station, we selected the largest 40 waveforms in every-hour and stacked them to obtain a reference waveform at every hour. Assuming that the relative arrival time differences among these 40 events are common to all the other stations, the one-hour time window is shifted at each station to obtain the stacked waveform in the best correlation with the reference waveform. This time shift represents a delay or advance of the T-wave arrival relative to the reference station. We calculated the average of the time shifts at each station to determine the average epicenter of the swarm and the average T-wave speed. The epicenter was located at (20.3729°N, 144.9508°E) and the sound speed was determined to be 1.5021 km/s. We found that the every-hour time shift shows a semidiurnal variation with an amplitude of ±0.1 to 0.2 s in a consistent way among the stations. We interpret this as the consequence of the path length change due to vertical distortion of the SOFAR axis in response to the semidiurnal internal tides. This path length change is evaluated from the path length change of a constant density plane near the SOFAR depth. We calculate for this purpose the distribution of the isopycnal vertical displacement and phase associated with the M_2 component of the internal tide. The result shows that the isopycnal vertical displacement along the Boso path is an order of magnitude larger than those along other paths so that the path length change is also an order of magnitude larger. The amplitude and phase of this change are consistent with the observed ones.

OS41C-0817 0830h POSTER

The Global S_1 Ocean Tide

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The small S_1 ocean tide is caused primarily by diurnal atmospheric pressure loading. Its excitation is therefore unlike any other diurnal tide. The global character of S_1 is here determined by numerical modeling and by analysis of Topex/Poseidon satellite altimeter data. The two approaches yield reasonably consistent results, and large (>1 cm) amplitudes in several regions are further confirmed by comparison with coastal tide gauges. Notwithstanding their excitation differences, S_1 and other diurnal tides are found to share several common features, such as relatively large amplitudes in the Arabian Sea, the Sea of Okhotsk, and the Gulf of Alaska. The most noticeable difference is the lack of an S_1 Antarctic Kelvin wave. These similarites and differences can be explained in terms of the coherences between near-diurnal oceanic normal modes and the underlying tidal forcings. While gravitational diurnal tidal forces excite primarily a 28-hour Antarctic-Pacific mode, the S_1 air tide excites several other near-diurnal modes, none of which has large amplitudes near Antarctica.

OS41C-0818 0830h POSTER

Multiresolution Interpolation and Detiding of the ADCP data

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To account for the uneven sampling of current measurements collected by acoustic Doppler current profilers, we propose a robust, three-dimensional interpolation scheme based on the multiresolution representation of the regional mean and tidal current fields. Instead of reconstructing the tidal field by getting bin-averaged time series that relies on heavy sampling or invoking radial basis function expansion, such as using the biharmonic splines with subjectively selected knots, the resolving capability of the proposed scheme relies fundamentally on the scale hierarchy of the resolvable local information constrained by the data. We demonstrate that the proposed scheme flexibly incorporates merits of the two conventional techniques. It enforces the resolution of model information while accommodating the local sampling density. Since it is based on knots network defined by regular grids, efforts of experimentally and subjectively constructing the proper number and locations of controlling nodes are avoided. Constructing multiresolution representation of the current fields in terms of the three-dimensional wavelet basis is implemented by computationally effective discrete wavelet transform of coefficients of the interpolation equations. Applications of the proposed multiresolution scheme on artificial as well as field data sets of the ADCP measurements demonstrates that it is a promising approach.

OS41C-0819 0830h POSTER

Thermal Constraints on Upper Basement Permeability Near a Venting Seamount

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We used transient numerical simulations of coupled heat and fluid transport to quantify relations between fluid fluxes, basement permeability, and the vigor of local convection on seafloor heat flow patterns adjacent to a basement outcrop through which warm hydrothermal fluids are discharged. These finite-element models are designed to replicate conditions near the Baby Bare outcrop on 3.5-Ma seafloor on the eastern flank of the Juan de Fuca Ridge, where 5-20 L/s of warm fluid seeps from the seafloor. Several transects of heat flow observations co-located along seismic reflection profiles around this feature provide observational constraints for the models. Heat flow is not greatly influenced by venting at the outcrop at distances of several kilometers from the point of sediment onlap, but values rise abruptly immediately adjacent to the outcrop. The model domain consisted of a 21 km x 5 km radial grid, with 8 sedimentary and 6 basalt units, and a characteristic node spacing of 20-500 meters. Conductive simulations include a small rise in heat flow near the outcrop as a result of conductive refraction, but the magnitude of the rise is much smaller than observed. Additional simulations were run using elevated basement thermal conductivity as a proxy for local convection, to evaluate the vigor of local convection required to generate large increases in heat flow near the outcrop. Nusselt numbers (the ratio of heat transported within the edifice by conduction and advection to that which would be transported by conduction alone) of $100 < Nu < 1000$ are required in order to homogenize temperatures along the sediment-basement interface and closely match the observed heat flow profile. Interestingly, it is not necessary to vent any fluid at the outcrop to generate this pattern; local convection is sufficient. Fully-coupled simulations were run with fluid forced from the seamount at 5-20 L/s. We find that local convection occurs within the seamount in cases with sufficiently low fluid velocities (<10 L/s) and high basement permeabilities ($>10^{-10}$ m^2), and this convection is as effective at redistributing heat as single-pass flow in which little or no local convection occurs.

