During Fall 2000, a flood occurred in the northern Adriatic Sea, which introduced large quantities of sediments in the Po delta area in particular. Twelve samples were taken during June 2003 to investigate their geotechnical and microstructural properties in order to trace the signature of the flood layer in a downstream direction. Most of the analyses involved CAT-scan profiling, coupled to some X-ray radiographs and basic geotechnical testing including water content, Atterberg's limits, along with intact and remolded undrained shear strength. The sediment consists of a very soft light brownish silty-clay to dark gray silty-clay with some sandy layer and a high amount of organic matter. Some shells and warm tubes are observed. The flood deposit is found between 8 to 15 centimeters depth depending on the station and is about 10 centimeters thick. Typically, the flood layer is recognized on geotechnical profiles by a water content (105%); higher than for layers above and below; it less bioturbated and starts at the base with a sandy layer which has a much higher sensitivity (15). On the other end, the shear strength is in line with other layers. The pre-flood deposit is characterized by a water content of (60%) which is controlled by the consolidation process, with a normal higher shear strength but with a higher remolded shear strength in some case, around 1.5 kPa compare to less than 1 in the post-flood and flood deposits. The post-flood deposit is characterized by an hemipelagic deposit with an high percentage of bioturbation, by a water content of (75%) and a very low near surface shear strength increasing with depth. CAT-scan and X-ray radiograph profiles are also quite similar for all layers. In addition, the CAT-scan provides a 3D view of the biogenic structures. CAT-scan analyses coupled with geotechnical testing are being used to develop a measure of bio-porosity which could be used eventually as an index to correct the shear strength measured on the sediment matrix.

OS52A-0903 1330h POSTER

Snorri Drift: A Comparison of Stadial 2 and Stadial 4 on the SW Iceland Slope

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Preliminary investigations of an 18 meter marine core collected from the southwest Iceland slope south of Denmark Strait reveal a coherent record reaching back to oxygen isotope stage 7. The core provides a rare opportunity to study the environmental and oceanographic conditions just south of Denmark Strait over the last 200k years. Oxygen isotope data, sedimentological analyses, grain counts, and radiogenic isotopic data enable interpretation of climatic shifts, sediment source, as well as changes in the strength and direction of the bottom currents. Core MD99-2323 was collected in 1062 meters water depth from Snorri Drift, which is one of the northern North Atlantic drifts. The chronology of the core is based on radiocarbon dates, tephrachronology and an oxygen isotope curve derived from the planktic foram, Neogloboquadrina pachyderma sinistral. The 18 meter core shows a widely varying lithology with the interglacial intervals consisting of mostly muddy sand with few clasts and some laminations. Within the interstadials are abrupt coolings, which are marked by darker gray, clast rich units. The stadial units are characterized by alternating layers of dark gray clast rich intervals with a coarser matrix and lighter gray layers which have a finer matrix and fewer clasts. Often these units are somewhat laminated. Darker units are coarse and represent coolings. Lighter units are finer and represent warmings. The sediments of Stage 2 and 4 stadials reveal very different climatic conditions, sediment source and depositional processes on the Iceland slope. The d18O, foraminifera abundances, and number of ice rafted grains suggest that stage 2 was colder, more variable and unstable than stage 4 which was warmer and more stable. The radiogenic isotopes and grain counts indicate distinct sediment sources for these two stadials. During stage 2 the source appears extremely variable, but with a distinct Icelandic component, while during stage 4 the source is also variable, but with a more distal signature, possibly a Greenland source. This core represents the varying contribution from iceberg rafting and contourite deposition. The sediment of stage 2 have more IRD and larger grain sizes suggesting a higher energy transport process such as icebergs rafting. Stage 2 is during the LGM with evidence for a migrating glacial front affecting marine sedimentation. This is in contrast to the East Greenland terrestrial records, which suggest a stable Flakkerhuk stade from 60-10 ky with little ice sheet movement. In contrast, the sediments of stage 4 are finer and contain less but more consistent IRD. The finer grain size, distal source, and less IRD all suggest increased contourite deposition at this SW Iceland slope site which indicates a shift in the bottom current's direction and/or source of icebergs.

OS52B MCC: Level 2 Friday 1330h

General Ocean Sciences: Marine Sediments Posters *(joint with PP)*

Null

OS52B-0904 1330h POSTER

Enigmatic Shallow Subsurface Stratigraphy on the New Jersey Mid-Outer Shelf: Catastrophic Erosion or Diagenesis?

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High-resolution (1-15 kHz), shallow-penetration (~50 m), deep-towed chirp seismic profiles on the New Jersey mid- and outer-shelf have been collected in support of ONR's Geoclutter program. Geoclutter goals are to understand and predict acoustic scattering from the seafloor and the shallow sub-seafloor in order to distinguish man-made objects from naturally occurring features ("geological clutter") on sonar returns. Area 2 of the chirp survey covers 8.6 $\times$ 10.2 km, mostly surveyed at 50 m line spacing. Three shallowly buried, dendritic and meandering channel systems, ~2-4 km apart, are oriented E to NE. Channel flanks are truncated by the seafloor and seismic stratigraphy suggests multiple stages of incision and filling. The northernmost channel system, which is best constrained, is mainly V-shaped, up to 350 m wide and 12 m deep. This scale is among the smallest in the entire Geoclutter survey area. Sampling using an active-heave-compensated AHC-800 rig supplied by DOSECC reveals a sand and mud channel fill with, at its base, a burrowed contact with underlying mud that correlates well with the seismic interpretation. A prominent, vertical, seismic facies change occurs throughout Area 2: stratified material is overlain by up to ~20 m of seismically transparent material, within which the younger, dendritic channels are incised. These two facies are separated by an irregular boundary. In places, the boundary resembles steep-sided (commonly 50°-90°) incisions which truncate underlying reflections. Mapping of the boundary reveals that its irregularities are not random. Some align to form predominantly NE- and E-trending "channels" that may converge to the SW. Rare "blocks" of stratified material within the transparent facies, along with more numerous smaller, isolated reflections, may correspond to clasts of stiff clay recovered in a 35-cm core. We suggest that the seismically transparent material contains such clasts, of a wide range of sizes, derived from the underlying, presumably clay-rich, stratified material. If the facies boundary represents an erosion surface, the steep flanks suggest that the stratified material was consolidated at the time its erosion. To preserve these flanks, burial must have immediately followed erosion, pointing to erosion and re-deposition during a single, perhaps catastrophic event. One possibility is that widespread erosion accompanied sheet flow across the shelf, following breaching of glacial lake dams in southern New England ~17-15 ka , perhaps partially confined by an outer-shelf flexural bulge which has since relaxed. However, chirp profiles off North Carolina image a similar seismic facies contrast which could preclude an origin related to the collapse of glacial lakes. A second possibility is some form of diagenetic front, but testing this hypothesis will require further sampling.

