

and tufted puffins) in the Northern Gulf of Alaska, in relation to the distribution of water masses and acoustic measures of water column volume scattering. We surveyed a 200 km transect (inner-shelf, mid-shelf, shelf break, and oceanic domains) during April, May and July 2001 along the Seward line. Stratification increased seasonally due to surface layer freshening, and warming of the shallow mixed layer (~10-20 m) along the Seward Line in July. Diversity and abundance were low in April and high in May and July. Highest seabird concentrations occurred at the shelf break in April and May, and on the mid-shelf in July. Evolution of the physical properties of the water column in association with changes in volume scattering along the transect suggests that the cross-shelf circulation may have a fundamental role in shaping the distribution and abundance of seabirds.

OS31D-78 0830h POSTER

Preliminary Data on Euphausiid Distribution and Growth in the Northern Gulf of Alaska.

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Seasonal and interannual variability in distribution and population structure of two major euphausiids species *Thysanoessa spinifera* and *Euphausia pacifica* were studied in the northern Gulf of Alaska in 1998-2001. Other common euphausiid species were *T. inermis*, *T. longipes*, *T. raschii* and *T. inspinata*. Euphausiid aggregations were related to water mass properties with *E. pacifica* frequently observed on outer shelf during years, when a strong shelf break front was developed. In contrast, *T. spinifera* was more abundant on inner shelf in spring. Individual euphausiid growth rates were minimal in early spring, showing indications of body shrinkage under unfavorable food conditions. Intermolt periods were ranging from 12 to 7 days in average as temperature varied from 5°C to 10°C over sampling season. Reproduction of *T. spinifera* seemed to coincide with the phytoplankton bloom in spring, while *E. pacifica* continued to spawn from May through October. Egg production rates of *E. pacifica* tended to be higher in mid summer.

OS31D-79 0830h POSTER

Importance of Nutrient-Foodweb Dynamics of Freshwater Ecosystems in Determining Sockeye Salmon Production

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The number of adult salmon allowed to escape for spawning has fundamental significance for productivity and recruitment of sockeye salmon. In addition, sockeye lakes are fertilized and stocked with sockeye fry to compensate for reduced nutrient loading from salmon carcass or for low smolt production. In this presentation, we will discuss how the changes in nutrient loading and fry density, associated with variable escapements, fertilization and fry stocking, can potentially affect the productivity of sockeye salmon. We demonstrate the importance of nutrient-foodweb relationships in determining the patterns of long-term changes in the growth and production of juvenile sockeye salmon. We use a large data set on nutrients, algal biomass, size-distribution, biomass and composition of zooplankton, and the density and size of the juvenile and smolts of sockeye salmon from Alaska. Specifically, we show how the variable escapement and associated changes in nutrients and fry density could potentially change the size distribution, composition, and biomass of zooplankton, and their relationship with the growth and production of sockeye smolts. Nutrients are most effective in producing large-sized smolts when large filter-feeding zooplankton such as *Daphnia* are present in substantial numbers. Escapement or fry stocking beyond the carrying capacity of sockeye systems dampen the impact of nutrients on the growth and associated size of smolts produced.

OS31D-80 0830h POSTER

On the microbiogeophysiochemistry of intermittently anoxic fjords on Vancouver Island, British Columbia

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Barkley and Clayoquot Sounds, along the outer coast of Vancouver Island, BC, have numerous fjords containing semi-permanent anoxic bottom waters with renewal time that range from seasons to decades. Within the framework of providing undergraduate research experiences, we have combined approaches from organic geochemistry, microbiology and physical oceanography in order to assess the health and function of these unique coastal environments. In this poster we will present the results from the first two years of a five year project. During 2000, the visited inlets were all anoxic, yet during the summer of 2001 many of the inlets turned over, resulting in large fish kills and large scale changes to the water column and sedimentary systems. Both the preservation of organic materials in the sedimentary record and the growth activity of heterotrophic watercolumn bacteria reflect the physical conditions of the various fjords. See also: Grocock and Keil, Preservation of Terrestrial and Marine Organic Matter in an Intermittently Anoxic Coastal Fjord; Effingham Inlet, BC.

