSTER

### Relationship of Offshore Sediment Distribution to Short-Term Shoreline Change Using High Resolution Shoreface Mapping Techniques

David J Bernstein[1] (843-347-9675; dbernste@coastal.edu)

Jun-Yong Park[1] (843-234-1424; jpark@coastal.edu)

Michael F Forte[1] (843-347-9675; mforte@coastal.edu)

Paul T Gayes[1] (843-347-9152; ptgayes@coastal.edu)

Wayne Baldwin[2] (727-803-8747 ext.3135; wbaldwin@usgs.gov)

[1]Center for Marine and Wetland Studies, Coastal Carolina University, 1270 Atlantic Avenue, Conway, SC 29526, United States

[2]USGS Center for Coastal Regional Marine Studies, 600 Fourth Street South, St. Petersburg, FL 33701, United States

Real time kinematic GPS (RTK-GPS), bathymetric, and side-scan sonar data were integrated to analyze short-term shoreline change, from December 2001 to August 2002, in relation to offshore sediment distribution. Local beach behavior, induced by erosional and depositional events, can be identified by longshore trends in shoreline position variability. Those trends can be identified with high-resolution spatial data. Accurate shoreface morphology is measured through comprehensive high-resolution surveys incorporating shore-parallel and -perpendicular beach profiles, providing 3D maps of the shoreface. The Mean-High-Water (MHW) contour was extrapolated from these maps to obtain a reliable evaluation of shoreline change. This study presents preliminary results of shoreline position along the Grand Strand of South Carolina, and the spatial correlation of shoreline change to the inner shelf sediment distribution. Maps of maximum change in the shoreline position shows 3 distinct patterns in shoreline variability. The southern portion of the study area (low-change area) is characterized by a relatively minor change in shoreline position, with an average shift of 5.5 meters. Shoreline change increases gradually from the south to the north in the mid-section (transitional area). The variability reaches a maximum average of 7.25 meters, in the northern-most section (high-change area). Low variability trends in the southern portion of the low-change area correlate spatially with offshore presence of hardbottom morphology, while high variability trends correlate with low-backscatter, sandy morphology. These preliminary results suggest that the offshore geologic framework and shoreline variability are closely related. Further studies will focus on the influence of geologic framework on shoreface morphology.

URL: http://www.coastal.edu/cmws/berm/

### OS71B-0271 0830h POSTER

### Geologic Framework and Surficial Sediment Mapping Within South Carolinas Long Bay, From Little River to Winyah Bay

Wayne E Baldwin[1] ((727)803-8747 x-3135; wbaldwin@usgs.gov)

Robert A Morton[1] (rmorton@usgs.gov)

William C Schwab[2] (bschwab@usgs.gov)

Paul T Gayes[3] (ptgayes@coastal.edu)

Neal W Driscoll[4] (ndriscoll@ucsd.edu)

[1]Center for Coastal and Regional Marine Studies, U.S. Geological Survey, 600 S. 4th St., St. Petersburg, FL 33701, United States

[2]Woods Hole Field Center, U.S. Geological Survey, 384 Woods Hole Rd., Woods Hole, MA 02543, United States

[3]Center for Marine and Wetland Studies, Coastal Carolina University, 1270 Atlantic Ave., Conway, SC 29526, United States

[4]Geological Sciences, Scripps Institution of Oceanography, 8602 La Jolla Shores Dr., La Jolla, CA 92037, United States

High-resolution seismic reflection profiles, sidescan-sonar imagery and interferometric swath-bathymetry, groundtruthed with surficial sediment samples and vibracores, allow for a detailed interpretation of the shallow geologic framework within South Carolinas Long Bay. This mapping provides a better understanding of the areas nearshore geology by identifying structural and stratigraphic controls that influence the location of paleochannel incisions and distribution and thickness of surficial sediment bodies.

The study area lies on the southwest flank of the Cape Fear Arch (CFA) or Mid-Carolina Platform High. The CFA accounts for the regional southerly dip and localized folding within lithified Cretaceous and Tertiary continental shelf strata that comprise the sedimentary base of the study area. Uplift of the CFA is also primarily responsible for the observed sediment starvation of this inner shelf region, because of massive diversion of post-Cretaceous fluvial sediment input away from its axis into the bounding Southeast Georgia and Albemarle embayments. The dipping and folded strata that underlie the area are incised by paleochannels that are progressively larger and more frequent to the southwest, where they display characteristics of integrated drainage networks. These features are the products of fluvial incision during multiple lowstands in sea level. In many areas, differential resistance to erosion of the underlying shelf strata appears to influence both the location and depth of paleochannel incision. Nested fill geometries within the paleochannels indicate that their stratigraphic histories are complex and likely include repeated periods of abandonment and reoccupation. Differential erosion of paleochannel fill and continental shelf strata produce a well-defined unconformity. This surface is mapped throughout the area and considered to represent the last marine transgression. Coarse clastic and biogenic surficial sediments (sand, gravel, and shell hash) are observed to directly overlie this unconformity. Differentially eroded strata beneath this unconformity crop out at the sea floor, where sediment cover is thin, to form low-relief hardgrounds. Surficial sediments are patchy and thin northeast of the inferred offshore contact between Tertiary and Cretaceous strata. The thickest accumulations of surficial sediment within the area are either inlet-related shoals, associated with the retreat paths of tidal deltas, or shoreface-attached and -detached sand ridges that trend oblique to the shoreline.

### OS71B-0272 0830h POSTER

### Distribution and Architecture of Channels Preserved on Continental Shelves: A Comparison of the Carolinas and the U.S. East Coast

John Patrick Walsh[1] ((858) 822-1003; jwalsh@ucsd.edu)

Neal W. Driscoll[1] (ndriscoll@ucsd.edu)

William C. Schwab[2] (bschwab@usgs.gov)

Paul T. Gayes[3] (ptgayes@coastal.edu)

Wayne E. Baldwin[4] (wbaldwin@usgs.gov)

[1]Scripps Institution of Oceanography, University of California, San Diego, La Jolla, CA 92093-0244, United States

[2]U.S. Geological Survey, 384 Woods Hole Road, Quissett Campus, Woods Hole, MA 02543, United States

[3]Coastal Carolina University, Department of Marine Sciences, Conway, SC 29526, United States

[4]Center for Coastal and Regional Marine Studies, U.S. Geological Survey,600 Fourth St. S, St. Petersburg, FL 33701, United States

Many channels are preserved on the Carolinas continental shelf, and they are widely distributed with a marked variability in form. Preserved channels are largely believed to be excavated by rivers during sea-level low stands, however, they also can be created and modified by processes (e.g., waves and tides) active during high-stand, falling, and rising sea-level conditions. Today, the Carolinas continental shelf receives water and sediment from several moderately sized rivers, and these same rivers have carved a network of channels on the shelf. This research synthesizes and compares high-resolution seismic-reflection data collected along the Carolinas and U.S. East Coast continental shelf to emphasize that several factors are instrumental in determining the architecture and distribution of preserved channels. Processes active in carving, altering, and preserving channels are considered to result from three general controls (sea level, climate and tectonics). Dominant processes include river discharge (water and sediment), tectonic changes, sea-level position, tidal range and wave climate. Naturally, these processes exhibit spatial and temporal variability.

There are two critical concerns when investigating subaqueous channels: (1) the seismic system has a dramatic influence on the imaging quality, and (2) the survey path and assumed sound speed significantly affects the channel geometry. Taking these into consideration, distribution and attributes (e.g., width, depth) of channels on the continental shelf is determined. A classification system and measurement protocol developed for the various parameters is employed in the analysis of data from throughout the U.S. East Coast, compiled from several sources.

Several important insights are gained from the examination of the various seismic datasets. Tidal inlets appear to be commonly preserved with the widespread occurrence of narrow channels (hundreds of meters wide) with steep sidewalls ($> 15^{\circ}$). Incised valley networks seaward of large river mouths (e.g., Pee Dee, Delaware) are hundreds of meters to kilometers wide and tens of meters deep, and the underlying lithology apparently has a notable impact on their preserved channel morphology. Large surface channels are only evident in the New York Bight (i.e., Hudson and Block Island Shelf Valleys), perhaps reflecting large water and sediment discharge during the late Pleistocene.

### OS71B-0273 0830h POSTER

### Investigation of the Geologic Framework of the Grand Strand Coast in South Carolina

Thomas R. Putney[1] (843-406-0149; trputney@aol.com)

Michael P. Katuna[1] (katunam@cofc.edu)

M. Scott Harris[2] (msharris@coastal.edu)

Eric E. Wright[2] (ewright@coastal.edu)

[1]Department of Geology and Environmental Geosciences, College of Charleston 66 George St., Charleston, SC 29424, United States

[2]Department of Marine Science, Center for Marine and Wetland Studies, Coastal Carolina University, Conway, SC 29528, United States

The Grand Strand consists of a continuous 100 km arcuate shoreline extending from Winyah Bay to Little River, South Carolina. This coastal segment of South Carolina is dominated by mainland beaches, which are attached to eroding Pleistocene headlands. Pleistocene and Holocene age deposits generally form a relatively thin veneer of unconsolidated sediments that overlie early Tertiary or late Cretaceous sedimentary units. These older indurated to semi-consolidated deposits are exposed as "hardgrounds" in the immediate shoreface zone. Wave erosion of Quaternary deposits and the underlying older strata provides a varied sand source for this sediment-starved coastal segment. Therefore, knowledge of the geologic framework of the lower coastal plain and the inner continental shelf is extremely important in understanding long and short-term coastal changes that affect this region.