OS52B-0905 1330h POSTER

Mapping a Pre-Last Glacial Maximum Paleo-Seafloor and Shelf-Slope Sediment Wedges beneath the New Jersey shelf

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The New Jersey margin has been intensively investigated but attempts to gather geophysical ground truth through coring have seen limited success. In 2001 and 2002, cruises funded by ONR have resulted in a suite of ultra-high resolution chirp reflection lines and shallow drilling using the DOSECC AHC 800 system, placed on board the R/V Knorr. The purpose of these experiments is to determine the geologic history of the margin during the last eustatic sea-level cycle. A key marker for examining the late Pleistocene-Holocene history is a high-amplitude seismic reflector which has been called "R". Previous coring has shown "R" to lie atop sediments 47 ka; however, the surface is likely time-transgressive. "R" underlies the so-called mid-shelf corridor of the New Jersey margin from Cape May to the Hudson Paleo-Shelf Valley, and changes west to east from a sub-horizontal reflector lying on average <9 m beneath the modern seafloor to an eastward dipping reflector that forms the base of two sediment wedges. This transition occurs across three discrete changes in the dip (inflections) of the "R" reflector that can be traced for 10s of km along a trend of N35degE, differing from the modern isobaths in strike by 15 degrees. The first change in dip occurs across an erosional zone previously described as the "R" outcrop area. Sediments overlying "R" between the first and second inflection points thicken by a factor of two and in places display stratified lower layers. The second inflection in "R" marks the westernmost limit of the outer shelf wedge, which is characterized by a stratified lower unit that thins seaward, overlain by a non-reflective unit, which is in turn overlain by a series of eastward-dipping stratified units. AHC 800 drilling penetrated through one of these shallow stratified units, confirming that the contact of stratified to non-reflective sediments is a change from interbedded sands and clays downward to denser, massive clay. We infer the lower stratified unit of the outer shelf wedge to be a return to interbedded sands and clays. The third inflection (12 km east) is the western limit of a previously unmapped sediment wedge that post-dates the outer shelf wedge and consists of stratified reflectors. Based on the geometry of "R" and the pair of wedges deposited east of the inflections in "R", we interpret the reflector to be paleo-seafloor and the inflections to mark a succession of eastward-migrating shelf-edges during sea level fall. Existing ages and the stratified reflections within the wedges argue against rapid emplacement, but rather a process that involves continual shedding of sediments off the evolving paleo-shelf edge by reworking, preceding and possibly following the last glacial maximum.

URL: http://www.ig.utexas.edu/research/projects/geoclutter/geoclutter.htm

OS52B-0906 1330h POSTER

Geomorphologic comparisons of shallowly buried, dendritic drainage systems on the outer New Jersey shelf with modern fluvial and estuarine analogs

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An investigation of the morphometry of shallowly-buried channels imaged beneath the middle and outer New Jersey shelf is being conducted in order to determine the hydrologic regime at the time these channels were active, during the last sea level lowstand and transgression (∼22-8 ka). These features have been mapped using 1-4 kHz and 1-15 kHz, deep-towed chirp sonar. Profile spacings average ∼200 m over an area of ∼600 sq km. Our analysis measures several parameters associated with the geomorphology of the channel systems. We compare mapped and analyzed shelf drainage patterns with a representative group of modern fluvial and estuarine systems. The following drainage basin and hydraulic parameters were quantified: (1) channel width/depth ratio and cross-sectional area; (2) longitudinal profile, density, and patterns of channel networks; and (3) sinuosity and angles of tributary junctions. These parameters were used to constrain paleohydrologic conditions such as water discharge, bed stress, sediment transport, and the extent of bedload versus suspended load. Calculated width/depth ratios of observed drainage patterns are typically ∼10 for smaller tributaries (1st order) and >100 for trunk or main channels (4th-5th order). High aspect ratios suggest the existence of bed load channels with limited carrying capacities, whereas low aspect ratios reflect more suspended load drainage. The New Jersey shelf drainages suggest partial replacement of a fluvial system by a tidal river and (or) estuarine environment. If the paleodrainage systems were created during the last transgression as opposed to having formed at the last glacial maximum (available radiocarbon dates of ∼12-13 ka for the channel fill suggest that to be the case), then relative Holocene sea level rise must have slowed down or even been in minor stillstand during their formation. Based on available sea-level proxy records (e.g., ice-, deep-ocean cores, etc.), we suggest that these drainages formed during the Younger Dryas at ∼12 ka. Additional support for a Younger Dryas time of formation comes from the location of these drainage systems landward of the ∼90 m isobath, as sea-level was in equilibrium at the ∼80 m isobath at Younger Dryas time.