OS41C-0820 0830h POSTER

A New Tool for Probing Thermohaline Fine Structure in the Ocean: Seismic Reflection Profiling of the Labrador Current/North Atlantic Current Front

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We present acoustic images of thermohaline structure in the ocean created from marine multichannel seismic reflection profiles across the major oceanographic front between the Labrador Current and the North Atlantic Current. The images show that distinct water masses can be mapped, and their internal structure imaged, using low-frequency acoustic reflections. The reflections are generated by sound-speed contrasts at interfaces across which temperature changes by up to 3 degrees C. Returns from reflection coefficients (RC) as low as 0.0001, corresponding to sound speed changes of 0.3 m/s (temperature changes of 0.1 degrees C), can be imaged. The warm/cold front is characterized by strong (RC 0.004; 12 m/s), east-dipping reflections generated by thermohaline intrusions in the upper 1000 m of the ocean. Regions away from the front show weaker undulating reflectors suggestive of internal waves in the thermocline and submesoscale eddies beneath the thermocline. Our results imply that standard low frequency marine seismic reflection techniques can provide excellent spatial resolution of important oceanic phenomena, including thermohaline intrusions, internal waves and eddies.

OS41C-0821 0830h POSTER

Fine-scale thermohaline structure revealed by seismic reflection profiling in the Gulf of California.

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We present cross-sectional acoustic images of the ocean revealed by standard seismic-reflection profiling acquired in the Gulf of California. The data were acquired with a 6 km streamer, 480 channels and 20 gun array with a frequency content of 10-120 Hz. Seismic lines acquired in several different locations throughout the Gulf of California show similar characteristics. The images reveal acoustic reflections caused by fine-scale thermohaline structure. These reflections are prominent in the uppermost 500 m of the water column and become weaker with depth until they reach 1000 m, where they disappear as the abyssal waters become acoustically transparent. Time-lapse cross-sectional images show no overall change in reflectance characteristics in the uppermost 500m and in deeper waters, but the location of the reflections varies slightly between the images. We believe that these changes in location are consistent with the dynamics of internal waves.

OS42A MCC: Level 2 Thursday 1330h

General Ocean Sciences: Instruments, Techniques, and Programs II Posters

Presiding: **G S Lagerloef,** Earth and Space Research**; C T Friedrichs,** Virginia Institute of Marine Science**; J Diebold,** Lamont-Doherty Earth Observatory

OS42A-0822 1330h POSTER

R/V Mirai, her missions, facilities and special project "BEAGLE 2003"

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The R/V Mirai, with its large ice-strengthened sturdy hull, was launched in 1997. The ship, in particular, with its large size and its anti-rolling device of special design, is capable of undertaking missions to high-latitude and Polar Regions exposed to the extremely harsh weather and sea conditions. The ship is equipped with many state-of-the art oceanographic and marine meteorological instruments and is expected to act as a floating platform for sophisticated interdisciplinary researches, emphasizing on global change. The R/V Mirai has many characteristic features. Several examples are as follows; (1) Possible for longer survey voyages and wide area observation: She has abundance of laboratories and instrumentation for various observation and facilities for data processing and analyzing. (2) Superior navigation under rough weather with ice strengthened hull: Large class vessel in the world as research vessel, equipped with Hybrid type anti-rolling systems. Also its hull structure is ice strengthened for the voyage to the Arctic Ocean area in the summer seasons. (3) Ability to carry large types of observation instruments on board, and deployed and retrieval of equipment in research areas: Transport, deployment and retrieval of ocean observation buoy developed by