Sixteen borings drilled to a maximum depth of sixty feet, as well as 150 additional data points derived from geophysical well logs and existing core data, have been utilized to characterize the near-surface stratigraphy and define the Holocene unconformity beneath the Grand Strand. Pleistocene and Holocene sediments analyzed from these borings suggest deposition in beach ridge/spit, tidal inlet, back barrier, nearshore marine and fluvial/deltaic paleoenvironments. To the south, these younger sediments overlie an erosional surface incised into fine-grained shelfal sand, silt, and clay strata of the Paleocene Black Mingo Group, whereas to the north, these deposits unconformably overlie sandy mudstones and siltstones of the late Cretaceous Peedee Formation. Coast-parallel and perpendicular seismic surveys confirm the presence of buried fluvial channels that were incised into these older stratigraphic units by ancestral Piedmont rivers during Pleistocene sea level low stands.

The identification of nearshore morphological features, coupled with the sedimentological characteristics and thickness of modern shelfal deposits, are important criteria in defining both the sediment budget and sediment transport processes affecting this coastal segment. Through further integration of land-based data and offshore geophysical surveys, a comprehensive model of the geologic framework is being developed to better understand both the geologic evolution and the modern day processes that influence the Grand Strand coastline.

## OS71B-0274 0830h POSTER

### Comparison of Historical and Recent Shoreline Change Rates to Shoreface and Lower Coastal Plain Geomorphology: Geologic Framework Influences on Shoreline Evolution in South Carolina

Michael S Harris[1] (843.347.9135; msharris@coastal.edu); Eric E. Wright[1] (843.234.1422; ewright@coastal.edu); Triniti A. Dufrene[1] (triniti1978@aol.com); Paul T. Gayes[1] (843.347.9152; ptgayes@coastal.edu); Michael P. Katuna[2] (843.953.5588; katunam@cofc.edu); Thomas R. Putney[2] (trputney@aol.com); David M. Bush[3] (770.836.4597; dbush@westga.edu); William C. Schwab[4] (bschwab@usgs.gov)

[1]Coastal Carolina University, Department of Marine Science 1270 Atlantic Avenue, Conway, SC 29526, United States

[2]College of Charleston, Department of Geology and Environmental Geosciences 58 Coming Street, Charleston, SC 29401, United States

[3]State University of West Georgia, Department of Geosciences, Carrolloton, GA 30118, United States

[4]U.S. Geological Survey, 384 Woods Hole Road, Woods Hole, MA 02543, United States

The lower Coastal Plain and inner Continental Shelf of the United States East Coast vary coherently in both pre-Holocene and modern morphology, in long-term trends of coastal change, and in respect to critical areas of beach erosion. As a portion of the USGS-SC Sea Grant Consortium coastal erosion program, this study presents a comparison of historical to recent shoreline change rates with the geomorphology of the lower Coastal Plain and inner portions of the Continental Shelf of South Carolina.

Shoreline change trends of re-digitized historical data of Anders *et al.* (1990) and recent aerial photographs were analyzed using ARC/INFO, ArcGIS and scripts modified from the original DSAS program (Thieler and Danforth, 1994) and the currently active National Shoreline Change Program (US Geological Survey, St. Petersburg, FL). Lower Coastal Plain and coastal geomorphology data come from digital USGS topographic data, Horry County department of engineering (approximately 0.4 m vertical resolution), and NOAA LIDAR data for the immediate coastline. NOAA and USGS processed bathymetry were merged with these data for South Carolina to produce a seamless hypsographic data layer for these physiographic regions. Sidescan sonar surveys over the past eight years in South Carolina provide additional shoreface data for the Charleston and Grand Strand (Myrtle Beach) areas of South Carolina.

As expected, the highest and most consistent variances in shoreline change trends are associated with inlets, small swashes, washover barriers, and beach renourishment projects. However, critical trends in coastal change in regions outside those typically associated with hot spots of erosion point to other, non-hydrodynamic influences on the coastal system. These influences may include truncation of modern dune ridges, of low-elevation Pleistocene terraces and beach faces, of highly-varied stratigraphic units, and of indurated near-surface strata, which all have direct influence on long-term average shoreline change trends at the scale of a few hundred meters along the coast. Continued studies combining high-resolution subaerial and submarine subsurface stratigraphic data with high-resolution shoreline and shoreface change models will further help communities mitigate future and imminent coastal issues.

## OS71B-0275 0830h POSTER

### Geologic Development and Sand Accumulation Within a Northeastern South Carolina Spit

Eric Wright[1] (843.234.1422; ewright@coastal.edu); Steve Forman[2] (312.413.9404; slf@uic.edu); Sarah Kruse[3] (813.974.7341; skruse@chuma.cas.usf.edu); Michael Scott Harris[1] (843.347.9135; msharris@coastal.edu); Michael Katuna[4] (843.953.558; katunam@cofc.edu); Terence Edgar[5] (727.803.8747 x3008; tedgar@usgs.gov)

[1]Coastal Carolina University, Department of Marine Science, 1270 Atlantic Ave., Conway, SC 29526, United States

[2]University of Illinois at Chicago, Department of Earth and Environmental Science, 845 W. Taylor St., Chicago, IL 60607, United States

[3]University of South Florida, Department of Geology, 4202 East Fowler Ave., Tampa, FL 33620, United States

[4]College of Charleston, Department of geology and Environmental Geosciences, 58 Coming St., Charleston, SC 29401, United States

[5]U.S. Geological Survey, Center for Coastal and Regional Marine Studies, 600 4th St. South, St. Petersburg, FL 33701, United States

As part of the USGS-South Carolina Sea Grant Consortium Coastal Erosion Program, this continuing study examines the geologic development and evolution of the North Island spit, located seaward of Winyah Bay in northeastern South Carolina. This prominent Holocene spit, which is over 5 km in length and 1 km in width, has developed as a series of southward prograding, recurved shorelines located at the southern end of the 75 km long Grand Strand coastline. Measurements of sediment thickness and rate of shoreline progradation of this feature will not only allow for a better understanding of regional sediment transport along the Grand Strand system but also the geologic processes active in spit formation.

To determine geologic architecture, ground-penetrating radar data were collected along the length of the spit and along three shore-normal transects. Fifteen vibracores and several newer deeper auger cores have been collected to ground truth the GPR data and to determine age control. Cores were split, photographed, visually described, and subsampled for textural and component analysis. To determine shoreline age, luminescence age estimates have now been obtained on basal or near basal dune sands along the length of the spit.

Except for a small paleo-channel at the northern end of the spit, GPR records indicate continuous spit progradation to the south. Uneven GPR reflectors, recorded in the upper 2-6 m, are composed of fine sand. This upper unit is interpreted as part of the spit platform. Underling this upper unit, southward steeply dipping reflectors extending beyond 10 m depth are composed of bedded shelly sands. This lower unit is interpreted as channel infill. Major boundaries within the lower unit appear to be tied to geomorphic shorelines. The most prominent of these shorelines are dated at ∼150, ∼300 and >∼650 years ago. This study will allow for a better understanding of regional sedimentary transport and processes affecting the Grand Strand as well as other coastal systems.

## OS71B-0276 0830h POSTER

### Geophysical Surveys of the Northern North Carolina Inner Continental Shelf Show Geologic Framework, Modern Sediment Distribution and Sediment Transport Patterns

E R Thieler[1] (508-457-2350; rthieler@usgs.gov)

D S Foster[1] (dfoster@usgs.gov)

E S Hammar-Klose[1] (ehammark@usgs.gov)

C S Roberts[1] (csroberts@usgs.gov)

C F Polloni[1] (cpolloni@usgs.gov)

[1]USGS, 384 Woods Hole Rd., Woods Hole, MA 02543-1598, United States

We have recently mapped the inner continental shelf off the northern Outer Banks of North Carolina using sidescan sonar, interferometric swath bathymetry, and high-resolution CHIRP and boomer subbottom profiling systems. The study area is approximately 170 km long by 11 km wide, extending from False Cape, VA to Cape Hatteras, NC, in water depths ranging from 7 m (mid-shoreface) to 34 m (inner shelf). Late Pleistocene stratigraphic units provide the basic, shallow geologic framework of this region. Regional to local-scale variations in the geometry and lithology of these units dictate the character of sediments on the sea floor as shown by sidescan sonar imagery. For example, areas of high acoustic backscatter typically correspond to coarse-grained, fluvial and marine sediments representing several Pleistocene units that crop out on the sea floor. The distribution of Recent sediment (above the Holocene ravinement surface) on the shoreface and inner shelf suggests that sediment availability is controlled by the underlying geologic framework, which influences the geomorphology of the overall barrier island system. For example, sediment-rich coastal segments have wide, accretionary barriers dominated by beach ridges; sediment-starved coastal segments have narrow, washover-dominated barriers. The large shoal complexes in the study area, False Cape, Platt, Wimble and Kinnakeet, are composed of both underlying indurated sediments and mobile sand bodies. Historical bathymetric comparisons indicate that large volumes of sediment in these complexes are moving hundreds of meters in tens of years. Sediment transport patterns inferred from the analysis of modern bedforms suggest that the inherited paleo-topography of the present sea floor may exert a primary influence on near-bottom currents and thus sediment transport pathways. When viewed in a larger context with other studies of this area, it appears that inner shelf geology and the regional coastal sediment budget are coupled in complex but understandable ways over time scales ranging from storm events to millennia.

