transitions smoothly from being driven by wind stress curl off the equator to being driven (in part) by wind stress divergence at the equator. Unlike in midlatitudes, upwelling depends strongly on the vertical eddy coefficient of friction. The resulting circulation cells will be compared to features of the circulation, such as the equatorial cold tongue, as inferred from microwave measurements of SST by the TRMM Microwave Imager.

OS32L HC: 314 Wednesday 1330h

Coupling of Biogeochemical Processes Between the Upper and Mesopelagic Ocean II

Presiding: **R B Rivkin,** Memorial University of Newfoundland**; L Legendre,** Laboratoire d"Ocanographie de Villefranche

OS32L-01 1330h INVITED

Mysterious microbes of the mesopelagic

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Microbes and microbial processes in the mesopelagic zone are not especially well characterized. New approaches for characterizing and quantifying microbial community members, and some of their functional properties, are now being applied to microbes living in this vast habitat. As might be expected, the phylogenetic composition of microbes in the mesopelagic is different from that found in the upper water column. For instance, archaea are quantitatively significant members of mesopelagic microbial communities. Cell numbers of one archaeal group in particular, the planktonic crenarchaeota, can approach the sum of all other bacterial groups combined at mesopelagic depths. The unique properties of these archaea, including their potential CO2 fixing capabilities, likely influence carbon and energy cycling at subphotic zone depths of the Pacific Ocean. Other aspects of mesopelagic microbial communities also need to be understood in greater detail. For instance, in recent work we have found novel groups of ribulose-1,5-bisphosphate carboxylase/oxygenase (RubisCO) genes in DNA depth profiles and bacterial artificial chromosome (BAC) libraries. These RubisCO genes appear to be quite common at depths between 100m to 3000m off the California coast. The origin, function and significance of these mesopelagic RubisCO genes, and their involvement in deep-sea autotrophic processes, is one of many mysteries remaining to be solved in mesopelagic microbial communities.

OS32L-02 1350h

Distribution, Bacterial Utilization and Transport of Dissolved Organic Matter in the Far North Atlantic, May 2000.

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Dissolved organic matter (DOM) is an important and dynamic component of the ocean carbon cycle. It can be transported long distances horizontally and exported vertically. The extent of transport, however, is dependent on the lability of component compounds and the intensity of microbial oxidation/mineralization as well as circulation. We measured the concentrations of dissolved organic carbon, nitrogen and phosphorus (DOC, DON and DOP) in the upper 1000 m on a detailed mesoscale hydrographic survey of the Faroes - Iceland - Scotland region of the North Atlantic Ocean (57-65N, 2-25W; RRS DISCOVERY Cruise 253), to estimate their transports, and the stoichiometric ratios of transported DOM in the ambient circulation. The region is characterized by ridge- and -bank topography with bottom depths ranging from <100 to >2000 m. Bacterial stocks and production rates were also estimated.

Our survey occurred during or just following the spring phytoplankton bloom in the south part of the study area, and preceded the bloom in the north. Vertical profiles suggest some net production of DOM had occurred. DOC and DON concentrations in the upper 25 m were elevated by several micromolar relative to deeper water. Bacterial abundance ranged from 1 - 8 x 10^8 cells/L and production rates were generally low. Following large-volume incubations on ambient DOC, newly produced bacterial biomass had $\Delta^{14}C$ values of -230 to -150, i.e. radiocarbon ages of 1300-2000 years, indicating at least a small fraction of older DOC had been incorporated. Assuming 10% conversion efficiency, the bacterial turnover time of semilabile DOC in the upper 100 m was 50-100 d. The low bacterial turnover potentially enables long-range transport of DOM in the region. We will estimate net transports using a new diagnosis of the regional circulation made on the same cruise.

This research was sponsored by NSF OCE 0095223 to HWD and 0095090 to DAH. Shiptime and logistic support were provided by UK-NERC and Southampton Oceanographic Centre.

