OS21T-11 1120h

Mesoscale Physical and Biological Fields on the Northern Norwegian Shelf Region

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The shelf of northern Norway is a highly productive area where the circulation is complicated by the North Atlantic Current and fresh water runoff. To study the zooplankton advection by both the North Atlantic current and Norwegian coastal current, and the role of mesoscale eddies in ecosystem dynamics, a mesoscale physical and biological survey was carried out in late June 2000 on the R/V Jan Mayen. Cross shelf transects with high-resolution measurements of CTDF fields and zooplankton distribution were conducted using a towed instrument package including an Optical Plankton Counter (OPC), CTD , and fluorometer. The survey covers the region from 68°N 70°N in latitude and from onshore to 150 km offshore. The OPC data showed a high concentration of abundance in the top layer of the water body. This layer changes gradually from 50 m on higher latitude (70°N) to 10m on the lower latitude (68°N). The zooplankton distribution is fairly even across the shelf except in the deep canyon area, where the zooplankton abundance is distinctively concentrated. The co-occurrences of a warm temperature layer, Chl-a maximum, and high zooplankton abundance imply that the temperature is critical to the phytoplankton and zooplankton distribution. The convergence of the circulation is further investigated to understand the maxima of zooplankton and subduction of phytoplankton into a greater depth.

OS21T-12 1135h

Effects of Wildfire on Discharge and Phosphorus Export from an Upland Watershed on the Western Boreal Plain: a Component of the FORWARD Study

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Water and nutrient export during the peakflow season (May to July) were affected by a wildfire in early summer 1998, which burned 90% of an upland watershed on the Boreal Plain of western Canada. Water export increased after fire (1999 to 2000) relative to a prefire study year (1983) and compared to a reference system ($P = 0.01$). The increase in particulate phosphorus (PP) export after fire was also greater in the burned than the reference watershed ($P = 0.05$). Whereas PP comprised a similar proportion of total phosphorus export in the burned stream before fire and in the reference stream (65%), it comprised a higher proportion after fire (77%, $P < 0.02$). Changes in phosphorus export were most evident during peakflow and were largely restricted to the particulate fraction. This suggests that even in this low relief region, removal of vegetation enhances overland flow during and after storm events such that particulates are readily flushed from the watershed. This study is a component of the Forest Watershed and Riparian Disturbance (FORWARD) study, which links water quality and watershed disturbance indicators with management on the Boreal Plain of western Canada.

OS21U HC: 323 C Tuesday 0830h

Primary Production and Plankton Distributions

Presiding: **M P Lizotte,** Bigelow Laboratory for Ocean Sciences**; K J Edwards,** Woods Hole Oceanographic Institution

OS21U-01 0830h

Chemoautotrophic Primary Production in Lake Kinneret, Israel

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Intensive chemosynthetic microbial activity fueled by H_2S oxidation was measured by ^{14}C fixation in the dark and in presence of DCMU in Lake Kinneret waters. This process occurred in water collected below the photic zone (20 m) at the chemocline in the late autumn (Nov-Jan), and close to the sediment water interface in May when the chemocline starts to form. Averaged depth-integrated chemoautotrophic primary production at the chemocline was 16% and 24% of the photosynthetic primary production in May and during autumn, respectively. The $\delta^{13}C$ of particulate organic matter at the chemocline ranged between - 27$^o/_{oo}$and - 39$^o/_{oo}$, the latter being associated with intensive chemosynthesis. These ^{13}C values support our earlier hypothesis that chemoautotrophic bacteria constitute, directly or indirectly (through the microbial loop), a ^{13}C -depleted food source for the zooplankton in the lake during autumn and early winter. Mass and isotopic balance of carbon and H_2S suggest that chemosynthetic productivity may constitute 20 to 25% of the primary production in Lake Kinneret annually.

