

(number of layers and layer spacing), 3) forcing at the boundaries (by elevations or velocities), and 4) the parameterization of vertical mixing (Large-McWilliams-Doney, Mellor-Yamada-2.5, Pacanowski-Philander, and a Lamont scheme). The results of these simulations were used to evaluate the model performance with respect to these factors.

#### OS11C-0247 0830h POSTER

##### The Limitation of Internal Wave Propagation the Offshore Direction

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No reports of clearly formed solitons propagating offshore from the continental shelf break have been published yet. Why do the internal waves generated from the shelf break propagate onshore not offshore? The objective of this project is to investigate the limitation of internal wave propagation offshore (deep water) from the continental shelf break. The two-layer analytical model will be formulated to investigate the internal wave reflection and transmission when there is an abrupt change in the bottom slope. The numerical simulation of internal wave evolution and propagation with observed data in South China Sea will be able to provide reliable guideline for the test of limitation of internal wave propagation offshore.

#### OS11C-0248 0830h POSTER

##### Are Asymmetric Flow Fields Around Kilometer-Scale Topographic Seafloor Elevations Reflected in the Sediment?

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Kilometer-scale topographic seafloor elevations like abyssal hills, knolls and seamounts are ubiquitous and abundant features of the oceanic seafloor. Modeling and field studies in physical oceanography have indicated that there are asymmetric flow fields enfolding such seafloor elevations: On the northern hemisphere the lateral asymmetry in the flow exhibits an accelerated flow to the left of the elevation, looking downstream, and decelerated flow to the right. We expect this asymmetry to affect the near-bottom hydro- and particle dynamics and, thereby, the intensity of sediment deposition.

To address the proposed effect on intensity of sediment deposition we assessed the spatial distribution of sedimentary excess 210Pb (210Pb<sub>ex</sub>) inventories using samples taken from the four major slopes and the summit of an abyssal knoll (rising up to ca 850m above the surrounding abyssal plain) in the NE Atlantic. Reference samples were obtained from an upstream far-field station on the abyssal plain (i.e. located southward as viewed from the knoll) not being profoundly influenced by any topographic elevations. Sediment inventories of 210Pb<sub>ex</sub> were compared to the expected 210Pb input from the water column.

This comparison shows that on the summit and on the western slope 210Pb<sub>ex</sub> inventories are smaller than expected. There is also some evidence for 210Pb<sub>ex</sub> inventories on the northern and eastern slopes to be somewhat higher than expected. The spatial 210Pb<sub>ex</sub> pattern (low deposition on the summit and in the west, higher deposition in the northeast) coincides with the predicted pattern of flow intensity (high on the summit and in the west, lower in the northeast) around the topographic elevation.

Other data (e.g. organic carbon, carbonate, uranium contents, grain size distribution) suggest an additional effect of the hydrodynamic asymmetry on the composition of the sedimentary deposit. Given the ubiquity of kilometer-scale topographic seafloor elevations, possible consequences of the described asymmetries for general pattern formation in the deep ocean are discussed.

## OS11D MCC: Hall D Monday 0830h

### Progress in El Niño Forecasting Posters (joint with A)

**Presiding:** B Kirtman, Center for Ocean-Land-Atmosphere Studies; L Goddard, International Research Institute for Climate Prediction, Columbia University; P Schopf, George Mason University

#### OS11D-0249 0830h INVITED POSTER

##### Retrospective ENSO Forecasts from the ARCs Coupled Model Project

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Results are described from a series of 40 retrospective forecasts of tropical Pacific SST, starting January 1 and July 1, 1980-1999, performed with several coupled ocean-atmosphere general circulation models sharing the same ocean model, the MOM3 OGCM, and the same initial conditions. The atmospheric components of the coupled models were COLA, ECHAM, and CCM3 models at T42 horizontal resolution, and the coupling between the ocean and atmosphere did not use empirical corrections. Additionally, the forecasts using the COLA and ECHAM atmospheric models were carried out with two resolutions of the OGCM. The high resolution version of the OGCM had 1 deg. horizontal resolution (1/3 deg. meridional resolution near the equator) and 40 levels in the vertical, while the lower resolution version had 1.5 deg. horizontal resolution (1/2 deg. meridional resolution near the equator) and 25 levels. The initial states were taken from an ocean data assimilation performed by GFDL using the high resolution OGCM. Initial conditions for the lower resolution forecasts were obtained by interpolation from the GFDL ocean data assimilation.