URL: <http://boto.ocean.washington.edu/aog>

OS31E HC: Hall III Wednesday 0830h

Linking Modern and Past Biogenic Fluxes III

Presiding: R Francois, Woods Hole

Oceanographic Institution; R A

Jahnke, Skidaway Institute of

Oceanography

OS31E-81 0830h POSTER

Organic Matter Burial in Modern and Ancient Sediments of the Northern Gulf of Mexico

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The accumulation of terrigenous and marine organic matter (OM) in the northern Gulf of Mexico throughout the Holocene is examined using stable carbon isotopes and terrigenous biomarker analyses. The stable carbon isotope composition of sedimentary OM at the base of the Mississippi Canyon (27.96°N, 89.47°W) ranges from -20 ‰ to -23 ‰ during the late Holocene. Enriched isotopic composition at ca. 1000 ybp coincides with lower C/N ratios and greater calcite content (%CaCO₃), indicating an increase in marine OM input during this time. The isotopic variation prior to 1000 years is not accompanied by a shift in %CaCO₃ nor in C/N, suggesting that marine OM input alone does not explain the isotopic variability throughout the record. Preliminary analyses of lignin, a terrigenous biomarker, indicate that changes in the flux and composition of terrigenous OM have occurred during the late Holocene, and may explain the fluctuation of stable carbon isotopes at this site. The isotopic composition of sedimentary organic matter deposited in the Pigmy Basin (27.20°N, 91.41°W) varies between -22 and -26 ‰. Calcite content is higher at this location than in the Canyon (12 to 25%CaCO₃), but is less variable downcore. Carbon to nitrogen ratios range between 4 and 12 in sediments deposited within the past 3000 years, but little variability is observed in early Holocene sediments. Quantification of terrigenous and marine OM content, based on isotopic and terrigenous

biomarkers, will provide more detailed information regarding the relative importance of marine and terrigenous carbon input throughout the Holocene. The processes responsible for the observed isotopic trend, such as changes in terrigenous vegetation, will be evaluated using lignin content and composition.

OS31E-82 0830h POSTER

Phosphorus Distribution in Oceanic Particulate Matter

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Despite the recognition of the importance of phosphorus (P) in regulating marine productivity in some modern oceanic systems and over long timescales, P cycling within the ocean is not well understood. The major carrier phase of P to marine sediments is likely particulate organic matter, although few direct measurements of particulate P flux in the oceans have been made. Little is known about the distribution of P within different fractions in marine particulate matter, and how it differs from P in sediments.

We analyzed particulate matter from sediment traps for their P concentration and association. Samples represent 3 different oceanic regimes: a coastal environment (Monterey Bay), an open ocean environment (Equatorial Pacific), and a polar environment (Ross Sea) as well as different depth (300-4000 m), and temporal (seasonal to annual) distributions. Reactive P concentrations, defined as the sum of oxide-associated and labile organic (includes P sorbed to and incorporated in oxyhydroxides as well as any P associated with labile organic matter), authigenic (authigenic carbonate fluoroapatite), and acid-insoluble organic P, range from 13-36 μmol P g⁻¹. These concentrations are of the same magnitude, but slightly higher than those found in recent sediments (9-24 μmol P g⁻¹). Particulate P values are consistent with loss of reactive P between the shallower sediment traps (26-36 μmol P g⁻¹, 1200 m) and the core top sediments, although the range of reactive P values from the deeper sediment traps (15-24 μmol P g⁻¹, 4000 m) is similar to the range in the sediments. P in the sediment traps is primarily composed of oxide-associated and labile organic P (32%) and acid insoluble organic P (36%) with lesser proportions of authigenic P (23%) and detrital P (9%). Reactive P in particulate matter likely represents a transitional distribution between very labile organic P present in the photic zone and authigenic P eventually buried in the sediments, with some P lost to regeneration in the water column. These associations of P should be considered when interpreting P cycling in the oceans and burial in the sediments.

OS31E-83 0830h POSTER

Factors Controlling the Transfer of Organic Carbon to the Deep sea

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Particle fluxes measured with sediment traps deployed below 2000m at 11 sites in the North Pacific are combined with satellite-derived export production estimates in the overlying water to assess the factors affecting the transfer of particulate organic matter from surface to deep water. Multiple linear regression is used to derive an algorithm suggesting that the transfer efficiency of organic carbon, defined as the settling flux of organic carbon normalized to export production, increases with the flux of carbonate and decreases with water depth and f-ratio. The algorithm predicts more than 80 percent of the variability in organic carbon transfer efficiency at 43 additional sites from oceanic regions ranging from tropical gyres to the Antarctic and the Arabian Sea. The influence of the carbonate flux suggests that the ballasting effect of this biogenic mineral may be an important factor promoting export of organic carbon to the deep sea by increasing the density of settling particles. However, the lack of a similar effect for biogenic opal suggests that other factors, such as the hydrodynamic properties of settling particles, also play a role. The adverse effect of increasing

f-ratio on the transfer efficiency of carbon is tentatively attributed to greater biodegradability of organic matter exported from regions with high f-ratios, seasonality and cold SST. In high latitude opal-dominated regions, while a higher fraction of net production is exported, a higher fraction of the exported organic matter is remineralized before reaching bathypelagic depths. On the other hand, in low latitude, carbonate-dominated regions with low f-ratios, a higher fraction of the exported organic matter sinks to the deep-sea. Increasing the f-ratio or inducing diatom blooms by Fe fertilization may not result in a proportionally higher carbon flux to the deep-sea.