OS32L-03 1405h

The Response of Surface and Deep Bacterioplankton to High Molecular Weight and Low Molecular Weight fractions of Dissolved Organic Carbon in the Sargasso Sea

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Deep convective mixing during winter can result in a portion of the seasonally accumulated DOC to be mixed to depths below the euphotic zone at the Bermuda Atlantic Time-series (BATS) site. Following stratification of the water column a portion of the exported DOC becomes trapped below the euphotic zone and is removed. Experiments demonstrate that when surface water DOC, resistant to rapid degradation by surface microbial assemblages, is inoculated with water from 250 m DOM is removed on time scales of weeks. In addition, previous studies have demonstrated rapid cycling of high molecular weight (HMW) DOC relative to low molecular weight (LMW) DOC (Amon and Benner, 1994). Here we will present data from an experiment conducted in August 2001 designed to investigate whether bacterioplankton collected at different depth horizons (10 and 250 m) would respond differently to surface water fractionated into HMW and LMW DOC. Water collected from 10 m at the BATS site was fractionated into HMW (greater than 1000 KD) and LMW (less than 1000 KD) DOC by tangential flow filtration. Each molecular weight fraction was then divided in two and inoculated with microbial assemblages collected from 10 m and 250 m. The seawater cultures were incubated at in situ temperatures in the dark for one week.

Bacterioplankton production (as measured by change in cell abundance) was greater in the molecular weight fractions inoculated with 250 m water compared to same media inoculated with 10 m water. For example, in treatments where HMW and LMW DOC were inoculated with 250 m water bacterial abundance increased 8 and 5 fold, respectively. This compared to just a 2 fold increase in bacterial abundance in treatments inoculated with 10 m water. The availability of DOC to deep water microbial communities has implications for C cycling through DOC at BATS. We will present data describing the variability of microbial community structure and DOC dynamics within these experiments.

Amon, R. and R. Benner, 1994. Nature 369: 549 552.

OS32L-04 1420h

Penetration of the Bomb ^{14}C Signal Into the Central North Pacific Ocean and Sargasso Sea Over the Last Decade

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Radiocarbon and $\delta^{13}C$ measurements are presented for dissolved and suspended particulate organic carbon (DOC, POC) and dissolved inorganic carbon (DIC) from the water column in the central North Pacific (31^{o}N, 159^{o}W) and the Sargasso Sea (31^{o}50'N, 63^{o}30'W).

Results are available from 1987 and 1999 for the Pacific and from 1989 and 2000 for the Atlantic. Penetration of the bomb ^{14}C signal at the Pacific site was detected in DIC as deep as 3000 meters. In 1999, $\Delta^{14}C$ of suspended POC in the Pacific was approximately 50 $^o/_{oo}$ lower throughout the entire water column than values found 12 years earlier. In 2000, $\Delta^{14}C$ values of suspended POC at the Atlantic site were lower at 0-100 m depth than values obtained 11 years earlier; higher values were found in 2000 for depths greater than 600 m. Discussion of the penetration of the bomb ^{14}C signal into these two mid-gyre regions, and implications for the flux of carbon between the surface and the deep sea, will be presented.

OS32L-05 1435h

Dissolved Organic Carbon Export with North Pacific Intermediate Water Formation

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The biological pump primarily occurs by two mechanisms: sinking of biogenic particles and downward mixing of dissolved organic carbon (DOC) with the oceans overturning circulations. The locations, timing and rates of particle flux have been studied extensively for several decades. Advances in characterizing the traits of DOC export, in contrast, have been hampered by a dearth of data. Here an evaluation of DOC export with the formation of North Pacific Intermediate Water is presented. Data from sites representing the region's important water masses (North Pacific subtropical, subpolar, and subtropical transitional) are used to demonstrate and quantify the process. We suggest that subpolar, DOC-replete Oyashio water mixes with subtropical, DOC-deplete Kuroshio water in the Mixed Water Region east of Japan. The new intermediate water, formed at a rate of 2-5 Sv, supports net DOC export at $13 \pm 6 Tg C y^{-1}$, delivering water with elevated concentrations of relatively young DOC to the central North Pacific. Based on these findings, we present an alternative explanation for the ^{14}C-DOC age gradient recently reported for intermediate depths of the North Pacific.