The systematic errors of the coupled models depend strongly on the atmospheric model, with the COLA versions having a warming bias in tropical Pacific SST, the CCM3 version a cooling bias, and the ECHAM versions a slight cooling bias. Each of the models exhibits similar levels of skill, with better forecast performance from the July 1 initial conditions. A consensus forecast produced by taking the ensemble average of the forecasts from all of the models is markedly superior to any of the individual forecasts.

There are obvious problems with the forecasts that can be connected to the systematic errors of the coupled models, and which are ultimately due to physical errors in the parameterizations and numerical truncation errors in the models. These errors lead to initial shock and the development of unrealistic modes of behavior which degrade the forecasts.

#### OS11D-0250 0830h POSTER

##### Are scale interactions a limit to ENSO predictability ?

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Westerly wind bursts and Madden and Julian Oscillations have been suggested to play an important role in the onset of ENSO through a rectification of the low-frequency coupled variability. We assess that the scale interaction between high-frequency wind variability and ENSO does not reduce to these specific atmospheric events. Indeed, we demonstrate that, in order to explain the amplitude and phase of, at least, strong El Niño events such as the 1997-1998 one (largest on record), it is crucial to simulate the high-frequency wind variability prior to and during El Niño. The complex succession of high-frequency westerly and easterly wind anomalies define its phase (relative to the seasonal cycle) and amplitude, therefore the characteristics of its teleconnections and impacts. As a conclusion, ENSO cannot be viewed as a low-frequency coupled mode of the tropical Pacific, but as a multi-scale phenomenon where both high-frequency and low-frequency variability interplay leading to each unique observed

El Niño. This result has strong implications considering that even if the present ENSO prediction systems claim its predictability up to 12 months (not verified in 1997-1998, nor in 2002), they may actually always be limited by the unpredictability at such lead times of the high-frequency wind variability.

#### OS11D-0251 0830h POSTER

##### Assimilating SST data for ENSO predictions

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With a simple 3D Var assimilation scheme, a new strategy of assimilating sea surface temperature (SST) observations has been proposed in this paper. The strategy involves in assimilating two proxy data, SST and subsurface thermal data, into the ocean model. An ensemble of predictions for the Niño3 region SST anomalies (SSTA) is performed to validate the new strategy. The results show that the new strategy can effectively improve Niño3 SSTA predictions at all lead times, in particular for lead times over 6 months, and for the predictions of El Niño episodes. The prediction skills of the Niño3 SSTA attained by the new scheme can be as high as those attained by the assimilation of subsurface data and sea level height. Comparisons between two schemes of SST assimilations suggest that the impact of observations on the initializations of ENSO predictions could greatly depend on how the observations were assimilated.