## OS71B-0277 0830h POSTER

### Quaternary Seismic Stratigraphic Framework of the Northern North Carolina Inner Continental Shelf

David S Foster[1] (508-457-2271; dfoster@usgs.gov)

E Robert Thieler[1] (508-457-2350; rthieler@usgs.gov)

Mark K Capone[1] (508-457-2221; mcapone@usgs.gov)

Jane F Denny[1] (508-457-2311; jdenny@usgs.gov)

[1]US Geological Survey, 384 Woods Hole Road, Woods Hole, MA 02543, United States

The U.S. Geological Survey has recently collected high-resolution Boomer and CHIRP seismic-reflection profiles along the inner continental shelf of North Carolina between False Cape, VA and Cape Hatteras, NC. The two systems were used concurrently on a dense survey grid with shore parallel lines spaced about 300 m apart. Tie lines were run perpendicular to shore and were spaced about 4 km apart. The survey area covers the inner shelf from about the 7-m isobath to 11 km offshore. Boreholes were drilled on the barrier islands to provide ground truth and correlate the seismic stratigraphy mapped on the shelf and in the backbarrier estuary. Seismic interpretations on the inner shelf are being verified with vibracore data.

At least five transgressive unconformities are observed as planar reflections that dip to the southeast. The seismic sequences bounded by these unconformities also thicken slightly to the southeast. As a result, the Quaternary stratigraphic section is more compressed in the northern part of the study area. The deepest unconformity is believed to be the top of the Yorktown Formation (Pliocene) and is recognized as a distinct angular unconformity on Boomer profiles in the northern part of the study area. Three shallower unconformities have been identified on the Boomer profiles, which can be related to discrete Pleistocene sea-level fluctuations using amino acid racemization chronologies. In addition to these surfaces, the Holocene transgressive unconformity is best identified on the Chirp profiles. However, for much of the study area there is no definitive seismic reflection where we believe the unconformity should be located, based on lithologic contacts in vibracores. In some areas, there is a strong seismic reflection that correlates to the base of a mud unit that is most likely pre-Holocene back-barrier lagoon deposits. Accurate mapping of Recent marine sands requires integrating Chirp data with vibracores.

There are several areas of fluvial cut and fill that partially remove older Pleistocene units and truncate some of the transgressive unconformities. The paleo-Roanoke River valley complex is the most extensive seen on the seismic profiles. The relative ages of smaller fluvial channel complexes to the north and south cannot be linked with the main Roanoke channel complex based on the geophysical data alone. Radiocarbon ages from onshore boreholes indicate the channel complex was cut during at least two late Pleistocene lowstands.

## OS71B-0278 0830h POSTER

### The Relationship Between Shoreline Change and Surf Zone Sand Thickness

Jennifer L Miselis[1] (804-684-7857; jmiselis@vims.edu)

Jesse E McNinch[1] (804-684-7191; mcninch@vims.edu)

[1]Virginia Institute of Marine Science, P.O. Box 1346, Gloucester Point, VA 23062-1346, United States

There is a lack of information concerning surf zone geologic processes and their relationship to shoreline behavior despite the consensus that the two are intimately linked. Variations in sand thickness over a highly irregular migration surface close to the shoreline may influence wave dynamics and sediment transport and thus may be connected to hotspot formation. A nearshore survey, spanning 40km from north of the USACE-FRF pier in Duck, NC to just north of Oregon Inlet, was conducted using an interferometric swath bathymetry system and a chirp sub-bottom profiler. The study was conducted within 1km of the shore (in the surf zone) to investigate the processes that may be responsible for the behavior of shoreline hotspots in the area. The topmost reflector and the seafloor of the seismic profile were digitized and the depth difference between them was calculated. Though no ground truths were done in the survey area, cores collected from just north of the site suggest that the topmost reflector is a pre-modern ravinement surface (cohesive muds with layers of sand and gravel) upon which the Holocene sands migrate. An isopach map was generated and shows that the layer of sand above the first sub-bottom reflector is very thin and in some places, exposed.

There are many variables that may influence hotspot behavior, including bar position and wave conditions, however, the purpose of this study is to determine if there is a spatial correlation between a thin

or absent (exposed reflector) nearshore sand layer and the presence of a shoreline hotspot. In an area associated with a hotspot approximately 14km south of the USACE-FRF pier in Duck, the maximum thickness of Holocene sands was less than 2.5m. The average thickness was less than 1m (0.705m). Thicknesses that were less than 0.2m were classified as areas where the reflector was exposed and accounted for 5 percent of those calculated. It seems the thin layer of sand may represent a deficient nearshore sand source, which may perpetuate erosion in the area. Also, the interaction of waves with both a sand-starved nearshore and exposed reflectors may cause variations in sediment transport, which may be linked to hotspot formation. Research was conducted with the support of the USGS, USACE, and ARO.

## OS71B-0279 0830h POSTER

### Relationship of Hotspots to the Distribution of Surficial Surf-Zone Sediments along the Outer Banks of North Carolina

Courtney A Schupp[1] (804-684-7861; cschupp@vims.edu)

Jesse E McNinch[1] (804-684-7191; mcninch@vims.edu)

Jeffrey H List[2] (508-457-2343; jlist@usgs.gov)

Amy S Farris[2] (508-457-2288; afarris@usgs.gov)

[1]Virginia Institute of Marine Science, Route 1208 Greate Road, Gloucester Point, VA 23062, United States

[2]U.S. Geological Survey, 384 Woods Hole Road, Woods Hole, MA 02536, United States

The formation and behavior of hotspots, or sections of the beach that exhibit markedly higher shoreline change rates than adjacent regions, are poorly understood. Several hotspots have been identified on the Outer Banks, a developed barrier island in North Carolina. To better understand hotspot dynamics and the potential relationship to the geologic framework in which they occur, the surf zone between Duck and Bodie Island was surveyed in June 2002 as part of a research effort supported by the U.S. Geological Survey and U.S. Army Corps of Engineers.

Swath bathymetry, sidescan sonar, and chirp seismic were used to characterize a region 40 km long and1 km wide. Hotspot locations were pinpointed using standard deviation values for shoreline position as determined by monthly SWASH buggy surveys of the mean high water contour between October 1999 and September 2002. Observational data and sidescan images were mapped to delineate regions of surficial sediment distributions, and regions of interest were ground-truthed via grab samples or visual inspection.

General kilometer-scale correlation between acoustic backscatter and high shoreline standard deviation is evident. Acoustic returns are uniform in a region of Duck where standard deviation is low, but backscatter is patchy around the Kitty Hawk hotspot, where standard deviation is higher. Based on ground-truthing of an area further north, these patches are believed to be an older ravinement surface of fine sediment. More detailed analyses of the correlation between acoustic data, standard deviation, and hotspot locations will be presented.

Future work will include integration of seismic, bathymetric, and sidescan data to better understand the links between sub-bottom geology, temporal changes in surficial sediments, surf-zone sediment budgets, and short-term changes in shoreline position and morphology.

## OS71B-0280 0830h POSTER

### Evaluating the Persistence of Shoreline Change Hotspots, Northern North Carolina

Jeffrey H. List[1] (508-457-2343; jlist@usgs.gov)

Amy S. Farris[1] (508-457-2288; afarris@usgs.gov)

Charlene Sullivan[1] (508-457-2335; csullivan@usgs.gov)

[1]U.S. Geological Survey, 384 Woods Hole Rd., Woods Hole, MA 02536, United States

Shoreline change hotspots are sections of coast that exhibit significantly higher rates of erosion than adjacent areas. Although hotspots may occur at a wide range of spatial and temporal scales, we consider two distinct types of hotspots that have been observed on high-energy coasts away from the influence of coastal structures: 1. hotspots related to individual storms, with an alongshore spatial scale of 2-5 km and the characteristic of being almost completely reversed by accretion within 1-2 weeks of calm conditions following the storm, and referred to here as short-term reversible hotspots, and 2. hotspots related to the long-term trend of shoreline change on a time scale of decades, with a similar spatial scale as short-term hotspots but not readily reversible during fair weather, and referred to here as long-term hotspots.