OS52B-0907 1330h POSTER

LATE PLEISTOCENE DEPOSITIONAL ENVIRONMENTS OF THE NEW JERSEY CONTINENTAL SHELF: FORAMINIFERAL EVIDENCE

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The glacial- interglacial history of the New Jersey shelf is difficult to unravel because of associated erosion. Drilling on the NJ slope (ODP Leg 150) penetrated thick sequences of displaced sediments, deposited as the shoreline shifted seaward. Subsequent attempts at recovery of shelf sediments (ODP Leg 174A) were less successful because the variable lithologies resulting from the discontinuous nature of deposition on the Pleistocene NJ shelf made continuous recovery difficult. As part of a long term ONR initiative (STRATAFORM, GEOCLUTTER), grab samples have been recovered to identify surface and shallow subsurface geologic features, and high resolution seismic reflection data (CHIRP) were collected to image the shallow subsurface. Most recently, long cores have been recovered to verify interpretations of seismic reflection data using an innovative Active Heave Compensated drilling system supplied by DOSECC. Core catcher samples from nearly continuous long cores (Sites 1-3) have been analyzed for foraminiferal content (benthic and planktonic) to determine environment of deposition, and stratigraphic position. Subsurface lithology varies but generally consists of sands, shell hash, and/or bioturbated clays. Benthic foraminiferal assemblages are in agreement with bathymetry and facies. For example, the bioturbated clay present at the deepest water Site 1 (∼ 129 m water depth) contains a diverse assemblage, including abraded and transported specimens, but also *in situ* components. However, the sediments at Site 2 ((∼ 80 m water depth) contain a bimodal population: inner - middle neritic sands, as indicated by abundant *Elphidium* spp., and a fluvial-dominated system, as suggested by common pebbles, metamorphic rock fragments, abundant mica, and wood and shell fragments. Grab samples, collected at sites identified from detailed bathymetric and backscatter analyses, have also been analyzed for foraminiferal content to assess the environment of deposition and to evaluate reworking. Samples have been analyzed both on and adjacent to features such as gravel lags, sand ridges, and erosion pits. Both the fauna and the mineralogy are varied and reflect the high degree of variability of surface morphology. Generally, the foraminiferal populations are bimodal, with an *in situ* component, and another assemblage of very abraded, reworked foraminifera. The mineralogy also reflects at least two populations and includes abundant clear angular quartz, and reworked rounded, frosted, often iron- stained quartz. The presence of lithic fragments, coupled with a variable lithology, together suggest that some of these grains may be ice rafted debris (IRD), although it is difficult to differentiate between reworked shelf sediments and IRD.

OS52B-0908 1330h POSTER

Active Heave-Compensated Coring On The New Jersey Shelf

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The continental shelves are of obvious scientific and strategic importance. However, the ability to cost-effectively collect core samples of continental shelf sediments has been limited by technical difficulties. Many sites of scientific interest are too shallow to be drilled by large drill ships, and they are too deep to be drilled economically from jack-up platforms. DOSECC has developed an Active Heave Compensated (AHC800) drilling system under sponsorship of the Office of Naval Research to overcome these obstacles by building a small active heave compensated drilling rig that can be used to collect high-quality core from selected vessels of opportunity. The AHC800 drilling rig is designed to collect continuous core to a total drill string length of 800 m. Water depths of 200 m and less are optimal; however, with some modification operation in deeper water is possible. The AHC800 senses vessel heave using a constantly tensioned low-stretch taut line attached to a seafloor weight. A linear position transducer is attached to this taut line and through the data acquisition system, the ship's distance from the bottom is communicated to the heave compensation computer running Labview RT operating system and object-based software language. This real-time control system is used to achieve a 10-ms control loop for both data gathering and output functions. The Labview RT system continuously controls two hydraulic cylinders that keep the heave carriage and the drill string at the same reference distance from the bottom. The AHC800 system was used on the R/V Knorr on the New Jersey continental shelf in water depths from 74 to 130 m from 25 Sep to 15 Oct 2002. The AHC800 system performed up to and beyond its design specifications. The rig was designed to compensate for 2.44 m of heave with an 8 s period. However, the Knorr's response was a 6 s period resulting in a significant increase in the required acceleration as well as a faster response time for the system as a whole. We believe this 6-second period resulted from rapidly changing wind and wave conditions. During times when the heave was greater than 2.44 m with a 6 s period, the response time of the system was insufficient to keep the drill bit on bottom. However, we were able to continue operation in sea states up to 2.9 m with periods greater than 8 s. The system still requires some tuning in order for it to move from a research and development stage to real production drilling; however, the concept and engineering design are sound.

OS52B-0909 1330h POSTER

Sedimentology and Age Control of Late Quaternary New Jersey Shelf Deposits

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High-resolution Chirp geophysical profiles have delineated a complex network of shallowly buried stratigraphic features within the New Jersey shelf. These features have been interpreted as fluvial channel incisions ("channels" horizon) and associated infill and regional erosional unconformities (e.g., "R" horizon) related to sea-level fluctuations during the late Quaternary. Age control on these features has been difficult to obtain, hindering geologic interpretations and stratigraphic model development. In addition, the ONR Geoclutter Initiative, also carried out on the New Jersey margin, is seeking to understand and model the interaction of these and similar buried structures with incident acoustic energy from tactical sonars. To address both these needs, drill cores were collected at 3 sites