JAMSTEC is effectively handled. Further, CTD/water sampling systems, 20 m length piston core sampler system etc. are possible to be installed and operated on board. The R/V Mirai has special missions for ocean science, because of her superior characteristic features. Several examples are as follows; (1) Observation at Arctic region for interaction among atmosphere, ocean and sea ice: Sea ice distributed over a high latitude area works as a lid, which controls the energy transportation between the atmosphere and the ocean. A global climate change will be supposed by ice reduction in a result of global warming. We investigate the interaction between sea ice, ocean and atmosphere. (2) Material cycle in ocean: Investigation of CO2 flux between the atmosphere and the ocean will help to predict a global warming. (3) El Niño: To investigate the mechanism of El Niño, Japanese buoys are installed along the Equator. Interactions between the atmosphere and the ocean, heat flux in the ocean is observed using the buoys. This year the R/V Mirai is surveying down to the southern hemisphere for the round trip of the world on the 30° S latitude. The cruise nickname was BEAGLE 2003 after Charles Darwin′s cruise "BEAGLE" The BEAGLE cruise will focus on the studies of three main themes: the heat and material transports and their variability in the general ocean circulation, the basin-scale biogeochemical changes of the chemical properties and chemical interaction between air and sea water, and the paleo-environmental changes in the ocean. This cruise are also designed to make clear the oceanic circulation at the southern hemisphere special references to the overturn of the Antarctic circulation of cold current, decadal change on the line of WOCE held on 1991 to 1996 again to get more precise data by using the much more sophisticated technique and instrumentations, and the paleoceanographic study on both Arctic and Antarctic area on the climatic and environmental changes.

OS42A-0823 1330h POSTER

Multibeam Bathymetry and Imagery Capabilities of the Newest UNOLS Research Vessel: R/V Kilo Moana (AGOR-26)

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The R/V Kilo Moana is the newest vessel in the UNOLS fleet, owned by the Office of Naval Research and operated by the School of Ocean & Earth Science & Technology at the University of Hawaii. Kilo Moana is equipped with two separate multibeam mapping systems, one for shallow water (95kHz Simrad EM1002) and one for deep water (12 kHz Simrad EM120). Here we present results from sonar acceptance tests conducted during mission trials, and show examples of bathymetry and acoustic imagery collected during the first year of the ship's operation. This information can be used both as a performance baseline for Kilo Moana's mapping systems, and as a guideline for users who are planning future mapping surveys. Kilo Moana has a SWATH (Small Water Area, Twin Hull) hull design that offers two strong advantages for multibeam mapping. For their size, SWATH vessels are more stable than monohulls. Increased stability reduces bathymetry errors due to pitch/roll/yaw, and facilitates the acquisition of high quality acoustic imagery (backscatter), because backscatter characteristics are strongly dependent on the insonification direction. The SWATH design also reduces bubble sweepdown beneath the hull. These two characteristics (stability and lack of bubble sweepdown) enable Kilo Moana to conduct mapping operations at high speeds in high sea states, and here we show examples of performance in a variety of sea conditions. Results from initial shipboard acceptance tests indicate that each of Kilo Moana's multibeam system meets or exceeds performance targets. Tests were conducted in the Michelson Test Area (water depth 4900 m) and Key West Test Area (water depth 65 m). For the shallow water EM1002, the accuracy requirement for each of the system's 101 beams is 0.30% of water depth where the error is calculated as the standard deviation of a beam divided by the water depth. For the deep water EM120, the accuracy requirement for each of the system's 191 beams is 0.20% water depth. Kilo Moana multibeam performance has also be characterized by sea state, shaft RPM, and water depth, and results from these tests are presented here as both a means for evaluating the performance of the Kilo Moana multibeams, and as a guideline to assist users in planning multibeam mapping surveys. In addition to performance data, we present a series of examples from both deep and shallow water to demonstrate the capabilities of the sonar and the types of standard data products available to users of the vessel.

URL: http://www.soest.hawaii.edu/hmrg

OS42A-0824 1330h POSTER

MERCATOR-Ocean monitoring and forecasting : a 4D vision of the global ocean. Data policy and applications.

