anemones and environmental data from the Hexacorallia database, and used the geospatial clustering tool LOICZView to identify the environmental parameters that define suitable habitat for the anemones (all are at www.kgs.ukans.edu/Hexacoral). Initial tests were done using unsupervised clustering of the environmental variables mean depth, mean monthly sea surface temperature (SST), mean salinity, and wave height. Although promising, the results were less generalizable than desired. In refining the clustering, the best results were from mean depth after excluding minimum depths greater than 100 m, minimum monthly SST, minimum monthly salinity, wave height, ocean color, tidal range, and coral reef occurrence. In addition to more selective definition of environmental parameters, known occurrences of anemones were used to train the prediction process. The revised clusters were tested for ability to predict occurrence of anemonefish, which served as indicators of anemone occurrence. Our preliminary results indicate that 1) reef occurrence is a good predictor of anemones and the fishes that live with them, 2) environmental clusters supervised with data on anemone occurrence are equally good predictors of anemonefish occurrence, and 3) we were readily able to identify about one-third of the potential range that has occurrence probabilities substantially better than random chance.

URL: http://www.kgs.ukans.edu/Hexacoral/

OS42C-141 1330h POSTER

Environmental GIS Modeling of Distribution Patterns in *Actinodendron plumosum*, a Sea Anemone With a Large Geographic Range.

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I use locality records to plot the distribution pattern of morphotypes as a way to test the hypothesis that several named species of the sea anemone genus *Actinodendron* actually comprise a single species, *A. plumosum*. GIS tools, prediction algorithms such as LOICZView and GARP, and existing environmental databases can be used not only to predict distribution patterns but also to solve taxonomic problems in marine biota with large geographic range. The known distribution of these sea anemones consists of sparse data points with various grades of precision. The associated environmental parameters can be used to predict the geographic range of each morphotype. I comparatively analyze the predicted distribution patterns to test a species hypothesis. Overlap between distributions of morphotypes supports the hypothesis of synonymy. Geographical separation of morphotypes can be used as evidence that the morphotypes belong to different species.

URL: http://www.kgs.ukans.edu/Hexacoral/

OS42C-142 1330h POSTER

Taxonomic recognition of plankton using optics

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In this contribution of the SCOR working group 118 (New Technologies for Observing Marine Life), we review the state-of-the-art optical methods for obtaining information on phytoplankton species composition and taxonomic distribution in the ocean. Single-cell imaging systems are presented as well as methods for analyzing bulk optical properties to obtain information on the dominant species. We present methods based on both in-situ and laboratory measurements of optical properties, as well as from satellite remote sensing. The application of these methods to the specific condition of red tides (i.e. extreme blooms) is presented as an example. Present limitations and future development are discussed.

OS42D HC: Hall III Thursday 1330h

Coupling of Biogeochemical Processes Between the Upper and Mesopelagic Ocean III

Presiding: **C Robinson,** Plymouth Marine Laboratory**; J Tremblay,** McGill University

OS42D-143 1330h POSTER

Remineralization Ratios in the Indian Ocean Based on WOCE Carbon and Nutrient Analysis

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We have derived subsurface (>500m) remineralization ratios for carbon and nutrients using an optimum multiple parameter (OMP) technique for all available carbon and nutrient data taken during the Indian Ocean WOCE program. The internal consistency of the CO2 data was assured using reference materials and a crossover analysis. For carbon, the anthropogenic CO2 signal was subtracted from the data while the effects of denitrification and calcium carbonate dissolution on all parameters were included in the OMP parameterization. The OMP technique estimates the contribution of up to six different predefined end-members for each sample using a non-negative least squares analysis. The mixing effects are then subtracted from the observations to reveal the changes in nitrate, phosphate, silicate, dissolved inorganic carbon and alkalinity due to remineralization of organic and inorganic carbon. Sensitivity of the estimated remineralization ratios to end-member definitions was determined by iteratively varying the definitions. The spatial patterns of the remineralization ratios, denitrification and calcite dissolution will be discussed and compared to previous studies in the Indian Ocean. The preliminary results show large spatial and depth related variations in the remineralization ratios and seem to be related to the local biogeochemical regimes.