Here we evaluate these hotspot types with respect to their persistence, i.e., the degree to which hotspot locations remain fixed through time. Relevant to this session, hotspots that are spatially fixed and/or recurring are more consistent with hypotheses relating hotspot formation to geologic framework controls than hotspots with variable or moving locations. Observations consist of a recently-completed three-year time series of monthly shoreline position measurements along 130 km of North Carolina's Outer Banks using SWASH, a ground-based system for surveying regional shoreline position as the mean high water datum's intersection with the beach foreshore.

We identify short-term reversible hotspots through the comparison of pre-, mid-, and post-storm shoreline surveys. The pre- to mid-storm comparison typically exhibits 2-5 km wide regions of significant shoreline erosion (10-20 m) alternating with areas of little change. The mid- to post-storm accretion appears as a mirror image of the erosion pattern, almost completely reversing the storm erosion.

We identify long-term hotspots through a comparison between our three-year SWASH time series and a three-year series of beach profiles surveyed by the U.S. Army Corps of Engineers in the 1970's. We find the mean shoreline position for each series through time-averaging, greatly reducing the variance due to short-term reversible hotspots and other sources of shoreline position variability. We then find shoreline change as the difference between the two series' mean shorelines, with shoreline change significance estimated with a standard t-test.

Observations show that short-term reversible hotspots have both fixed and changing locations. Some hotspots repeatedly occur at fixed locations through multiple storms, while others occur only once, with the hotspot/coldspot pattern completely reorganized from one storm to the next. At a broader spatial scale (10's of km), there are zones where hotspots typically occur (with or without fixed locations for individual hotspots), while in other zones we have never observed hotspots during our three years of observations.

Long-term hotspots also have both fixed and non-fixed characteristics, although the paucity of data relevant to this temporal scale make conclusions difficult. However, a preliminary comparison between our long-term change results (found as described above), and shoreline change results previously published by the State of North Carolina for a 50-year period ending in 1992, suggests that while the overall patterns of shoreline change (hotspots and coldspots) have remained the same, there is also some evidence for the along-coast migration of several of the most significant erosional hotspots.

## OS71B-0281 0830h POSTER

### Acquisition, Processing, and Archiving of High-Quality Core Data, North Carolina Outer Banks

Robert W. Brooks[1] (1-919-733-7353; bob.brooks@ncmail.net)

Charles W. Hoffman[1] (1-919-733-7353; bill.hoffman@ncmail.net)

Kathleen M. Farrell[1] (1-919-733-7353; kathleen.farrell@ncmail.net)

[1]North Carolina Geological Survey, Coastal Plain Office, 1620 MSC, Raleigh, NC 27699, United States

Rotosonic drilling technology was used to recover approximately 350 m of core (10 cm diameter) at eight different locations on the Outer Banks of North Carolina as part of a coastal geology cooperative research program. A combination of vibration and rotation of the drill pipe and casing is used to advance the hole. Water is used to wash out the casing, but is not circulated and no cuttings are brought to the surface. This leaves the site relatively undisturbed, so working in municipal areas is not a problem. Drill costs averaged about $140/m.

Coring runs are 3.3 m (10 ft) long, with each run recovering two 1.65 m (5 ft.) long polycarbonate tubes containing the core sample. In the laboratory, tubes are cut lengthwise with a circular saw and then split by pulling piano wire through the sediment. One half-core is used for sampling; the other half is used to create a detailed visual log and digital image, and is retained as an archive sample. The drilling recovered high-quality lithologic samples in unconsolidated sediments with recovery rates of over 90 percent in most holes. This allowed for thorough, detailed description and stratigraphic analysis, and closely controlled sampling for age dating and geochemical studies.

High-resolution (2048 x 1536 pixel) digital images (TIFF format) of the cores are taken in a controlled setting. Lighting, camera settings, and core positioning are carefully monitored to ensure consistency. A tape measure is included in the frame to provide depth reference information in each image. Approximately 36cm of the core is imaged at a time (9 Mb file). To construct composited core images, each 36 cm-long segment is digitally stitched together using a software program written specifically for piecing together panoramic photographs. This process yields a high-resolution (TIFF format; 36 Mb) image showing the full 1.65 m (5 ft.) core tube. The composite image is then saved in JPEG format to reduce the file size to just over 4.5 Mb without unduly compromising the image quality. Lower-resolution images can be easily made for Internet distribution.

## OS71B-0282 0830h POSTER

### Sedimentologic and Stratigraphic Aspects of Late Quaternary (<14 cal. ka?) Valley Fill (Paleo-Roanoke River) Beneath the Barrier Islands of the Outer Banks, North Carolina, USA

Kathleen M. Farrell[1] (1-919-733-7353; Kathleen.Farrell@ncmail.net)

Robert W. Brooks[1] (1-919-733-7353; Bob.Brooks@ncmail.net)

[1]North Carolina Geological Survey, Coastal Plain Office, 1620 MSC, Raleigh, NC 27699-1620, United States

Provided here is a preliminary interpretation of the late Pleistocene (<14 cal. ka) facies succession that infilled the paleo-Roanoke River valley, and its transition into the overlying barrier island complex beneath the Outer Banks of North Carolina. Previous work (e.g. Riggs and others, 1992) reported that the Albemarle Embayment of eastern N.C. is underlain by a series of Pleistocene paleovalley complexes and provided hypotheses to test regarding valley distribution, sea level changes, and the ages of facies and sequences generated in response to coastal evolution. This report provides stratigraphic and sedimentologic criteria to support collaborative interpretations of eight cores acquired by a coastal geology cooperative research program on the Outer Banks to test these hypotheses.

In cores OBX-02, 03, and 05, the late Quaternary (<14 cal. ka) fill is about 41 m thick. Here it erosionally overlies a bioturbated marine shelf deposit (OBX-2, 3, 5) that Wehmiller (personal communication) correlated (at OBX-05, depth -41 m) with the early/middle Pleistocene aminozone, AZ-4 (see Riggs and others, 1992). Above this, the late Quaternary fill (in cores OBX-02, 03, 05, 06) includes a succession of four facies units: 1) a basal sandy gravel (<6 m), 2) a dark gray complexly interbedded mud and gravel (<9 m), 3) bioturbated muddy sand (<15 m), and 4) an upward fining sand, with a basal gravel (<15 m). (Dimensional aspects of these units remain undefined until integration with GPR and seismic profiles).

Six radiocarbon dates (from Thieler, personal communication) on samples from unit 2 (OBX-05: from -32.3, -33.6 and -35 m; OBX-02: from -27.7, -33.0, and -33.0 m) fall within the range 10 to 14 cal. ka. These were deposited during the Younger Dryas (Mallinson and others, Thieler, personal communications). Stratigraphic relations suggest that unit 1, although not dated, was deposited at the onset of this phase of global cooling. Unit 1, interpreted as fluvial thalweg and channel bar deposits, fines upward into unit 2. Unit 2 includes deltaic like features such as laminations, wavy, flaser and lenticular bedding, coarse lags with gravel, detrital organics, chaotic bedding, and slump blocks. It was deposited subaqueously with no evidence of subaerial exposure in a non-marine setting. The interbedding of high-energy lags and suspension deposits in unit 2 suggests that periods of intense flooding alternated with standing water deposition.

Units 3 and 4 are Holocene. Unit 3 appears to either coarsen upward from a basal interbedded zone with unit 2 (OBX-02, 05), or is a sharp-based upward fining unit (OBX-03). It has common *Ophiomorpha* and *Thalassinoides* burrows (OBX-02, 03, 05, 06), traces of parallel laminations (OBX-02, 03, 06), and zones of mud intraclasts (OBX-05 only). Unit 3 formed as accretionary shoreface deposits that laterally infilled the embayment during the Holocene transgression. The contact at the base of unit 3 is a significant flooding surface. Unit 4 represents a complex of inlet, shoreface and regressive beach ridge deposits.