OS32L-06 1450h INVITED

Mesopelagic Bacterial Processes in the Subarctic Pacific: Distribution, Production and Ectoenzyme Activities

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Data on bacterial biomass, production and ectoenzyme activities in the mesopelagic zone provide useful information on the cycling of particulate- (POM) and dissolved organic matter (DOM). We review our recent results from two cross-Pacific cruses that investigated the basin-scale distribution of mesopelagic bacterial variables in the subarctic Pacific and Bering Sea. Bacterial biomass and production in the layer between 100 and 1,000 m ranged from 1.6 - 4.3 g C m^{-2} and 5 - 18 mg C m^{-2} day^{-1}, respectively, yielding an average turnover time of 170 - 648 days (avg. 317). Bacterial growth appeared to be largely controlled by organic carbon, as indicated by the strong dependency of bacterial production on total organic carbon concentration. The regional pattern of mesopelagic bacterial production substantially differed from that of surface phytoplankton distribution, suggesting either lateral transport of DOM or variable efficiency in the dissolution of sinking POM. In the upper mesopelagic layer (100 - 200 m), ratios of leucyl-aminopeptidase (LAPase) and beta-glucosidase (BGase) activity systematically shifted along the east-west axis of the investigated region: the LAPase : BGase ratio was high (>100) in the eastern region whereas the ratio was low (< 20) in the western region. We hypothesize that the export of protein to the mesopelagic zone is high in the eastern Pacific because low level of dissolved zinc (a catalytic element of proteases) stressed proteolytic activity in the euphotic zone.

OS32L-07 1530h

Degradation of Particulate Organic Matter in the Water Column: an Experimental Approach

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Substantial losses of settling organic particulate matter (POM) are indicated by sediment traps in the upper 1000m. The rates of loss are notoriously difficult to determine and are usually estimated by algorithms derived from sediment trap data. Different algorithms arrive at substantial differences in upper water loss rates of POM. In order to understand loss processes in the upper part of the water column, potential decoupling of C and N remineralization, and influences of environmental parameters, degradation experiments were carried out with natural particulate matter from the Arabian Sea, North Atlantic and Baltic Sea. The particulate matter was incubated under different environmental conditions simulating temperature, pressure or oxygen concentrations in different water layers. In time course experiments changes in organic carbon (particulate and dissolved), nitrogen compounds, enzyme activity, bacterial growth and oxygen concentration were determined. Fresh POM from the upper mixed water layer had highest degradation rates; POM from underneath the seasonal thermocline up to a few hundred meters was also degraded at detectable rates. However below 1000m no degradation was found. Temperature had the most pronounced effect on bacterial activity and on loss rates of various compounds, while pressure and oxygen effects were either small or ambigous. The type of particles (large versus small) also had an influence on degradation rates. Rapid re-utilisation of dissolved components, in particular of nitrogenous ones, was indicated at longer incubation times. The observed degradation rates are compared to loss rates determined from sediment traps in the upper 1000m.

OS32L-08 1545h INVITED

High Frequency Observations of Ocean Biological Pump Processes by Robotic SOLO-carbon Explorers

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The fact that marine plant carbon biomass turns over on 'day to week' time scales poses a unique observational challenge to the understanding of the ocean's biological carbon pump. We have initiated work that promises to help solve this problem. The international project Argo is deploying several thousand autonomous profiling floats over the next few years to measure mid-depth ocean circulation, temperature, and salinity to provide an improved view of the climate state of the ocean. The recent 20-fold plus improvement of rates of ocean to satellite data telemetry permits augmentation of the long-lived Argo-style floats with low-power sensors for carbon system components. We have developed a prototype robotic observer capable of performing high frequency (diurnal) observations of the upper kilometer for seasons to years. The prototype uses SIO's the Sounding Oceanographic Lagrangian Observer (SOLO) platform with Seabird CTD sensors, modified with ORBCOMM satellite communications, and further augmented with optical sensors for particulate organic carbon (WETLabs, Inc.) and light scattering (Seapoint). The aim is to demonstrate a capability for improved exploration of the ocean biological carbon pump processes and how the pump responds to day-to- day variations of physical forcing.