OS42D-144 1330h POSTER

Biogeochemical Patchiness at the Sea Surface

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The surface distributions of many tracers in the ocean are highly correlated in time and space on meso (∼100km) and smaller scales. However, their characteristic scales of variability differ. Some variables like sea surface chlorophyll are very fine-scaled or patchy, while others like sea surface temperature are not. We characterize the patchiness of tracer distributions using a variance-based approach and quantitatively relate sea-surface patchiness to the characteristic response time λ of the tracer to processes that alter its concentration in the upper ocean. Tracers that are more patchy require higher resolution to model and sample; this too can be characterized in terms of λ.

OS42D-145 1330h POSTER

Distribution of Dissolved Enantiomeric Amino Acids in the Oceanic Water Column and Their Bacterial Utilization

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The distribution of selected species of dissolved total enantiomeric amino acids was measured in the water column of the North and (sub)tropical Atlantic, the Eastern Mediterranean, the Southern Ocean and the North Sea. Specifically, we measured the concentration and the ratio of D-/L- amino acids indicative of bacterioplankton cell wall origin (alanine, serine, aspartic acid, glutamic acid) but other enantiomeric amino acid species were measured as well. Also, the bacterioplankton utilization of enantiomeric aspartic acid was determined on selected samples throughout the water column in the North Atlantic and the Southern Ocean.

The ratios of individual dissolved D/L-amino acid species were remarkably constant with depths in all the oceanic provinces. The contribution of total dissolved amino acids to DOC was significantly lower in the eutrophic North Sea than in the open oceanic provinces. Generally, the main components of the D-amino acid pool were the bacterial cell wall-derived aspartic acid, glutamic acid, serine and alanine. The dominant L-enantiomeric amino acids were aspartic acid, serine and alanine as well as glycine and valine. The uptake ratio of D-/L- aspartic acid by bacterioplankton increased with depth from about 0.01 in the surface layers of the North Atlantic to about 1 at 1000 m depth. A similar tendency was observed for the water column of the Southern Ocean. Thus deep-water bacteria are obviously adapted to utilize D-amino acids which are usually considered refractory as efficiently as L-amino acids.

OS42D-146 1330h POSTER

Chemical and Isotopic Characterization of Dissolved and Particulate Organic Compound Classes in the North Pacific and Atlantic Oceans.

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Dissolved organic matter (DOM) in oceanic systems is comprised of identifiable biomolecules such as carbohydrates, proteins and lipids as well as operationally defined and long-lived geomacromolecules (e.g. humic and fulvic substances). However, up to 90% of open ocean DOM is still chemically uncharacterized due to difficulties ranging from the need for large sample sizes to the limitations of currently available analytical techniques. In addition, while $\Delta^{14}C$ analyses of bulk DOM indicate that it is on average long-lived (10^3-10^4 yrs) in open ocean systems, recent studies have shown that the DOM pool also contains a labile fraction that cycles on very short timescales (days to years). We investigated the major compound class compositions of ultrafiltered DOM (UDOM) and the contributions of these organic fractions to the ^{14}C age of bulk DOM. Large volume (1000-3000 L) surface and deep UDOM samples from the North Central Pacific and Sargasso Sea were extracted sequentially for individual organic fractions (as lipids, carbohydrates and proteins) and lipid biomarkers. The $\Delta^{14}C$ and $\delta^{13}C$ signatures of individual organic fractions were also determined.

Lipid biomarkers in UDOM suggest that components of the oceanic DOM pool may be relatively more bioreactive at greater depths compared to surface DOM due the presence of higher percentages of polyunsaturated fatty acids (PUFAs). This contrasts with lipid biomarker results from concurrently measured suspended particulate organic matter (POM_{susp}) which show decreasing percentages of PUFAs with depth. The relative differences in PUFAs between surface and deep samples coincide with decreasing elemental ratios (C:P and N:P) in UDOM and increasing ratios in POM_{susp}. However, all ratios were still much greater than Redfield, indicating that organic P is preferentially remineralized in both pools. Thus, the microbial processing and remineralization of UDOM and POM_{susp} occurs by different biogeochemical pathways and/or over different timescales. Isotopic information on the turnover times and sources of the different aged organic fractions will also be presented.