#### OS11D-0252 0830h POSTER

##### Effect of salinity barrier layer in the preconditioning and onset of El Niño

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Specific salinity stratification of the western Pacific warm pool known as the barrier layer has been proposed to be important in the coupling between sea surface temperature (SST) and winds leading to El Niño-Southern Oscillation. Thick barrier layer maintains surface waters warmer than 28C (the threshold for organized atmospheric convection) by reducing the entrainment cooling from below the ocean mixed layer. This mechanism allows an accumulation of heat in the upper ocean layers prior to El Niño. It also confines the forcing of westerly wind burst (WWB), the most accepted process as a trigger of El Niño, in a shallow mixed layer thus increasing the eastward displacement of the eastern edge of the warm pool. The importance of salinity barrier layer in the preconditioning phase characterized by high ocean heat content and in the onset phase characterized by high WWB activity is investigated using a general circulation coupled model of the tropical Pacific, coupled to a general circulation model. The Meteo-France/ARPEGE global atmospheric model coupled to the LODYC/OPA ocean model is able to reproduce self-sustained El Niño events together with WWBs. The methodology consists of removing the stratification effect of salinity in the vertical mixing parameterization. This cutoff is restricted to the western side of the equatorial band (4N-4S) where SST is larger than 28C. By removing the barrier layer, the main effect is to reduce the ocean heat content in the preconditioning period and to modify the ocean dynamics in response to WWBs in the onset period. Considering three El Niño events of different intensities, hindcasts show that interactions between the ocean and the atmosphere over the warm pool do not amplify and each El Niño is weakened or even aborted. A detailed analysis confirms that the physics of the warm pool such as vertical diffusion and horizontal advection is essential to set up the favorable conditions for the development of El Niño. For each event, a 5 additional members ensemble confirms that salinity stratification play a crucial and significant role during these initial phases of El Niño and that it should be considered in coupled models in order to improve El Niño forecasts.

## OS11D-0253 0830h POSTER

### The Low-order Construction of "Optimal" Initial Conditions for an ENSO Forecasting Model: General Methodology and Improved Forecast of the 1997/98 El Niño

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The failure of the Lamont coupled model to forecast the 1997/98 El Niño, the strongest in the observational record, led to a succession of improvements to the ENSO forecasting procedure. These strides in forecast skill and length of predictability resulted not from alterations of the basic physics of the model, but from new initialization techniques.

As a crucial first step in improving the data assimilation scheme for the Lamont model, a set of "optimal" initial conditions has been developed. These "best" initial conditions can serve as a target to which new sequential assimilation schemes can strive.

The method presented in this work is a pragmatic alternative to the computationally costly use of a full dimensional adjoint to the non-linear forecast model. The dimension of the computation is drastically reduced by constructing low-order Markov model approximations to the full nonlinear model. These Markov models can be used in an "inverse" fashion to arrive at initial states that start a trajectory segment best fitting the observed data. These inverse solutions can then be refined through the iterative application of low-order, empirically derived forward tangent models. The method presented here is generally applicable to forecasting models that be adequately represented as low-order systems, such as many general circulation models.

The new initial conditions lead to improved model forecast skill at all lead times from 1 to 12 months. Most notably, at 6 month lead times the new initial conditions were able to capture the timing and rapidity of the onset of the 1997/98 El Niño event, an improvement over the standard initial conditions. At 9 and 12 month leads, the standard initial conditions failed to forecast the 1997/98 event at all, however the new initial conditions successfully predicted the warm event. URL: <http://rainbow.ldeo.columbia.edu/~aliciak>

## OS11D-0254 0830h POSTER

### Climatically Relevant Singular Vectors for Coupled General Circulation Models

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Singular vectors have proved a powerful tool in prediction and data assimilation studies of the atmosphere and climate systems. Such patterns are (linearly) optimal in exciting a response in a given dynamical system. In recent years the tool of choice in climate (ENSO) prediction and variability studies has become the coupled general circulation model (CGCM) which offers a relatively complete physical description of climate. Calculation of singular vectors for such models is a problematic undertaking however since the fastest growing modes are inevitably connected with weather rather than climate phenomenon. Here we present a novel method for overcoming this difficulty which allows us to calculate "climatically relevant" singular vectors. We test the method in a stochastically forced intermediate ENSO coupled model for which "climatic" singular vectors are known exactly. We then apply our methodology to the NASA CGCM and demonstrate convergence and robustness of our results.