The first two SOLO-carbon observers were deployed April 10 2001 near ocean station PAPA (50N 145W) to explore the 0- 1000 m variability of carbon biomass in the high nutrient low-chlorophyll (HNLC) waters of the subarctic north Pacific. The two floats continue to operate after 7+ months within several hundred km of PAPA. Each observer has relayed a nearly unbroken record of T, S, POC and light scattering on diurnal frequencies. Biofouling effects have been less than 2 percent. This paper presents highlights of the high-frequency observations of the biotic response to events such as the April 2001 asian dust event and the passage of multiple storms. Progress on development of an autonomous particle flux observing system will also be presented.

URL: http://www-esd.lbl.gov/OBP

OS32L-09 1605h

The Uptake of Silica During the Spring Bloom in the North-East Atlantic Ocean

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Estimates of silica uptake during the spring bloom in the North Atlantic are few. Here, we present silica uptake data from 32Si tracer incubation studies for ten North East Atlantic sites during the UK-NERC Faeroes-Iceland-Scotland Environmental and Hydrographic Survey (FISHES) cruise in May 2001. The data are interpreted in the context of the physical and chemical characteristics at each station in order to assist in resolving the stage of development of the spring bloom at each survey site. Hourly column Si uptake rates, determined from 6h dawn-noon on deck incubations, ranged from 0.26 to 7.27 mmol/m2/h. Substantial silica uptake was observed both at depth and in the dark at all stations. Daily uptake rates estimated using both the light and dark uptake data varied from 6 to 166 mmol/m2/d. Except to the SW of Iceland, surface dissolved silica concentrations were generally less than 2M; a weak correlation was observed between these concentrations and daily uptake rates. Surface nitrate and phosphate concentrations generally ranged between 5 to 12 M and O.3 to 0.8M respectively and were not related to silica uptake rates. A broad correspondence was evident between the silica uptake rates and primary production, estimated using 14C uptake, but not between silica uptake and chlorophyll a, suggesting that a range of stages of the spring bloom was sampled. Despite the overall positive trend between silica uptake and primary production, considerable variability in the column-integrated C: Si uptake ratios was apparent, indicative of decoupling of the uptake processes. Rates of phosphate uptake determined in the same experiment range between 0.9 and 12.0 mmol P/m2/d.

OS32L-10 1620h

Variation in Silica Production and the Contribution of Diatoms to Primary Production and Carbon along Line P in the NE Subarctic Pacific during 1999 and 2000: Coastal to HNLC Waters

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Iron has been shown to limit phytoplankton productivity in high-nutrient low-chlorophyll (HNLC) regions such as the NE subarctic Pacific. Conversely, nitrate and silicic acid concentrations typically limit growth in coastal surface waters during the spring and summer. Although diatoms can often dominate the phytoplankton in coastal regions, they are also continuously present, usually in small numbers, in HNLC regions as well. Silicic acid concentrations are usually inversely proportional to diatom concentrations in the surface waters. HNLC Surface waters are rarely depleted of macronutrients by phytoplankton due to the year-round limitation of iron. There are times, however, when silicic acid concentrations are reduced to low or near zero concentrations as was the case in late summer 2000 (<5 mM). This occurrence can presumably be attributed to sporadic inputs of iron into the surface waters. Recent research has shown that under iron limitation, phytoplankton tend to decrease their uptake of nitrogen. Additionally, diatoms have been shown to increase their ratio of consumed silicic acid to nitrate and phosphate under iron stress or limitation in both oligotrophic HNLC waters as well as in coastal upwelling regimes. We report on silicic acid uptake (32Si) and biogenic silica concentrations and their relation to nutrients and primary productivity in the euphotic zone along the E-W Line P transect in the subarctic Pacific during 1998-2000. This includes the coastal region off the shelf of British Columbia to the HNLC region of Ocean Station Papa (OSP) as well as the transition zone in between. This is the first report of Si uptake rates in this N Pacific, HNLC region. Typical results show low silica production rates in coastal as well as HNLC stations. The transition stations show slightly higher rates in the late spring and summer. Winter rates remained low throughout the transect, mainly due to light limitation. Biogenic silica concentrations were typically maximal near shore and decreased westward Line P. At OSP, biogenic silica remained relatively constant year-round, while varying seasonally near the coast in areas with higher iron concentrations. Although silica production remained relatively low offshore, it can act as an indicator of iron limitation in areas where silicic acid concentrations are replete.