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with the DOSECC AHC-800 from the RV KNORR in Sept-Oct 2002. Sites were selected from Chirp profiles to target prominent geologic features and cores were analyzed for texture, AMS C-14 age control and physical properties. These results will be integrated with complementary geophysical studies to provide a better understanding of the Quaternary geologic history of the New Jersey margin. Site 1 (129 m water depth) penetrated the outer shelf wedge, which has been interpreted as predominantly a submarine deltaic deposit. Sediments are sandy from 0-1.0 mbsf, and exhibit ages of 7-10 kyr BP, whereas deeper than 1.0 mbsf, sediments are clays interlaminated with silts and are much older, 32 Kyr BP. This transition from sand to silty clay and a hiatus of 20 kyrs suggests transgression-related nearshore storage of coarser terrigenous material and outer shelf sediment starvation and/or erosion. Site 2 (80 m water depth) penetrated the axis of a large, infilled channel beneath the mid-shelf. These dominantly sandy channel-fill sediments have been previously interpreted as the infill of a fluvial/estuarine(?) system. Below the surficial sand sheet, from 0.8-3.3 mbsf, ages fall between 12.8 and 12.3 kyr BP, whereas from 4.0-10.8 mbsf, ages fall between 13.5 and 13.4 kyr BP. The boundary between these two units with distinct age ranges corresponds to a downcore change in dominant sediment type from sand to mud, suggesting a transition from estuarine to nearshore/open marine shelf conditions 13 kyr BP. Site 3 (76 m water depth) penetrated through both the surficial sand sheet and the "R" erosional unconformity. Although sediments are similarly sandy throughout, ages above "R" are younger than 10 kyr BP, whereas ages below "R" vary between 40 and 35 ky BP, confirming previous interpretations of "R" as a lowstand erosional unconformity and/or a transgression-related hiatus.

OS52B-0910 1330h POSTER

Characterizing Dynamic Bedforms Using Multibeam Bathymetry in the Haro Strait and San Juan Channel Areas of British Columbia, Canada, and the San Juan Islands, Washington, USA

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The San Juan Islands in the U.S. and British Columbia, Canada, are an archipelago located in Northwestern Washington, between the Northern Cascades Mountain Range and the Olympic Peninsula and are the result of tectonic compressional processes. This region has experienced a complex tectonic history of convergence, thrust faulting, uplift, subsidence, glaciation, tidal scour and sediment transport (deposition and erosion) that in turn have produced diverse marine benthic habitats. There are a variety of habitats including dynamic bedforms, moraines, and glacially scoured fractured and faulted bedrock outcrops. Multibeam bathymetric and backscatter data image the bedforms in detail and show they are concentrated within the waterways of the San Juan Islands, including Haro Strait, the Strait of Juan de Fuca and San Juan Channel. These bedforms may provide habitat for marine species, including migrating salmon. An interpreted map will be presented that focuses on the characterization of marine benthic habitats based on high-resolution (Simrad EM 1002 95 kHz) multibeam bathymetry and backscatter data. This study will assist in a better understanding of the physical and biological characteristics of the San Juan Islands Archipelago, especially near established Marine Protected Areas and will benefit effective implementation of resource management objectives.

OS52B-0911 1330h POSTER

Large incised channels on the Chukchi Shelf provide new constraints on onshore drainage: Implications for tectonic and climatic evolution of NW Alaska

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High resolution Chirp seismic data acquired onboard the USCGC Healy in September 2002 imaged large, incised channels across the Chukchi Shelf, offshore NW Alaska. The channels range from several meters to tens of kilometers in width and trend roughly NNW across the margin. Subbottom profiles across many of the channels display evidence for a marine transgression, with stratal geometries that suggest fluvial infill as well as marine. Piston cores taken within the channels show relatively coarse, well-sorted sand overlain by open marine muds. The level of discharge required to excavate the observed offshore channels is not consistent with the discharge observed from modern streams and rivers on the NW Alaskan margin. This appears to indicate that the offshore channels are misfit with the present day drainage. There are several ways to reconcile the very low, modern discharge and the huge offshore drainage networks observed in the Chirp data. One possibility is that there has been much greater climate variability than previously recognized, such that past discharge levels were much higher than the modern. Higher discharge levels require an increased moisture supply, either in the form of increased precipitation rates or released from storage in regional ice cover. Alternatively, several tectonic explanations may be invoked. Previous researchers have indicated that any channels on the Chukchi shelf should be related to modern drainage from the Hope Valley region. This would require the formation of Herald Bank, a bathymetric high that effectively acts as a modern drainage divide between Hope Valley and the outer Chukchi shelf, to post-date the channel incision. However, the stratal geometry observed in the Chirp subbottom profiles indicates that the underlying, Cretaceous, northward dipping strata were tilted prior to channel incision. Our preferred explanation is that tectonic deformation has altered onshore drainage patterns rather than offshore. In this scenario, tectonic deformation and erosional uplift of the Brooks Range in NW Alaska may have resulted in headward stream capture and diverted much of the drainage to the east. The modern drainage shows an axial parallel pattern, flowing east along the trend of the Brooks Range. Examination of the topography and drainage divides indicates that relatively minor uplift in the region could result in a reorganization of the stream networks. This hypothesis does not exclude the possibility of increased climatic variability. Rather, isostatic rebound derived from increased mechanical erosion and/or glacial unloading could also result in the uplift, stream capture, and changes in drainage discharge.

OS52B-0912 1330h POSTER

A Remote Sensing - GIS Based Approach to Monitor Morphodynamics of the Alaskan Arctic Coasts