OS42D-147 1330h POSTER

Particulate Flux from the Upper Ocean to the Mesopelagic Ocean During a Phytoplankton Bloom in the Western North Pacific

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Particles play the important role that transports energy and substances from the upper ocean to the mesopelagic ocean. It is well known that there is the phytoplankton bloom in spring in the western North Pacific, and be expected that there is large particulate flux associated with the plant plankton production during the spring bloom. We conducted extensive observations for two periods (May 13-15 and 24-28, 1999) during the MR99-K02 cruise of the R/V Mirai. Each period, we conducted the floating sediment trap experiments and measurement of ^{234}Th in water column at two points, one is the low fCO_2 (less than 200 μatm) and high fluorescence blooming point and another is the high fCO_2 (higher than 400 μatm) and low fluorescence one. The vertical profiles of ^{234}Th showed significant deficiency of ^{234}Th to ^{238}U in the top 40 m layer at the blooming points in both periods whereas there was no deficiency at the non-blooming point in the first period. This suggested that there is no net particulate flux at the non-blooming point, however, enormous amount of particles were transported from the upper ocean to the deeper ocean in or just after the blooming. This was confirmed by the results of the sediment trap experiments. At the non-blooming point in the second period, we found the ^{234}Th deficiency which is smaller than one observed at the blooming point, although there was no deficiency at the non-blooming point in the first period. This suggested that the non-blooming point in the first period was in the pre phytoplankton blooming condition and one in the second period was the condition the phytoplankton blooming had already ceased.

OS42D-148 1330h POSTER

Methane cycling in mid-water suspended particle layers, Monterey Bay, California

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The remotely operated vehicle Ventana was used in September 2001 to measure the vertical distribution and the optical characteristics of suspended layers of fine particles along the axis of Monterey Canyon in Monterey Bay, California. A combination of a nephelometer, a transmissometer and a structured light source with high definition video detection was used for these measurements. The particles layers ranged from broad bands extending over several hundred meters of depth to thin, concentrated layers <20 m thick.

Ventana was also used to collect water samples, without the physical disruptions inherent in CTD/rosette-based sampling, within and around the particle layers. Samples were collected from depths of 400 - 1300 m and were analyzed for methane, methane carbon stable isotopes, alkalinity, nutrients and pH. Particle concentration was positively correlated with alkalinity and negatively correlated with δ^{13}C-methane. The latter ranged from -60 per-mil in the most particle-rich water to -30 per-mil in the clearest water; the former is indicative of active biogenic methane production within the particle layers, whereas the latter presumably reflects the effects of the biogenic oxidation of methane diffusing out of the layers. Interestingly, methane concentrations were not correlated with the other parameters, but instead showed a noisy vertical gradient with concentrations ranging from 4 nM at 400 m down to 1 nM at 1250 m (values approximately twice those found in the open ocean at such depths). These observations demonstrate the power of isotopic analysis in studies of methane dynamics in complex systems.

OS42D-149 1330h POSTER

Decoupling of Dissolved Zinc and Silicon in the Upper Water Column of the Subarctic North Pacific

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Total dissolved Zn concentrations are reported for winter and summer along the E-W line P transect and for summer along S-N line Z transect extending from Ocean Station Papa (OSP; 50 °N 145 °W) to the respective shelf waters. Surface water (10m) concentrations ranged from 0.04 nM in the open ocean to 0.9 nM at the Canadian shelf station. A clear gradient is evident, with Zn concentrations decreasing with increasing distance from shore along the E-W transect. Very low concentrations of Zn (0.05-0.07 nM) were observed in near surface water at OSP in winter. However, significant concentrations of Si were observed at all of the open ocean stations in this High Nutrient Low Chlorophyll (HNLC) area. The vertical distribution of dissolved Zn below the surface layer showed a silicon-like vertical profile. There is a significant difference in Zn/Si in the surface water and the nutricline. Dissolved Zn/Si ratios in the upper 200m indicate a trend of decreasing with distance from shore, which infers a decoupling between Zn and Si in the upper ocean. We hypothesise that the silicon-like profile of Zn is a result of recycling from relatively biologically resistant organic particulate phases, that leads to profiles very similar to those of dissolved silicon. The decoupling of Zn and Si cycling and removal in the upper ocean is supported by the reduction in Zn:Si ratios as move offshore from coastal to open ocean waters. Concentrations of the natural organic ligand and the free Zn ion also indicate a change moving offshore. Low concentrations of free Zn ion activity were observed at OSP, which has implications for phytoplankton growth. It is essential to know more about the dissolved and particulate separation and cycling of Zn to fully understand the cycle of this element and implications for speciation and potential influence on primary production.