## OS11D-0255 0830h INVITED POSTER

### Forecasting Tropical Pacific SST with the NASA Seasonal-to-Interannual Prediction Project's CGCMv1

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The NASA Seasonal-to-Interannual Prediction Project (NSIPP) uses a coupled ocean-atmosphere-land-surface model for dynamical prediction of tropical Pacific sea surface temperature and its global teleconnections. The latest version of the model, CGCMv1, uses an updated atmospheric model with realistic surface winds and precipitation in the equatorial Pacific, and an ocean model with an improved mixed layer simulation. The ocean model is initialized by assimilating global in situ temperature observations. Ensemble forecasts are conducted by perturbing the ocean initial conditions. Twelve-month hindcasts have been conducted from 1993 onwards. In spite of imbalances in the coupled model at the time of forecast initialization, the coupled model drift has been significantly reduced in the CGCMv1. Previously, the CGCMv0 was deficient in connecting the surface temperature variations with subsurface temperature anomalies in the eastern Pacific. These problems are alleviated somewhat with the new implementation of the surface mixed layer. However, at long leads the forecast is impacted by the weak annual cycle of the coupled model, even when the ocean model is initialized by assimilating observed temperature profiles. Thus, although hindcast experiments conducted to date show an ability to predict the initiation of the 1997-98 El Niño, the forecast underestimates the strength of the event. The rapid decay of the event is captured. Forecasts for 2002 show a weak warm event. For the 1997/98 event and the 2002 forecast, SST anomalies in the eastern equatorial Pacific are impacted not only by the propagation of subsurface anomalies from the western Pacific, but also by anomalies from the southeastern Pacific.

## OS11D-0256 0830h POSTER

### The nonlinear ENSO mode and its interdecadal changes

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Nonlinear canonical correlation analysis (NLCCA) via a neural network approach was applied to the monthly surface wind stress (WS) and sea surface temperature (SST) in the tropical Pacific for the period 1961-1999. The strength of the nonlinearity varies with the lead/lag time between WS and SST. Relative to the CCA modes, the NLCCA modes explain more variance of the two sets of variables and have higher canonical correlations, particularly, at longer lead/lag times. Unlike the CCA, the NLCCA modes are capable of capturing the asymmetry in the spatial patterns between warm El Niño and cool La Niña episodes, with the westerly anomalies and positive SST anomalies located further east of the easterly anomalies and negative SST anomalies. With the WS lagging and then leading the SST, the roles of the predictor field and the lagging response field were interchanged—the spatial asymmetry was found to be considerably stronger in the response field than in the predictor field.

The NLCCA was then applied to the subset data for the 1961-75 and 1981-99 periods, separately. The leading NLCCA mode between the WS and SST reveals notable interdecadal changes of ENSO behaviour before and after the mid 1970s climate regime shift, with greater nonlinearity found during 1981-99 than during 1961-75. Spatial asymmetry (for both SST and WS anomalies) between El Niño and La Niña episodes was significantly enhanced in the later period. During 1981-99, the location of the equatorial easterly anomalies was unchanged from the earlier period, but in the opposite ENSO phase, the westerly anomalies were shifted eastward by up to 25 degrees. According to the delayed oscillator theory, such an eastward shift would lengthen the duration of the warm episodes by up to 45%, but leave the duration of the cool episodes unchanged. Supporting evidence was found from observations, and from a hybrid coupled model built with the Lamont dynamical ocean model coupled to a statistical atmospheric model consisting of either the leading NLCCA or CCA mode.

## OS11D-0257 0830h POSTER

### ENSO Hindcast Results From the Hamburg Coupled Model and From the Demeter Super Ensemble

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The (6 month) hindcast performance of the MPI-OM/ECHAM5 coupled model is presented for the period 1969 to 2001. The MPI-OM, the latest version of the HOPE ocean model, uses an equatorially refined conformally mapped C-grid, and includes an improved scheme for slope convection and a Gent and McWilliams style eddy-induced mixing parameterisation. ECHAM5 is the latest version of the ECHAM atmospheric model, with the main changes being in the radiation and cloud schemes, and in the coupling between land surface and atmosphere.

Hindcasts consist of 9 ensemble members, and are run four times a year, once per season. Initialization is through a simple coupled assimilation scheme in which the model's SST is strongly nudged to observed SST. This scheme has the advantage of producing a balanced set of initial conditions, specially at subsurface. Individual ensemble members are initialised by choosing different atmospheric conditions about the hindcast start date. Hindcast results indicate anomaly correlation skill between 0.6 and 0.7 for Niño3 SST anomalies at lead 6 months. Hence, demonstrating the coupled assimilation scheme, although simple, is an effective way of using the abundant satellite derived SST data for initialising ENSO forecasts models.