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The Alaskan Arctic coast is a dynamic region undergoing continuous spatial and temporal changes in morphology and sediment distribution. There is a complex interplay of natural processes, anthropogenic activities resulting in changes in morphology. Coastal erosion is particularly intense (1-10 m/year) due to thermoerosion, occasional storms and ice action. Understanding Arctic coastal processes is critical for effective environmental management. Considering the variable and unpredictable physical and climatic conditions, poor accessibility, high fieldwork costs in the Arctic, a remote sensing - GIS based approach to monitor the coast is envisioned as a feasible, cost effective and perhaps the only long-term viable strategy. For monitoring Arctic coastal processes, we review the potential use, capabilities and limitations of several operational satellite sensors such as AVHRR, SeaWiFS, SAR, MODIS, LANDSAT, ASTER and IKONOS, which have different spatial and temporal resolutions. The relevance of hyperspectral data is discussed. The value of using SAR imagery for studying ice cover and its influence on the Arctic coast is established. The importance of using high spatial resolution aerial photographs in conjunction with high spectral resolution satellite imagery is demonstrated via a pixel-based fusion product. We also propose the architecture of a Geographic Information System (GIS) for monitoring the Arctic coast. The architecture allows for the GIS to operate on two spatial scales (a) Small scale covering the entire Arctic coast and (b) Large scale allowing a zoom in' on specific sites of interest. Data input comprises of remote sensing data, field observations and ancillary information on geology, geomorphology, bathymetry, and weather information. An open database structure allows for incorporating input on remote sensing data, processes and modeling results in the metadatabase. The architecture has a linkage with pre-existing models, such that our models are open for refinement and can be run using dynamic data exchange calls.

OS52B-0913 1330h POSTER

Comparison of Airborne Lidar and Multibeam Bathymetric Data in the Florida Reef Tract Along Broward County

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Although large, well-known concentrations of corals are found in deeper waters off Florida's eastern seaboard, most mapping of Florida's coral resources addresses the relatively shallow waters of the Florida Keys. To date, technological limitations precluded mapping corals in these deeper waters. Satellite imaging systems and natural color aerial photography, two mapping mainstays, are generally only effective in Florida waters shallower than 20 meters. Conservation of the northern portion of the Florida reef tract, which parallels the Atlantic coast in Miami-Dade, Broward, and Palm Beach counties, has been hampered by minimal or nonexistent coordinated management, monitoring, and mapping activities. In November 2000, the Simrad EM3000 multibeam system was used to collect data south of Port Everglades. Additionally, the Broward County shore protection project conducted a Laser Airborne Depth Sounder (LADS) survey in 2001. Wavelet analyses performed on overlapping transects of the two data sets compare the accuracy of reef bathymetry and complexity captured in the two data collection projects.

URL: http://www.floridamarine.org

OS52B-0914 1330h POSTER

Laboratory Measurements of Turbulence Under Shoaling Waves

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Understanding the sediment transport in surf and swash zone is essential for numerous coastal projects and applications. Many time-dependent models parameterize the sediment transport. While some can be quite successful in predicting the evolution of the bed shape, our understanding of the sediment suspension mechanisms is still rather poor. When the waves approach the shore and break, the energy of the waves is lost to the generation of turbulence and currents, the entrainment of bubbles, and a fraction of the energy from breaking waves is transferred to suspend the sediment particles. A further investigation of the turbulence caused by breaking waves, resulting in the suspension of the sediment particles from the beach bed, is therefore necessary to improve our understanding of the suspension processes. We have used a Particle Image Velocimetry (PIV) technique to study the temporal and spatial structure of the turbulence in the bottom boundary layer. The experiments were performed in the large linear wave flume at the Air-Sea Interaction Laboratory at the University of Delaware. Continuous linear monochromatic deepwater waves were mechanically generated and sent to break naturally on an adjustable planner Plexiglas beach. The beach angle was adjusted to 1:2.6, 1:3.2, or 1:4.6 and a number of wave amplitudes were utilized for each of the beach angle. The PIV field of view was also arranged parallel to the beach bottom and in the vertical plane. The measurements were taken after reaching a quasi-steady state. Ensemble phase averages are used to obtain mean and turbulent fields. Time evolution is studied to investigate the formation and evolution of the turbulent structures and hairpin vortices within the bottom boundary layer. The results are discussed in the context of sediment transport.

OS52B-0915 1330h POSTER

The Golden Gate Mirror Bar

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The provenance of the sand and gravel that is deposited in central San Francisco Bay appears to be mainly the nearby ocean coast, on the basis of lithologic type and grain size distribution. Outside of the

Golden Gate is an arcuate sand bar called the San Francisco Bar, or historically the Golden Gate Bar. The Bar is maintained by deposition from fanning-out and slowing of ebb tidal jet currents leaving the deep, narrow throat of the Golden Gate (the paleo channel of the Sacramento River), as well as longshore drift. It is proposed that a similar mechanism operates inside the Bay, depositing sediment via fanning-out and slowing of flood tidal jet currents, called the Golden Gate Mirror Bar mechanism. Inside the Bay, the currents pass over a series of Franciscan bedrock ridges, so the form of the Mirror Bar is less regular than that of the Bar. Other sediment sources in the central Bay include longshore transport from the south, erosion of uplifted Pleistocene sand deposits, and possibly paleo tsunamis. A sediment-buried Holocene graben in the San Andreas fault zone, crossing the San Francisco Bar, indicates the possibility of local tsunamigenic faults just off the Golden Gate.

OS52B-0916 1330h POSTER

Variations in accumulation rate of late Quaternary turbidite deposits in Santa Monica Basin, offshore southern California

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The Santa Monica Basin off southern California provides an ideal setting to study the effects of sea-level change and turbidity current initiation styles on turbidite depositional processes along a narrow continental margin. It is the perfect sink: all sediment delivered through multiple submarine canyons along its northern margin remains within the basin, except for quantifiable advection of shelf mud to the south. High-resolution deep-tow boomer data, which provides stratigraphic detail (to 50-cm resolution) for the upper 20 to 80 m of basin fill, permits mapping of a series of reflectors across the basin floor and onto the lower basin slopes. Age control for the upper basin fill at ODP Site 1015 is provided by 11 new radiocarbon dates, back to 31 ka (radiocarbon years) at 98 m. The average sediment-accumulation rate during the Holocene of 2.4 m/ka is about half the peak lowstand accumulation rate of 4.7 m/ka. During oxygen isotope stage 3, the accumulation rate was 2.5 m/ka (based on two dates), comparable to the Holocene rate. Additional dates from samples taken with conventional piston cores on the basin slopes confirm age assignments and stratigraphic correlation based on the boomer data. Basin floor reflectors in the turbidite fill can be traced from ODP Site 1015 to as much as 40 m above the floor of the basin at both the western and southeastern margins. Intervals of thick sands on the basin floor have correlative fine-grained turbidites on the basin margins, whereas intervals with only thin sands on the basin floor lack identifiable turbidites. Volume estimates of sediment accumulation can thus be made for individual time slices, allowing identification of periods of shelf trapping (e.g., 7.5 - 4 ka), preferential mid-fan deposition from high-density turbidity currents (e.g., 4 - 1.5 ka) and preferential basin-plain deposition from thick turbulent flows (e.g., 1.5 - 0 ka).