OS31F HC: Hall III Wednesday 0830h

Physical, Chemical, and Biological Processes Associated With Active Submarine Volcanism in the Pacific I

Presiding: B Embley, NOAA/Pacific Marine Environmental Laboratory; M Kinoshita, JAMSTEC

OS31F-100 0830h POSTER

Hydrothermal Microbial Ecosystem at the Suiyo Sea Mount on the Izu-Ogasawara Arc

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Microbial population and composition in hydrothermal fluid, plume and in situ incubation samples collected from the Suiyo Sea Mount caldera using Japanese submersibles in 2001 were estimated by recent bio-techniques for creating a microbial ecosystem model in this very active arc-type hydrothermal system, as well as finding new bio/gene resources. The Japanese Archaean Park Project supported this study.

In almost all samples including high temperature fluids emitted from drilled bore holes, microbial cells were detected and counted more than 10000 cells/ml, showing the predominance of the domain Bacteria in both molecular and cellular quantification analyses. Dense population was detected at the central region of the caldera, where Bathymodiolus bivalve-rice benthic animals colonized and made lots of patchy shell mounds, than the surrounding sandy seafloor. In hot subsurface samples obtained from a catheter-type incubator and others, many environmental gene clones assigned to new members within the epsilon-proteobacteria, and a few in archaea. Remarkable number of microbes was also detected in plume layer above the seafloor of the 1380 m depth, corresponding to anomaly in vertical nephelometric profiles (ca.1100-1200 m). Undeniable that a hydrothermal energy-driven, highly productive ecosystem is present in this isolated aphotic region, even in a hot sub-vent environment.

OS31F-101 0830h POSTER

Very High Productivity of Microbes in Hydrothermal Vent Unveiled with In Situ Measurement

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In deep-sea hydrothermal vent ecosystem, bacterioplankton exist usually 2 to 5 order of magnitude higher than in the ambient. As is generally suggested, these environments O'are in effect chemostatOL, where concentration of reduced compounds are continuously maintained in supersaturated level by the effluent of chimney. Our recent observation at Dai-Yon Yonaguni-and Hatoma Knolls located in the southern part of Okinawa Trough, 1330 <ETH> 1530 m bsl supported that and moreover we first found directly that the microbial production was unexpectedly high in the vicinity of the plume. We succeeded to carry out incubation of near plume water under in situ condition near the dense colonies of the bivalve Bathymodiolus platifrons, using a diffusion chamber, which did not obstruct the supply of dissolved gases and elements. We detected 12-14% FDC, 22-26 hours generation time in number of bacteria and less than 1 hour of their biomass turnover time. Image analysis revealed significant increase in cell size of existing bacteria during 7 <ETH> 9 days incubation. Those belonged to domain Eubacteria according to in situ RNA hybridization.

OS31F-102 0830h POSTER

Hydrothermal Plume Processes in the Indian Ocean (Kairei and Edmond Vent-Sites, Central Indian Ridge)

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During May and June 2001, RRS Charles Darwin cruise CD128 conducted a detailed investigation of the physical dispersion of, and biogeochemical cycling within, non-buoyant hydrothermal plumes overlying the recently-discovered Kairei and Edmond vent-sites on the Central Indian Ridge near 25 deg 19 min South and 23 deg 53 min South, respectively. The cruise combined detailed investigations into plume dispersion and biogeochemistry with deep-tow biological investigations in which RMT 1-8 nets were used to provide an overview of the range of investigations conducted. Details of many of these will be presented in additional talks and/or posters. A total of 24 CTD stations were occupied for conventional water column sampling. These stations included a tow-yo directly across the Kairei vent-site to map out the dispersion characteristics of the plume and ten detailed "process" stations (8 at Kairei and 2 more, for intercomparison, directly above the Edmond field) to investigate plume evolution characteristics. These process stations included simultaneous large-volume in situ filtration sampling of suspended particulates through three different pore-size filters coupled with time-series sampling of unfiltered water from the same locations, over 2-4 hour time intervals, using Niskin bottles. This novel approach allows us to investigate the kinetics of key reactions at plume height and the partitioning of different materials into coarse, fine and colloidal particulates as well as truly dissolved phases. Additional CTD operations included a time-series tow-yo directly above the Kairei site to investigate plume-tidal interactions and determine heat-flux from the site and a background station, approximately 200km off-axis, to provide first detailed trace-element geochemical profiles in East Indian Ocean basins. Water column sampling was completed with the collection of a suite of 10 further large volume in situ filtration samples, collected from the Edmond hydrothermal plume to investigate vertical cycling using combined radiochemical and geochemical techniques. For biological sampling, a key focus was the use of the RMT 1-8 nets for which 34 samples were collected within and above the Kairei and Edmond plumes. As with CTD operations, principal focus was at the Kairei site (22 of 34 deployments) with the remaining trawls conducted at Edmond. As with previous experience from the Mid-Atlantic Ridge, larval vent-shrimp were successfully recovered from the water column overlying both sites.