## OS71B-0283 0830h POSTER

### Aminostratigraphy of Subsurface Units, Eastern Albemarle Sound and Northern Outer Banks, North Carolina

John F. Wehmiller[1] (302-831-2926; jwehm@udele.edu)

E. Robert Thieler[2]

Linda L. York[3]

Vincent Pellerito[1]

[1]Department of Geology, 101 Penny Hall University of Delaware, Newark, DE 19716, United States

[2]US Geological Survey, 348 Woods Hole Road, Woods Hole, MA 02543, United States

[3]U. S. National Park Service Southeast Regional Office, 100 Alababa St., S.W., Atlanta, GA 30303, United States

The Quaternary geochronology of subsurface and emergent units on the US Atlantic Coastal Plain aids the understanding of the geologic framework that affects Holocene coastal processes. Amino acid racemization (AAR) and radiocarbon results for mollusk samples from a variety of sampling sites along the NC coastal plain contribute to this chronologic framework. Recent drilling on the northern Outer Banks has yielded AAR/14C results that are compared with existing data for samples from nearby inner shelf or beach sites, or from subsurface sampling in mainland Dare County (Riggs and others, 1992). AAR data serve to delineate stratigraphic units; suitably calibrated, AAR data can be used to estimate ages for units with no independent radiometric data. New AAR data from two holes, OBX-5 and OBX-8 (north and central portions of cross-section D-D' of Riggs et al., 1992), identify three pre-Holocene aminozones. The oldest one (OBX-5, 135' depth) corresponds to an early/middle Pleistocene aminozone (AZ-4) seen in other subsurface sections in the region (Riggs et al., 1992). Based on AAR, AZ-4 is approximately 2/3 the age of the James City Formation, a mapped early Pleistocene unit exposed in central NC. Two younger aminozones are seen in superposition in OBX-8, at 65' and 114'. These aminozones have D/L values that are slightly greater than those seen in AZ-2 and AZ-3, interpreted as late and late/middle Pleistocene (Riggs et al., 1992), respectively. Infinite or near-infinite 14C dates at depths between 65' and 104' in OBX-8 confirm the Pleistocene age assignment based on AAR. Radiocarbon and AAR constrain the boundary between the early Holocene and AZ-4 (early/middle Pleistocene) in OBX-5 to an interval between ca. 110' and 135' depth; intervening late Pleistocene strata may be present but are not identified based on chronologic data. Paired 14C/AAR analysis of reworked/transported beach or shelf shell in the region supports the relative ages seen in the OBX holes and correlates these reworked samples with their source units exposed on the inner shelf or shoreface.

URL: http://www.geology.udel.edu/wehmiller/shells.html

## OS71B-0284 0830h POSTER

### Quaternary Sea-level Fluctuations and Environmental Change Indicated by Foraminiferal Assemblages, Outer Banks, North Carolina

Steve J Culver[1] (252 328 6360; culvers@mail.ecu.edu); Stanley R Riggs[1] (252 328 6379; riggss@mail.ecu.edu); Robert E Thieler[2] (508 457 2350; rthieler@usgs.gov); John F Wehmiller[3] (302 831 2926; jwehm@udel.edu); Scott W Snyder[1] (252 328 4395; snyders@mail.ecu.edu); David A. Mallinson[1] (252 328 1344; mallinsond@mail.ecu.edu); John Bratton[2] (jbratton@usgs.gov)

[1]East Carolina University, Department of Geology East Carolina University, Greenville, NC 27858, United States

[2]US Geological Survey , US Geological Survey 384 Woods Hole Road, Woods Hole, MA 02543, United States

[3]University of Delaware, Department of Geology University of Delaware, Newark, DE 19716, United States

A 155-ft. drillcore at the site of a former inlet penetrates several Quaternary depositional sequences previously recognized in seismic records and shorter cores. Several foraminiferal assemblages from the early Pleistocene to the Recent reflect changing environmental conditions that correspond to several high frequency sea-level fluctuations previously described for this region. At the base of the core, low energy, low oxygen, open embayment mud, containing a high diversity fauna dominated by *Elphidium excavatum* and buliminids (Assemblage 6), and of probable early to mid-Pleistocene age, is overlain at 128 ft by inner to mid shelf, high energy sand containing a high diversity assemblage dominated by *E. excavatum*, *Epistominella* sp. and the epifaunal taxon *Cibicides refulgens* (Assemblage 5). New amino acid racemization (AAR) data suggest a mid-Pleistocene age (ca. 500 to 600 ka) for Assemblage 5. A sparsely fossiliferous, shallow inner shelf sand, containing a low diversity fauna (Assemblage 1) dominated by *E. excavatum*, follows at 114 ft, and is overlain at 104 ft by a barren, probably non-marine, carbon-14 dead, muddy unit. A moderate diversity, inner shelf fauna, dominated by *E. excavatum* and *Ammonia parkinsoniana* (Assemblage 3) characterizes overlying sand (at 95 ft) that is probably of mid-Pleistocene age (530 to 330 ka based on previously published AAR data). Assemblage 2, again dominated by *E. excavatum*, but containing several miliolid taxa indicative of normal salinities, occurs at 68 ft in the overlying muddy sand and is of similar probable mid-Pleistocene age (carbon-14 dead at 64 ft; new AAR data from 65 ft indicate350 to 420 ka). Assemblage 1 is a high dominance (*E. excavatum*), low diversity, low abundance fauna occurring in sand that comprises the top 55 feet of the core. This unit represents the shoreface and inlet sands of the modern (late Holocene) barrier island, although correlations with nearby cores suggest that the lower 20 ft of this sequence may represent an earlier, late Pleistocene (78 to 51 ka based on previously published AAR data) barrier island complex.

## OS71B-0285 0830h POSTER

### Ground-Water Salinity and Isotope Stratigraphy of North Carolina's Outer Banks

John F. Bratton[1] (508-457-2254; jbratton@usgs.gov)

E. R. Thieler[1]

C. W. Hoffman[2]

R. W. Brooks[2]

[1]USGS, 384 Woods Hole Road, Woods Hole, MA 02543-1598, United States

[2]NC Geological Survey, Coastal Plain Office 1620 Mail Service Center, Raleigh, NC 27699-1612, United States

As part of a larger investigation of the geologic framework of the North Carolina coast, ground-water and sediment samples were collected and analyzed for salinity and $\delta^{13}C$ of total organic carbon (TOC). Salinity was measured on samples from eight borings (depths up to 56 m), located between Kitty Hawk and Nags Head, to determine the thickness of the barrier island's fresh-water lens, and to examine stratigraphic control on freshwater-saltwater boundaries. $\delta^{13}C$ was measured to establish the origin of organic matter (OM) preserved in the sediments.

Results indicate that ground-water salinity is strongly correlated with stratigraphy based on core descriptions and downhole gamma logs. The subsurface fresh-water lens is 3-30 m thick across the study region (20 km). The thickness of the fresh-saline transition at depth is also highly variable (<2 m to 15 m). At three of four deep coring locations (>38 m), a zone of fresher water exists beneath an intermediate saline zone. The maximum salinity of water in the saline zone is typically around 27 ppt, but in one location a brine (45 ppt) is present. Based on preliminary $\delta^{13}C$-TOC data, most OM in the cores appears to be derived from mixed terrestrial ($\delta^{13}C \approx$ -26 permil VPDB) and marine ($\delta^{13}C \approx$ -20 permil) sources. Two cores show a clear trend from more terrestrial OM at depth toward more marine OM with a component of salt-marsh material ($\delta^{13}C \approx$ -13 to -15 permil) near the surface. Sharp upcore transitions from terrestrial to mixed, or mixed to salt-marsh OM may indicate either unconformities, marine incursions associated with rapid sea-level rise events, or opening of inlets. Such transitions are present in one core at a depth of 20 m ($^{14}C$ age = 23.7 cal ka), and in two other cores at 33 to 36 m (10.6 cal ka). The study showed that filled paleo-valleys and paleo-tidal inlets under the modern barrier are serving as conduits for both salt-water migration and sub-estuarine transport of fresh water from the mainland. Channel fills contain OM from a variety of distinct coastal paleoenvironments.

URL: http://woodshole.er.usgs.gov/project-pages/northcarolina/index.htm

## OS71B-0286 0830h POSTER

### Utilizing GIS for a Regional Aminostratigraphic Database

Vincent Pellerito[1] (302-831-6602; vpelleri@udel.edu)

John F Wehmiller[1] (302-831-2926; jwehm@udel.edu)

[1]University of Delaware Department of Geology, 101 Penny Hall, Newark, DE 19716, United States

Several laboratories have obtained Aminostratigraphic data from Atlantic Coastal Plain sites over the past two decades, occasionally with conflicting results or interpretations. The University of Delaware Aminostratigraphy Lab (UDAL) has obtained amino acid racemization (AAR) data for over 1000 collection sites in the region, with particular emphasis on North and South Carolina. AAR data are used to delineate stratigraphic units, whether by calibration with independent methods, such as radiocarbon or U-series, or as a relative dating tool. Outcrop, subsurface, beach, core, and inner shelf grab samples are included in this collection.

Recently, several cores were collected along the barrier island system of the northern Outer Banks, NC. Both AAR and radiocarbon analyses are available from these more recent cores and are compared with existing data for surface and subsurface samples from the region. Because of the need to amass geochronologic information for ongoing studies of the geologic framework of the Carolina Coastal Plain, a regional AAR/radiocarbon/U-series database is being compiled. Ultimately, data from all published references and currently unpublished (UDAL) data will be included in this database; the first stage is focused on sites in North Carolina.

The database presents AAR analyses via a Relational Database Management System (RDBMS) and exhibits the data on a geographic information system (GIS). An RDBMS allows for querying among data sets so that comparison and evaluation of all available data may be conducted. Results from different labs, or the same lab over a period of several years, from multiple genera or from "similar" sites can be compared in a systematic manner, once all data are included in the database. Accessibility of the AAR database via web-mapping software is crucial to allow broad inquiry and augmentation of the database by interested coastal managers and regulatory agencies with the goal of better understanding coastal processes along the Carolinas.