OS21U-02 0845h

Seasonal Distribution of Magnetotactic Bacteria in a Chemically Stratified Coastal Pond

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Magnetotactic Bacteria (MB) are a diverse group of prokaryotes that precipitate the mineral magnetite (Fe3O4) or greigite (Fe3S4) intracellularly. MB exhibit magnetotaxis along the Earth's geomagnetic field lines in dysaerobic and anaerobic water columns and sediments. While these bacteria play distinct roles in biogeochemical cycling of Fe, S, C, and N, little is known about their abundance and distribution, nor have the factors that control their occurrence been elucidated. Consequently, it is not possible to ascertain their absolute or relative biogeochemical roles, or understand the ecological role they play in sub-oxic microbial communities. We are conducting studies to understand the occurrence, distribution, and diversity of MB in the environment, using a chemically stratified salt pond in Massachusetts as a model system. Preliminary results of our studies will be presented on: 1) seasonal evolution of water column chemistry in Salt Pond, MA; 2) phylogenetic diversity of MB; 3) electron and light microscopic studies of MB. Results show distinct stratification of dominant MB populations with depth that correlates with trends in O2 and Fe. Studies reveal unprecedented dominance of greigite-MB in both anoxic and dysaerobic portions of the water column; this is surprising as most studies to date have focused on the magnetite-MB, which appear to be less abundant. Results also show an evolution in the species diversity over the summer season, which correlates with the degree of water column stratification (less early in season; more later). These studies demonstrate the need for molecular quantitative assessments of MB populations, so that they may be put into biogeochemical context in the environment.

OS21U-03 0900h

Chaotic Attractors in a Semi-Tropical, Polymictic Lake?

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Numerical models, laboratory experiments, and field exercises have shown that external disturbances, e.g., episodic flushing and nutrient loading events, can have a profound effect on phytoplankton succession patterns and resulting biodiversity. Well accepted conceptual models, such as Connell's Intermediate Disturbance Hypothesis, have provided a framework where controlling mechanisms that shape phytoplankton community structure are described, which often involve synergism between external disturbances and internal processes. More recently, numerical models have shown that in some cases internal processes alone, e.g., competition for multiple limiting resources, can explain succession patterns and resulting biodiversity. In such cases it is assumed that the role of external disturbances is inconsequential. In addition, some of these models have shown chaotic behavior where the succession pattern and resulting biodiversity is influenced by chaotic attractors, and is highly sensitive to the initial community composition.

Chaotic phytoplankton succession patterns have not yet been demonstrated in the natural environment. In this research, an 11-year phytoplankton record from a semi-tropical, polymictic lake, where seasonal disturbances are small, was analyzed. Findings from cluster and discriminant analyses indicated that when diatoms of the Genus *Melosira* dominated winter assemblages, summer assemblages were either dominated by euglenoids of the Genus *Trachelomonas*, or cyanophytes of the Genus *Psuedoanabaena*, *Synechococcus*, or *Cylindrospermum*. There was no apparent trend observed between the hydrology and nutrient loading records, or the in-situ water quality records, with community composition. However, the historical data does not include other parameters known to influence phytoplankton succession patterns, e.g., grazer community structure. So, it is impossible to determine what processes might have influenced phytoplankton succession patterns and resulting biodiversity over this period. Forces of chaos might have been at play, however, as indicated by the strongly bipolar summer community composition following *Melosira*-dominated winters, which is consistent with chaotic modeling simulations. In this case chaotic attractors might have pulled phytoplankton succession towards a community dominated by either *Trachelomonas* or a Genera of cyanophyte.

OS21U-04 0915h

Contrasts Between Temporal Patterns of Primary Production and Plankton Biomass: Results of a Long-Term Study of the Trophic Evolution of a Northern Reservoir Following Impoundment

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Cat Arm Reservoir is a deep (18 m mean depth), dystrophic (2m euphotic zone) lake surrounded by boreal forest on the Great Northern Peninsula of insular Newfoundland. Measurements of primary production and plankton biomass between 1983 and 1998 reveal only a weak linkage between production and biomass within growing seasons and a trend towards negative correspondence across years.

Impoundment produced an immediate sharp increase in seasonal mean zooplankton biomass, attributable to reduced flushing, and a 45 % drop in phytoplankton biomass for an overall total plankton biomass increase of only 30 %. Total plankton biomass increased further during the second year of filling but once normal reservoir operation was established seasonal mean biomass dropped to a relatively stable level slightly less than initial conditions and with a nearly even balance between phytoplankton and zooplankton.

Mean primary production exhibited a distinctly different temporal pattern, dropping during the two years

of filling and then climbing steadily through 1990. Two subsequent sampling seasons displayed a three-fold range in mean production that seems related to weather conditions. One summer was unusually cold and the reservoir remained mixed until early August with very low primary production. Mixing subjects the phytoplankton to lengthy intervals of darkness because the mean depth is eight times that of the euphotic zone. In contrast, the other summer was exceptionally warm and early. The epilimnion was forming by mid June and production then was more than double the maximum observed in any other year, typically occurring in late July or August. There was only a 23 % increase in seasonal mean plankton biomass despite a nearly three-fold increase in seasonal productivity.