W E D

OS32L-11 1635h

Seasonal Responses of Phytoplankton Growth and Particulate Dimethylsulfoniopropionate (DMSPp) Concentration to Iron-additions in the NE Subarctic Pacific

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Phytoplankton growth in high-nutrient low-chlorophyll (HNLC) regions such as the NE subarctic Pacific have been shown to be regulated by the availability of the micronutrient, iron (Fe). Since global climate has been related to the oceanic and atmospheric exchanges of carbon dioxide and dimethylsulfide (DMS), phytoplankton growth over large oceanic areas play an important role in regulating global climate. The growth of phytoplankton due to an increase in iron supply to HNLC waters should also elevate oceanic DMS concentrations due to the increase of the DMS-precursor, dimethylsulfoniopropionate (DMSP), a secondary metabolite produced by specific groups of phytoplankton. To elucidate the effects of enhanced iron supply on phytoplankton growth and DMSPp concentrations, we preformed a series of shipboard-bottle experiments during the winter, late spring and late summer months at Ocean Station PAPA (50oN; 145oW) in the NE subarctic Pacific Ocean. Phytoplankton growth and DMSPp content were measured during 7-10 day incubations under iron-deplete and iron-amended (2 nM) conditions. The results showed that phytoplankton growth and DMSPp concentrations were substantially enhanced within the iron-amended treatments during all seasons with the late spring and late summer experiments having greater than twice the phytoplankton biomass and DMSPp than that measured during the winter season. This suggests that although iron concentration plays the dominant role in controlling phytoplankton growth and DMSPp concentrations within the NE subarctic Pacific, both

are further affected by the seasonal light regime. With the potential for future large scale open ocean iron manipulations, this study provides important seasonal information for the potential alterations in the oceanic sulfur cycle.

OS32L-12 1650h

A multi-element ecosystem model for global biogeochemical cycles

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We have developed an ecosystem model to simulate the dynamics of small and large phytoplankton as they relate to regenerated production, sinking particle export and transport of dissolved organic matter. Regeneration is described as a function of temperature and community structure, competing with the sinking of detrital material through the water column which is described as a function of ballast. Dissolved organic matter production is described as a function of phytoplankton production and nutrient limitation. This model has been calibrated through the generation of a synthesis of euphotic zone data on temperature, chlorophyll biomass, primary production and new production and/or particle export from over 100 sites. Where available, we have also utilized data on size-fractionated phytoplankton biomass and the carbon:chlorophyll ratio of phytoplankton. The resulting model has been incorporated into the Princeton Ocean Biogeochemical Model to diagnose new production, total production, phytoplankton biomass, particle export and dissolved organic matter transport through restoring of surface nitrogen, phosphorous, silicate and alkalinity in the MOM3 general circulation model. Comparison of model results with a synthesis of dissolved organic carbon survey data and satellite-based phytoplankton biomass from ocean color will be presented.