## OS71B-0287 0830h INVITED POSTER

### Digital Geomorphic Mapping of Cape Hatteras National Seashore, North Carolina Using Remotely Sensed Data

Charles W. Hoffman[1] (919-733-7353x25; bill.hoffman@ncmail.net)

Kathleen M. Farrell[1]

[1]N.C. Geological Survey, Coastal Plain Office, 1620 MSC, Raleigh, NC 27699, United States

Several digital databases have become available in the last several years that permit high-resolution mapping of the geomorphology of the North Carolina Coastal Plain. Cape Hatteras National Seashore was mapped using such databases in support of the geological resource inventory program of the National Park Service. The primary digital data layers used are 1998 color infrared orthophotos (1:12,000 scale) and high-resolution topographic data generated from a recent LIDAR survey (available as bare earth points and as 20- and 50-foot DEMs). Additional digital photography (1998 black and white) at higher resolution was applied in limited areas. National Wetlands Inventory maps, a refined wetlands map series by the N.C. Division of Coastal Management, and soils maps (all in digital form) were also used.

Cape Hatteras National Seashore encompasses approximately 130 km of the N.C. Outer Banks barrier island system. This system includes barrier island segments with well-developed beach ridge complexes as well as segments dominated by overwash processes. Two tidal inlets (Oregon and Ocracoke) presently occur within the study area, however several former inlets are known from historical records. Thus, a wide variety of subaerial and submarine geologic environments are present within the project area. These environments are characterized by landforms that are mappable via heads-up digitizing using Geographic Information System (GIS) software. Map units include salt marsh, overwash fan, flats, dunes, dune ridge, beach ridge, beach, tidal delta, among others.

The map produced by analysis of these data sources in GIS results in a significant improvement over existing maps and provides a digital database for use as a resource management tool. Refinement of the mapping by field ground truth and integration with ongoing research by the northeastern N.C. coastal geology cooperative will further improve the maps.

## OS71B-0288 0830h POSTER

### Process-Response, Time-Slice Geomorphic and Ecologic Mapping of Core Banks, Cape Lookout National Seashore *CLNS*, NC

Robert M White[2] (252-347-3939; whitermw@yahoo.com)

Stan R Riggs[1] (252-329-6015; riggss@mail.ecu.edu)

David A Mallinson[1] (252-328-1344; mallinsond@mail.ecu.edu)

Dorothea Ames[1] (252-328-6015; amesd@mail.ecu.edu)

[1]East Carolina Univerrsity, Geology, Graham Building, Greenville, NC 27858, United States

[2]East Carolina University, CRM, Ragsdale Building, Greenville, NC 27858

The Core Banks barrier islands are relatively unaltered by human development. However, major geomorphic and ecologic changes have occurred in their character and dynamics since it became part of CLNS in 1966. To understand this evolutionary change, it is imperative to evaluate the barrier's recent history and develop a set of four-dimensional, process-response maps. The goal is to determine the causative processes and define the detailed responses operating within this dynamic and complex coastal system.

Sixty four of the original 77 USACE survey transects established in 1960-62 along Core Banks were located and resurveyed to define vertical and horizontal changes through time. These transects were occu-

pied by Godfrey et al. in 1972-74 for ecological mapping of Core Banks. Type localities were established along Core Banks for detailed time slice analysis using aerial photography. These were mapped at 1:2000 scale on 1998 DOQQ's and ground-truthed with cross-barrier geomorphic, ecological, and elevation survey transects. Using these data sets, the geomorphic and ecologic mapping was extrapolated backwards through time utilizing georeferenced aerial photographic time slices back to 1940. The time-slice interpretations are integrated with GPR surveys and pre-existing drill data of Heron et al. Shallow vibracores provide samples for stratigraphic analysis and age dating. The process-response geologic maps of undeveloped Core Banks are being compared to those of the highly modified Cape Hatteras National Seashore barrier system to the north to aid in future short- and long-term management of this coastal resource.

### OS71B-0289 0830h POSTER

## Shoreline Erosion in the Albemarle-Pamlico Estuarine System, Northeastern North Carolina

Megan A. Murphy[1] (ma_murphy00@hotmail.com)

Stanley R. Riggs[1] (252-328-6015; riggss@mail.ecu.edu)

[1]Geology Dept., East Carolina University, Greenville, NC 27858, United States

Computer analysis of aerial photographic series demonstrates that the estuarine shorelines within the North Carolina Albemarle-Pamlico coastal system are eroding at 2-3 times greater rates than previous studies reported. Specific rates and amounts of shoreline recession vary tremendously depending upon local variables including: 1) shoreline type, geometry, and composition; 2) geographic location, size, and shape of associated estuary; 3) frequency, intensity, and fetch of storms; 4) type and abundance of associated vegetation; and locally 5) boat wakes. Organic or wetland shorelines (marsh and swamp forest) comprise approximately 62% of the estuarine margins in NE NC, whereas sediment banks (low, high, and bluff) constitute about 38%.

The goals of this study were to determine the rates of recession for different shoreline types and the role of local variables in the erosion process. Shorelines were mapped using high precision GPS mapping techniques, digital orthographic quarter quadrangles, and other georeferenced aerial photographs from the early 1950's to 2001. Shoreline change was then calculated for 20 estuarine study sites. Field mapping of each site provided data on shoreline characteristics and erosional processes.

Data synthesis suggests mean annual shoreline erosion rates are significantly different for shoreline types as follows: 1) marshes = 7.4 ft/yr (range 2.7-17.0 ft/yr), low sediment banks = 5.0 ft/yr (range 1.0-12.0 ft/yr), bluff sediment banks = 5.0 ft/yr (range = 3.9-6.0 ft/yr), swamp forests = 3.0 ft/yr (range = 1.7-4.0 ft/yr), high sediment banks = 2.8 ft/yr (range = 2.7-2.9 ft/yr). Modified shorelines continue to erode, however at lower mean annual rates that range from 0.9-2.7 ft/yr. Locally, specific marsh shorelines have eroded at rates up to 100 ft/yr during particularly stormy periods. Thus, about 1166 acres of land are lost each year along the 1593 miles of mapped estuarine shoreline in NE NC. If these erosion rates are representative of all 3,000 miles of NE NC's estuarine shorelines, if sea level continues to rise, and if the storm pattern persists at present levels, NC will experience significant loss of both wetlands and uplands at the estuarine water-land interface.

### OS71B-0290 0830h POSTER

## Sedimentology and Geochemistry of Estuarine Sediments From the Albemarle Sound and Adjacent Tributaries in Eastern North Carolina

Erin Letrick[1] (eml1107@mail.ecu.edu)

D. Reide Corbett[1] (corbettd@mail.ecu.edu)

David Mallinson[1] (mallinsond@mail.ecu.edu)

[1]Department of Geology, East Carolina University, Greenville, NC 27858

Scientists from East Carolina University, the U.S. Geological Survey Woods Hole, and the North Carolina Geological Survey are conducting geological and geochemical investigations of estuarine and barrier island systems in North Carolina. Data are being used to define the Quaternary evolution of the North Carolina coastal system and the response of the coastal environments to climate and sea-level changes. An important component of this investigation is to define the geology and geochemistry of the modern depositional systems in order to better evaluate depositional facies acquired in deep cores. This investigation is concerned with characterizing the sedimentology and geochemistry of estuarine sediments. Twenty-nine shallow push cores (13-73 cm in length) were acquired from the Albemarle, Currituck, Croatan, and Roanoke Sounds and adjacent tributaries. Core sediments are dominated by variable mixtures of terrigenous sands and muds, and organic matter (0.2-58%) from terrestrial, estuarine, and marine sources. The origin and spatial and temporal variability of organic matter deposited in the estuarine environment is being determined using a combination of stable isotopes ($\delta^{13}$C and $\delta^{15}$N) and C:N ratios. Grain size data are being determined to evaluate variations in sediment flux and as a potential correlation tool. From the information recovered, regional trends can be seen in grain size, organic matter, and isotope data. In the region there is a general increase in grain size and decrease in organic matter from west to east. In nearly all of the cores there are several inflections in grain size that are correlative to inflections in the amount of organic matter. These regional correlations are likely to be caused by natural processes (storms) and/or anthropogenic influences (agriculture). Isotope data show a regional trend of $\delta^{13}$C with more terrestrial carbon sources in the west to a greater marine influence to the east. All cores exhibit an upward increase in $\delta^{13}$C values, which likely corresponds to the closure of inlets and decreasing marine influence since the early 1800s. Regional trends of $\delta^{15}$N are seen in the cores with a decrease from west to east. Nitrogen isotope values are thought to be higher in the west due to a larger amount of anthropogenic influences. Overall, data from cores in lateral tributaries show a much greater variability as a result of being in closer proximity to point sources and anthropogenic influences.