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Mercator Ocean is a public interest grouping formed in Toulouse in early 2002 by six major players in the French oceanography community: the space agency CNES, the scientific research centre CNRS, IFREMER (the institute of marine research and exploration), the development research institute IRD, the Météo France weather service, and SHOM (the French Navy's hydrography & oceanography department). In 1995, these same organizations gave themselves seven years to achieve a challenging objective: to conceive, develop and implement France's first operational oceanography system. The unique system would be capable of describing, analysing and predicting conditions at the ocean surface and subsurface in real time, anytime, anywhere in the world, even in the most inhospitable seas. That objective was met on 17 January 2001 with the release of the first Mercator ocean bulletin, providing a two-week forecast for the entire North Atlantic. Two thousands new forecast charts are now added to the MERCATOR bulletin every week. Building on these successes, a dedicated operational oceanography team, Mercator Ocean, was set up in 2002. Mercator Ocean's mission is to deliver incremental improvements in the service provided by this new operational oceanography capability by increasing the resolution and the geographic coverage of the models used. The new high-resolution model that is now on line offers 6 km grid resolution, and the first models offering global ocean coverage will be implemented late 2003. Over the next four years, Mercator Ocean also plans to establish a European Operational Oceanography Centre in Toulouse. Objective 1. Develop an operational oceanography system using three-dimensional simulation and a high-resolution primitive-equation model capable of assimilating satellite data (from the Jason altimetry satellite in particular) and in-situ ocean observation data (particularly those gathered by the CORIOLIS centre). 2. Support applications for commercial shipping and naval forces, promote sustainable stewardship of the world's oceans, oceanographic research, safety at sea, environmental monitoring and conservation, and further knowledge of the ocean's role in climatic change. 3. Contribute to the international GODAE initiative (Global Ocean Data Assimilation Experiment) through routine real-time analysis and forecasting of global ocean conditions. Our poster describes our data distribution policy and some of our major recent applications : Ocean racing, Fishing, Oil spill and Off-shore oil exploration.

URL: http://www.mercator-ocean.fr

OS42A-0825 1330h POSTER

A three-dimensional variational data assimilation system for coastal oceans

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A three-dimensional variational data assimilation system (3DVAR) has been developed in association with the Regional Oceanic Modeling System (ROMS) and implemented in a real-time forecasting system for the U. S. West Coastal region. This 3DVAR system assimilates sea surface temperature (SST) and along track sea surface heights (SSH) from multiple satellites, as well as a variety of autonomous underwater vehicle (AUV) and in situ measurements. The real-time implementation of this 3DVAR has shown satisfactory performance in terms of results, reliability, and efficiency. Several particular strategies are implemented in this 3DVAR. A new strategy for incorporating three-dimensional error self-covariances and cross-covariance is developed that allows us to cope with strongly inhomogeneous and anisotropic error covariances in coastal oceans. Since the quality of many remotely sensed measurements deteriorates approaching the coastline, the 3DVAR is further implemented with constraints in geostrophic and hydrostatic balances to control the dynamical behavior of the analysis increment. This 3DVAR system has been programmed with both OpenMP and MPI parallelism. A limited-memory, quasi-Newton, minimization algorithm with preconditioning is employed to accelerate the convergence towards optimization.

URL: http://ourocean.jpl.nasa.gov

OS42A-0826 1330h POSTER

Development and Validation of Ocean Surface Wind Derived from the TRMM Precipitation Radar Measurements

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Spaceborne scatterometery has been used for several years now to retrieve the ocean surface wind field based on measurements of the normalized radar cross section at the Earth's surface level. Though designed specifically for the measurement of precipitation profiles in the atmosphere, the Precipitation Radar (PR) of the Tropical Rainfall Measuring Mission (TRMM) also acquires surface backscattering measurements over global ocean. As such, this instrument provides an interesting opportunity to explore the benefits and pitfalls of alternative radar configurations in the satellite remote sensing of ocean winds. In this paper, a technique was developed for retrieving ocean surface winds using surface backscattering measurements from the TRMM Precipitation Radar. The wind retrieval algorithm developed for TRMM PR makes use of a maximum likelihood estimation technique to compensate for the low backscattering associated with the PR configuration. The high vertical resolution of the PR serves to filter out rain-contaminated cells normally integrated into Ku-band scatterometer measurements. The algorithm was validated through comparisons of ocean surface wind speeds derived from PR with remotely measured winds from TMI and QuikSCAT, as well as in-situ observations from oceanographic buoys, revealing good agreements in wind speed estimations.

OS42A-0827 1330h POSTER

Identification of Errors and Uncertainties in Sea Surface Temperature Retrievals by Comparison of Microwave and Infrared Observations from TRMM

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The availability of both infrared (VIRS) and microwave (TMI) sensors onboard the Tropical Rainfall Measurement Mission (TRMM) provided an opportunity to perform a detailed intercomparison of Sea Surface Temperature (SST) retrievals from two distinct but perfectly co-located sensors. Infrared (IR) retrievals provide good spatial resolution but they are affected by clouds and atmospheric water vapor, and are therefore limited to clear sky conditions. Microwave (MW) observations provide supplemental SST information in cloudy areas, but they are subject to other limitations like poor spatial resolution and possible wind biases. A rigorous study of the uncertainties and potential errors in IR and MW SST retrievals by satellite is described here. One year of co-located VIRS and TMI SSTs are analyzed, together with other colocated ancillary datasets including surface winds and water vapor. Results from the IR/MW intercomparison

and the analysis of the correlation between SST differences and potential sources of error are presented. In particular, we focus on the effects on SST retrievals due to: high winds, land contamination, atmospheric water vapor, undetected clouds, choice of IR SST algorithm, satellite maneuvers and calibration errors. In addition, both the datasets are used to investigate the amplitude of the diurnal variation of skin SST. The identification of error characteristics can lead to improvements in both IR and MW SST algorithms. Moreover, the results of this intercomparison are valuable for the development of a future generation of a blended IR/MW SST dataset, which combines the strengths of each observational method