It thus seems that seasonal primary productivity is most heavily influenced by physical factors in the early growing season whereas total plankton biomass is more stable and likely related to nutrient supply.

OS21U-05 0930h

Recording Microscale Phytoplankton Distributions with an Untethered, Free-Falling Imaging System

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To support the nondestructive, unobtrusive *in situ* study of heterogeneous plankton distributions on microscales (<1 m), we have developed an untethered, free-falling vehicle that incorporates a laser sheet-illumination system and downward-looking camera. The system has been evaluated in terms of hydrodynamic influence, fluorescence detection sensitivity, and *in situ* vehicle stability. Flume tests with a scaled model indicated the absence of any observable hydrodynamic effects downstream of the vehicle in a laminar flow regime. A laboratory-based calibration experiment demonstrated that the CCD camera system has adequate sensitivity to record the laser-induced chlorophyll fluorescence from a single, healthy *Lingulodinium polyedrum* cell within a 29 cm x 29 cm x 0.7 cm volume at a target distance of 80 cm. Finally, data from a sea deployment of the full-scale vehicle established that the system is stable enough in the field to support the noninvasive measurement of *in situ* phytoplankton structure.

OS21U-06 0945h

Microscale Distributions of Phytoplankton: Observations in the Field Using a Free-Falling Fluorescence Imaging System

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An untethered free-falling system was developed to image chlorophyll **a** fluorescence of undisturbed phytoplankton *in situ*. A sheet of laser light extending below the slowly sinking instrument platform excited fluorescence, while a sensitive CCD camera imaged the fluorescence over an area of 32 cm x 32 cm x 0.6 cm with 0.3 mm x 0.3 mm spatial resolution. In addition to the imaging system, the platform had pressure sensors, tilt and rotation sensors, a pressure-activated ballast release, and a CTD-fluorometer-transmissometer package. The platform was ballasted to fall at 3 - 10 cm/s, and to profile the upper 80 m of the water column. Images were gathered at stations off San Diego, CA in July 2001, near the end of a dense red tide of *Lingulodinium polyedrum*. Individual phytoplankton cells are clearly visible in the fluorescence images, allowing calculation of cell concentrations and nearest-neighbor distances. Bottle samples before and after the free-fall profiles gave information on species composition of the phytoplankton, and the contributions of various size classes to the extracted chlorophyll **a**. Phytoplankton >20 μm in size tended to dominate the fluorescence images, though they only represented about 20 % of the total chlorophyll **a**. Layers dominated by particular cell types (chains vs. single cells) were evident in the images; however diatom chain lengths were underestimated in bottle samples as chains broke during handling. Images of side-scattered light revealed that a relatively small fraction of the particles were fluorescent.

URL: http://spiff.ucsd.edu

OS21U-07 1020h

Temperature as a passive isopycnal tracer in salty, spiceless oceans: consequences for the vernal bloom

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The decoupling between the gradients of temperature and density in cold, relatively fresh oceanic waters is discussed theoretically and demonstrated with observations from the Baltic Sea. Temperature anomalies in this null-space of density and spice are advected by freshwater gradients. Recognition of such dynamics could prove to be helpful to the understanding of the glacial Arctic Ocean and the circumstances that trigger thermohaline transitions.

As interesting as this physical process is by itself, its greatest implications may be found in the preconditioning for the vernal phytoplankton bloom. There is ample evidence that a sufficient residence time in the euphotic zone is needed for the bloom commencement. In most cases, the residence time is provided by stratification. In a spiceless ocean, the stratification is created by freshwater advection, resulting in an advective restratification and therefore a non-local vernal bloom development. This process is discussed in the light of observations from the Baltic as well as with numerical experiments.

OS21U-08 1035h

High Variability of Primary Production in the Atlantic Subtropical Gyres: Uncoupling from Phytoplankton Biomass and Size Structure

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Oligotrophic conditions prevail across > 70% of the open ocean, where more than half of the global marine carbon (C) fixation takes place. Despite their large biogeochemical importance, oligotrophic waters are undersampled relative to temperate and coastal environments and thus gaps exist in our understanding of the critical ecosystem processes involved.