OS52B-0917 1330h POSTER

Acoustic Facies of Late Quaternary Channel and Overbank Systems - Gulf of Santa Catalina, California Borderland.

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The Gulf of Santa Catalina is a deepwater (>300m) basin that lies offshore between Long Beach and Dana Point California. Deep-tow Huntec boomer data from the northern gulf cover a complex channel system consisting of a series of slope gullies euphemistically known as the Newport Canyon. The boomer data have a vertical resolution of 50 cm and the system works effectively for imaging sandy turbidite deposits. A preliminary evaluation of the seismic-reflection data, together with available multibeam bathymetry, provides a better understanding of when different parts of the Newport channel system were active. Three distinct acoustic facies characterize the late Quaternary turbidite sequence of the Newport channel system: an acoustically transparent facies, a high-amplitude discontinuous facies, and a moderate-amplitude sinusoidal facies. The acoustically transparent facies drapes the sea floor on both overbank deposits and some channel floors. Commonly the overbank areas on the west sides of channels preserve the thickest transparent sediment cover. The seismic characteristic of this facies is consistent with a mud-rich deposit but the thickness variation appears to rule out a simple hemipelagic deposit. The high-amplitude discontinuous facies is associated with depressions in the sea floor. These features include active channels, large-scale scours and channel remnants. The moderate-amplitude sinusoidal facies is typical for large amplitude sediment waves. The sediment waves interpreted from the boomer data are not everywhere coincident with the scale of those visible on the multibeam bathymetry. The sediment waves migrate upslope and away from the channel axes. This wave growth pattern is probably related to flows that are substantially thicker than the channel relief and is similar to wave forms found on sediment drifts in the deep ocean. A second channel system similar to the Newport system, associated with the San Gabriel Canyon approximately 9 km to the west, provides additional insight to the depositional processes in the Gulf of Santa Catalina. This system has been strongly affected by the Palos Verdes fault and, therefore, the channel activity is less likely to be autocyclic in nature.

OS52B-0918 1330h POSTER

Process Related Interpretation of Acoustic Data From the Hudson River Estuary

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Acoustic surveying provides valuable information on the distribution of sedimentary environments in subaqueous settings. Frequently, differences in acoustic backscatter strength are used to distinguish sedimentary environments on the basis of their grain size composition. Here, we are presenting acoustic backscatter data from a section of the Hudson River Estuary that are better explained by sedimentary processes than by a variable such as sediment grain size distribution. Funded by New York State, the entire 240 kilometers of the Hudson River Estuary has been mapped using sidescan, chirp sub-bottom profiling, and multibeam bathymetry as part of the Benthic Mapping Project of the Hudson River Estuary Program. In additon, hundreds of gravity cores, and grab samples provide ground truth for a classification of the river bottom into discrete substrate types. Analyses of sedimentary environments reveal patterns in backscatter strength beyond those that can be related to the the sediment grain size distribution alone. Sediment classses can be distinguished based on internal volume scattering, compaction, scattering from surface roughness, scattering from aquatic plants and their roots, shelly substrates, and presense of gas bubbles. Many of the classes can be linked to dynamic processes including contemporary deposition, winnowing, erosion, and sediment migration in sand waves. To distinguish different classes and related processes we use the complete data sets. The results provide a better understanding of the dynamic processes of the Hudson River Estuary and improve the interpretation of the acoustic backscatter data from fine grained sedimentary environments.

OS52B-0919 1330h POSTER

A Study on Geotechnical Properties of Deep-sea Sediments, NE Equatorial Pacific of KODOS Area

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Deep-sea surface sediment were analyzed for their geotechnical properties, and the sediment samples were collected with a multiple-corer from 31 stations along the track line(131°30'W, 5-12°N) in the northeast equatorial Pacific. Most of the sediments from the northern part(8-12°N) showed typical properties of siliceous sediments, whereas the southern part(5-6°N) showed calcareous characteristics due to high biogenic carbonate productivity in the surface waters, where its water depth was shallower than the carbonate compensation depth (CCD: 4,400 m). Geotechnical properties changed sharply at the boundary of 7°N. Calcareous sediments from the southern part had low water contents, low porosity, low shear strength, high bulk density and high specific grain density, whereas siliceous sediments from the northern part attained high water content, high porosity, high shear strength, low bulk density and low specific grain density. Higher sediment activities were observed in the northern sediment samples than the southern sediment samples. The core samples of the northern sediments were divided into a semi-liquid upper layer and a consolidated lower layer with a boundary at 5-8 cm. These sediment samples showed a rapid increasing pattern along the downcore in original shear strength when an opposite trend was observed in the southern samples. The results showed that sediment variabilities in geotechnical properties between the northern and southern parts such as productivities of surface water, grain solubility due to water depth variation, sedimentation rate, erosion and redistribution of sediment, and combined sedimentary processes were distinctly different along the latitude.