OS31F-103 0830h POSTER

Particle geochemistry and radionuclides in the Edmond and Kairei hydrothermal plumes, Indian Ocean: Preliminary results

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RRS Charles Darwin cruise 128 (May-June, 2001) was a detailed investigation of the chemistry and biology of the hydrothermal plumes overlying the newly discovered Kairei and Edmond vent sites on the Central Indian Ridge. As part of this study we collected large volume samples of particulate material for elemental and isotopic analysis using in situ filtration. A total of nine particulate samples were collected from the Kairei plume and thirteen from the Edmond plume. Of these, eight and five respectively have associated samples (in the form of manganese absorber cartridges) for measurement of dissolved thorium isotopes. With these samples, we will test hypotheses regarding the influence of hydrothermal plume processes on marine geochemical budgets via particle formation and scavenging.

We will present dissolved and particulate thorium-234, particulate lead-210, particulate Fe, and dissolved uranium data from these two plumes. Particulate Pb-210 activities are greater than 3 dpm/L in most of the samples from both plumes, which is high relative to previous results from the Rainbow plume on the Mid-Atlantic Ridge but comparable to or perhaps lower than values at TAG. Particulate Pb-210 activities are higher in the Edmond plume samples than in those from Kairei. Particulate Th-234 activities are generally quite low (only two samples with greater than 0.3 dpm/L, one from each site). Total (dissolved + particulate) Th-234 activities are in equilibrium (2.5 dpm/L) with the parent U-238 except for two samples at the Kairei site for which total activities are less than 2 dpm/L, indicating significant scavenging removal of Th-234. We will discuss the data in the context of our previous results from the Mid-Atlantic Ridge and available data from the Pacific Ocean as well.

OS31F-104 0830h POSTER

Iron (II) Oxidation Rates in Hydrothermal Plumes at the Kairei and Edmond Vent Sites in the Indian Ocean

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During Cruise 128 of RRS Charles Darwin to the Rodriguez Triple junction area of the Indian Ocean Ridge system, water samples were taken at the Kairei and Edmond vent sites. Both the neutrally buoyant plume (as identified by light scattering sensor anomalies) and the adjacent, background, water column were sampled. Where Fe (II) concentrations were too low to detect, a spike of Fe(II) was added to the water sampling bottle, and the loss of Fe II monitored with time. These incubation experiments were done at ambient deep-water temperature within the sampling bottles. Reactive Fe was determined by complexation with Fe II-specific Ferrozine, and molecular spectrophotometry. The average pseudo first-order rate constant for oxidation of Fe(II) for 11 experiments was 0.303(standard deviation 0.029)h⁻¹ which equates to a half life of Fe II in these waters of 2.31h. This half-life is of the same magnitude as that predicted by Field and Sherrell (2000) for Indian Ocean waters, who argued that Fe oxidation rates should change through the major ocean basins as a result primarily of variations in oxygen concentration. The oxidation rate of Fe II naturally present in samples from the neutrally buoyant plumes was not detectably different to that of Fe II added to deep water collected from outside the plume, suggesting that no components in the plume significantly influenced the rate. These first data investigating rates using incubation of plume waters thus support the general argument of Field and Sherrell that there are substantial differences in Fe II oxidation rates in hydrothermal plumes between ocean basins. This slower formation of element scavenging iron (III) hydroxy-oxide phases in older waters with lower concentrations of oxygen will allow more time for effective mixing of background and hydrothermal waters and possible enhanced removal of some trace elements. Field, M.P. and R.M. Sherrell, *Geochim. et Cosmochim. Acta*, 2000. 64(4) 619-628.

OS31F-105 0830h POSTER

Total Dissolvable Manganese Anomalies Over the Knipovich Ridge: Evidence for Hydrothermal Activity

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The Knipovich Ridge extends between 73° deg 50'N and 78° deg (northern Norwegian-Greenland Sea) and spreads at just 8mm/year, full-rate (Crane et al., 1991). The ridge exhibits a single continuous rift-valley, ca. 500km in length, which lies at a water depth of >3000m