An analysis of 36 profiles of size-fractionated chlorophyll and primary productivity in the oligotrophic North and South Atlantic Ocean revealed a relatively high degree of variability (20-fold) in C fixation rates. Over the observed range in productivity (18 to 364 mgC m-2 d-1), temperature and nitracline depth were negatively correlated with C fixation. Our results indicate that photoacclimation irradiance and nutrient supply to the euphotic layer (both dependent on the depth of the upper mixed layer) are the main controlling factors of primary productivity in subtropical regions.

Changes in productivity were not associated with variations in incident surface irradiance, chlorophyll concentration, picophytoplankton biomass or phytoplankton size-structure. However, a significant relationship existed between the relative biomass contribution of different groups of picophotoautotrophs and the rate of primary production. The relative importance of *Prochlorococcus* spp. increased with decreasing productivity, whereas the opposite was true for *Synechococcus* spp. It is argued that, in the oligotrophic ocean, constancy of microbial biomass, size-structure, and trophic organization should not be taken as an indicator of unchanged biogeochemical functioning.

OS21U-09 1050h

The Influence of Phytoplankton Community Composition on Nutrient Drawdown

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The importance of phytoplankton community structure on ocean biogeochemistry has focused primarily on the role of functional groups responsible for key processes (e.g., N-fixation, calcification, silicification). However, recent studies in the Southern Ocean (e.g. Arrigo et al. 1999, Science, 283:365-367) have shown that variability in generalized biogeochemical relationships, such as the Redfield ratio for C:N:P, may be related to phytoplankton taxonomic composition. Thus, understanding the role of phytoplankton community structure may be critical for making progress from current ocean biogeochemistry models (with generic phytoplankton parameterizations) to more explicit models. High-Performance-Liquid-Chromatography (HPLC) methods for measuring phytoplankton pigments have been used widely in the past two decades, and have proven useful in deriving estimates of phytoplankton community structure based on taxonomically distinct pigment signatures. As part of the U.S. JGOFS Synthesis and Modeling Project, a global synthesis of HPLC pigment and nutrient databases were analyzed to select data sets in which a single taxonomic group dominated (defined as > 2/3 of total chlorophyll a biomass). Dominance at this level was rare in most data sets, particularly for oligotrophic and tropical sites, but more common in eutrophic and polar sites. Data sets having multiple samples dominated by single taxa were dominated by either diatoms or prymnesiophytes. Regressions of nitrate vs. phosphate made for these data sets showed that nutrient drawdown during phytoplankton blooms dominated by diatoms or prymnesiophytes can differ significantly from the norm represented by the Redfield ratio for N:P (= 16). In particular, diatom blooms in the Southern Ocean and Arabian Sea were consistently low (N:P = 4-12). The implications for developing and testing ocean biogeochemical models and for understanding ecosystem processing of materials will be discussed.

OS21U-10 1105h

The Relationship Between Initial Community Composition and Phytoplankton Succession Under Continuous and Pulsed-Flow Conditions

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Three pulsed vs. continuous nutrient loading experiments were conducted to investigate phytoplankton competition in mixed assemblages from the Rincon Delta, Texas, in March, June and September 2001. Flow-through incubators received the same amount of nutrient loading and hydraulic flushing over the course of each experiment, as well as identical photoperiod and irradiance. Initial conditions in the incubators were assumed identical because water samples were drawn from the same well-mixed carboy that contained the field sample. Our findings showed that in one experiment pulsed flows supported greater secondary productivity with less accumulated phytoplankton biomass, and greater phytoplankton diversity, than continuous flow, while another experiment showed the opposite trend, and a third experiment, as yet, shows no trend. In one of the experiments the variability within a treatment was also high. We anticipated our observed results between treatments, but we did not anticipate the differences sometimes observed within treatments comprising an experiment, or the differences between experiments. This raised the question of what might be causing these differences in phytoplankton succession patterns. Differences between the experiments may be due to the initial presence or absence of phytoplankton species characteristic of minimum cell quotas that are below grazer food-quality thresholds, i.e., when in a starved state are unsuitable food sources. In turn, this would allow phytoplankton blooms of low diversity. However this does not explain the differences observed within treatments of the same experiment. It may be that phytoplankton succession in these assemblages behaves chaotically. In which case, minute variations in the initial phytoplankton community composition would have a profound impact on secondary productivity, phytoplankton standing biomass, and species diversity.