OS42A-0828 1330h POSTER

Environmental Impact of a Submarine Cable: Case Study of the Acoustic Thermometry of Ocean Climate (ATOC)/ Pioneer Seamount Cable

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To better understand the potential impacts of the presence of cables on the seabed, a topic of interest for which little data is published or publicly available, a study of the environmental impacts of the ATOC/Pioneer Seamount cable was conducted. The 95 km long, submarine, coaxial cable extends between Pioneer Seamount and the Pillar Point Air Force Station in Half Moon Bay, California. Approximately two thirds of the cable lies within the Monterey Bay National Marine Sanctuary. The cable is permitted to NOAA-Oceanic and Atmospheric Research for transmitting data from a hydrophone array on Pioneer Seamount to shore. The cable was installed unburied on the seafloor in 1995. The cable path crosses the continental shelf, descends to a maximum depth of 1,933 m, and climbs back upslope to 998 m depth near the crest of Pioneer Seamount. A total of 42 hours of video and 152 push cores were collected in 10 stations along cable and control transects using the *ROVs Ventana* and *Tiburon* equipped with cable-tracking tools. The condition of the cable, its effect on the seafloor, and distribution of benthic megafauna and infauna were determined. Video data indicated the nature of interaction between the cable and the seafloor. Rocky nearshore areas, where wave energies are greatest, showed the clearest evidence of impact. Here, evidence of abrasion included frayed and unraveling portions of the cable's armor and vertical grooves in the rock apparently cut by the cable. The greatest incision and armor damage occurred on ledges between spans in irregular rock outcrop areas. Unlike the nearshore rocky region, neither the rocks nor the cable appeared damaged along outcrops on Pioneer Seamount. Multiple loops of slack cable added during a 1997 cable repair operation were found lying flat on the seafloor. Several sharp kinks in the cable were seen at 240 m water depths in an area subjected to intense trawling activity. Most of the cable has become buried with time in sediment substrates on the continental shelf whereas much of the cable remains exposed in sediments at deeper depths. The cable is exposed in rocky environments of the nearshore region and on all of Pioneer Seamount. The main biological features associated with the cable were organisms utilizing the cable as substrate and occasionally as shelter. Considerable care was taken to count megafauna in video transects and macrofauna from the top 5 cm of push cores. Few differences were found between cable and control sites at the 95% confidence level. Anemones *Metridium farcimen* and *Stomphia sp.* colonized the cable and were more abundant in cable transects at most soft sediment sites. Coarse extrapolation of the transect data suggest that more than 5,000 *M. farcimen* may live on the continental shelf portion of the cable. Several other species of anemones living on the cable are common along deeper sections of the cable route. Where the cable was buried, the presence of linear rows of sea anemones proved to be a reliable indicator of the cable's position. Flatfish and rockfish apparently congregate near the cable and were as much as 1 order of magnitude more abundant near the cable at some sites.

OS42A-0829 1330h POSTER

Technique for Localization of Ocean Bottom Seismometers and Airgun Sources

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In any seismic survey a number of factors contribute to the total uncertainty of the data including the uncertainty of the position for the seismic sources and receivers. This may be not a major issue for a conventional seismic survey using a towed array, because the relative geometry is usually known accurately enough and is easily obtained. For applications using deployed autonomous receivers (such as Ocean Bottom Seismometers (OBS)) for seismic tomography, the absolute positions must be known with high accuracy in order to achieve optimal results. This paper describes a technique for localizing seismic sources and receivers using regularized inversion of the travel times of the direct water wave and it has the following features: a) inversion of the full ray-tracing equations for a general sound velocity profile b) simultaneous inversion for all unknowns; c) smoothest solution for source ship track lines; d) correction for non-constant drift for the OBS clocks (approximated by two linear segments); e) correction for random time-base errors in OBS data; f) correction for a bias in the water column velocity profile. The technique will be presented along with results for synthetic tests including solution uncertainty estimation. Results will also be shown for localization of sources and receivers in a gas hydrate seismic survey off Vancouver Island (COAMS'99) consisting of 5 OBS's and more than 18000 shots to demonstrate the contribution of each feature of the algorithm into the elimination of the misfit between measured and calculated travel times.