### OS71B-0291 0830h POSTER

## The Late Holocene Stratigraphy of an Inlet-Dominated Barrier Island, Pea Island, North Carolina.

C. G. Smith[1] ((252) 321-8643; cgs0818@mail.ecu.edu); D. Ames[1] ((252) 328-6015; amesd@mail.ecu.edu); D. R. Corbett[1] ((252) 328-1367; corbettd@mail.ecu.edu); S. Culver[1] ((252) 328-6360; culvers@mail.ecu.edu); D. Mallinson[1] ((252) 328-1344; mallinsond@mail.ecu.edu); S. R. Riggs[1] ((252) 328-6379; riggss@mail.ecu.edu); D. Vance[1] ((252) 328-4385; djv1213@mail.ecu.edu)

[1]Department of Geology, East Carolina University, Room 101, Graham Building, Greenville, NC 27858, United States

Sedimentological, foraminiferal, geochemical, and geophysical data sets as well as aerial photographs have been used to investigate the natural processes (inlet dynamics, ocean/estuarine washover, and sea-level change) responsible for the late Holocene units preserved in the barrier island subsurface at Pea Island National Wildlife Refuge.

Historic nautical charts indicate that three inlets characterized Pea Island between early European exploration (1590) and the late 19th century; aerial photographs show New Inlet open in 1932 and 1940. Vibracores (up to 5.5 m) collected along three transects across Pea Island extend our knowledge of the geological evolution of this region to pre-historic times.

The section in the longest core (PI01S6) consists of four fining-upwards depositional sequences. The basal unit of each sequence is a bedded, medium to fine, clean quartz sand with increasing concentrations of organic matter (3-4 % detrital and 5-7 % *in situ Spartina alterniflora* roots) or irregular mud clasts (2-5 cm) to spherical mud balls (1-2 cm) up core. The clean sand units have so far proven to be barren of foraminifera except for a shelly unit at ca. 220 cm below MSL. The foraminiferal assemblage in this unit is of open shelf character (*Elphidium excavatum*, *Hanzawaia strattoni*, and *Buccella inusitata*). A $^{14}$C age on a disarticulated *Chione cancellata* valve from this unit is cal. 930±60 BP. The sand grades into a gray, tight mud in the first two sequences and into an inter-laminated mud and in situ peat in the third sequence. The peat contains leaf fragments and rhizomes of the marsh plants *Juncus roemarianus*, *Spartina cynosuroides*, and/or *Phragmites* spp. The peat and muddy sand units contain marsh foraminifera (*Trochammina* spp., *Miliammina fusca*, *Arenoparrella mexicana*), which are also found in modern marsh deposits. A peat sample from the third fining upward sequence (the only one to grade into a true peat) has a $^{14}$C age of cal. 395±35 BP, cal. 295±35 BP, or cal 180±40 BP.

The four fining-upwards sequences have sharp erosional basal contacts. These deposits appear to reflect back-barrier processes including sequential deposition of flood-tide delta sands and/or sound sands adjacent to marshes. The shelly sands, containing open shelf foraminiferal assemblages, represent oceanic overwash, inlet deposits, or open embayment sands deposited behind a laterally extensive breach in the barrier island. The sequences are capped by the deposits of modern environments that include algal flats, tidal creeks, high and low marshes, back-barrier berms, overwash fans, and aeolian dunes. Several of the modern environments became covered with marsh vegetation after the construction of barrier dune ridges in the late 1930?s.

### OS71B-0292 0830h POSTER

## Mapping and Monitoring Bedforms on the Mid-Continental Shelf : 23-Mile Site, Onslow Bay, NC

Matthew E Head[1] (910-962-2353; mattedhead@yahoo.com)

Nancy R Grindlay[1] (910-962-2352; grindlayn@uncwil.edu)

Lynn A Leonard[1] (910-962-2338; lynnl@uncwil.edu)

[1]University of North Carolina at Wilminton-Center for Marine Science, 5600 Marvin Moss Ln, Wilmington, NC 28409

This study attempts to constrain the spatial and temporal variations in the seafloor morphology, as well as the relationship between sidescan sonar data and seafloor characteristics at the 23-Mile hardbottom area on the mid-continental shelf of Onslow Bay, NC. The 23-Mile site consists of an upper limestone hardbottom at 29-30m depth covered in a thin discontinuous veneer of sediments. The lower sand flats at 32-33m depth consist of concentrated areas of contrasting grain size. A dual-frequency sidescan sonar system was used to repeatedly image the seafloor of a 3.5 km by 2.1 km region at 23-mile site over a period of 2.5 years. Cruises were conducted in December 1999, December 2000, July 2001, and May 2002. During this time period no major tropical storms impacted the shelf, although at least three small (sustained winds <30 kts/hr) noreasters were recorded in the region of study. Textural analysis of the sidescan sonar imagery was conducted using grey-level co-occurrence matrices. Two textural indices: entropy (acoustic roughness), and homogeneity (level of textural organization) were used. Following the textural analysis both unsupervised and supervised classification schemes were utilized. Four distinct seabed units were identified. Ground-truthing by divers indicates that these units show a strong positive correlation between backscatter intensity and sediment grain size. Further analysis will be conducted to determine if the classification system is capable of recognizing distinct benthic assemblages. A comparison of results between successive surveys shows a significant difference in the spatial orientation of the coarse-grained and fine-grained contacts of the lower sand flats. In some areas sediment movements in excess of 10 m are documented. This movement, however, shows no consistent trend in direction or magnitude. Flow data collected on-site by an acoustic Doppler profiler moored 2 m above the seabed suggest that mean bottom current velocities are sufficient during small storms to initiate sediment movement. Following documented storm events, medium to coarse-grained sands were retrieved from sediment cups deployed 60cm above the seabed. Tidally induced mean currents do not appear to play a significant role in shaping the observed sedimentary morphology.

URL: http://people.uncw.edu/grindlayn/cmgl/comp/

### OS71B-0293 0830h POSTER

## Shoreface Behaviour Along a Partially Allochtonous Shelf and Coast of River-derived Sand

George M. Kaminsky[1] (360-407-6797; gkam461@ecy.wa.gov)

Marie A. Ferland[2] (509-963-2793; ferlandm@cwu.edu)

Peter J. Cowell[3] (62-2-9351-2189; P.Cowell@csu.usyd.edu.au)

[1]Washington Department of Ecology, Coastal Monitoring Analysis Program, P.O. Box 47600, Olympia, WA 98504-7600, United States

[2]Central Washington University, Department of Geological Sciences, Ellensburg, WA 98926-7418, United States

[3]University of Sydney Institute of Marine Science, Coastal Studies Unit, School of Geosciences, Sydney, NSW 2006, Australia

In a study of the Columbia River littoral cell, a 165-km coast of river-derived sand in the US Pacific Northwest, historical bathymetric change analyses has revealed that erosion of the lower shoreface has contributed to progradation of the barriers over time scales of decades to centuries. In order to better determine the relationship between shoreface behaviour and coastal change, a series of vibracores were collected along transects starting on the upper shoreface (shallower than 12 m), crossing the toe of the progradational wedge, and extending across the lower shoreface to depths of 40 m or greater. The vibracore sites were selected where their data could be compared with other data including bathymetric change, seismic, side-scan, barrier drilling, and ground penetrating radar, as well

as process measurements and beach and nearshore morphology data.

Results of this vibracoring project are providing insights into the effect of the inherited shelf substrate slope and structure on the transport and accumulation patterns of sand originally supplied by the Columbia River. Deeper inherited substrates appear to have a larger capacity to accumulate river-derived sand on the lower shoreface, whereas shallower substrates appear to have less accommodation space, with little to no river-derived sand accumulation. Thus the configuration of the shoreface relative to its equilibrium profile can have a significant influence on the transport, residence time, distribution, and ultimate fate of river-derived sediment. Along coasts with shallow shoreface substrates, an external supply of sand can be efficiently delivered to the upper shoreface, resulting in rapid progradation of the coastal barriers. In contrast, aggrading shorefaces require a larger volume of sand and a larger accommodation space to result in the equivalent rate of barrier progradation. These and other observations of the coupling between the behaviour of the lower shoreface on a partially allochtonous shelf and the evolution of the coastal barriers comprised of river-derived sand will be discussed in light of the vibracore results and previously collected data.