OS42D-150 1330h POSTER

Biological and Physical Controls on Export Fluxes at two Contrasting Continental Margins.

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Continental margins are dynamic systems where production and export of particles results from a complex interplay of physical and biological forcing. In this paper we compare two continental margins that differ in their characteristics. The Goban Spur, in the Celtic Sea, has topographically driven shelf-edge upwelling and a broad, gradual slope whereas at the north Iberian Margin strong, periodic wind-driven upwelling drives pelagic production, and a narrow shelf drops more steeply to the abyssal plain. Export fluxes at mid-water depths below the winter mixed layer, from sediment trap moorings, show strong differences but also commonality between these systems. In this paper we use bulk (dry weight, POC, opal, carbonate) and detailed marker (algal pigments, organic biomarkers, TEP, radionuclides, microscopy) analyses on sedimenting particles to reconstruct processes at the surface leading to flux. Whereas seasonality in production and flux are evident at the Goban Spur, the Iberian Margin situation is strongly dependant on short-term fluctuations in upwelling intensity; rapid and periodic destabilization of the upper water column leads to pulses of organic matter sedimentation. Based on empirical relationships, fluxes from the shelf to the abyssal plain are calculated in the water column and at the sediments. The spatial distribution of water column and benthic fluxes reflect topographic differences between the Goban Spur and Iberian Margin and are used to estimate particulate export from the continental margin to below the depth of winter mixing. This is a crucial factor in the ability of the margins to sequester atmospheric CO_2.

OS42D-151 1330h POSTER

Effects of El Niño 1997-98 on Particle Fluxes from two Coastal Upwelling Areas: Northern Chile and Southern California

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We compare daily fluxes of siliceous phytoplankton, biogenic silica, organic carbon, calcium carbonate, and lithogenic particles at two mooring sites deployed in boundary current systems of the Pacific Ocean. Both moorings are influenced by strong seasonal and interannual variability that allows to evaluate the effect of physical forcing on particle fluxes under non-El Niño and El Niño conditions. The SBB trap, deployed in the Santa Barbara Basin, off southern California (34°N, 120°W), collected particulates from August 1993 to April 1998. The CH trap, off Central Chile (30°S, 73°W), was deployed between June 1993 and May 1995, and from February 1997 to June 1998. Lithogenic components dominate the flux at the SSB site; their contribution largely increased under El Niño conditions, presumably reflecting higher rainfall and runoff into the basin. Flux of biogenic opal, the second most important bulk component, decreased under El Niño conditions, and was accompanied by major changes in the composition of the siliceous microplankton assemblage and increased diversity. Tropical species invaded the basin while representatives of upwelling conditions diminished sharply (*e.g.* spores and vegetative cells of the diatom genus *Chaetoceros*) Thus, the "normal" scenario of high biogenic opal and organic carbon fluxes in boreal spring (upwelling period) and low fluxes in boreal fall-winter was altered during the 1997-98 El Niño event. Particle flux off northern Chile, on the other hand, is strongly dominated by calcium carbonate, with lithogenic particles and biogenic opal as secondary contributors. Export fluxes were markedly lower during the 1997-98 El Niño: total mass flux diminished by 60%, probably due to poorly mixed subsurface waters and reduced intensity of coastal upwelling. However, the seasonal pattern of particle export at the CH site varied little under non-El Niño and El Niño conditions. Upwelling in austral winter determined the maximum export production pattern of bulk components and siliceous microorganisms. Biogenic opal and siliceous plankton fluxes depict almost unimodal pattern of downward transport, attaining their annual maximum within 3-5 weeks in late austral winter, in coincidence with highest pigment concentrations in surface waters. Major components of the diatom flora maintained much of their regular seasonal cycle of flux maxima and minima during both sampling periods: resting spores of *Chaetoceros* dominated the diatom flux, and the occurrence of pelagic diatoms reflected the intermingling of warmer waters of the Subtropical Gyre into the coastal upwelling system.

THU

OS42E HC: Hall III Thursday 1330h

Bentho-Pelagic Coupling at High Latitudes III

Presiding: **C Smith,** University of Hawaii at Manoa**; A R Baco,** University of Hawaii

OS42E-152 1330h POSTER

The Lipid Pool in Holothurians From the Antarctic Shelf and the Porcupine Abyssal Plan, Northeast Atlantic, and its Relationship to Food Availability

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