OS21U-11 1120h

A Numerical Study of Phytoplankton Distribution in Mediterranean Sea

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A three dimensional fully coupled ecological hydrodynamical model has been used to asses the role of the physical forcing of the seasonal cycle of phytoplankton in the Mediterranean Sea. Twelve state variables describe the nitrogen and phosphorus cycles coupled with fixed but compartment depedent N:P ratios. Two different size-fractionated functional groups represent small and large cells, and their evolution is governed by nutrient availability, light and temperature. In addition advection and turbulent diffusion act on all the biological variables reproducing the prevailing trophic regimes during stratification and mixing season and the concomitant response of the food web. The clorophyll surface seasonal cycle, as derived from the model results using a non-linear semi empirical formulation of the C:Chl ratio, compares favourably in a quantitative and qualitative way with the pigments concentration obtained from CZCS images calibrated for the Mediterranean Sea. An analysis of the buoyancy content, proportional to the integral of density anomaly contained above th depth z,, is used as a measure of stratification. The model simulations show that the buoyancy content calculated above the nutricline in the eastern and western subbasuns of the Mediterranean are locked in phase but the stratification is stronger in summer in the eastern part. This seasonal cycle induces a corresponding bloom-recyclin pattern for the autotrophs, which maxima are correlated the minimum of buoyancy. Even though large cells are dominant in wetern part and their concentration is almost three times the concentrations of the eastern basin, the integrated phytoplankton biomasses in the upper layer are not very dissimilar in the two subbasin. This result confirm recent hypotheses based on chlorophill data

OS21U-12 1135h

The Use of Chlorophyll Fluorescence Lifetime to Assess Phytoplankton Physiology within and around the Mississippi River Plume

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As an alternative to the14C technique, measurements of chlorophyll fluorescence lifetime provide a non-intrusive assessment of phytoplankton photochemical conversion and can be used to estimate parameters directly related to phytoplankton primary productivity. Phytoplankton carbon fixation estimated from 14C techniques are often difficult to make due to sample manipulation and artifacts common to the sampling within closed containers. Furthermore, the increased spatial and temporal coverage of chlorophyll fluorescence lifetime measurements, compared to classical incubation-based techniques used to estimate carbon fixation, provides a meaningful snapshot of photosynthetic efficiency within environments which are physically variable at relatively small spatial and temporal scales.

Chlorophyll fluorescence lifetime was used to assess phytoplankton photosynthetic efficiency within the horizontal and vertical mixing gradients associated with the Mississippi Rivers intrusion into the Gulf of Mexico. Numerous studies have addressed the seasonality and magnitude of primary production attributed to Mississippi River outflow, but few studies have examined the photosynthetic efficiency of phytoplankton along this estuarine continuum. Measurements of fluorescence lifetime, downwelling and surface irradiance, and phytoplankton absorption were used to estimate primary productivity within this environment. Productivity estimates derived from measurements of phase fluorometry were compared to previous estimates of primary productivity measured within the plume and within waters adjacent to river outflow.

OS22A HC: Hall III Tuesday 1330h

Research Experiences of Undergraduates in Ocean Sciences

Presiding: **R L Cuhel,** University of Wisconsin-Milwaukee**; C Aguilar,** University of Wisconsin-Milwaukee

OS22A-143 1330h INVITED POSTER

Dynamics of DOM Production by the Diatom *Thalassiosira oceanica*

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The fate of dissolved organic matter (DOM) is influenced by many factors in the open ocean environment, including biological (i.e. community structure), chemical (i.e. composition of inorganic nutrient pools), and physical (i.e. interannual and seasonal changes in physical forcing) variables. It is important to understand each of the mechanisms responsible for community shifts and changes in DOM cycling to gain a better predictive comprehension of an ecosystem and to recognize human-induced changes over a long-term time scale. In this study, the focus is the flux of material from POM to DOM and its composition (i.e. C:N:P ratio) based on growth parameters. This was completed through laboratory culture experiments with *Thalassiosira oceanica*, a species of diatom common to the Sargasso Sea. The triplicate cultures were initially nutrient-replete, and maintained at a constant temperate and light regime (12:12) for 8 days with low bacterial growth ($\mu_{bact} < \mu_{phyto}$). Measurements were taken at 3 points along the exponential and stationary phases of the growth curve. Significant differences were found between DON and DOP release. At a high growth rate (μ=0.81), almost all (99%) of NO_3 taken up was retained (little DON released), while a slight amount (15%) of DOP was taken up in addition to PO_4. At a low growth rate (μ=0.10), a large amount (74%) of NO_3 taken up was released as DON, while little (15% of PO_4 uptake) DOP was released. On day 1, the ratios of DON:DOP that accumulated in the medium compared to the phytoplankton biomass (PN:PP) were similar (5:1); however, by day 8, DON:DOP (19:1) was much greater than PN:PP (4:1). This suggests that the cells were passively leaking DOM during exponential growth, then, as their growth rate slowed, the cells actively released more DON to the medium than DOP. In conclusion, it has been demonstrated that the amount and composition of DOM released by *T. oceanica* varies with the growth rate and availability of dissolved nutrients. The compositional shifts in DOM under a lower light level, and DON release of natural assemblages of phytoplankton measured using ^{15}N tracer methods in field experiments will also be explored with further studies. These data provide a first step towards understanding the production and source of DOM, which is necessary before the mechanisms behind DOM cycling can be described.