### OS71B-0294 0830h POSTER

## Observations About the Holocene Inner-Shelf Sequence in Southwest Washington and Northwest Oregon Based on Vibracores

Marie A. Ferland[1] (1-509-963-2793; ferlandm@cwu.edu)

George M. Kaminsky[2] (1-360-407-6797; gkam461@ecy.wa.gov)

[1]Dept. of Geological Sciences, Central Washington University, 400 E. 8th Avenue, Ellensburg, WA 98926-7418, United States

[2]Washington Dept. of Ecology, Coastal Monitoring and Analysis Program, P.O. Box 47600, Olympia, WA 98504-7600, United States

We will present initial interpretations of the Holocene geologic framework of the inner shelf of southwest Washington and northwest Oregon based on vibracores collected during August 2002. Thirty-three vibracores were collected along shore-normal transects starting in water depths of 8 m and ending in 40-75 m (with 27 cores from <40 m). The average core length is 4.2 m, and the 23 cores already opened are mostly undisturbed. Twelve of the cores obtained in water depths of 8-46 m contain relict shoreface, fluvial, and backbarrier sediment at -1 to -5 m (below the seabed). Immediately south of the Columbia River (CR) mouth, in water depths of 12-18 m, laminated clays and sandy mud were identified <1 m below the seabed, and the same relict sediment was identified at -3 and -5 m in two nearby cores (in depths of 25 and 40 m). Nine cores contained a shell and/or gravel lag, which may represent the Holocene transgressive lag. A deeply-weathered Pleistocene clay was also encountered at -2.6 m in one core from 43 m water depth. The relatively thin, modern shelf sequence (at some core locations) is surprising, given the very large input of sediment from the CR throughout the Holocene. Interpretation of previously-collected seismic and sides-scan data (Twichell and Cross, USGS Open-File Report 01-076) also suggested thicker modern shelf sand deposits than those identified in the cores. In addition, sand sampled at depth in multiple cores off Grayland (north-central part of the study area) appears to have been derived from a local source, rather than the CR. If so, this will affect calculations of the Holocene and historical sediment budget. Further analyses of the cores will include x-ray, grain size, mineralogy, and radiocarbon dating. These will be followed by a detailed comparison of the vibracoring results with seismic and side-scan data collected along the same transects, in order to ground-truth those data. Preliminary interpretations indicate that the shallow stratigraphic record contained in the vibracores will provide new insights into the ways in which the inner shelf has shaped (and will shape) the evolution of the barriers.

# OS71C MCC: Hall D Sunday 0830h

## Use of High-Resolution Geophysical Techniques in the Marine Environment I Posters *(joint with GP, S, T)*

*Presiding:* **J Knight,** University of Ulster, Coleraine**; A K Shah,** Naval Research Laboratory

### OS71C-0295 0830h POSTER

## Morphology and Sedimentology of the Subtidal Zone and Upper Slope of Roberts Bank (Fraser River Delta, British Columbia, Canada)

Liliane Carle[1,2] (lcarle@pgc-gsc.nrcan.gc.ca)

Philip R. Hill[2] (phill@nrcan.gc.ca)

[1]Universite du Quebec a Rimouski, Institut des Sciences de la Mer (ISMER), 300 Allee des Ursulines, Rimouski, Que G5L 3A1, Canada

[2]Geological Survey of Canada, Pacific Geoscience Center (PGC), 9860 West Saanich Road, Sidney, BC V8L 4B2, Canada

The Fraser River delta that underlies suburbs of Vancouver has been subject to a significant reduction of sediment input due to dredging of the Main Channel. Subsidence and marine transgression increase the erosion risk to infrastructure such as the delta port, ferry terminal and submarine power cables located on Roberts Bank. This bank receives little direct sediment supply because fluvial sediments from the Main Channel are deflected northward by the Coriolis effect and by tidal asymmetry. New information on shallow water (3 to 100 m depth) sediment transport features on the delta slope of Roberts Banks has been obtained from high-resolution multibeam surveys. Depositional bedforms are grouped in complexes of large asymmetric 2-D dunes (sinuous crested and straight crested) and large asymmetric 3-D dunes (high relief and low relief). Transverse profiles of some dune fields show that these dunes are superimposed on larger, 500 meter-scale bedforms. The orientation and the shape of the dunes give an indication of the dominant transport process (tidal current, waves and wind driven currents). A map of sediment transport directions has been constructed from these data. These sediment transport features are superimposed on a slope that also shows evidence for considerable erosion by downslope gravity processes (turbidity currents, rotational slumping and creep).

### OS71C-0296 0830h POSTER

## Seafloor Characterization from Spatial Variation of Multibeam Backscatter vs. Best Estimated Grazing Angle

Tianhang Hou[1] ((603) 8620831; thou@cisunix.unh.edu)

Larry Mayer[1] (larry.mayer@unh.edu)

Barbara Kraft[1] (bjkraft@cisunix.unh.edu)

[1]Center for Coast Ocean Mapping, University of New Hampshire, Durham, NH 03824

Backscatter vs. grazing angle, which can be extracted from multibeam backscatter data, depends on characteristics of the multibeam system and the angular responses of backscatter that are characteristic of different seafloor properties, such as sediment hardness and roughness. Changes in backscatter vs. grazing angle that are contributed by the multibeam system normally remain fixed over both space and time. Therefore, they can readily be determined and removed from backscatter data. The component of backscatter vs. grazing angle due to the properties of sediments varies from location to location, as the sediment changes. The sediment component of variability can be inferred using the redundant observations from different grazing angles in several small sections of seafloor assuming that the sediment property is uniform in any given section of seafloor yet varies from one section of the seafloor to another.

The multibeam data used in this research is from the ONR sponsored STRATAFORM project. The location of the study area was the mid-outer continental shelf off New Jersey. A small subset (11 x 17 km) of the NJ multibeam survey was selected and divided into 1380 equal working cells. The backscatter vs. grazing angle dependence for each cell was computed by averaging backscatter data by the corresponding grazing angles using all data with the same grazing angle from different survey lines. Taking into account the effects of local topographic variations of the seabed, the estimated grazing angle for each beam has been computed from available adjacent soundings within a 15-meter radius using a least squares fit with a Butterfly weighting function.

A graphic interface was developed to ease evaluation of the spatial variation of backscatter vs. grazing angle. With a mouse click, images based on different subsets of the data can be compared throughout the survey area. The subsets were created from specific grazing angles. These images show significant variations between nadir and off-nadir beams. Variations apparent in the images may provide some indication of the sediment (or seafloor) characteristics, which can be compared to ground truth data (sediment grain size) and measured values such as velocity and density.

### OS71C-0297 0830h POSTER

## Multibeam Sonar on the Inner Shelf of the Eel Margin: Nearshore gravel-floored troughs

Vicki Lynn Ferrini[1] (vferrini@ic.sunysb.edu)

Roger D. Flood[1] (rflood@notes.cc.sunysb.edu)

[1]Marine Sciences Research Center, Stony Brook University, Stony Brook, NY 11794-5000, United States

A high-frequency (300 kHz) multibeam sonar survey was conducted on the inner shelf of the Eel River Margin in August 2000 using a hull-mounted Simrad EM 3000D echosounder. The survey, which was conducted as part of the STRATAFORM project, was intended to provide high-resolution bathymetry and backscatter data on the inner shelf in water depths of 8 to 65 m. In addition to the multibeam data we collected nearly 100 grab samples with which to ground truth the backscatter imagery. One year prior to this survey, a test survey was conducted in a small portion of the survey area. This preliminary survey was done with a single hull-mounted EM 3000 transducer, and provided the opportunity to assess bathymetry and backscatter change on a time scale of 1 year. The largest changes between the two surveys were in the nearshore area, water depths of 8 to 15 m, a region of wave-induced sediment transport.

During both surveys we noted the presence of nearshore troughs in less than 15-m water depth. The troughs are typically 0.2-1.0 m deeper than the adjacent seabed and are characterized by high backscatter. Gravel-sized sediment was recovered from the floors of the troughs in 2000. Although the shapes of individual troughs are irregular, the data collected in 2000 reveal that on a larger-scale, the scours create a cuspate pattern in the along-shore direction. The water depth and morphology of the features suggests that they may be the seaward extent of longshore bars.

These troughs indicate active transport of large volumes of sediment and are likely related to nearshore processes. In one small region that was surveyed both years, we document both erosion and accretion with bathymetric change of up to 2-m in isolated locations. Similar to the pattern associated with the scours, bathymetric change reveals a cuspate pattern of erosion and accretion in the along-shore direction. In this subsampled area (1 $km^2$) we observe significant bathymetric change and estimate a net removal of about 1 x $10^5$ $m^3$ of sediment.

### OS71C-0298 0830h POSTER

## New Insights on Late Pleistocene Sedimentation at the New Jersey Margin Based on Chirp Sonar Profiles and Vibracores

N. Christie-Blick[3] (ncb@ldeo.columbia.edu); G. S. Mountain[1,3]; A. Ghosh[3]; C. M.G. McHugh[2,3]; S. F. Pekar[3]; S. G. Schock[4]

[1]Department of Geological Sciences, Rutgers University, Piscataway, NJ 08854, United States

[2]School of Earth and Environmental Sciences, Queens College, C.U.N.Y., 65-30 Kissena Blvd., Flushing, NY 11367, United States

[3]Lamont-Doherty Earth Observatory of Columbia University, P.O. Box 1000, Palisades, NY 10964, United States

[4]Department of Ocean Engineering, Florida Atlantic University, Boca Raton, FL 33431, United States

Chirp sonar profiling and vibracoring at the New Jersey margin during cruise 370 of R/V Endeavor (May, 2002) sheds new light on late Pleistocene sedimentation beneath the outer shelf and upper continental slope. The sonar transmitted 40msec, 1 to 4 kHz pulses, and generated profiles with a vertical resolution of 20 cm and subsurface penetration on the order of 30-50 m. Here we discuss new observations concerning the youngest of five Pleistocene sequence boundaries, a prominent offlap surface informally termed pp0 that corresponds approximately with the Last Glacial Maximum. This surface is characterized in places by