This work is being performed under Demeter, an EU project to implement, test, and evaluate the performance of a super-ensemble of ENSO climate models. This project involves six European climate models, the output of which is to be used in crop and health models to assess the economic benefits of the Demeter system. Results are clearly indicating the superiority of a multi-model approach, and shall be discussed.

## OS11D-0258 0830h POSTER

### Estimating Energy Dissipation Rates in the Tropical Ocean.

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Nobody anticipated that El Niño would be weak and prolonged in 1992, but brief and intense in 1997-98. Why are different El Niño episodes so different, and therefore difficult to predict? Do successive El Niño events occur independently from each other, or are they essentially a part of a continual (perhaps weakly-damped) oscillation sustained by random atmospheric disturbances? The answers to these questions depend, to a large degree, on the strength of the damping of the ocean motion associated with the interannual variability. If the ocean damping is much stronger than positive feedbacks provided by ocean-atmosphere interactions, the system is strongly damped so that there is no connection between two subsequent events, and the noise is solely responsible for the initiation of El Niño. On the other hand, if the ocean damping is relatively weak, the system may be close to neutral stability or even unstable. In this paper we estimate the rates of damping in the tropical ocean utilizing the energetics of the coupled ocean-atmosphere. To a first approximation, the ENSO energetics are described by a simple equation  $dE/dt = W - \alpha E$  (1), where E is the available potential energy of the tropical ocean, and W is the work done on that ocean by the winds, per unit time. The energy dissipation in Eq. (1) is parameterized as a linear function of E, which is shown here to accurately approximate dissipation for a broad range of frequencies. The damping rate for the thermocline depth anomalies is  $\alpha/2$ , since the energy is a quadratic function of the thermocline displacement. We calculate W and E by means of a realistic ocean GCM forced with observed winds over a 50 year period. Further, we compute a lag-correlation between W and E as a function of frequency by using, in a frequency domain, a sliding window of a fixed width. Comparing this lag-correlation function with theoretical results obtained from Eq. (1) yields  $\alpha$ . Such estimates give 2.3 years as the damping time for the thermocline depth anomalies ( $2/\alpha$ ), which agrees well with the values used in the original Cane-Zebiak model (1987) but is significantly longer than the 6 months to 1 year time-scale calculated by Picaut et al (1993).

URL: <http://www.aos.princeton.edu/WWWPUBLIC/alexey/publications>

## OS11D-0259 0830h INVITED POSTER

### ENSO Forecasting using Coupled General Circulation Models: Plenty of room for Improvement Still Exists

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"Skill" for several coupled ocean-atmosphere general circulation models (GCMs) is examined in a variety of ways from a set of controlled experiments. The coupled models all have the same ocean component model and are all initialised using data from a comprehensive ocean data assimilation system (ODA).

Results from one of the coupled models are explored in greater detail. Topics to be covered include initialization strategy, noise control, and statistical correction of dynamical forecasts.

#### OS11D-0260 0830h POSTER

##### El Nino Prediction Using a Simple Equatorial Heat Content/El Nino Trigger Model

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Lagged correlations show that  $h(t)$ , the anomalous depth of the 20° C isotherm averaged over the equatorial Pacific from 5° South to 5° North, both leads and lags the El Nino index NINO3.4 by 9 months with correlation coefficient magnitude greater than 0.7. Simple physical arguments, based mainly on mass continuity and geostrophic balance at 5° North and South, can be used to explain this result. The linear El Nino predictor

$$S(t) = a \text{NINO}3.4(t) + bh(t) + ct(t)$$

where  $\tau(t)$  is based on precursor equatorial winds in the eastern Indian and western Pacific Oceans and  $a$ ,  $b$  and  $c$  are constants dependent on calendar month performs exceptionally well. Based on cross-verified hindcasts since 1981, this simple model performs at least as well as other models which have been cross-verified over a comparable record length.