OS22A-144 1330h INVITED POSTER

The Role of Epibiont Sponges and Their Microbial Symbionts in the Nutrient Limited *Rhizophora mangle* Stands

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In Twin Cays, Belize, diverse *Rhizophora mangle* subtidal epibiont communities, which are dominated by sponges, occur along the islands fringe, channels and lakes. Red mangroves in the fringe zone are severely nitrogen limited, which reduces their growth capability. Previous studies show that the presence of live sponges on *R. mangle* prop roots increases their biomass relative to spongeless roots. This relationship could be due to nitrogen-fixing processes mediated by symbiotic microbes within sponge tissue. I isolated bacterial genes from *Haliclona implexiformis*, one of the most abundant members of the sponge epibiont community. I used RFLP analyses to identify dominant members of the sponges bacterial community then analyzed 16S rRNA sequences to differentiate among bacterial species. I found four dominant species of bacteria in *H. implexiformis*. These numerically abundant bacteria might play important roles in mangrove community ecology. I am doing further work to characterize the trophic roles of these bacteria and predict ways in which they might affect nitrogen cycling.

OS22A-145 1330h INVITED POSTER

The Role of Fresh Groundwater Discharge in the Dispersion and Recirculation of Salt in Estuarine Sediment

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In estuarine environments significant groundwater systems exist that discharge fresh water into the near shore surroundings. This fresh groundwater can be mixed with salt water in the upper few decimeters of the sediment. As a result, net measured discharge rates at the sediment-water interface are equal to the volume discharge of fresh groundwater although the salinity of the escaping water is high. Seepage meters were used to measure discharge rates over about 50 l/day/m^2 near the shoreline of The Great South Bay, a wide, shallow lagoon with a tidal range of $\sim$0.21m situated at the surface of a coastal plain aquifer along the South Shore of Long Island, New York. These rates decreased to 15 l/day/m^2 at a distance of 100 m from shore. No consistent variation in discharge with tidal phase was found, but water collected at sampling locations freshened over time from 30 ppt to 23 ppt in twelve hours demonstrating a freshening of any salt penetrated sediment beneath the seepage meter and suggesting that the use of seepage meters turns off the mixing process. Piezometers recorded vertical hydraulic gradients (at ambient salinity, 28 ppt) between 0.08 and 0.02 in the upper meter of the sediment and the vertical hydraulic conductivity was measured by a falling head test to be between 1 and 20 m/day. Conductivity measurements showed the pore water salinity decreasing from ambient bay values at the surface to near fresh water values at a depth of 0.6m. The vertical downward dispersion coefficient for salt was estimated to be 0.02 m^2/day. Both wave induced transport and gravitational convection (salt fingering) into the sediments are considered possible mechanisms driving salt penetration that must be studied.

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Salt and Salmon: the Effects of Hard Water Ions on Fertilization

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Mine effluents contain a variety of ionic species that may be harmful to important organisms living in the discharge area. In this study the industrial effluent from the Red Dog Mine (near Kotzebue, AK) was modeled in the laboratory in order to determine the response of developing salmon to this specific effluent. Previous experiments demonstrated that an increase in total dissolved solids (TDS) in the simulated mine effluent caused a decrease in the fertilization rate of exposed salmon eggs. The current study attempted to determine which specific ionic species were responsible for this decrease in fertilization. Concentrations of K^+, Ca^{+2}, $SO_4^=$, and Mg^{+2} typical of their presence in a 2500 ppm mine simulation effluent were tested in a salmon egg fertilization experiment. Since previous