OS42A-0830 1330h POSTER

Seismic airgun sounds recorded on moored hydrophones near the Mid-Atlantic Ridge and East Pacific Rise

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Sounds of seismic airguns were detected in two years of data collected from large, remote areas near the Mid-Atlantic Ridge (MAR) and the East Pacific Rise (EPR). From February 1999-February 2001, six autonomous hydrophones were moored near the MAR between 15-35 N and 33-50 W, and six more were moored in the EPR between 8 N - 8 S and 95-110 W. Continuous acoustic data recovered from both arrays were examined for sounds associated with seismic airgun activity. This was done using an automatic detection algorithm designed to identify repetitive sounds in the 20-60 Hz band. Airgun impulses occurred every 10-20 s and were recorded frequently on all hydrophones. In the Atlantic, airgun activity peaked in the summer months, and airgun impulses were detected in nearly 100% of the hours examined; Pacific seasonal trends were less obvious. Because of the high source level of the airgun signals, it was possible to estimate the locations of ships conducting seismic surveys despite their great distance, often over 3,000 km from our array. In the Atlantic, we located seismic vessels, presumably commercial, working off the coast of Nova Scotia during summer, and off western Africa and northeast Brazil in spring, summer,and fall. During summer 1999, research airguns were recorded on the MAR near 26 N 50 W. In the eastern tropical Pacific, the predominant source of airgun sounds was seismic vessels in the nearshore waters of southern Ecuador and northern Peru. All of the areas in which intense airgun activity was detected include important habitat for marine mammals; one area included habitat of the critically endangered northern right whale. Sounds from airguns appear to be a major contributor to the sound field in the Atlantic and parts of the Pacific Ocean, and may be of concern given the recent interest in ocean noise and its effects on marine mammals. Acoustic pressure levels of earthquakes are also investigated, and received levels in some common marine mammal habitats are calculated. It is hoped that these data will provide the marine mammal community with insight into the major components of the marine noise field.

OS42A-0831 1330h POSTER

Seafloor Sounding in Polar and Remote Regions

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Accurate and detailed knowledge of global bathymetry is a prerequisite for progress in numerous scientific disciplines related to earth systems. Among these are modeling of ocean circulation and its relation to climate; modeling of tides and tsunamis; describing tectonic plate structure and dynamics; understanding the formation, modification and ultimate destruction of Earth's crust; sediment transport, distribution, and thickness; paleoceanography; etc. Detailed understanding of seafloor shape and features is also necessary to select sites and routes for undersea communication cables. Detailed bathymetry is required to understand the energy and mineral potential of the seas. In two specific areas of the world oceans - the Arctic Ocean and the Southern Ocean - the existing database of bathymetry is too sparse to meet science needs. The Seafloor Sounding in Polar and Remote Regions (SSPARR) project intends to fill the bathymetry data gaps in both polar regions, by the development and deployment of unmanned drifting depth sounders with satellite telemetry. Each SSPARR buoy will incorporate a single-beam depth sounder, capable of reliably measuring ocean depths up to 5000 meters or more; a GPS receiver for geographic position determination; and a bi-directional satellite communication link for telemetering data to a shore site and for receiving commands from the shore site. A buoy control processor will receive and implement commands from the shore site; sample and archive GPS position data; initiate the depth sounding function and archive resultant data; monitor status of various buoys sensors; and respond to polling requests from the shore site by telemetering requested data. The buoy will be battery powered, with sufficient power to operate for several years (although in harsh polar environments, damage from sea ice may shorten the buoy lifetime.) With its GPS receiver and subsurface acoustic system, the SSPARR buoy may also be programmed to act as an aid to navigation for underwater vehicles, by transmitting position and time information to those vehicles by acoustic modem. A three year development is planned for the SSPARR depth sounder and buoy: In the first year, assessment and demonstration of technology required for the system is planned - a low power depth sounder capable of reliably and autonomously determining seafloor depths up to 5000 meters, integrated with a combined data acquisition, navigation, control, and telemetry system. Initial development of components of the shore site, including communication protocols, will also be accomplished in the first stage of SSPARR development. In this paper, we will present the conceptual design of the SSPARR depth sounder and buoy, and results of development and testing to date. An overview of the planned development activities leading to buoy production and system operational capability will also be presented.