#### OS11E MCC: 104 Monday 0830h

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

Presiding: J Knight, University of Ulster, Coleraine; B Brandsdóttir, University of Iceland

#### OS11E-01 0830h

##### Quaternary River Systems of the Eastern English Channel: Infilled Sediment Bodies Identified From High Resolution Shallow Seismic Reflection Profiling and Borehole Data.

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This paper presents the results of an ongoing research project into the nature and origin of the Quaternary river systems of the Eastern English Channel.

During the Quaternary the area of the European continental shelf known as the Eastern English Channel has fluctuated between marine and terrestrial conditions. These variations mean that during the cold glacial maxima subaerial inner continental shelf conditions prevailed and large river systems eroded out large fluvial valley features. These were subsequently infilled both by sediments from the cold stage terrestrial and fluvial systems, and also by the deposits accumulating during intervening transgressive interglacial periods.

Mapping and interpretation of high resolution shallow seismic and vibrocore sample data retrieved from offshore infill sequences at 30 m to 50 m ordnance datum (OD), indicate sediment body formation during multiple cut-and-fill events. The many sedimentary facies identified include coarse gravels, fine sands and silts, as well as organic peat deposits, indicating a broad range of depositional environments.

Some 1000 km line of high-resolution shallow seismic profile data demonstrate the geometry and bedrock

bounding surface of these Quaternary deposits. Sediment isopach and depth below ordnance datum maps reveal the extent and depth of palaeovalley features below the seabed. Major palaeovalleys identified are up to 5 km wide and can be infilled with 30 m of sediment.

Ages of the palaeovalley features and associated sediments have not yet been determined but are presumed to be Late Quaternary. Litho- and Biostratigraphical analyses are ongoing in an effort to provide a palaeoenvironmental reconstruction for the study area.

#### OS11E-02 0845h

##### Internal Architecture, External Geometry, and Cyclicity of Mass Transport Complexes in the Gulf of Mexico From 3-D Seismic Data

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High resolution data from a three-dimensional seismic survey in the Gulf of Mexico was evaluated to determine the three-dimensional external geometry and internal architecture of two mass transport (landslide) complexes, and to investigate the link between sea level changes and mass transport complex development. Most common external geometries are channel-form with concave up basal surfaces and nearly flat upper contacts. The mass-transport complexes exhibit significant pinching and swelling both along dip and along strike sections, the overall thickness of the complex generally controlled by the depth of the lower (incisional) surface of the mass-transport complex. The portions of the mass transport complexes most proximal to the shelf and furthest shoreward tend to be composed of fairly coherent (still stratified) reflectors, whereas the reflectors (sediments) become progressively more disaggregated down-slope. The most distal position of the mass transport complexes is composed typically of completely reflector-free or chaotic seismic stratigraphy, interpreted to indicate complete disaggregation of previously stratified sediments. At least one mass transport complex is observed to share (laterally) a basal contact with an unslumped cut and fill succession of reflectors that exhibit a consistent down-slope dip into the cut, which is a seismic geometry that typically would be interpreted as a basin floor fan, in this case filling a mini-basin. We find this and other evidence suggestive that these mass transport complexes are typically composed of sediments originally deposited during highstands of sea level and then resedimented as large slide sheets during subsequent lowstands.

#### OS11E-03 0900h

##### Ground-Truth Analysis of Deep-Tow Sidescan Sonar over Mud Volcanoes in Eastern Mediterranean Sea

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Deep sea submersible observations, also recorded on video, and precise sampling over several mud volcanoes and cold seeps of the Eastern Mediterranean Sea were used to ground truth 13kHz multibeam swath mapping and 30 kHz high-resolution deep-tow sidescan sonar associated with 6kHz subbottom profiler.