OS32M HC: 318 B Wednesday 1330h

Bentho-Pelagic Coupling at High Latitudes II

Presiding: **H E Hartnett,** Rutgers University**; U Witte,** Max Planck Institute for Marine Microbiology

OS32M-01 1330h INVITED

Benthic Processes in the Bering Strait Region of the Arctic: Temporal/Spatial Variability And Global Change

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Pelagic-benthic coupling can be studied via underlying sediment processes on various time scales. Sediment metabolism can be an indicator of weekly-seasonal carbon depositional regimes, whereas benthic faunal populations can act as multi-year, long-term integrators of a variety of marine processes. Recent environmental changes in the Arctic that are being observed include a seasonal reduction in the extent and duration of sea ice, increased seawater temperature, and changing hydrographic conditions, both spatially and temporally. High latitude ecosystems appear particularly sensitive to climate change, and the shallow, productive nature of the Bering Strait region in the North American Arctic may prove to make it a sentinel indicator for larger-scale regional and global changes.

Recent studies indicate that the Bering Sea is shifting towards an earlier spring transition between ice-covered and ice-free conditions. Coincident changes in the timing, extent, composition and location of annual production (both primary and secondary trophic levels) can have dramatic ramifications on higher trophic level fauna, including those utilized by subsistence hunters in the Arctic. These apex predators include benthic-feeding walrus, bearded seal, gray whale, and diving seaducks. Retrospective analyses of benthic processes in the Bering Strait region since the 1930s indicate a declining trend in carbon deposition and benthic biomass in the region, particularly in the 1990s. Declines in sediment oxygen respiration at individual stations have ranged as high as 73% over the past 15 years. Benthic biomass has declined as much as 89% over a longer time period. The region south of St. Lawrence Island, where we have the longest time-series record, has had both a reduction in bivalve standing stock and a change in dominant species composition. These ecological changes may directly influence the declining populations of a federally-listed (threatened) species, the spectacled eider. The entire world population of this Arctic duck winters in the waters south of St. Lawrence Island, feeding on bivalves on the continental shelf. As part of the NSF-funded Bering Strait Long Term Observatory project, we are maintaining an ecosystem-level study of this system within a global change framework.

URL: http://arctic.bio.utk.edu

OS32M-02 1400h

A Two-Year GIS Comparison for Assessing Ice-Cover Impacts on a Productive Benthic System in the Northern Bering Sea

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During April 1999 and March-April 2001, late winter biological, sediment, and hydrographic measurements were made at 28 stations in an area of historically high benthic biomass in the northern Bering Sea. Benthic macroinvertebrates are an important food source for diving seaducks (e.g., the threatened Spectacled Eider) and marine mammals in this region. This presentation will quantify the influence of seasonal ice cover on water column production and benthic processes during the two late winter cruises, using satellite ice coverage data and GIS mapping tools within the context of a longer, decadal ecosystem study in the region.

The years of 1999 and 2001 were very different in terms of ice extent and concentration. From mid-January to the end of April 1999 the ice concentration was at least nine-tenths for the entire study region. This uniformity of ice during the winter of 1999 may explain the lack of any correlation between ice coverage and any water column or benthic parameters, during our subsequent April sampling. In contrast, the ice concentration and extent during 2001 was greatly reduced over the Bering Sea. A spatially and temporally integrated measure of ice concentration prior to late winter sampling was significantly correlated with water column chlorophyll *a* measured during the cruise (Spearmans ρ=-0.415, p=0.35). Integrated chl *a* concentrations ranged from 3.1 to 52.2 (μg m^{-2}), low by comparison to maximum spring production events (e.g. during May 1994 integrated chl *a* ranged from 21.1 to over 1000 (μg m^{-2}). These data indicate a relationship between low winter ice coverage and temporal acceleration of water column production, which would be a likely scenario with global change. During both 1999 and 2001 benthic biomass (g C m^{-2}) was significantly correlated with late winter measurements of sediment chlorophyll *a* (Spearmans ρ=0.504, p=0.01; Spearmans ρ=0.330, p=0.05). These data support the conclusion that late spring production events and subsequent advection of carbon within the study area are important for deposition and use of carbon in this region over an annual cycle.