OS42A-0832 1330h POSTER

Absolute Height of Sea Surface by Trajectory of GPS Antennae Over Submerged Pressure Gauges

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Water height data provided by seafloor tide gauges is a combination of sea-level variations and ground motion. Both of these signals are of scientific interest, but they must be separated in order to be useful. Estimating ground motion is specially important in very tectonically active areas such as the Pacific Ocean rim. One promising method to separate the two contributions is to use satellite altimetry data which gives absolute water height, but these data must be calibrated using ground truth measurements. Once different components of the signal are separated, bottom pressure gauges can be used to detect vertical movements of the seafloor such as co-seismic or slow inter-seismic motions.
The Vanuatu archipelago is part of the Pacific ring of fire, where plates are rapidly converging. In the area, movements are very rapid and the seismic activity is intense, which gives a good opportunity to study deformation and seismic cycle. To get an integrate picture of vertical deformation over one plate and between the two plates, one needs to be able to monitor vertical movements on both underwater and emerged areas. We conducted an experiment in the Vanuatu archipelago, South-West Pacific, to compare measurements from bottom pressure gauges located beneath altimetry satellite tracks with sea surface altitude measurements from GPS. Two bottom pressure gauges are immerged since Nov. 1999 on Sabine bank (15.90°S, 166.14°E) and Wusi Bank (15.34°S, 166.55°E), West of Santo island, Vanuatu. In order to perform absolute calibrations of JASON and ENVISAT altimeters that overfly the Wusi and Sabine banks, respectively, we performed GPS measurements of instantaneous sea surface altitude. The GPS antennae were fixed on top of the 30m long R/V Alis. An inertial unit also recorded the high frequency vessel motions. The height of the antennae over the sea surface was measured using a laser distancemeter in calibration sessions during particularly calm sea states. We present results of GPS computations in kinematic mode, together with the corrections for pitch and roll from the inertial unit. We compare the results with the sea level variations recorded by the tide gauges.

OS42A-0833 1330h POSTER

Multibeam Sonar Image Classification

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High-frequency multibeam sonar has become an increasingly common geophysical tool used in shallow water environments. It is used to rapidly acquire depth and co-registered backscatter intensity data, effectively providing a snapshot view of the seabed. These high-resolution data contain detailed information about the morphology and texture of the modern layer of the stratigraphic record that can be used to understand the dynamics of the sedimentary environment if patterns in the acoustic imagery can be related to the physical environment. Using data collected with an EM 3000 (300 kHz) multibeam sonar system at the Shallow-Water High Frequency Acoustics Experiment site (SAX99) off western Florida, we have developed image classification techniques that can be used to aid acoustic image interpretation. This particular dataset is ideally suited for developing classification algorithms because multibeam tracks were closely spaced and lines were run in several orientations. In addition, the site had relatively uniform water depth and sediment type with the exception of a muddy trough that transects the survey area. Within the sandy sediments are seabed ripples with wavelengths of approximately 70 cm. The image classification techniques focus primarily on multibeam acoustic backscatter data and can be used to distinguish broad transitions in sediment type (mud v. sand). In addition, we are able to detect variations in ripple properties throughout the sandy region of the survey area. We also apply these methods to EM 3000 data collected in other environments, including the Hudson River, in order to verify their validity. By utilizing other datasets, we are able to better understand the acoustic image classification as it relates to the physical environment.

OS42A-0834 1330h POSTER

Determination of shallow water depth by using optical satellite images

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The remote sensing method processing with multi-temporal images collected by optical/near infrared sensor of the SPOT satellites can be a more effective approach to retrieve shallow water depth in compare to the traditional sounding ones. This method based on Lambert-Beer law, which presumes that attenuation of sunlight in water is an exponential function of water depth, is known for depth retrieval from optical data. We compare two satellite images gathered in different dates and calibrate each one by the correspondent tidal records. With the reference of the water-level difference in these two dates, we can derive the attenuation coefficient of sunlight in the water by image pair. This method also assumes that the attenuation coefficient is spatially homogeneous. We apply this method to the Peng-Hu archipelago, which comprises 64 basaltic volcanic isles lay on the southeastern Eurasia continental plate V geographical location between the Mainland China and Taiwan. Around and within these isles, the water depth is very shallow and the bathymetry information is quite lack. Our results provide water depth information for the shallow water area, which can contribute further information for ship traffic.