Mud volcanoes in the eastern Mediterranean Sea have been identified by their distinctive acoustic signature as well as their morphology and sedimentology. They are characterized by circular topographic relief up to 200 meters high and a few kilometers wide, with a high backscatter signature inferred to be caused principally by the heterogeneous clast content composing the mud flows of the volcano. Deep-tow sidescan sonar gives a very high resolution of the acoustic response of the seafloor, enabling the mapping of the different mud flows. The tectonic lineations, interpreted from linear features on the sonograms, indicate a genetic relationship between mud volcanoes and regional faulting.

The visual seafloor observations reveal an abundance of fluid seeps, mainly methane and methane-rich brines, as well as specific seeps-associated fauna (e.g.

tubeworms, clams and chemosynthetic bacteria) and diagenetic phenomenon (i.e. carbonate crusts) which may also affect the acoustic backscatter response of the mud volcanoes. The seafloor surface characteristics and the degree of colonization by benthic fauna present a high variability related to the intensity and, probably, age of seepage activity, and can be correlated to the observed backscatter variations. For example, the dives have shown different types of carbonate crusts form: some form circular mound-like structures, up a few meters wide and 1-2 m thick, over isolated seeps whereas some cover the seafloor as thin (1 to 10 cm thick) pavement, presumably in area of diffuse seepage. These cause backscatter patterns also indirectly related to seeps activity.

The synthesis of the different data provides constraints on spatial and temporal variation of mud volcanism and insights into the origin of the geophysical signature.

#### OS11E-04 0915h

##### High-resolution geophysics over Chesapeake Bay: impact crater structures and "magnetized" paleochannels?

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High resolution surveys including gravity, magnetics, single-beam bathymetry, chirp and sidescan sonar were conducted over two sections of Chesapeake Bay during May-June 2002. We surveyed 70 km<sup>2</sup> in Maryland waters near the Choptank River and Parker's Creek outflows, where the sub-bottom is dominated glacial-age channels and tributaries of the Susquehanna River. When longer-wavelength trends are removed, the magnetic field appears to show lineations of up to 12 nT corresponding to portions of paleochannels formed by the Susquehanna River during the Wisconsinian glaciation. A possible source of these anomalies is the deposition of higher-magnetization sands by the Susquehanna during the sea-level low associated with the last ice age, where the denser and coarser materials were deposited in channels due to the higher-energy environment there. Igneous and metamorphic rocks outcropping in the Susquehanna watershed are a likely source of such materials. This is consistent with previous density and susceptibility measurements of USGS cores, although the magnetic field anomalies are a bit greater than expected. Bouguer anomalies roughly hint lows of 1 mgal over the Susquehanna channel, suggesting infill by unconsolidated muds, but the anomalies are close to resolution limits of the instrument. Further south, near the mouth of the Bay, the sub-bottom is dominated by the 35 m.y.o. Chesapeake impact crater. The crater has been previously described by USGS workers as a complex peak-ring crater with outer escarpments forming a rim of diameter of 90 km. The diameter of the peak-ring is 35-40 km, with regional gravity data showing a low near its center. Our data refine the structure of this broad low, showing a step-like drop of 12 mgal along the peak ring. This drop may be created by a 0.5-1 km-deep density contrast of 300-600 kg/m<sup>3</sup> between impact breccia and crystalline basement. Towards the center of the ring, a slight increase of 2 mgal is suggested, perhaps caused by a central peak. A slight 2 mgal "rim high" is observed along parts of the peak ring, and is attributed to uplift along the edge of this basin. Magnetic anomalies show sharp variations of up to 100 nT. Although they may be due to basement features, the proximity of the largest gradients to the peak ring suggests a relationship between the two. Such anomalies may have been crated during melt of the impacted crystalline rock, or perhaps alteration associated with later hydrothermal circulation through the brecciated rock.

#### OS11E-05 0930h

##### 2D Seismic Slope Tomography

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Stereotomography is an inverse method devoted to crustal velocity estimation from seismic data. Its specificity is to use not only sources to receivers travel times but also slopes both at sources and receivers. These data are automatically picked on semblance panels. Data modelling is based on ray theory in an isotropic media. Model includes both velocity field and rays parameters in order to account for all the data uncertainties (sources and receivers locations, travel times and