OS52B-0920 1330h POSTER

Sedimentation Patterns, Forced Folding and Fluid Upflow Above a Buried Basement Ridge: Results From a High Resolution Seismic 3D Survey

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During the German R/V Sonne Cruise SO 149 (2000), a high resolution 3D seismic data set was collected at the eastern flank of the Juan de Fuca Ridge off the west coast of North America. On the basis of this data set, a consistent layer model could be developed for the unusual complex stratigraphic pattern at and around a sediment buried basement elevation called First Ridge. This basement ridge acted and acts as an obstruction for incoming turbidites, however, the effect exerted by bathymetry on the flow of turbiditic particle clouds decreased as the adjacent sedimentary basins filled up. Subsequent major turbiditic events affected the whole area including the top of First Ridge. Hydrothermally driven fluid upflow above First Ridge appears to be focused by narrow high porosity zones, which are observed above equally narrow pronounced basement peaks. The higher porosity can be explained by forced folds developing an extensional strain field throughout the sediment column. The forced folds may either be the result of fault movement within the basement or related to fault processes within the sediment cover itself. Yet forced folds and high porosity do not necessarily mean detectable fluid flow. 3D seismic data rather provide information about the development and distribution of a potential plumbing system and thus an understanding of the nature of the flow. One implication is that the contribution of fluids discharging at First Ridge does not balance the in-going and outcoming fluid budget at the eastern flank of the Juan de Fuca Ridge.

OS52B-0921 1330h POSTER

Analysis of Dissipation Response for the Piezoprobe and DVTP-P on ODP LEG 204

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OS

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The Strain Path Method (SPM) is used to predict the initial undrained pore pressure response upon insertion of the Davis-Villinger Temperature/Pressure Probe (DVTP-P) and Fugro McClelland's tapered piezoprobe. Uncoupled-isotropic consolidation is assumed and the coefficient of consolidation is estimated from excess pore pressure dissipation. The modeled response to insertion in normally consolidated Boston Blue Clay (BBC) includes the following. The initial excess pore pressure at the port is 3.3 times the in situ vertical effective stress for the DVTP-P, whereas for a piezoprobe, it is 2.4 times the in situ vertical stress. Dissipation of the piezoprobe is much faster than that of a DVTP-P in the early stages due to the much narrower tip of the piezoprobe. The time to achieve 50% dissipation, t50, for the DVTP-P is 2.6 times that for the piezoprobe. Nevertheless, the piezoprobe dissipation is retarded by the arrival of a pore pressure front from above tapered section, which forms a platform on the dissipation curve. The DVTP-P and the piezoprobe were deployed in the Ocean Drilling Program (ODP) on ODP Leg 204 at approximately 53 mbsf in the same lithology, but in an adjacent borehole. The in situ pore pressure (9.55MPa) can be estimated accurately within 0.5 hours at this site by comparing the dissipated pore pressures measured at pressure ports of the piezoprobe and DVTP-P (Two-Point Intersection Method), which is approximately the hydrostatic pressure (9.53MPa). The peak excess pore pressures of the DVTP-P and piezoprobe are 3.0 and 2.2 times the in situ vertical effective stress, respectively. t50 of the DVTP-P is approximately 2.5 times that of the piezoprobe. The results show very good agreement between the predicted and measured dissipation curves for both the piezoprobe and the DVTP-P. The coefficient of consolidation is estimated to be 8x10-7 m2/s.

OS52C MCC: 3000 Friday 1340h

Gas Hydrates in Accretionary Complexes II *(joint with A, B, PP, T, C, GC)*

Presiding: **A M Trehu,** Oregon State University**; J E Johnson,** Oregon State University

OS52C-01 1340h

Gas hydrate distribution and its relationship to free-gas sources within southern Hydrate Ridge: Results from recent seismic experiments

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In August and September, 2002, we conducted a two-ship seismic experiment with the R/V Ewing and the D/V Resolution in coordination with Ocean Drilling Program Leg 204 on Hydrate Ridge, offshore Oregon. We acquired three types of vertical seismic profiles, (zero-offset, constant offset, and walkaway VSP) at four drill sites, and ocean bottom seismometer refraction and seismic reflection data across southern Hydrate Ridge using a high-resolution seismic acquisition system. At Site 1247, which lies near the summit of southern Hydrate Ridge, the constant offset VSP records have two arrivals interpreted as primary-to-shear wave conversions from horizons 46 and 109 m below seafloor, 79 and 16 m above the bottom simulation reflection (BSR) respectively. These events correlate with the top of two hydrate intervals observed in cores and inferred from pore fluid geochemistry. The deeper event also correlates with a seismic reflection, which is discordant with local stratigraphy, and is interpreted as a reflection from the top of the hydrate layer. Both VSP and seismic reflection observations are evidence for a regional hydrate layer that extends at least 250 m around the borehole and directly above the intersection of an inferred free-gas source horizon and the BSR. Seismic p-wave velocities were also measured from the high-resolution seismic reflection data to infer hydrate concentrations within the hydrate stability zone. Preliminary results show that north of the summit of southern Hydrate Ridge, near Sites 1244, 1245, and 1246, seismic velocities are notably higher on the flanks of the ridge than at the ridge crest (1700 m/s between the seafloor and BSR on the flanks vs. 1580 m/s in the equivalent interval on the crest). At the summit of southern Hydrate Ridge, near Sites 1249 and 1250, velocities are locally high (1680 m/s in the interval between the seafloor and BSR at the summit vs. 1580 m/s in adjacent, equivalent intervals). VSP and seismic interval velocity data are consistent with hydrate accumulations above the intersection of the inferred free gas source horizons and the BSR.