OS42B MCC: 3000 Thursday 1340h

Beyond Hydrate Ridge: Studies of Natural Gas Hydrate From Around the Globe I *(joint with A, B, PP, T, C, GC)*

Presiding: **G A Barth,** U.S. Geological Survey**; D W Scholl,** U.S. Geological Survey

OS42B-01 1340h INVITED

Global Occurrences of Marine Gas Hydrate Beyond Active and Passive Continental Margins

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Natural gas hydrate occurs worldwide in oceanic sediment mainly in slopes and rises of active and passive continental margins. The Blake Outer Ridge, a passive margin in the Atlantic Ocean, and Hydrate Ridge, an active margin in the Pacific Ocean, are two regions of gas-hydrate occurrence that are particularly well studied. But gas hydrate occurs in other geologic settings where conditions of temperature, pressure, and amount and composition of gas and water are appropriate. For example, gas hydrate has been recovered from inland seas and lakes (Black Sea, Caspian Sea, and Lake Baikal). Gas hydrate has been inferred, based mainly on geophysical evidence, to be present in sediment of the Central Argentine Basin, the Bering Sea, and the Barents Sea. Submarine mud volcanoes such as Haakon Mosby in the Norwegian Sea and Kula in the Mediterranean Sea have yielded samples of gas hydrate, and near-surface sediment of the Gulf of Mexico contains gas hydrate associated with submarine gas vents. In fact, submarine gas hydrate was first observed by Russian scientists about thirty years ago when near-surface sediment recovered from the Black Sea was found to contain micro-crystalline aggregates of gas hydrate resembling hoarfrost. Most marine gas hydrate contains micorbially-generated methane; however, thermogenic methane has been observed in gas hydrate from the Gulf of Mexico and the Caspian Sea. Although most marine gas hydrate is found in sediment of active and passive margins, various occurrences beyond these margins demonstrate how globally extensive natural gas-hydrate phenomena actually are.

OS42B-02 1355h INVITED

Laboratory and Seafloor Experiments with Hydrocarbon Clathrate Hydrates: A Review with Potential Applications to Hydrates in Nature

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The in-situ chemical composition, structure, and textural positions of clathrate hydrates within sediments, and their effects on the properties of their host sediments are important features that are rarely, if ever, determined directly. All hydrocarbon clathrate hydrates retrieved from their natural environments for study in the lab at atmospheric pressure have been to some degree altered and/or partially decomposed during transit and handling. Thus interpretation of their structures, textures and properties is not always straightforward. Laboratory and seafloor experiments on synthetic hydrocarbon hydrates and aggregates with sediment are useful for aiding the interpretation of retrieved materials. Here we describe such exploratory efforts at the USGS, MBARI and LLNL: (1) Rock-physics theory and measurements of the physical properties of multi-phase granular materials in general indicate that the textural position (conformation) of hydrates in the pore space of sediment dictate the quantitative effects of hydrates on sediment properties. Our ice-to-hydrate synthesis method permits us to make synthetic sediment/hydrate aggregates with known conformation as well as measure accurately their bulk properties and test the rock-physics theories. Such tests currently seem infeasible using natural samples. (2) Such synthetic samples with known hydrate characteristics and properties can be subjected to known P-T-time pathways that simulate the retrieval pathways of natural samples. The effects of the retrieval process can be evaluated by comparing the starting hydrate characteristics and properties with those of the simulated "retrieved" material. Optical-cell experiments can be potentially useful in evaluating the textural effects of retrieval by direct observation. (3) The governing physical chemistry of our ice-to-hydrate synthesis method is probably different from that in natural environments. We have found, however, that exposure of lab-made samples to the seafloor and their subsequent retrieval within the P-T stability of methane hydrate alters their grain textures as determined by cryogenic SEM. Such samples resemble natural samples taken from the shallow seafloor of the Gulf of Mexico, suggesting that similar processes that lead to rapid textural equilibration are occurring in both settings. (4) Samples of hydrates at vents sampled by ROV's may be quickly decomposed to gas near the seafloor and retrieved for later gas analysis. Such analyses are not as prone to gas partitioning during transit and hence may be more representative of the in-situ hydrate gas compositions.

OS42B-03 1410h INVITED

Coordinated Studies of High-Resolution Marine Methane Hydrates

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High resolution Studies of marine methane hydrates based on Long-Base-Line (LBL) acoustic navigation allow investigators to collocate direct samples (e.g., cores, heatflow, water-samples, etc.) with remote measurements such as conventional and deep-tow seismic data. Examples are presented based on work done on the Cascadia margin off Vancouver Island using the Naval Research Laboratory's DTAGS (Deep-Towed Acoustics/Geophysics system), coring, water samples and direct observations with an ROV. These data were acquired at the "Bullseye" vent using an acoustic bottom transponder constellation to position DTAGS' source and receivers with an accuracy of 1 to 2 meters. (The constellation was also used to co-locate piston cores with the seismic data with the same accuracy.) This site is of particular interest as it brings together, in a relatively small area, processes of hydrate dissociation, generation, fluid flow, and evidence of chemosynthetic communities. These data are used to constrain numerical simulations of perturbation of the