URL: http://arctic.bio.utk.edu

OS32M-03 1415h

The short- and medium-term fate of fresh organic carbon in deep-sea sediments

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The deep-ocean floor is one of the major marine reservoirs in the global carbon cycle and the transfer of carbon through the ocean plays a key role in controlling atmospheric CO2 concentrations. Estimates of deep-sea carbon fluxes are usually derived from surface water properties. However, a variety of factors conspire to limit the accuracy of these estimates and there are many advantages in assessing deep ocean fluxes through seafloor studies (Jahnke 1996). For logistic as well as financial reasons, however, these measurements can only be performed at a few spots. Thus, although it is evident that there are temporal changes of SCOC in many areas of the deep-sea it still remains difficult to pinpoint the steering factors triggering the benthic response and predict its speed and amplitude from POC flux measurements. The descriptive approaches to this question have so far been hampered by logistic difficulties and the unpredictability of seasonal sedimentation events (Pfannkuche et al., 1999). To overcome these difficulties, we choose an in-situ experimental approach in our study: a series of in-situ enrichment experiments were performed that were designed to clarify the short- and medium-term fate of fresh algal carbon arriving at deep-sea sediments. A food pulse, consisting of diatoms labeled with 15N and 13C, was simulated in benthic chambers deployed for periods of days to weeks during a 2 months lander campaign at abyssal depth (4800 m) in the NE Atlantic. Additional experiments were carried out at the Norwegian coast at 1300 m. The stable isotopes served as tracers in order to follow the transport into the sediment and uptake, incorporation and remineralization of the algal material by the different functional benthic groups of organisms. In addition, chitin was added to study the degradation pathway of this most abundant polysaccharide in the marine environment. As bacteria are the primary agents of the early diagenesis of organic matter in deep-sea sediments, particular attention was paid to microbial degradation and incorporation of organic matter. Macrofauna was in focus as large organims can be keystone players for the rapid subduction of organic matter into the sediment (Levin et al., 1997). In well-oxygenated marine sediments the sediment community oxygen consumption (SCOC) is generally considered to be an adequate measure of the total benthic mineralization of organic carbon (BCR). Oxygen is either consumed directly in the heterotrophic degradation of organic matter by microorganisms and animals, or consumed by the often microbially mediated reoxidation of upward diffusing, reduced solutes. The experiments revealed an instantaneous reaction of the abyssal benthos in total: SCOC doubled within 2.5 days and the high activity level was maintained throughout the 8.5 and 20 day experiments. *13C values of polychaetes rose from background values of 17 to 19 to values up to +2200 within days, demonstrating the fast incorporation of 13C algal material. The entrainment of label into deeper sediment layers and the incorporation into bacteria biomarker was fast in the Norwegian-coast sediments, but a considerable time lag was recorded in the PAP pointing to a pronounced difference in the response pattern of slope and abyssal plain communities to a food pulse.

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Reproductive Investment in *Mysis mixta* and *Acanthostephia malmgreni* in the Hyperbenthos of Conception Bay, Newfoundland

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Two hyperbenthic crustaceans, the mysid *Mysis mixta* and the amphipod *Acanthostephia malmgreni*, were sampled in Conception Bay, Newfoundland from October 1998 to November 2000 to determine their reproductive patterns. Due to their high abundance and year-round presence, these species are thought to play important energetic roles in the food web of Conception Bay. The amount and form of energy invested into reproduction by crustaceans can depend on numerous factors including the life cycle type, the number of reproductive events per year, seasonal food input, diet, and seasonal temperature profiles. These factors, in addition to reproductive traits of both species, are compared with seasonal reproductive costs. Costs in the form of lipid investment (LI, % of female lipid) are calculated using lipid profiles of brooding females compared with their embryos.

In general, LI of total lipid in *M. mixta* varied seasonally, with maxima of 70 to 73 % occurring early in 1999 and 2000. The high LI periods resulted primarily from increased investment in neutral rather than polar lipid, with triacyglycerol (TAG) representing the majority of neutral and phospholipid (PL) representing the majority of polar lipid. LI of total lipid in *A. malmgreni* averaged 88 % and did not vary seasonally.