OS52C-02 1400h

Why Gas Hydrate Is Where It Is At Hydrate Ridge: The Story From Infrared Images

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A detailed analysis of infrared (IR) images from Ocean Drilling Program (ODP) Leg 204 to southern Hydrate Ridge, combined with core based observations of structure and lithology indicates that lithology plays a stronger role in influencing hydrate distribution at the ridge crest and western flank sites than on the lower eastern flanks and slope basin of southern Hydrate Ridge. Core based observations of silt layers and structural features from five sites representing the three major environments at southern Hydrate Ridge, the ridge crest, the ridge flanks, and the eastern slope basin, were documented in detail. These features were then correlated to the locations of negative temperature anomalies, indicative of decomposing gas hydrate, identified in IR images of the cores. The silt layers are typically $<$0.5 cm thick, laterally discontinuous, and compose $<$3% of the total sedimentary section in the gas hydrate stability zone (GHSZ). Structural indicators in the cores, though rare, typically consisted of shear bands and small offset faults ($<$1 cm). IR data at sites 1245, 1246, and 1250, on the western flank, high on the eastern flank, and ridge crest respectively, indicate that 40 to 60% of the temperature anomalies occur within the documented silt layers, yet show little correlation to structural features. The correlation between gas hydrate and silt layers is weaker at sites 1244 and 1251 where anywhere from 0 to 25% of the anomalies correlate with silt layers. Silt composes $<$1% of the sedimentary section at these sites east of the ridge crest. While counterintuitive at first glance, as lithology was expected to play a larger role in controlling gas hydrate distribution in the eastern slope basin than at any other site cored, these results, when placed in the regional geologic context for Hydrate Ridge should not be unexpected. Uplift and erosion of the summit and western slope of Hydrate Ridge has exposed previously deposited turbidite sequences with silty basal layers. These turbidities are sampled within 30 m of the seafloor at sites 1245, 1246, and 1250, well within the GHSZ. At sites 1244 and 1251, however, this sequence of frequent turbidite layers occurs deeper in the stratigraphic section. As a result, lithology exerts a lesser control at the core scale at sites 1244 and 1251, than at sites 1245, 1246, and 1251. It should also be noted that the steeply dipping faults and fractures likely to control fluid flow through the ridge are difficult to sample. Thus the gas hydrate imaged during the leg may be biased towards that located in sub-horizontal silt layers.

OS52C-03 1415h INVITED

Controls on Regional Gas Hydrate Occurrence at Southern Hydrate Ridge (ODP Leg 204)-Geochemical Evidence

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Ocean Drilling Program Leg 204 on southern Hydrate Ridge found concentrated gas hydrate (20-40% of pore volume) only in shallow (0-30 m) sediments over a limited area (0.3 x 0.5 km) at the summit of the Ridge, just above seismically imaged gas migration pathways. Although summit gas hydrates are dominated by microbial methane (δ^{13}C = -65 permil), the hydrates contain thermogenic ethane (δ^{13}C = -34 permil) and sediments cored within the migration conduits contain elevated amounts of C2-C6 hydrocarbons having carbon isotopic compositions indicating hydrocarbon origin at temperatures on the order of 120-140 deg C. At sites away from the summit of southern Hydrate Ridge, gas hydrate occurrence is more limited, with average contents on the order 1-3% of pore volume. Non-summit sites have no significant input of migrated thermogenic hydrocarbons to the hydrate stability zone. However, intense microbial activity results in relatively steep (1.6 to 3.6 mM/m) methane concentration gradients, and a top of gas hydrate occurrence marked by distinctive hydrocarbon fractionation (ethane depletion, propane enrichment) in the dissolved gas geochemistry. Ethane in shallow sediments is isotopically light (δ^{13}C = -52 permil) and probably related to microbial acetogenesis and carboxyl group reduction. Formation of Structure I methane hydrate involves a fourfold ethane-enrichment in the hydrate relative to the dissolved gas phase, and results in a net transfer of ethane from the pore water to the sediment. Steep porosity gradients result in the burial velocity of sediment being greater than that of pore water with respect to the sediment-seawater interface. Downward sediment velocity is even greater relative to the base of gas hydrate stability, which is shoaling due to tectonic uplift concurrent with sedimentation. Decomposition of ethane-enriched gas hydrate upon subsidence beneath the stability zone results in transfer of ethane from the sediment back to dissolved gas/free gas phases, and produces large shifts in C1/C2 ratio. Carbon isotopic composition of dissolved inorganic carbon indicates that anaerobic methane oxidation is an important process mainly in the summit region. At most non-summit sites, rapid burial apparently limits the amount of methane diffusing upward to the sulfate reduction zone.

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Sources of gas hydrates: ^{129}I results from Blake Ridge, Nankai Trough, Peru Margin and Hydrate Ridge

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The presence of the cosmogenic isotope ^{129}I ($T_{1/2}$= 15.7 Myr) allows the dating of iodine in pore waters associated with gas hydrates. Since iodine is closely associated with organic material, ^{129}I /I ratios give information on the age of the source material of iodine and, by association, of the methane found in gas hydrate occurrences. The first application of this type was carried out at Blake Ridge (ODP 164; Fehn et al., 2000), followed by a study of the Nankai area (Fehn et al., 2003). We compare here the earlier results to new data from the Peru Margin (ODP 201) and Hydrate Ridge (ODP 204). All of the results obtained show that stable iodine in sediment pore waters associated with gas hydrates is enriched 500-fold (Nankai) to 5000-fold (Hydrate Ridge) over seawater, indicating derivation from organic sources. The high concentration of iodine in the pore waters allows preparation of targets for AMS determinations from the small quantities (3 to 10 mL) typical for individual pore water samples. All ^{129}I /I ratios measured in the two new investigations indicate ages older than the host sediments, confirming findings from Blake Ridge and Nankai that iodine (and methane) is predominantly not derived from local sources. In contrast to Blake Ridge, however, ratios in the other three areas show considerable variation. In Nankai and Peru Margin, a clear decrease in ratio (and increase in age) with increasing depth is discernable, pointing to mixing between a deep, old and